TIPPING+

Enabling Positive Tipping Points towards clean-energy transitions in Coal and Carbon Intensive Regions

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D5.2 Case study key findings

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Leader organization:

Delft University of Technology

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Preface

TIPPING+ will provide an empirical in-depth social science understanding of fundamental changes in sociodemographic, geographical, psychological, cultural, political, and economic patterns which give rise to Social-Ecological Tipping Points (SETPs), both positive and negative in relation to socio-energy regional systems. Such empirical and theoretical insights will shed new light on the interdependencies between changes in regional socio-cultural structures and the technological, regulatory and investment-related requirements for embracing (or failing to embrace) low-carbon, clean-energy and competitive development pathways in selected coal and carbon intensive case study regions (CCIRs). The overall goal is to understand why and under which conditions a given social-ecological regional system heavily dependent on coal and carbon-intensive activities may flip into a low-carbon, clean energy development trajectory – or on the contrary may fall into an opposite trajectory with all its negative implications. Towards this goal, main focus of TIPPING+ is the participatory co-production of knowledge on the driving forces and deliberate tipping interventions leading to the emergence of positive tipping points toward clean energy transitions in European CCIRs.

Who we are

	Participant Name	Short Name	Country	Logo
1	Global Climate Forum e.V.	GCF	DE	
2	Delft University of Technology	TUD	NL	
3	CIRPA - Università Degli Studi di Roma La Sapienza	UR	IT	
4	Institute for Advanced Sustainability Studies e.V.	IASS	DE	
5	Paris School of Economics	EEP PSE	FR	
6	Nordland Research Institute	NRI	NO	
7	Universitaet Graz	UG	AT	
8	University of Piraeus Research Center	UPRC	GR	
9	Palacky University Olomouc, Faculty of Science	PUO	CZ	
10	Westport Consulting	WPC	BA	
11	National School of Political Studies and Public Administration	SNSPA	RO	
12	Institute for Structural Research	IBS	PL	
13	Aalborg Universitet	AAU	DK	
14	PT Sustainability and Resilience	Su-Re.Co	ID	
15	Eco-union	Eco-union	ES	
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16	University of Greenland	Ilisimatusarfik	GL	
17	Innolab Space Canada – Center of Urban Transitions	Innolab Space	CA	
18	Swinburne University of Technology Australia	SUT	AU	

Executive summary

This deliverable 5.2 is a compilation of novel research of 16 coal-and-carbon-intensive regions (CCIRs). These case studies were carried under the umbrella of the Tipping Plus project from 2020 until 2023. This collection presents empirical data and their analysis on the diverse transition processes in CCIRs. This report helps define the boundaries of the CCIR and to develop the narratives for each case study considering perspectives from different disciplines across the work packages: WP1 (geography including demography), WP2 (culture & social psychology), WP3 (policy, politics & governance) and WP4 (economics). Empirical findings help to critically study the concept of socio-ecological tipping points. Additionally, each case study presents key trends, and factors that either enable or hinder low-carbon transitions. This novel collection was a collective work of more than fourty-five partners from the Tipping Plus consortium.

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1 Introduction

This deliverable, D5.5, helps to define the boundaries of the coal and carbon intensive region and to develop the narratives for each case study considering perspectives from different disciplines across the work packages: WP1 (geography including demography), WP2 (culture & social psychology), WP3 (policy, politics & governance) and WP4 (economics).

Our point of departure in TIPPING+ is from a sectorial approach for coal and carbon intensive regions (CCIR). In our project we define 'sector' as:

- Upstream energy extractive sector: this includes the coal & fossil fuels sector; and
- Downstream carbon-intensive sectors: sectors reliant on high carbon energy sources such as steel, cement, transport.

We also have a special emphasis on region across the 16 country case studies exploring the energy sector (coal, oil, and renewable energy) and other high-carbon sectors including steel and chemical industries. Most case study regions including

Austria (Case study- CS1), Bosnia and Herzegovina (CS2), Alberta, Canad (C3), Moravian-Silesian, Czech Republic (CS4), Balearic Islands, Spain (CS5) and Teruel, Spain (CS6), Megalopolis, Greece (CS7), Bali, Indonesia (CS8), Sulcis, Italy (CS9), Italy Carloforte (CS10), Upper Silesia, Poland (CS11), Jiu Valley, Romania (CS12) Essen and Duisburg, Germany (CS13), Greenland (C14), Lofoten, Norway (CS15), and Svalbard, Norway (CS16) (see table 1).

To better understand how we will draw the boundaries of the formal, functional, and perceptual region, we need to explore regional narratives. This not only helps us to define the current 'baseline' or a mainstream perpsective but also to identify any indications that deviations or transitions from the mainstream. These deviations may have the potential for a radical transformation of the current high-carbon mainstream pathway.

This deliverable is structured as follows. Section 1 provides a summary on the rationale behind the case study, including how the case study report structure was developed (section 1.1), the theories behind the case study framing (section 1.1.1), and a framing for developing narratives (section 1.1.2). We also describe how and why we requested case studies to develop visualisations of their transitioning regions (1.1.3) and we provide a table summarising the core aspects of the case studies (section 1.2.). We then present the individual case studies begin from case study 1 (Austria) to case study 16 (Svalbard, Norway).

1.1 Developing the case study report structure

The case study guideline (see Appendix 1) was first developed by WP 5 leads then shared with WP1-4 leads to ensure that the disciplinary perspectives were appropriately considered in the guideline. A workshop on "characterizing regions" was carried out with WP1-4 leads on April 28th to discuss the role of geography, culture and social psychology, policy, politics and governance and economics in the tipping points of each region. Case studies submitted their first case study drafts on February 18th, 2022. These drafts were reviewed by WP5 & WP7 leads and comments provided by March 18th, 2022.

All WP leads then met in-person meeting in Potsdam on April 27& 28th 2022, where WP leads drafted key questions and key indicators to consider an interdisciplinary perspective in the case studies. These questions and indicators were to be considered further in the case studies narratives. They key added were in the narratives (values and identity, policy and politics and economic potential) and in the context discussion (geography and migration). Case study leads were then requested to submit a revised version by June 17th, 2022, in time for an in-person meeting in Athens on June 22-24. There case study leads presented their case study progress in posters using a streamline visualisation developed by WP5 & WP7 leads (see section 1.1.3). Final versions of case studies were requested to submit by September 15th, 2022. There were some delays and case studies were submitting their final version up until November 25th, 2022.

1.1.1 Background to the case study framing

Humans have undergone major revolutions since pre-historic time with common underlying aspects: Prior to the transformation there were long period of (slow) change or "evolutionary change" which we call "transition" in our study. As the transition occurred over long periods of time, problems arose requiring society to solve. These "basic problems concerned conflicts between different classes as well as engagement in mutual exchanges and cooperative efforts (Tomasello, 2014; Condemi & Savatier, 2019) aimed at managing new situations created by the evolution of society.

These changes, cooperation and conflicts may be divided into four major processes: development of technology; class divisions and the economy; Ideas and ideologies, and social-political institutions.

These four processes of society each developed their own momentum and outcome in relation to the other three." (Sherman, 2021, p 166). What's significant about these four processes is that they are a part of all historical evolutions of society since the Neolithic times when humans began to settle, and agriculture practices were developed. Moreover, they are pivotal to the activity system that is at the basis of a distributed and cultural approach to human cognition (Cole & Engeström, 1993) Thus, these four processes will also be used to describe the current evolution or what we describe as "transitions" towards a low carbon economy.

We will explore how the four processes defined by Sherman (2021) are contributing to a transition that could lead to a potential transformation, or radical shift of our societal organisation. These four processes are in line and integrated across our work packages (WP) on geography and culture (WP1), social psychology (WPs), polices and politics (WP3) and economics and resources (WP4): technology, economic institutions, ideology, and social-political institutions. These four processes are then influence or are influenced by policies. Policies can contribute to creating an enabling environment to promote a transition or on the contrary (the lack of) policies may create barriers to a transition.

1.2 Developing the narrative structure

Considering these four processes and the role of policies, we will apply the framing above to identify "the narratives" by capturing the changes in the transition. By narratives in our project, we mean the storyline describing how the CCIR pathway (i.e., pathway broadly is a course of direction) was historically developed until the present and how some promising CCIR pathway can be potentially developed in the future. Each narrative also has narrators (i.e., story tellers) and a range of individuals who engage with it in peculiar ways. In TIPPING+, we will make explicit the particular stakeholder group the narrators belongs to, as well as the individuals and groups that engage with narratives, that resist, attempt to reinvent or accept them.

In order to do so, we must make explicit the current high-carbon mainstream pathway as well as the range of co-existing narratives explaining that pathway and identify who the narrators are (including the institutions they belong to). We also need to make explicit the transition or transformation pathways, the narratives explaining that pathway, and identify who the narrators are, who the key characters are, and what spatial and temporal scales they span.

We first do so by identifying the mainstream narratives which include the four processes as well as the policies that has enabled the development of the CCIR.

1.2.1 Defining the mainstream narrative(s)

The mainstream narrative(s) (refer to Figure 1) identifies the pathway that represents the mainstream or dominant (mainstream and dominant are used interchangeably) energy/high carbon) sector (e.g. coal power sector). We also focus on the narrators who are the dominant stakeholders in power and who perpetuate the mainstream narratives. We also identify the enable policy environment that has promoted the high carbon energy technologies central to the energy mainstream system. This energy system includes the mainstream energy technology value chain, the workforce, other stakeholders and institutions as well as policies that support the system.

The starting point for developing narratives begins at the regional level in your case study. Once you have defined the boundaries for the regional level, you can bring in additional scales or governance levels (e.g., national or supranational (EU)) that impact your specific region. By documenting the mainstream narrative as well as the narrators (i.e., stakeholders and their institutions in power), you are making explicit how we got to where we are (i.e., the high carbon development trajectory) within the region.

Within the mainstream narratives we explore the following areas:

I. Technologies

We start drafting the mainstream through identifying the 'technologies' that enabled the development of the coal and other high carbon sectors.

II. Stakeholders, ideologies & institutions

We then explore the other three processes through the lens of stakeholders: ideologies, social-political and economic institutions in power that have enabled the development of the current mainstream pathway.

III. Policies

Along with the four processes, we explore how policies, or a policy mix has been influencing the development or the decline of the CCIRs.

1.2.2 Alternative narratives: on-stream and off-stream narratives

After drafting the mainstream narratives, we search for narratives that deviated from the mainstream by applying the same three core components of technologies, stakeholders, ideologies and institutions as well as policies to. These alternative narratives can provide us indications of changes or transitions that can potentially lead to a transformation.

The on-stream pathway can promote new low carbon technologies but under the 'same' system. They exist only in a special space within the mainstream pathway but do not challenge the current norms or the rules of the game. This might include carbon capture and storage technologies that support negative emissions but does not challenge the fossil fuel norms as they are add on technologies that could help fossil fuel companies continue to exist. Renewable energy technologies might so receive some subsidies but continue to operate within the existing energy system norms (e.g., with fossil fuel subsidies and within the centralise energy systems).

Policies and support mechanism in the on-stream pathway can promote equal treatment (i.e., equal opportunity policies) of different technologies or gender perspectives. While the largely mainstream perspectives continue to be accepted, alternative technologies (e.g., gender) perspectives are viewed as equally valid. However, the dominant pathway is not fundamentally questioned, and the underrepresented perspective only exists in special spaces without challenging the underlying power dynamics that keep the mainstream energy system in place.

The off-stream pathway refers to alternative perspectives that depart from the mainstream perspective and challenges the mainstream pathway. The narrators are often those stakeholders or institutions who are on the fringes of power in society, the economy and politics. Their narratives can challenge the very power dynamics of the mainstream narratives and narrators. Policies within the off-stream pathway promote low-carbon innovations in a dedicated space that is separate from mainstream technologies. Policies help to create protective spaces for low-carbon technologies, which exist outside the mainstream energy system. For instance, low carbon technologies may require new infrastructure to be built outside the existing infrastructure. These technologies may be supported through special incentives, programmes, and subsidies. In the off-stream pathway off-stream stakeholders may bring in new values and norms that challenge the mainstream power dynamics and (social) norms. The off-stream perspectives are viewed as distinct perspectives that do not reinforce the mainstream pathway. On the contrary, synergies of low carbon technologies supporting alternative narratives may emerge in an equality (gender) sensitive, off-stream energy transition.

Within the alternative narratives we explore the following areas:

I. Technologies

Within each region, explore the new technology, service or process that departs from the mainstream and has a potential to reduce emissions.

II. Ideologies, social-political and economic institutions

We then explore the other three processes: ideologies, social-political and economic institutions in power that challenges the current mainstream pathway.

III. Policies

Along with the four processes, we explore how policies, or a policy mix has enabled the development of an alternative technology.

1.3 Transformative-stream narratives

Based on the alternative narratives, we identify those that have potential for transformative changes.

Transformative pathways involve a radical technological, social and/or policy change and the representation of diverse stakeholders and their perspectives that challenges the CCIRs mainstream pathways, its power dynamics and becomes the new norm. This new mainstream pathway no longer resembles the previous dominant pathway. A transformation may occur as a result of on- and/or off-stream pathways leading to a future where different stakeholders are part of the decision-making processes. Transformation pathways are supported by a mix of stakeholder groups, policies and/or technologies that lead to a radically changed energy system dominated by low-carbon energy. The transformation process changes the power dynamics of the previous mainstream pathway and includes groups previously marginalized. Transformative pathways also consider broadening the discussion of equality and gender beyond women by including gender with other intersecting social identities.

The following figure summarises the different narratives that will be discussed above: *mainstream CCIR narrative* and *alternative narratives* that depart from the mainstream, consisting of on-stream narratives (those that complement but do not challeng the regime) and off-stream narratives (those that exist outside the regime and can potentially challenge the regime), which potentially could lead to a transformation pathway.

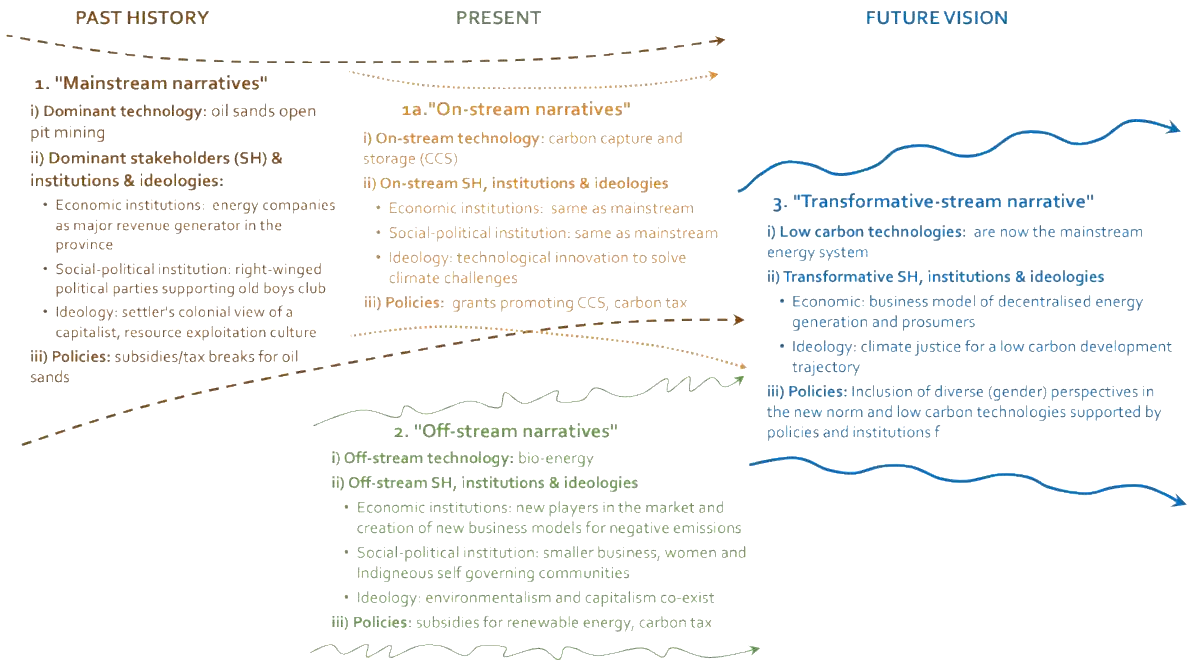

Figure 1: Mainstream and Alternative Narrative Framework.

Note: there are several streams of literature that have contributed to this framing: Social ecological tipping points (Tabara et al., 2018, p 120); Innovation literature techno-economic paradigm shifts (Freeman and Perez); Social technological transition through policy perspective (Kemp, 1994; Grin et al., 2010; Kern and Smith, 2008;) and agency (Smith and Sterling, 2005); Gender in Political Theory (Squires, 1999) and gender mainstreaming Walby (2005); Political and economic evolutions: Sherman (2021).

1.3.1 Case study visualisations

Based on an in-person meeting in Paris on Feb 25th and 28th, 2022 with WP5 (Jenny Lieu and Amanda Martinez Reyes) and WP7 lead (Diana Mangalagiu), a visualisation diagram template was developed for all case studies.

The intention was to create a visualisation that would allow WP leads and case study leads to easily digest the core elements driving the narratives' direction that is (potentially) leading to a decline of the current mainstream regime and to identify tragetories that are in transition and/or could lead to transformation. We wanted to experiment if we could observe patterns of transitions across case studies with these visualisations. We were testing to see if the visualisated was a helpful way to capture the main idea behind the narratives based on the cumulative researcher's experience (both tacit knowledge about the context, stakeholder engagement and data collected). This is similar to graphs from model outputs, which high light key trends based on large inputs of data.

We also based the shape of the curives on the four phases of the transition were considered to roughly discuss the status of narratives (see Figure). `

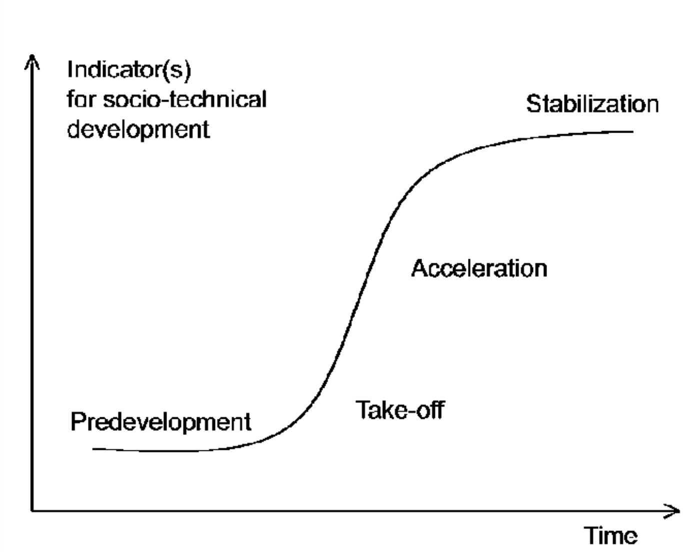

Figure 2. Socio-technical transition phases. Extracted from Rotmans, 2001 influenced by the S-curve diffusion of innovation Becker & Speltz, s. 31-33. 1983

If a transition is envisioned, case study leads were asked to approximate the speed and phase of the transition. For instance, a curve showing a steeper upward direction would indiate an acceleration of a transition. We also encouraged case study leads to illustrate the decline of the mainstream, if applicable, with a downward curve trend.

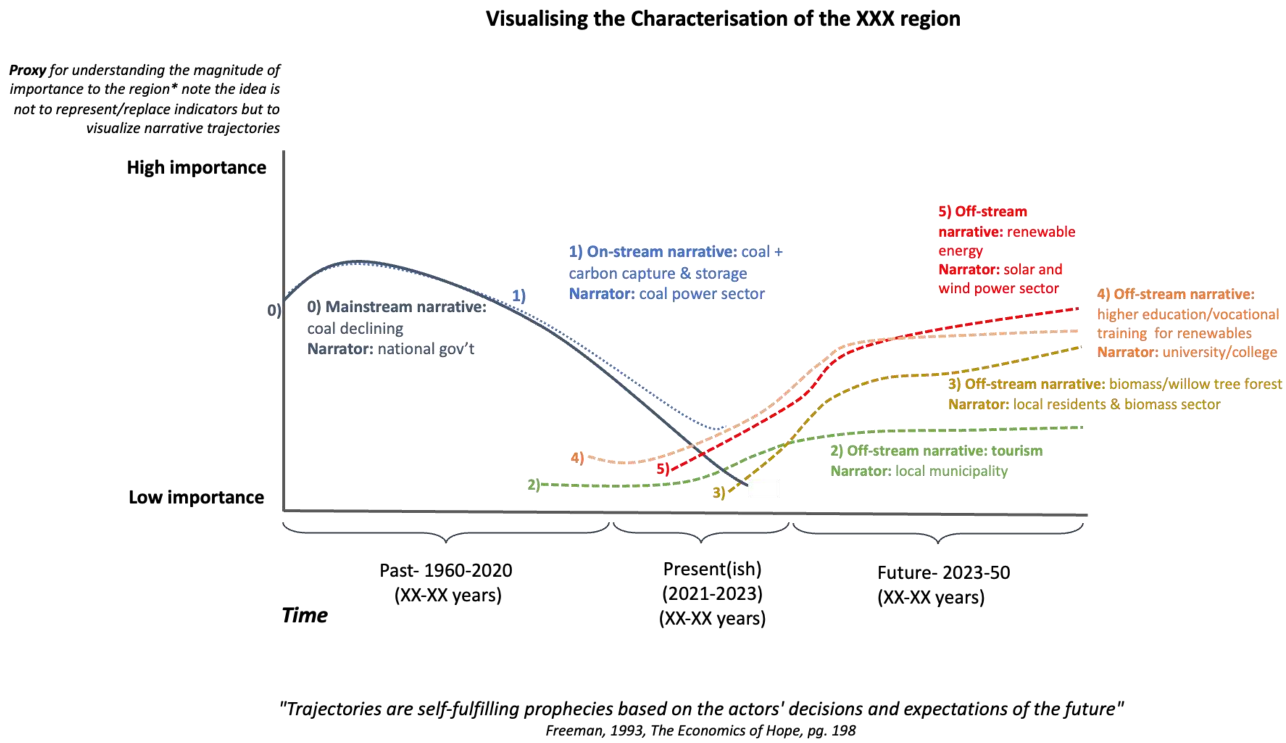

Figure 3: Example of case study narrative visualisation

Case study leads were asked to create a diagram considering the following two questions:

1. Mainstream narrative(s): when did the decline of the coal and carbon intensive sector begin and what is its expected future development/decline?

2. Alternative narrative(s): what (emerging) sectors are starting and what is their anticipated level of importance in the upcoming years and future?

We also highlighted the core aim of the visualisation which was to: show in a graph-like form the researchers' interpretation of the narratives direction and understanding of the context; and to illustrate the relative importance of the mainstream sector (coal and carbon intensive sector). The premise was to not to combine exact values from indictors to create the proxy but to illustrate the relative relationships and interactions and to visualize the trend (i.e., downward or upward trend) of the potential outgoing sector (coal and carbon intensive region) and incoming dynamics (alternative narratives).

Case study lead then presented their visualations in the Athens June 2022 workshop and were encouraged to include their visualisations in their case study report.

1.4 Summary of the case studies

An overview of the case study regions is provided in Table 1. We summarise the core aspects of the 16 case studies including the current narrative trend (e.g., mainstream declining), the mainstream technological sector, on-stream narrative (i.e., incremental changes), off-stream narrative (potentially shifting the regime). Additionally, some hindering and driving factors of the energy transition are presented.

We do not synthesie the results of the case study in this deliverable; rather we present the case studies individually and provide a synthesis as parts of WP7.

Table 1. Summary of the 16 case study regions.

Case study name, institution	Current narrative trend	Mainstream technology sector	Mainstream narrative	On-stream narrative	Off-stream narrative	Main drivers	Main hinders
1. Austria, upper and lower. University of Graz	Mainstream narrative declining, and alternative taking off	Coal-intensive: iron and steel, cement, chemical, and petrochemical industry	Transition from carbon intensive	Green hydrogen (up to 80% of CO2 reduction), industrial circular and decarbonized economy	None. The same companies compose the regime in alternative narratives	EU level policies: phase out of emission allocations, CBAM, innovation fund, plastic tax, and IPCEI.	In Austria, no particular industry policy is available (e.g., Carbon Contracts for Differences and/or a climate contribution). Job and identity dependency. Lack of CO_2 tax for industry Lack of market regulations and market for CCU/S. Coordination between national and international companies.
2. Bosnia and Herzegovina Westport Consulting	Reliance on coal mining for power generation (65% of energy mix) and slow-pace transition plan	Coal mining	National energy security Coal is seen as the fuel that guarantees the nation's energy supply and serves as the system's backbone	Clean coal technology Evolutionary and slow pace of transition, maintaining hard coal exploitation and usage in the gasification process and carbo-chemical installations	Swifter abandonment of coal mining and creating the national supply chains for industries supporting energy transition and a circular economy hydropower and bioenergy	Alignment with the EU ETS is scheduled to be completed by 2024	Lengthy investment cycle allowing the rise of coal output, and the expected long-term horizon for the coal phase-out. Governments' unwillingness to embrace the inevitable decarbonization of the electricity industry

Case study name, institution	Current narrative trend	Mainstream technology sector	Mainstream narrative	On-stream narrative	Off-stream narrative	Main drivers	Main hinders
3.Alberta, Canada, Innolab	Stable mainstream, and on-stream taking off	Oil sands	Fossil fuel exploitation (oil/gas)	Blue hydrogen, CCS, innovation. 85% reduction of oil produce	Sustainable land use and renewable energy technologies, but they lack detail	Federal climate policies Potential for hydrogen market revenues	Attachment to existing infrastructure Resistance to distributed power by current energy monopoly
4. Moravian-Silesian, Czech Republic Palacky University Olomouc	Declining of mainstream, declining of on-stream, and taking off of off-stream SMR is considered a transformed region	Coal mining	Coal exploitation	Re-industrialization with large industries Employ and support ex-miners Preserving historical industrial heritage Coal + CCS (presented as off-stream)	Just transition Bottom-up and small-scale approach Landscape reclamation Green technologies Investment into R&D	In late 1980s and 1990s coal mines closed due to economic unprofitability and federal policies on desulphuration Federal environmental mitigation program. Change of political regime. SMR: foreign direct investments favouring high-tech industries. Regeneration and re-use of abandoned post-industrial and post-mining areas	MSR: Industrial and mining tradition State-owned coal plants are operating until 2022 Lack of skilled jobs, peripherality, high urbanization rate, high population density cause outmigration of primarily younger population (not certain as hinder)
5. Spain, Balearic Islands Eco-Union	Decline of mainstream, take-off of alternative	Diesel for power generation Coal mining	Fossil fuel dependency	Energy connection Renewable energy system Reduction of local energy production, national dependency	Urgent fossil fuel phase-out Energy transition Prosumerism Reduce external dependency	Climate Change and Energy Transition act (in 2019) to decarbonize islands Advanced economic position	Insular identity (it poses obstacles to the needed vertical coordination among different governmental levels) Large capacity of electric grid interconnection with the mainland, this has increased the island's dependency and prevented the deployment of renewables

Case study name, institution	Current narrative trend	Mainstream technology sector	Mainstream narrative	On-stream narrative	Off-stream narrative	Main drivers	Main hinders
							Gas pipeline Dependence on international and national tourism
6. Spain, Teruel Eco-Union	Decline of mainstream, reached a tipping point, stabilization of on-stream	Coal mining, and coal-fired power plants	Transition from carbon intensive	Just transition installation of large-scale renewable energy projects (mainly solar and wind)	Local economy focus, SMEs of renewables	Spain's entry into the European Union (1986) led to adoption of coal regulations Non-competitive coal just transition criteria for companies	COVID-19 pandemic delayed participatory processes Lack of policies for alternative narratives
7. Greece, Megalopolis University of Piraeus Research Centre	Decline of mainstream, take-off of on-stream (natural gas as intermediate fuel), and pre-development of off-stream	Coal mining: lignite power generation	Transition from coal exploitation to natural gas	Large-scale RES With gas as intermediate fuel, economic diversification	Investment in local building sector (energy efficiency) Community energy Smart agriculture and livestock Tourism	Natural gas price Gas supply reserves adequacy REPowerEU Plan for reduction of dependency on imported natural gas Political commitment for electrification Funding Mechanisms	Renovation costs Political commitment for electrification
8. Indonesia, Bali Su.re.co Sustainability & Resilience	Stabilization of mainstream and pre-development and stagnation of alternative	Coal, oil, and gas national dependency Coal power plants in Banten and Bali	Transition from carbon intensive	Reducing oil dependency with natural gas and coal Biomass, CCT	Wind, hydro, geothermal and solar	Clean energy policies	PLN sells electricity generated from fossil fuels below the cost of production, thereby preventing the expansion of the renewable energy market
9. Italy, Sulcis Sapienza	Change of mainstream toward coal	Coal mining, coal-fired power plants,	Coal-to-gas transition to support phase-	Renewable energy transition Centralised, CCS	100% RE Community-led and place-based	Sense of place Injustices	Energy utility decision-making power Transition frames that do

Case study name, institution	Current narrative trend	Mainstream technology sector	Mainstream narrative	On-stream narrative	Off-stream narrative	Main drivers	Main hinders
Universita di Roma	to gas, and pre-developmen t of on-stream industrial reconversia nd off-stream	industrial cluster	out and secure energy supply. Postponing coal phase out.	and large scale RE Electrification of final consumption Tourism Circular economy	energy transition Agency and ownership for alternative development	Closure plan for the coal mine	not consider Sardinian dependence on coal and the lack of gas infrastructures high energy costs for industry and families macroeconomic trends
10. Italy, Carloforte Sapienza Universita di Roma	Tourism in the harbour and electric interconnect ion	Harbour, formerly functional for the coal transportation	Transition from coal exploitation	"We are the vanguard":on wind farms and solar projects "We are different from the Sulcis, we are green, we are cosmopolitan and sustainable entrepreneurs"	"We are Sardinians and subalterns as the other Sulcitanian are" "let's build wind farms, let's emancipate from the fossils".	Local institutional policy that -since 2007- promotes Carloforte as "Mediterranean's green island" Identity dimension, economic processes and aspirations for green tourism	Lack of agency on the part of the community and/or individuals
11. Upper Silesia, Poland Institute for Structural Research	Coal decline, with consensus on preserving coal herritage	Coal mining	Energy security Coal dependency of companies and employees	Labour market narrative Closure of coal mining Clean coal Technologies Energy security and economic patriotism	Local economy collapse creating national supply chains Circular economy health and living condition improvement Green technologies	Support of structural funds National clean energy and climate policy	Rapid mining closure not supported by a comprehensive regional development strategy Unemployment and and potential labour market destabilization due to rapid coal phase-out
12. Jiu Valley, Romania National University	Coal decline and emergence of off-stream	Coal mining, pit coal	Mining closure region's economic collapse, but they also led to a decrease in	Insolvency of coal-fired energy producer	Creation of the Academy for Renewable Sources and Energy (re-	Cooperation between the Romanian Government and the Platform for Coal Regions in Transition	Jobs dependency on coal mining

Case study name, institution	Current narrative trend	Mainstream technology sector	Mainstream narrative	On-stream narrative	Off-stream narrative	Main drivers	Main hinders
of Political Studies and Public Administration	narrative		the population's living standards		training project) Tourism Creation of new SMEs and investments in existing ones in the fields of research, green energy, and reduction of greenhouse gas emissions, but also to retrain the workforce and create new employment opportunities	Just transition plan	
13. Germany, Ruhr region Institute for Advanced Sustainability Studies Potsdam	Decline of mainstream and take-off of alternative The local mine in Essen closed in 1986 [40], in Duisburg another 20 years later in 2008	Coal mining and steel industry	Transition from coal exploitation	Small-scale coal exploitation	Coal and nuclear phase-out Tourism Sustainable development	Closure of mines and the need for brownfield redevelopment due to: Essen, lack of economic profitability, depletion of resources Duisburg, public protest in 2008, impact on households and environment National coals laws, including to end coal subsidies Decreasing workforce	Population decline
14. Greenland, Aalborg University	Stabilized mainstream, pre-development of	Hydropower and oil imports	Transition toward hydropower plants	RET systems for remote places such as solar and wind power in	Uranium and Oil, are not detailed		

Case study name, institution	Current narrative trend	Mainstream technology sector	Mainstream narrative	On-stream narrative	Off-stream narrative	Main drivers	Main hinders
	renewables			small-scale			
15. Lofoten, Norway Nordland Research Institute	Decline of mainstream narrative, take-off/stabilization of off-stream and on-stream	Untapped off-shore oil and gas reserves	The potential to exploite off-shore oil and gas reserves for exports in LoVeSe	Tourism Fisheries Climate concerns	Opposition to oil Decarbonization and circular economy	Management plan Oil price decline Paris agreement Elections Perceived risk of oil spill Protection of cultural heritage, traditional fisheries, and sustainable living	National and international discourse on energy security and revenues Young adult outmigration Low-birth rates Lack of infrastructure investments National identity with oil extraction
16. Svalbard, Norway Nordland Research Institute	Coal decline	Coal power electricity generation and coal mining	Coal decline Closing the coal power station by 2023	Coal + CCS Solar panels and geothermal energy are two potential technologies	Tourism, research, and education Tourism and education grew from the 1990s onward	Decision to phase out the coal mines was made Coal prices and demand	Russian invasion in Ukraine has caused a delay in coal phase-out until 2025

1.4.1 Next steps forward

This deliverable focuses on the 16 individual case studies while in WP7, we will synthesise the finding of the case studies in the upcoming 2023 special issue in the journal Global Environmental Change, the lead editor is Diana Mangalagiu (WP 7 lead) and supported by co-editors Biba Baltvilka (WP 7 co-lead) and Amanda Martinez Reyes and Jenny Lieu (WP 5 co-leads).

Additionally, case study leads will develop strategies for D5.3 "Regional Strategies Booklet" that can potentially foster transformative capacities or create dialogue with stakeholders to begin discussing more transformative narratives. Case studies leads can use their starting points from the alternative narratives (on-stream incremental change) and off-stream (potentially disruptive changes). These strategies then can be further developed into policy briefs aimed at regional policy makers.

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1 Case study 1: Austria

Low-carbon pathways and potential tipping interventions for the basic material industry in Austria

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1.1 Introduction

1.1.1 CCIR description

The Austrian case studies are carbon-intensive regions (CCIR) dependent on downstream carbon- and energy-intensive industries, focusing on the basic material industry sector. The two regions, namely Upper Austria and Lower Austria were identified as having a particularly intensive industry sector and planned industrial decarbonization initiatives. Both regions are characterized by intense industrial activity including heavy industries such as iron and steel, chemical, petrochemical or cement. The Lower Austrian industry sector makes up about 17% of the Austrian Gross Domestic Product (GDP) generated by Industry, and 3.5% of overall GDP, whereas the GDP of the industry sector in Upper Austria has a share of 25% of the GDP of the Industry Sector and 5.3% of the overall GDP (Statistik Austria, 2021). Furthermore, the regions can be defined as highly functional which can be traced back to past resource extraction in that area. In Upper Austria iron ore mining has a long tradition and led to the establishment of a large iron and steel industry. In contrast, in Lower Austria oil wells were found in the 1950s only and refineries were built to extract natural resources. These activities can be seen as the starting point for the regions functionality as afterwards more and more industries were settled in the same location.

1.1.2 Societal problem description

Globally, the industry sector is responsible for 24% of global CO2 emissions (IEA, 2022) whereas in Austria the industry sector covers 30% of national greenhouse gas emissions (Umweltbundestamt, 2021). A closer look at the industry sector shows that the basic material industry including the iron and steel, cement, chemicals, and petrochemical industries emit 65% of global industry CO2 emissions (IEA, 2022) with a similar trend for Austria. Furthermore, production-based emissions from the industry sectors are mainly emitted in Upper Austria, Styria, and Lower Austria (see Figure 1)(Klimadashboard, 2019).

In order to achieve European climate goals, drastic emission cuts are needed. However, the production of basic materials comes along with people's welfare, therefore disruptive but also economically feasible decarbonization strategies need to be implemented. Decarbonization strategies can follow one of the following approaches: 1) Existing technologies can be improved by either increasing the energy and process efficiency of existing processes or applying end-of pipe technologies. However, efficiency gains are also limited and may not have the disruptive potential needed. 2) Another strategy is to minimize the use of basic materials or even avoid them by either producing higher quality products or by demand-management strategies. In other words, the production of high-quality industrial goods balances tailor-cut consumer needs and economies of scale thus requiring less emissions and raw material but creating more added value. Demand-management strategies, however, tackle the overall consumption of products and concentrate more generally on incentivizing the reduction of material throughput (reduction of material consumption). 3) Finally, as the high amount of GHG emissions are either energy-related or process-related emissions, two other strategies are possible. Reducing energy-related emissions can be done by switching to renewable energy sources whereas the process emissions can only be reduced by either switching to a completely different process technology or embedding the process into a carbon capture (and sequestration or use) cycle. For example, a switch from coke-based blast-furnaces in the iron and steel industry to hydrogen-based direct reduction technologies is highly discussed with the prerequisite that the hydrogen is produced by electrolysis with renewable energy. In the cement industry, the process-related CO2 can be captured, and used as a raw material input in refineries or the chemical industry. Such a cross sectoral resource use not only can remove the emissions from cement production but can also substitute for primary fossil fuels use in these industries. In contrast to the decarbonization strategies one and two, these latter approaches have the ability to reach large-scale emission reductions.

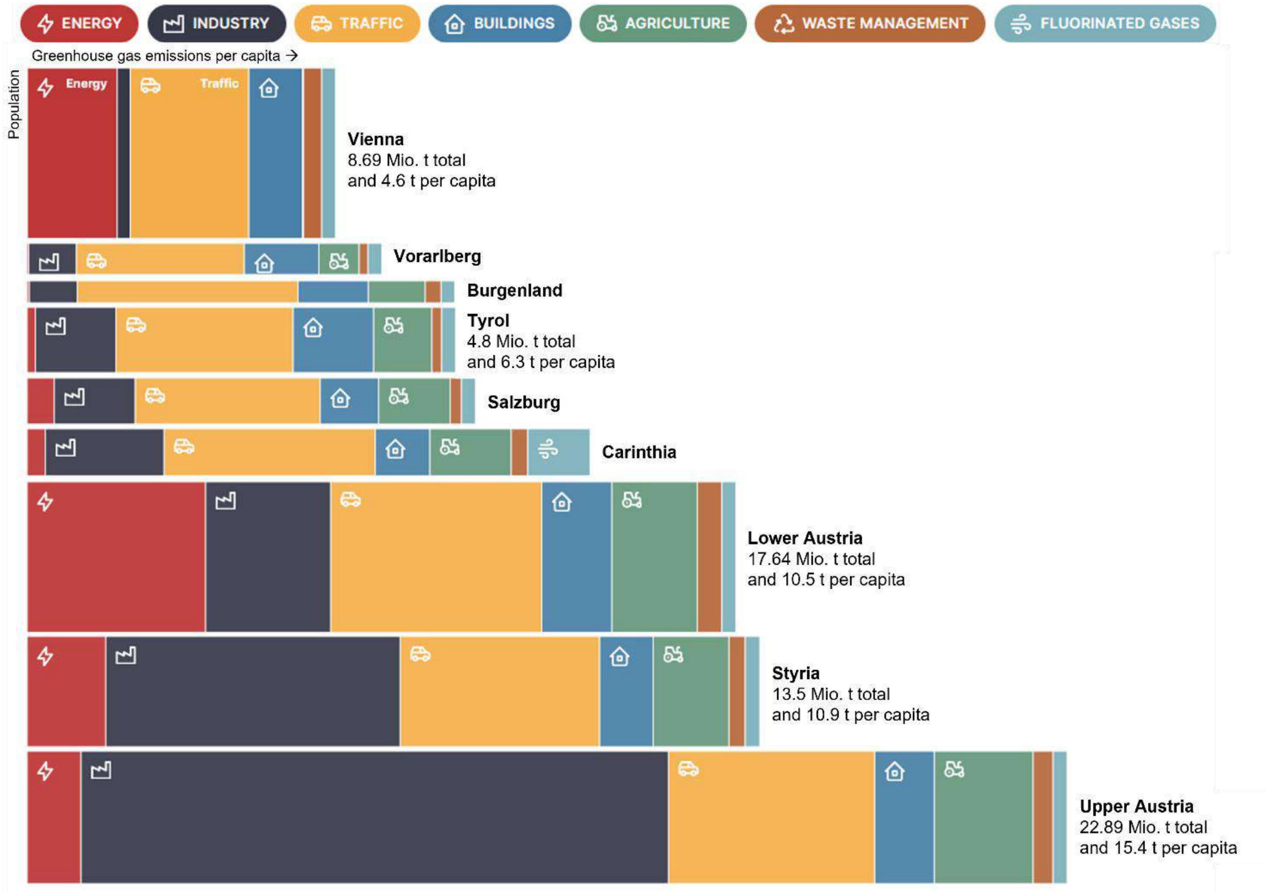

Figure 2. Production-based emissions for various sectors and states of Austria in 2019 (Klimadashboard, 2019)

1.1.3 Research problem

In terms of disruptiveness, switching to renewable energy sources in combination with innovative process technologies and the embedding into a carbon capture and use cycle is most promising. However, the socio-economic implications of large-scale implementation of these technological innovations together with fundamentally new industry structures are unknown.

Therefore, we examine the socio-economic implications of a cross sector value chain collaboration in the basic material sector. The collaborations consist of the cement, petrochemical, chemical and electricity industry. Furthermore, a carbon capture and use technology is applied as well as green hydrogen as alternative synthesis gas. The new output of this is either renewable based fuels or renewable based feedstock for the chemicals/pharmaceutical/plastics industry.

Among the socio-economic implications of a technology switch in these sectors, also various political instruments are investigated for their potential in upscaling such a circularity concept to the entire basic material industry sector. These instruments include among others Carbon Contracts for

Difference (CCfD), a climate contribution for basic materials, and financial incentives for infrastructure investment cost.

1.1.4 Research questions

The technology shift in combination with adequate political instruments are understood as tipping intervention, as it has the potential to shift the overall basic material industry sector onto a low-carbon trajectory, implying a large-scale reduction in GHG emissions. Hence, the case study explores the following questions:

What are technological narratives in the base material sector that lead to climate neutrality?

What political, economic and technological framework conditions and instruments are needed to ensure that the basic material industry sector is led to a socio-economic tipping point?

1.2 Research approach

To analyze potential tipping dynamics in the industry sector in Upper and Lower Austria qualitative methods comprising interviews, focus groups and workshops with key stakeholders from the industry were applied. In addition, based on a literature review, socio-economic impacts of the industry transformation and of specific policy instruments were analyzed. In order to also grasp trends in other relevant disciplines such as geography and migration, values and identity, and politics, desk research for the two provinces in which the industrial decarbonization initiatives are located was conducted. For an overview of the research approach see Figure 2.

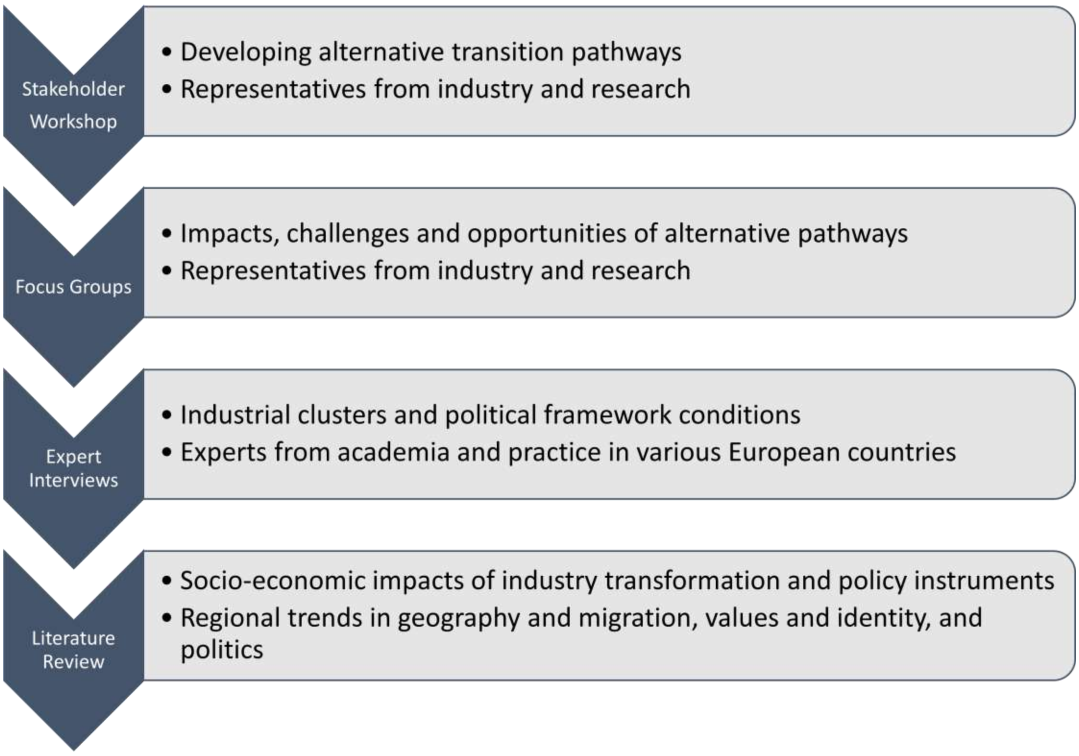

Figure 3. Overview of applied research methods and purpose.

1.2.1 Stakeholder Workshop

The first step was an online stakeholder workshop in fall 2020. Representatives of different basic material companies including the chemical industry, iron and steel industry, gas storage company, electricity company as well as research from the University of Graz and Johannes-Kepler University Linz (*n*= 11) attended the workshop and discussed potential pathways for industry transformation and current barriers and challenges.

The workshop dealt with the overarching question: "How should the transformation process be designed sothat we can successfully master the transformation?" and two follow up questions namely "Where must the industry sector head to in order to achieve decarbonization?" and "What tipping interventions are necessary to activate a tipping point?".

Based on this discussion, alternative narratives for the basic material industry were derived with a particular focus on technology innovation following the Alternative Pathways Framework by (Lieu *et al.*, 2020). The Alternative Pathways Frameworks is used to find dominant and alternative transition pathways to an existing mainstream narrative. Therefore, the framework distinguishes between on- and off-stream alternative narratives and transformative narratives. On-stream alternative narratives can be defined as existing in a niche space and not disrupting the ongoing mainstream narrative. Off-stream alternative narratives in contrast do diverge from the mainstream narratives and challenge it. For example, by introducing policies that promote low-carbon niche technologies or the establishment of infrastructure the is not present in the mainstream narrative. The transformative narrative comprises radical technological innovation and supersede the mainstream narrative. The transformative narrative can be the result of on- or off-stream alternative narratives (Lieu *et al.*, 2020).

1.2.2 Focus Groups

In a second step, a series of online focus groups were organized again with the same stakeholders as in the first workshops and at a later stage also representatives of the cement industry and petrochemical industry joined. In more detail four focus groups with different topics were discussed:

1. 7th December 2020: Presentation of study results from "The Economic Effects of Achieving the 2030 EU Climate Targets in the Context of the Corona Crisis - An Austrian Perspective" (Steininger et al., 2021) with a special focus on the electricity sector, iron and steel sector and cement sector. Based on these results necessary requirements and drivers for the transformation were discussed.
2. 14th January 2021: International examples of industry clusters and cross-sectoral value chains were presented, followed by a discussion on the role of industry clustering and collaboration in the Austrian context.

3. 21st May 2021: Framework conditions and policy instruments for achieving climate neutrality in the basic material industry. Results from expert interviews throughout Europe were presented in order to stimulate a discussion on potential tipping interventions for the Austrian basic material industry.
4. 2nd of July 2021: Discussion on the following questions: Is there a need for a long-term support for OPEX in addition to investment grants (e.g. Austrian Transition Fund, IPCEI)? Which instrument would be best suitable? What would be the advantage of this? Would such an instrument be able to include the entire Austrian industry in the transformation process?

1.2.3 Expert interviews

Thirdly, as a result of the focus groups where industrial collaboration was identified as an essential strategy to achieve climate neutrality, seven interviews (1-1.5 hours each) with experts from academia and practice in the European context were performed in May 2021 to collect potential political instruments enabling the upscaling of cross sector value chain collaboration (or industrial clusters) in the basic material sector. The expertise of interviewees comprised more generally the economic and political context of industrial clusters in the EU but also very specifically the cement industry and carbon capture and use or sequestration (CCU/S) technologies. Geographically, ongoing developments in Norway, Netherlands, Germany, Poland and Spain were discussed. The interviews were semi-structured and based on the following questions:

- Which industrial sectors do you currently work with? Are industrial clusters existing or developing in your country?
- What is the main driver from your perspective for the establishment of (CCU/S) industrial clusters?
- What are the main barriers for the establishment of the (CCU/S) industrial clusters?
- What policy instruments are required to foster the economic viability of the CCU/S/industrial cluster?
- Can the economic viability of the industrial cluster be ensured without political support? Or will they always have to rely on subsidies from the state?

1.2.4 Literature Review

Finally, the change in economic indicators such as in employment, GDP, and welfare were analyzed based on existing literature. Many studies are therefore applying general equilibrium models. This method is able to provide us insights about the new economic equilibrium once a TP in the basic material sector has occurred and potential impacts of political instruments.

1.3 Narratives

1.3.1 Mainstream narrative: technology

Iron and steel industry

The iron and steel industry has a very long history in Austria. Especially, in Carinthia, Styria and Upper Austria, the manufacturing of iron products leads back to the 11th /12th century (Bamberger, Maier-Bruck and Gutkas, 1995). With the Industrial Revolution, technological improvements such as blast furnaces to produce pig iron came to Austria in 1820/30. In 1860 new processes improved the manufacturing by switching from charcoal firing to coke firing. The iron and steel industry faced a crisis during World War I and World War II. In 1946, large iron and steel mills were socialized. A few years later, in 1952/53 a global breakthrough was achieved in Linz and Donawitz with the industrial-scale implementation of the Linz- Donawitz process, a specific oxygen reduction process. Since the 1970s, far-reaching restructuring has changed the Austrian iron and steel industry (Bamberger, Maier-Bruck and Gutkas, 1995).

Today, in Austria there are about six blast-furnaces in operation, all operated by Voestalpine, the largest iron and steel producer in Austria, and strongest industrial CO2 emitter in the country. In 2020, overall 33.450 employees (mining, iron and steel production) were counted in the iron and steel industry (Wirtschaftskammer Österreich, 2022a).

Cement industry

Today, the most common type of cement is Portland cement. The founder of Portland cement production in Austria was Alois Kraft about 150 years ago. 1856 the first Portland cement factory was established and Austria became a forerunner in producing quality cement. Furthermore, Austria was rich in raw materials for cement production and therefore many more cement factories were built (in total 50). Today, nine cement factories are in place (Friembichler et al., 2017). In the cement industry 1.247 people were employed in 2014 (Wirtschaftskammer Österreich, 2022a).

In order to produce cement, materials such as limestone, shells, and chalk or marl combined with shale, clay, slate, blast furnace slag, silica sand, and iron ore are used (Portland Cement Association, 2019). Most often, a dry method is used for producing the cement. Therefore, raw materials are crushed to a size of about 7-8 centimeter, and then combined with other ingredients such as iron or fly ash. The mixture is then fed into a cement kiln which heat all the raw material u to 1.500°Celsius. Through this process, certain elements are removed from material in form of gases (e.g. CO2) whereas the remaining elements form a new material called clinker. The clinker is then cooled down, grinded and mixed with small amounts of gypsum or limestone. The result is then cement (Portland

Cement Association, 2019).

Chemical Industry

The chemical industry generates many different kinds of products, while the Austrian Case Study is focusing on plastics production and its switch from fossil fuels to low-carbon raw materials. Within the chemical industry, plastic production (primary and final products) is about 48% of the total industry (FCIO, 2022a). Plastic processing in Austria comprises about 531 companies with mainly small to medium-sized enterprises. In total, around 18.872 people are employed in these companies in 2021 (Wirtschaftskammer Österreich, 2022b). The centers of production are in Upper and Lower Austria. These two provinces account for more than half of the jobs and generate most of the production value(FCIO, 2022b). Borealis, a large company in Lower Austria, started producing basic chemicals at this location in 1961 (Borealis, 2022).

Petrochemical industry

The petrochemical industry and establishment of refineries can be traced back into the 19th century. However, in 1955/56 the OMV ("Österreichische Mineralölverwaltung") was founded and is the only refinery in Austria and the largest mineral oil group in Central Europe. The establishment of the OMV was highly linked to the discovery of the largest oil field in Central Europe near Matzen (Lower Austria) in 1949 (Science Communications Research, 2016). Today, the mineral oil extraction in Austria (Vienna basin/Lower Austria, and Molasse basin (Upper Austria) faces a decreasing trend. In 2020, about 609 thousand tons of oil were extracted in Austria, whereas 7.5 million tons were imported from Kazakhstan, Iraq and Russia, hence, about 92% of crude oil is imported. From crude oil OMV produced 39% diesel fuels, 23% gasoline fuels, 12% fuel oils (extra-light, light, heavy), 13% petrochemical feedstocks, 4% jet fuel, 5% bitumen and 4% others in 2020 (Wirtschaftskammer Österreich, 2020). In 2020, the petrochemical industry in Austria employed about 4.625 people (Wirtschaftskammer Österreich, 2020).

1.3.2 Mainstream narrative: stakeholders and institutions

The Austrian industry landscape is characterized by only a few large enterprises and a lot of small- and medium-sized enterprises. In Upper and Lower Austria, however, the large basic material producers are located. These include Voestalpine (iron and steel), Lafarge (cement), Borealis (plastics and fertilizers) and OMV (mineral oil). As described above, the industries and also most of the named companies are located in these areas for 50-100 years. The history of Voestalpine, the dominant producer of iron and steel in Austria, traces back into the year 1935. Lafarge is an international cement and concrete producer, which is located in Austria since 1872. Borealis is an international chemical company, which is headquartered in Austria since 1994. Another key company is the above mentioned OMV. The basic material industry contributed a lot to the economic development of the regions (jobs, innovations, etc.) and play a central role for the Austrian economy.

Policymakers at national, state and local level played a central role as the lobbying of certain industry branches was high. From the 1990ies up to 2010, industrial policy was almost absent in Austria (Fürst, 2013). It was very common that policy interventions were made ad-hoc to favor specific companies, regions or sectors (Fürst, 2013). The EU played an increasing role for policies on competition and location, after Austria joined the EU in 1995.

The Federation of Austrian Industry is a voluntary, party-politically independent interest group with honorary functionaries and was founded 150 years ago. There is a specific association for each state of Austria. For example, in Upper Austria, it unites about 450 companies which are either national and international corporations, family-owned companies and numerous small and medium-sized enterprises from the manufacturing sector, the banking industry, infrastructure and industry-related services. The Federation of Austrian Industry is the interface between company and government and functions as advocacy of the industry, think tank, network and service partner.

In Upper and Lower Austria, several research institutions (private and public) support the development of industries. This includes higher education institutions such as Johannes-Kepler University or University of Applied Sciences of Upper Austria in Upper Austria. Furthermore, in Upper Austria three COMET-centers (Competence Centers for Excellent Technologies) were established, researching on technologies for materials and production as well as digitalization. In Lower Austria two COMET center are founded with a focus of either materials and production or life sciences.

1.3.3 Mainstream narrative: ideologies

In the industry sector in Upper and Lower Austria, the prevailing ideology was on individual strategies to achieve climate goals and ensure the economic viability of the company. Ambitious climate goals set by the EU was seen as a threat that might harm the company in terms of international competition (APA-OTS, 2007). In particular the EU Emission Trading system (ETS) was mentioned a reason for large Austrian industry such as steel to relocate outside the EU (Heilmann, Kleibrink and Zoglauer, 2015). The Paris agreement of 2015 that includes major emitter globally however changed the mindset of Austrian companies that increasingly investigate domestic GHG reduction options. Also the European Green Deal that aims that the EU will become climate-neutral by 2050 has contributed to this development.

1.3.4 Mainstream narrative: policies

On the EU level, the basic material sector is covered by ETS to reduce emissions. On the national level, no specific climate policy instrument for the basic material sector exists. However, single firms got investment subsidies from the national government for implementing innovative, low-carbon technologies. Subsidies mostly covered specific pilot projects. In addition, companies are part of research grants funded by the Austrian Energy and Climate fund.

1.3.5 Alternative (on-stream and/or off-stream) narrative

The alternative narratives for the Austrian case study are derived from a stakeholder workshop held in 2020 (see section 2 for more details). Given the scope of the stakeholder process, by mainly consulting representatives from industrial companies, off-stream alternative narratives were developed which may become the transformative alternative in the future. However, no transformative narratives that include a high degree of disruptiveness as for example, a deindustrialization of the regions and or closing of industries, were developed.

However, to identify the alternative narratives from the perspective of industry companies, the workshop dealt with the question "Where must the industry sector head to in order to achieve decarbonization?" and "What tipping interventions are necessary to activate a tipping point?". Therefore, also the tipping point concept was briefly introduced to the stakeholders to clarify the purpose of the case study.

Interestingly, the first question was quickly answered by the industry stakeholders as "technologies to achieve decarbonization are already known". Based on those discussions two off-stream alternative narratives were developed by the industrial companies who are also the narrators of the mainstream narrative (see also Figure 3):

1. Green Hydrogen
2. Industrial Circularity

However, the second question is more difficult to answer. The stakeholder dialogue (workshops and focus groups as described in section 2) showed that Austria is lacking specific and tangible framework conditions and policies which enable a system change within the industrial sector. Therefore, it is necessary to study and assess promising framework conditions and policies which foster the switch to these alternative narratives.

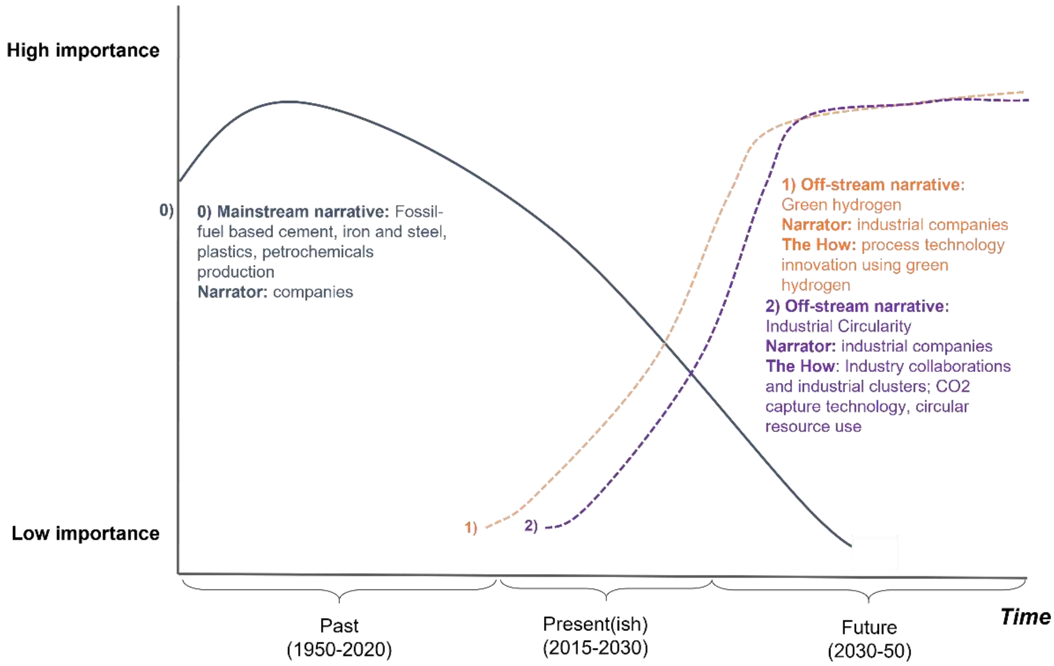

Figure 4: Relative importance of mainstream narratives and off-stream alternative narratives over time.

1.3.6 Alternative (on-stream and/or off-stream) narrative: technology

Green Hydrogen

In order to decarbonize the basic material industry, new process technologies are required that can make use of low-carbon energy sources such as hydrogen. In the iron and steel industry, this includes the shift from the conventional blast-furnace route to the hydrogen based direct reduction (H2-DRI) (see Figure 4 for an illustration of the technology transformation). Furthermore, captured CO2, for example from iron and steel or cement industry, can be synthesized with hydrogen to hydrocarbons. These hydrocarbons can serve as a feedstock for the chemical and petrochemical industry and could substitute hydrocarbons made from natural gas. For the iron and steel industry first pilot projects for the H2-DRI route are operated in Upper Austria and started in 2018. Further pilot projects are planned but not realized, yet.

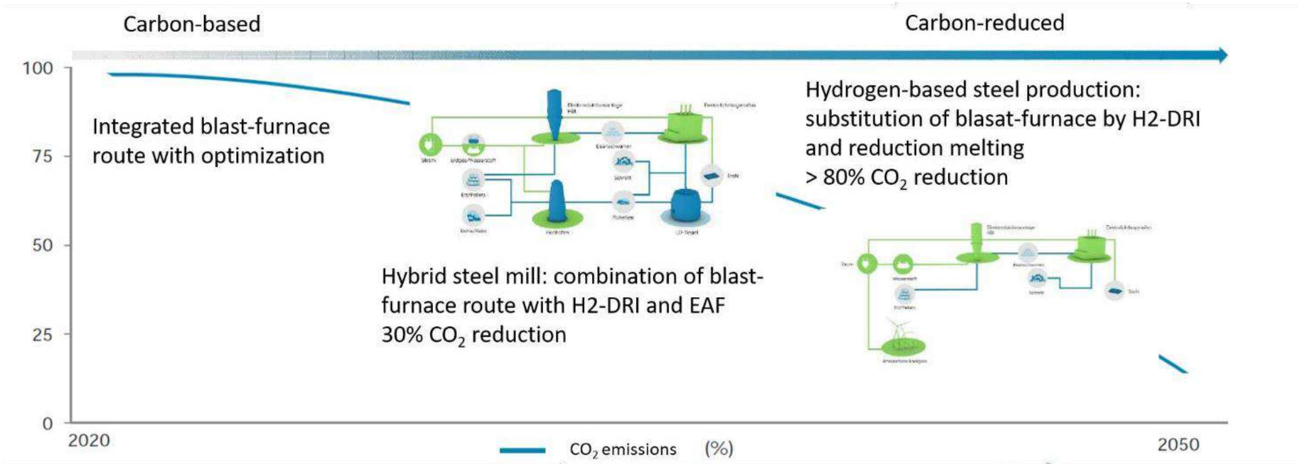

Figure 5: Technology development over time and potential CO2 reductions of largest Austrian iron and steel producer(hydrogen based direct reduction (H2-DRI), electric arc furnace (EAF)) (voestalpine AG, 2021).

In order to realize decarbonization efforts in the basic material industry, new strategies for resource and energy use are developing. For that purpose, strategies go beyond the scope of a single company or industry branch. In other words, different industries need to collaborate to achieve radical emission reductions.

For example, the cement industry is a so called "hard-to-abate" industry. The reason is, that 50% of emissions are the result of direct and indirect energy consumption, and about 50% of emissions are process-related which means that they are emitted by decomposition of raw materials in the heating process (Zhang et al., 2018). In order to get rid of process emissions, a switch to new technologies which does not include the decomposition process would be necessary or alternatively the CO2 is captured. The captured CO2 can then be used in other industry sectors as a feedstock and substitute the use of fossil-fuels (e.g. natural gas and oil to produce hydrocarbons for plastics industry). In Lower Austria, a pilot project called "Carbon 2 Product Austria" is planned including the cement industry, electricity industry, mineral oil industry, and the chemical industry to show the feasibility of such a concept (Markowitsch et al., 2022)(see Figure 5).

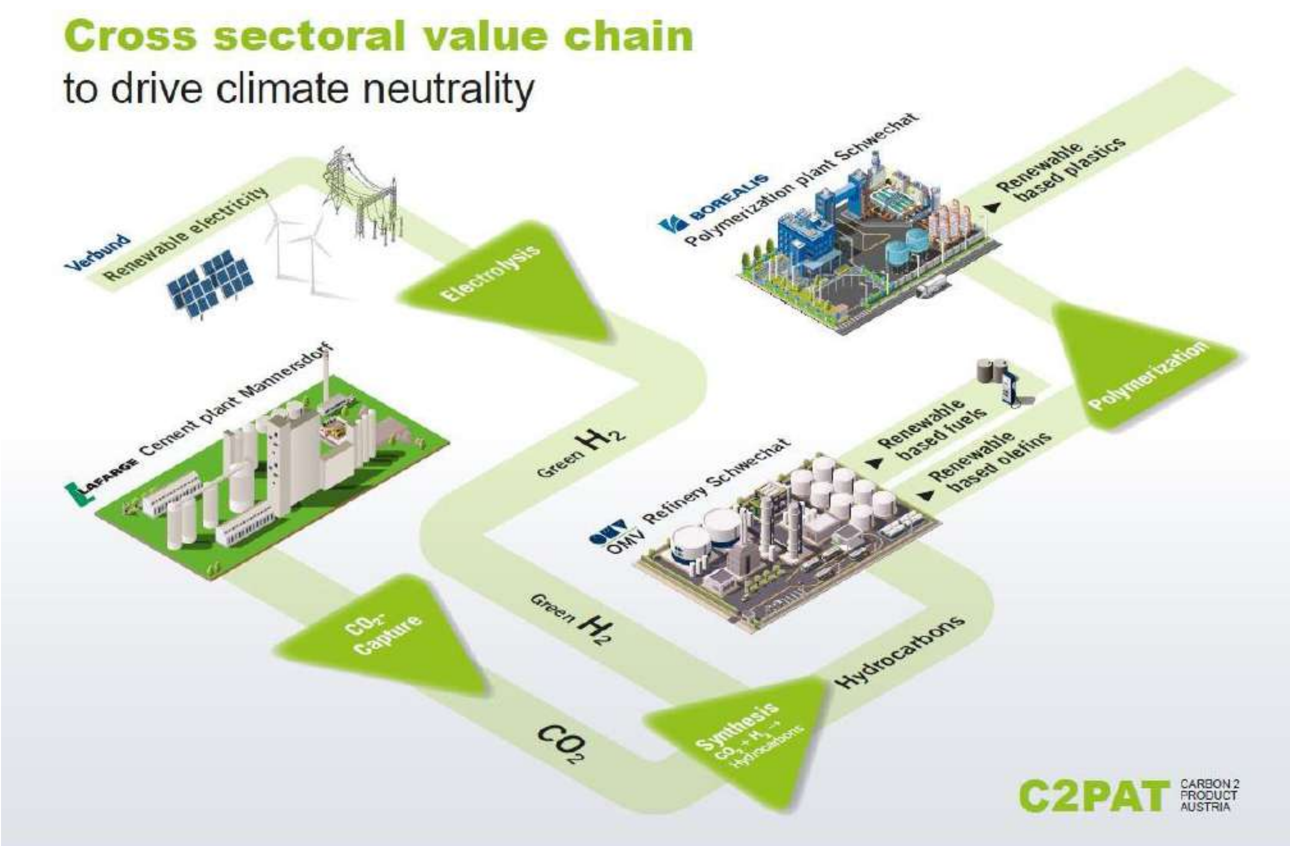

Figure 6: Industrial Circularity concept planned in the Austrian industry sector (C2PAT, 2020)

1.3.7 Alternative (on-stream and/or off-stream) narrative: stakeholders and institutions

Compared to the mainstream narrative, we still have the same large companies involved from the iron and steel, cement, chemical and petrochemical industry. However, in the alternative narratives the same companies collaborate with each to jointly reach climate goals instead of each company going its own way.

Furthermore, both alternative narratives are highly dependent on hydrogen, which best should be produced by electrolysis from renewable-based electricity. Therefore, the electricity sector gets a pivotal role and substitutes the fossil-fuel sector as input or feedstock supplier.

Policymakers at all levels (EU, national, state) are asked to find instruments and policies to support the alternative narratives so that they could become transformative narratives. This means that significant GHG emission reduction and in particular a net zero transition require that funding is made available for pilot projects and markets for green basic material are established so that the economic viability of companies is ensured in the long-term and also independently from public support. Furthermore, as the alternative narratives are dependent on the availability of renewable-based electricity, the expansion of renewables and required infrastructure for transmission needs to be accelerated.

The Federation of Austrian Industry is also present in the alternative narratives and can drive forward the transition by providing solutions, a network for collaboration and be a channel to policymakers.

Research institutions are still relevant as they support the innovation process in the industry and can provide proofs of feasibility for low-carbon pathways. Furthermore, they might build a bridge between industry and policy and act as a mediator to boost the transformation process.

Non-governmental organizations (NGOs) and activists become also relevant in the alternative narratives as they put pressure not only at certain companies but also on policy-makers. The Fridays-for-Future campaign has created awareness to take climate goals seriously and act as soon as possible.

1.3.8 Alternative (on-stream and/or off-stream) narrative: ideologies

The great challenge of reducing emissions in the basic material industry leads to different company ideologies. It is clear that single companies or industry sector will hardly achieve the required emission reductions but solutions are available if companies think across the value chain. Therefore, industry collaboration and the establishment of industrial clusters is becoming the new ideology. Furthermore, climate-friendly production is seen as an opportunity instead of a threat. As such companies' economic viability can co-exist with the achievement of strict climate goals.

1.3.9 Alternative (on-stream and/or off-stream) narrative: policies

As described in the mainstream narrative, until the end of the first decade of the 21st century, no specific climate-related industrial policy was in place in Austria. Only around this time, also with the EU addressing certain industrial policy aspects, the notion for it became more prevalent. This includes that competitiveness can be increased through better framework conditions instead of isolate intervention in favor of specific companies, regions or sectors and that innovation subsidies should be preferred to conservation subsidies (Aiginger and Sieber, 2009; Fürst, 2013). The implementation of a comprehensive climate-related industrial policy strategy, however is still missing until 2020.

From 2015 onwards, first policy developments that could support the alternative narratives are developing. On EU level, the European Green Deal and the Fit-for-55 package was implemented. The Fit for 55 package includes an update of EU legislation to achieve a 55% emission reduction until 2030. The update includes changes to the emission trading system (ETS) consisting of an extension of the scope of the scheme. Particularly relevant for the Austrian industry is the phase-out of free allocation of emission allowances to sectors that are covered by the carbon border adjustment mechanism (CBAM), the increase of funding from the innovation fund, the implementation of a CBAM to prevent from outsourcing the production of emissions in non-EU countries, and a revise of the renewable energy directive (European Council, 2022). In addition, a plastic tax is in place since January 2021 to reduce packaging waste and stimulate Europe's transition towards a circular economy (European Commission, 2021b). Finally, so called "Important Projects of Common European Interest (IPCEI)" were implemented to join forces in terms of knowledge, expertise, financial resources and economic actors (European Commission, 2022).

In Austria, EU laws and directives are executed but no particular industry policy is available. One suggestion to accelerate the industry transformation is a national transition fund, bundling private capital with public/federal funding – and in project financing complemented by EU funding (Steininger et al., 2021). In addition, the new renewable energy expansion law provides for yearly 40 million Euro subsidies for electrolysers, part of which will be allocated to Voestalpine. In 2019 the city of Linz has adopted a climate change plan which emphasizes the special responsibility of Linz to remain an industrial location. In addition, in June 2022 an Austrian hydrogen strategy was introduced (BMK, 2022).

1.4 Trends and indicators for sustainable transformations

1.4.1 Geography and migration

Upper Austria

The case study region Upper Austria with the city of Linz is characterized by a compared to other Austrian and foreign urban regions good spatial location and a very good competitive position. This is reflected on the one hand in the very high level of its economic power but also in the strong dynamics of the relevant economic indicators. Compared to the other Austrian provincial capitals, the city of Linz is much more closely intertwined with the surrounding area than its competitors. This area has a convenient, multimodal location (fast train connections to Vienna and Germany) as well as a strong research and development (R&D) and innovation infrastructure, a well-developed regional knowledge base and good educational facilities. The educational level is higher comparted to other Austrian cities for apprenticeships (27,6%) and slightly lower regarding academic education (17,6%) (Heilmann, Kleibrink and Zoglauer, 2015).

Linz has a pronounced industrial area in terms of area and the location is backboned on the one hand by internationally active leading companies, on the other hand diverse mix of small and medium-sized companies at the location. The 210.000 jobs in the area are almost equally distributed between men and woman. Within the city of Linz a large number of employees are working in the area of metal processing (69% of all related employees in the entire province), while in the surrounding areas more specialized jobs are dominating including also IT. R&D is strongly driven by the business sector (more than 90 % between 2010 and 2015 and increasingly by 7.5% per year) (Heilmann, Kleibrink and Zoglauer, 2015).

Lower Austria

The pilot project for industrial circularity in Lower Austria is located in the provinces "industry region", an eastern Austrian region close to Vienna and its refinery. There is a large potential for wind energy production given low population density and flat land in the eastern parts. The region has a strong industrial basis, well skilled labor and a strong know how base due to its vicinity to Vienna (Schafferhans et al., 2019). Also in Lower Austria middle-level education is strong (e.g. apprenticeships among men at 44,8%) and academic education lower that the Austrian average (12,5%). The industry region faces a high unemployment rate with traditional industries declining (Schafferhans et al., 2019).

1.4.2 Values, Identity and Politics

Upper Austria

Linz is a social democratic governed city, while the province of Upper Austria was governed by conservatives since 1945. The conservatives highlight the importance of climate change mitigation, while safeguarding the industrial location and jobs. This forward looking innovation strategy comes at the background of companies threaten to leave Austria if the cost for climate change would become too high. The city administration of Linz aims to apply to become EU environmental and climate capital in 2025.

Austrian residents think of Linz as an "industrial city" and associate it mainly with the company

Voestalpine (iron and steel producer), as a city of culture and with research university (MeinBezirk.at, 2014). As such, Austrians also like Linz as a city to study but 60% would not move to Linz for job (MeinBezirk.at, 2014). In a survey among residents from Upper Austria, the majority agrees that Upper Austria gained importance as a business location from 2015-2021 and that Linz needs to be competitive as a location to further boost economic development and jobs in the region. Overall Upper Austrians are pessimistic about the achieving the Austrian climate neutrality goal until 2040 but support measures that support the expansion of renewable energies, savings in energy and raw materials, new technologies for the transport, industry and energy sector. Half of the respondents also prefer the funding of research in hydrogen technologies (Tips, 2021).

Lower Austria

Lower Austria is a key conservative region in Austria. The conservative party is governing since 1945. Climate change mitigation was not an important issue for long time, only in 2021 the province has adopted a climate change plan (Amt der NÖ Landesregierung, 2019). A strong focus of this plan is to increase renewables. The research and innovation strategy aims to increase the biomass heating segment but does not explicitly mentions planned high-tech innovations (Amt der NÖ Landesregierung, 2019).

1.4.3 Policies

As described above, industrial policy was more or less absent in Austria. Only since the Paris agreement and when the efforts of the EU became more stringent, streamlined policies for the industry sector evolved. However, Austria is still lacking a comprehensive policy strategy for the whole basic material sector. Therefore, policy insights from other European countries can give an overview of current policy advancements in the basic material sector which might be adopted in Austria to move the Austrian industry sector on a low-carbon trajectory. Seven qualitative interviews with experts from Germany, Netherlands, Norway, Poland and Spain about industrial collaboration and required policies were conducted. Within those, experts differentiated mainly between framework conditions needed for (see Table 1) and policy instruments (see Table 2) to accelerate the decarbonization.

According to the interviewees a leading market for green products need to be established so that the same environmental information of products is available across the European or even global market. In a market with adequate environmental labelling, basic materials produced by low-carbon technologies can become competitive compared to "non-green" products. A further prerequisite for that is an improvement of emission accounting along the value chain. In addition, if industry sectors are going to collaborate and include either CCU or CCS, a market for CCU/S infrastructure providers is necessary to prevent from monopoly building and resulting high prices for the transport of CO_2. Another aspect is the regulation of

CCU/S infrastructure, particularly CO_2 transport by pipelines as it gives access to capacity (similar to electricity transmission and distribution system). Once the pipelines are installed, they should be used to its maximum capacity to also reduce operational costs, which needs some kind of regulation. In terms of public acceptance, a dialogue process with citizens need to be implemented to increase the acceptance for CCU/S infrastructure and make people aware of potential risks and opportunities.

Furthermore, the interviews showed that new business models need to be developed to efficiently run low- carbon technologies. This includes business models for CCU/S but also for industrial collaboration as in the C2PAT pilot project in the Austrian case study. For Austrian stakeholders, an open question is how value chains can be controlled across companies. For example, if value chains are entangled, but they are not entangled under corporate law. Within the interviews a difficulty emphasized was also the consensus between international and national companies. The reason is that for industrial clusters, participating companies pursue different long-term goals, depending also in which country the company is headquartered. For example, companies located and founded in an European country might want to follow European climate goals more stricter than non-European companies, leading to different efforts in terms of emission reduction. International companies often also follow short-term strategies to also comply with their shareholders instead of long-term strategies that are required for the implementation of low-carbon technologies. Furthermore, interviewees underline that clear signals for upcoming policies and potential infrastructure developments are necessary from the political level to ensure companies investments.

Table 2: Required framework conditions for the basic material industry sector

Market	**Company Level**	**Coordination**
Leading market for green products	New Business Models (for CCU/S)	Consensus between international and national companies
Market for CCU/S infrastructure providers	Improving emission accounting along the value chain	Dialogue process about CCU/S with society
Regulation for CCU/S infrastructure		Clear signal from political level

Table 2 presents policy instruments mentioned by interviewees that support the sectoral transition of the basic material sector. These include well-established instruments such as standards, quotas, CAPEX subsidies, and public procurement but also less-established instruments. The latter include a CO_2 tax on industrial emissions that exceeds the EU ETS benchmark. Such a tax came into force in the Netherlands in January 2021 and start at € 30 per ton of CO_2 (European Commission, 2021a). The levy then increases each year about € 10.56 up to a rate of € 125 per ton CO_2 in 2030. A such the tax is formed as a CO_2 minimum price (European Commission, 2021a). In addition, Dutch experts reported from public tenders for the promotion of infrastructure projects of industrial clusters (Netherlands Enterprise Agenvy, 2021). Therefore, industrial clusters submit a plan for infrastructure developments (e.g. hydrogen or CCU/S) that are needed to accelerate their technology switch and the Dutch government then decides on certain criteria to support these.

According to experts from Germany, Carbon Contracts for Difference (CCfD) are highly discussed in Germany and considered for implementation in combination with consumption charges on basic materials. A Carbon Contract for Difference is a project-based operating subsidy for low-carbon technologies (Richstein *et al.*, 2021). A CCfD ensures a fixed carbon price for the duration of the contract (10-20 years) for the company and therefore pose lower investment risks for companies. It works as follows: A carbon price (strike price) is set in the contract, and if the market price of CO_2 is below the CO_2 strike price, the government pays out the difference to the company. In contrast, if the market price is higher than the strike price the company pays back the difference to the government (Richstein *et al.*, 2021). Furthermore, a climate contribution is discussed as an alternative to current CBAM regulations. The climate contribution is a levy on each ton of produced or imported basic material, regardless of the production process and location of production (Neuhoff *et al.*, 2019; Chiappinelli *et al.*, 2020). The levy is the product of the weight of the material, an emission-benchmark of the material and the CO_2 price. The climate contribution intends to be an incentive for material efficiency and recycling along the value chain and includes all CO_2 costs. In combination with a CCfD the revenue from the climate contribution can be earmarked for financing CCfDs (Neuhoff *et al.*, 2019; Chiappinelli *et al.*, 2020)(Climate Friendly Material Platform, 2021).

Table 3: Implemented policy instruments in various European countries for the basic material industry sector

Policy Instruments	**Description**
CO_2 Tax	CO_2 tax on industrial emissions based on increase of CO_2 price
CAPEX subsidies	Investment grant for climate-neutral pilot projects
CarbonContracts for Difference – CCfDs	Companies receive project-related operating subsidies for investments in low-CO_2 technologies based on the CO_2 price

Climate Contribution	A levy is imposed on selected basic materials depending on the quantity used, regardless of the production process and location of production
Green Public Procurement	Public sector expenditures, are made according to mandatory sustainability criteria, in order to create lead markets for new technologies
CO_2 product requirements	Sales ban on basic materials from emission-intensive production
Quotas	Producers of consumer goods will be required to use specified proportions of materials produced without CO_2 in the basic materials
Standards	Manufacturers of consumer goods will be required to ensure resource efficiency and energy efficiency through appropriate design
Public tenders for the promotion of infrastructure projects of industrial clusters	Infrastructure projects are funded based on plans/requirements from industry clusters

The progress in terms of implementation of the above discussed policies in various European countries are demonstrated in Table 3. This gives a rough overview of the policy landscape in the European basic material industry and puts the Austrian case into context. We see that Germany is already planning an implementation of CCfDs in combination with a climate contribution whereas other countries only discuss this new instruments. Furthermore, Norway and Poland have a strong focus on CCU/S development and therefore other instruments for greening the basic material industry fall behind. In Spain, mainly international companies are located and therefore, the national government follow EU policies instead of developing tailor-cut policies for the Spanish industry. In contrast, the Netherlands pursue a very specific direction with the implementation of an industry-specific CO_2 tax and public tenders for infrastructure projects.

These results were also presented to Austrian industry stakeholders and the potential suitability of instruments for the Austrian industry was discussed. Austrian industry stakeholders showed the greatest interest in CCfDs in combination with a climate contribution. The reason is that these instruments prevent from carbon leakage which is highly relevant for export-oriented industries such as iron and steel and the plastics industry and reduced the investment risk in low-carbon technologies in the long-run. Furthermore, Austrian industry stakeholders identified the expansion of electricity, hydrogen and CO_2 transport infrastructure as a main prerequisite for the acceleration of industry decarbonization. Therefore, the idea of public tenders for industry-related infrastructure projects was also seen as an important instrument.

Table 4: Progress in policy implementation for decarbonizing the basic material industry in various European countries

Country	Instrument	Status quo	Institutional level
Germany	CCfD and climate contribution	Detailed planning	government
	Green public procurement, CO2 product requirements, standards and quotas	In discussion	government
	Transnational cooperation for CCU/S	Detailed planning	company
Spain	CCfD, climate contribution, green public procurement	In discussion, no priority	government
Poland	CCfD, public procurement, CAPEX subsidies	In discussion	government
	CCU/S	CCU/S strategy in preparation	government
Norway	Market for CCU/S providers	In development	Public-Private Partnership
	Regulation of CO_2 storage	Implementation of pilot projects	Public-Private Partnership
	Regulation of CO_2 transport	Suggestions from experts but no policy debate	Public-Private Partnership
Netherlands	CO_2 tax,	Implemented since January 2021	government
	Public tenders for infrastructure projects	Tenders from 2018 in implementation	government

	phase	
Labels and standards	In discussion	Company level

1.4.4 Economics

For the Austrian case study the pivotal question in terms of economics is which socio-economic implications can be expected by the alternative narratives. Or in other words, what are the socio-economic implications once a tipping point in the basic material industry occurred? As the alternative narratives in the basic material industry is only developing to-date, insights from economic modelling can help to understand potential impacts of a technology switch or the implementation of policy instruments in the basic material industry.

For example, (Mayer, Bachner and Steininger, 2019) investigated the switch from coke-based to hydrogen- based iron and steel making in the EU, with a focus on Austria and Greece. The study analyses the socio- economic impact of the technology switch without adequate climate policy. They found that the technology switch lead to only moderate cost increases but these increases might still be a barrier for the industry. As the low-carbon technology is also more capital-intensive, the sectoral transformation leads to a minor increase of the unemployment rate. Furthermore, they identified a carbon leakage risk which need to be targeted by specific policies (Mayer, Bachner and Steininger, 2019). Similar results are found by (Bachner et al., 2018) who developed different deep decarbonization scenarios for iron and steel industry in a co-creation process and conducted a macroeconomic assessment of the scenarios. Overall, they find that gross domestic product (GDP) and welfare decreases whereas unemployment increases in various deep decarbonization scenarios. However, these effects do not include any benefits from GHG emission reduction such as reduced health costs or abatement costs. Finally, in terms of cost effectiveness, an earlier transition is to be preferred to a later transition (Bachner et al., 2018). Furthermore, the macroeconomic effects of a more stringent GHG emission reduction target of the EU (i.e. -55%) under consideration of covid-19 recovery policies for Austria were calculated (Steininger et al., 2021) (note: all relative changes in economic indicators are compared to a baseline scenario which represents the EU 2030 target of -40% of emissions relative to 1990). The study showed that it is more favorable to implement climate change mitigation measures in parallel to covid-19 recovery policies. When looking at the sectoral implications for the basic material industry, the economic model demonstrates that a carbon pricing improves the relative costs of hydrogen-based steel making. Furthermore, in the short-run the investment stimulus in iron and steel lead to a higher GDP, a lower GDP in transition phase (2030-2040) and again higher GDP when the transformation is completed. Implementing an industrial circularity strategy in the cement industry where CO2 is captured and a new by-product (hydrocarbons) is utilized in other industries such as the chemical industry or refineries, lead to a higher GDP. The reason is that additional production gains are generated due to the by-product whereas otherwise abatement costs for CO2 emissions would arise and would lead to production losses (Steininger et al., 2021).

Due to the high interest of Austrian stakeholders in CCfDs and a climate contribution, it is necessary to also analyze the effectiveness and macroeconomic effects of such policy instruments. (Richstein et al., 2021) show that CCfDs reduce company's uncertainty with regard to the carbon price and promote investments in clean technologies. They also show that if 10% of production of key industrial sectors are transforming, CCfD can reduce government expenditures and can lead to revenues in periods with high carbon prices (Richstein et al., 2021). Furthermore, a climate contribution or consumption charge equivalent to €80/tCO2 is able to reduce EUs total energy-related and process emissions in industry by 10% by 2050 with only small GDP increases and a minor increase in unemployment (Pollitt, Neuhoff and Lin, 2020). Finally, (Stede et al., 2021) found that consistent carbon pricing of basic materials lead to small and progressive distributional impacts.

1.5 Summary of key findings

The Austrian case study investigated potential political, economic and technological tipping interventions that may lead to a socio-economic tipping point in the basic material industry. From a technological perspective, two narratives have been identified to be most promising for reducing GHG emission in the basic material sector. First, a process technology switch that enables the use of green hydrogen. Second, the implementation of industrial circularity concepts ensuring a sustainable use of resources.

These narratives are mainly driven by industry stakeholders as they want to maintain their industry activities in Upper and Lower Austria also in the future. Therefore, pilot projects for the described technology switch are already planned and partly implemented. However, to fully realize planned pilot projects or an upscaling of new industry concepts, political interventions are necessary. These include financial support for pilot project to trigger a tipping process in the basic material industry but also new instruments such as Carbon Contracts for Differences and/or a climate contribution that support the upscaling of new technologies. Furthermore, as described in section 4.4., the macroeconomic effects of a technology switch towards hydrogen-based production in iron and steel or an industrial circularity concept including the cement, chemical and petrochemical industry are only moderate and the introduction of CCfDs would ensures low investment risks for companies and might even lead to positive revenues for the government. Overall, a policy mix will be required that provides incentives for basic material producers and basic material users.

In summary, for the basic material industry in Austria alternative narratives are evolving but political interventions and financial investments are needed to accelerate the sectoral transformation and to reach a tipping point. To date, the efforts for climate neutral basic material production are promoted by large and highly emitting companies. These companies are seen as forerunners and their technology experience will then hopefully spillover to small and medium-sized companies, hence leading to a self-amplifying effect. However, a relevant prerequisite for the scale-up of these low-carbon technologies throughout the basic material sector, is the expansion of renewables and the electricity grid as well as of transport infrastructure for hydrogen and CO2. Only if the sufficient renewable-based electricity and the infrastructure for hydrogen and CO2 is available, the discussed alternative narratives can become transformative narratives. Finally, the narratives described in this report are mainly technology-driven. However, demand-side measures that reduce the demand of basic materials by either a more efficient material use or high-quality materials will also be necessary to lead the basic material sector on a low-carbon trajectory.

1.6 Reflection on inter- and transdisciplinary research approach

1.6.1 What disciplines does your case study and analytical approach draw from? Is it an interdisciplinary or multidisciplinary approach?

The Austrian case study was investigated under an economic and political lens. For that purpose, the interplay of political instruments and framework conditions as well as macroeconomic effects were discussed, and represent an interdisciplinary approach. In addition, aspects of the human geography and socio-psychological discipline were considered to embed the industry transition in a broader regional context.

What aspect of the research is transdisciplinary, that is the co-designing and/or co-development with stakeholders of

1.6.2 Which stakeholder groups were consulted and how did they contribute to framing the research problem?

For the identification of research question, representatives from different basic material industry companies were consulted. In the first stakeholder workshop (as described in section 2) potential alternative narrative for the basic material sector were discussed. Based on the alternative narratives, relevant research questions were developed.

1.6.3 Which stakeholder groups were consulted and how did they contribute to analyzing the problem or developing knowledge?

Among the industry stakeholders which were consulted over a longer time period in several focus groups, expert interviews were conducted about the economic and political context of industrial clusters in the EU and to discuss key framework conditions and political instruments that can accelerate the decarbonization in the basic material industry.

1.6.4 Which stakeholder groups were consulted and how did they contribute to the research impact/output?

1.6.5 How does your research project (potentially) contribute to solving the societal problem (described by the stakeholders)?

The study at hand summarized potential tipping intervention that can accelerate the sector transformation of the basic material industry. This can support policy-makers as well as industry stakeholders in their decisions for a climate neutral industry.

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2 Case study 2: Bosnia and Herzegovina

The transition narratives in Bosnia and Herzegovina
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Case study 1:

The Potential Decarbonization of Electricity Generation in the Entity Federation of Bosnia and Herzegovina

Case study 2:

The Transformation from Coal-Intensive Heating to Clean Biomass in the Entity Republika Srpska

2.1 Introduction

Since the Industrial Revolution, the growth of the global economy has been fuelled by the exploita-tion of non-renewable natural resources, which has led to multiple problems like pollution and growing scarcity. The increasing industrialization, population increase, and economic development are primarily responsible for the excessive burning of fossil fuels and the production of greenhouse gases (GHG), which are the major drivers of climate change. Particularly notable in terms of its impact on greenhouse gas emissions and global warming, coal consumption has been singled out as a major culprit.

Coal is essential in Bosnia and Herzegovina for a number of reasons, including but not limited to: domestic energy production, industrial use, domestic mining, and the creation of jobs. Yet, the 1992–1995 conflict split the country's unified energy system into three separate state-owned electric power generating and distribution companies: Elektroprivreda BiH (EP BiH), Elektroprivreda Republike Srpske (ERS), and Elektroprivreda Hrvatske Zajednice Herceg Bosna (EHZHB) (EP HZHB).

With the current structure in place, Bosnia and Herzegovina is taking a unique approach to the Ener-gy Union. But, in the next years, a legal framework for energy and climate, decarbonization measures at all levels, and an adequately effective institutional structure for implementation must be established.

There are a number of important concepts and prerequisites that must be taken into account on a regional scale if Bosnia and Herzegovina is going to successfully establish the institutional framework necessary for the Energy Union (Ministry of Foreign Trade and Economic Relations of BIH). A statewide legal and regulatory framework needs to be established for energy and climate that defines the goals and parameters for decarbonization initiatives.

Also, decarbonization efforts need to be carried out on a global, regional, and local scale. This will need the creation of strategies and plans of action that account for the differences in difficulties and po-tential offered by different regions. Other sectors, such as transportation and manufacturing, may also need distinct responses.

A strong institutional framework must be set up to monitor the execution of these policies. It means setting up procedures for coordination and collaboration among various parties and providing enough funding for the necessary organizations. In reality, this means consistent communication and coopera-tion across various levels of government, neighborhoods, and non-profits.

The decarbonization path of Bosnia and Herzegovina is an ambitious goal that will need time and a long-term vision to attain. Significant investments in infrastructure, technology, and human resources are necessary to make the shift to a low-carbon economy. As a result, it's important to take things slowly, setting intermediate and long-term targets and adjusting them as required. Bosnia and Herzegovina can achieve its energy and climate goals and make the transition to a low-carbon economy by adhering to these essential concepts and standards.

Once the Ministerial Council adopted the Clean Energy Package and the Decarbonization Roadmap in November 2021 (Energy Community Secretariat), Bosnia and Herzegovina is obliged to transpose rele-vant EU Directives on energy and climate. This new policy shows the country's commitment to working with the European Union and other international partners to reach the goal of zero greenhouse gas emissions by the year 2050.

The government of Bosnia and Herzegovina has increased its efforts to draft a National energy and Climate Plan (NECP) despite the difficulties caused by the COVID-19 pandemic. Targets for renewable energy sources and reductions in final energy consumption and primary energy supply as well as green-house gas emissions from the energy sector should be spelled out in detail in the plan. It is necessary to create appropriate policies and strategies in order to achieve the desired results.

It is essential for the energy sector's interconnected parts to establish policies and initiatives for inte-grated energy and climate management. Decarbonization, energy efficiency, security of supply, internal market energy, and research, development, and competitiveness are the five essential elements of the Energy Union that these policies and actions are principally connected to.

To this end, the government of Bosnia and Herzegovina has been working hard to modernize its as-sistance system mechanisms and shift towards market-based alternatives. Priorities include creating an electronic system for giving origin guarantees and implementing laws addressing the long-term sustaina-bility of biofuels. The nation only recently joined the Energy Community-led regional effort to create an electronic system for guarantees of origin.

Bosnia and Herzegovina achieved its sectoral goal of 40% for the proportion of renewable energy in heating and cooling in 2021 (Implementation Report 2022, Energy Community Secretariat), after a period of rapid growth in this area. Yet more effort is required to boost the electric and transportation indus-tries' usage of renewable energy.

Bosnia and Herzegovina's heavy dependence on coal and the subsequent requirement to decarbon-ize its energy system provide formidable difficulties for the country's energy and climate sectors. The government has yet to develop its NECP and take part in the regional initiative for guarantees of origin, both of which are good moves in the right direction toward resolving these difficulties. Integrating energy and climate management in the nation depends on the execution of policies and actions connected to the Energy Union's five key aspects. In Bosnia and Herzegovina, the planning of the energy transition of cities and regions, with an eye toward a socially just transition, will need more integration across sectors such as energy generation, buildings, mobility and transport, land-use, waste, water, health, etc. It is im-portant that the shift to clean energy be carried out in a manner that does not disadvantage the most in need people of society. It is important that this process be eco-friendly and long-lasting. This is signifi-cant because transitioning to a green energy system in Bosnia and Herzegovina is likely to generate mul-tiple co-benefits in terms of air quality, emissions reductions, and generation of new sources of em-ployment.

2.1.1 Research problem

The production of electricity is an essential economic activity in BiH. Coal-fired thermal and hydro power facilities are the primary sources of electricity generation, a total of 60% of coal-fire thermal pow-er plants in its energy mix (SERC 2022). Bosnia and Herzegovina is a net-exporter of electricity. A total of about 17,000 GWh per year is generated (State Electricity Regulatory Commission, 2022). Because of its abundant hydropower resources and coal deposits, BiH has long had a competitive edge in the power sector.

BiH has to devise a strategy to wean itself off of coal as the EU moves to impose a carbon border tax and phase out subsidies for new fossil fuel projects. Energy efficiency, renewables, greenhouse gas emis-sion reductions, interconnectivity, research, and innovation are all areas that are being addressed in Bi-H's National Energy Climate Plan (NECP), which is being developed in accordance with EU standards. Ac-cording to the Energy Community Secretariat (ECS), BiH will not be able to get access to more EU money in the energy sector unless their NECP, which includes a decarbonization plan, is approved.

In this case study, we investigate the decarbonization path of the energy sector focusing on the coal region in Tuzla, Bosnia and Herzegovina and a best practice example of Banja Luka where the city suc-cessfully switched its district heating system (DHS) from fossil fuels to woody biomass.

2.2 Research approach and methodology

Bosnia and Herzegovina is not immune to the global energy shift towards decarbonisation that is now underway. In terms of both generation and consumption, the nation has been encountering a num-ber of difficulties as of late. In this study, I want to give a comprehensive chapter on the two-stage meth-od utilized to assess the impact of policy shifts on the development of the energy transition in Bosnia and Herzegovina. We took the following steps in analyzing the decarbonization path of Bosnia and Herze-govina:

Step 1: Quantitative Analysis of Economic, Political, and Cultural Trends:

Economic, political, and cultural changes in Bosnia and Herzegovina were evaluated by a quantitative study of publicly available data. The study found that fossil fuels, and notably coal, are crucial to the pro-duction of power in the nation. The overuse of fossil fuels, however, has led to higher levels of pollution in the air and greenhouse gas emissions, both of which are bad for the environment and for people's health.

Step 2: Analysis of Development Strategies and Policies:

The second stage included a review of energy decarbonization policies and plans in Bosnia and Her-zegovina. New coal-fired power station investments and renewable energy alternatives were the focus of the study. We also looked at Bosnia and Herzegovina's long-term energy plan up to

2025.

Interviews with Key Stakeholders:

We also conducted interviews with key stakeholders such as state and entity energy, mining, and en-vironment ministries, chambers of economy/commerce, non-governmental organizations, local govern-ments, and regional development agencies. Decarbonization vs business as usual was the main topic of debate. Stakeholders voted unanimously to abolish major subsidies for coal-fired power and create an all-encompassing strategy to cut down on greenhouse gas emissions and air pollution. If this strategy is to succeed, a unified and harmonized state-level legislative and regulatory framework must replace the pre-sent fragmentation between entities and cantons.

Energy Summit of Bosnia and Herzegovina:

The study group also attended the April 2022 Bosnia and Herzegovina Energy Summit, which focused on the elimination of coal power and the adoption of renewable energy sources. Conventional electric power systems based on fossil fuels were highlighted as a long-term solution that cannot be sustained owing to their negative impact on the environment. The transition to a greener energy infrastructure is unavoidable and essential.

In conclusion, this case study presents a comprehensive chapter outlining the two-stage procedure used to ascertain the impact of policy shifts on the development of the energy transition in Bosnia and Herzegovina. The case study results emphasized the need of making energy efficiency a top priority and of embracing intermittent renewables such as solar and wind. In order to more readily include intermit-tent renewable energy sources like wind and solar into the electrical mix, the transmission and distribu-tion networks need to be updated to enhance their flexibility. In addition, a unified and harmonized legal and regulatory framework at the state level is required to replace the present fragmentation between entities and cantons in order to enable such a strategy. Ultimately, national political will and public sup-port are required to advance energy transitions.

2.3 Research questions

Bosnia and Herzegovina may choose from a number of different decarbonization options and path-ways. Many elements, such as political, social, and economic settings, might influence how decarboniza-tion is approached. The possible social and environmental implications of each option must be carefully considered to guarantee that the final result is just, inclusive, and sustainable.

A centralized, top-down decarbonization strategy that is not necessarily inclusive or just could be feasible in certain circumstances. In some situations, though, a bottom-up strategy that prioritizes input from locals and democratic decision-making may be more fruitful. For the best and longest-lasting results, it is important to weigh the pros and cons of alternative routes.

Just and long-lasting decarbonization paths can only be reached by taking into consideration a wide variety of conditions and methods. For instance, no one should be left behind throughout the transition, thus it is important to include people from all backgrounds and walks of life. Focusing on renewable en-ergy and energy efficiency may also aid in cutting down on greenhouse gas emissions and bolstering sus-tainable growth. Having transparent rules and regulations in place may assist establish a framework for decarbonization and guarantee that climate goals are being met.

There is no "right method" to decarbonize the economy; nonetheless, the path used must be just, in-clusive, and sustainable. Therefore, the case study is limiting itself to a decarbonization pathway of the energy sector in the coal region in the city of Tuzla and is set to answer the following two research ques-tions:

1. The first research question is "What is the decarbonization pathway of the energy sector in the coal region in Tuzla, Bosnia and Herzegovina?"

2. The second research question is "What is the best practice example of Banja Luka where the city successfully switched its district heating system (DHS) from fossil fuels to woody biomass?".

2.4 The landscape behind the decarbonization narratives in Bosnia and Herzegovina

2.4.1 Overview of international obligations

Bosnia and Herzegovina's international obligations in terms of energy efficiency, environmental pro-tection, and reducing the impact of climate change stem from international agreements signed by the country, including the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol, the Paris Agreement, and the Sustainable Development Agenda 2030. The United Nations Framework Convention on Climate Change was ratified by Bosnia and Herzegovina in 2001, the Kyoto Protocol in 2008, and the Paris Agreement in 2017. BiH is one of the first Western Balkan nations to ap-prove a revised Nationally Determined Contribution (NDC) with a goal to cut greenhouse gas (GHG) emis-sions by 33.2% by 2030 and almost 66% by 2050, compared to 1990 levels. The amended NDC, which was filed in 2015, boosts emission reduction objectives by 50% by 2030, concentrating on the country's core sectors: power, district heating, buildings, industry, transportation, forestry, agriculture, and waste.

The United Nations General Assembly approved the Sustainable Development Agenda till 2030 in 2015, and on that occasion, all member nations, including Bosnia and Herzegovina, committed to imple-menting the Agenda 2030 text and the global Sustainable Development Goals (SDG). Following the ap-proval of a resolution at the United Nations Summit in September 2015, the objectives of the 2030 Agen-da for Sustainable Development went into effect on January 1, 2016.

The 2030 Agenda is made up of 17 global objectives and 169 sub-goals for sustainable development, and it is a revolutionary plan to build a better and more sustainable future for the whole globe. Poverty, inequality, climate change, environmental degradation, prosperity, peace, and justice are among the global concerns addressed by the 2030 Agenda.

The Framework for the Sustainable Development Goals in Bosnia and Herzegovina (abbreviated as the SDG Framework) is a joint document of all levels of government that establishes broad development directions through which authorities at all levels and society in Bosnia and Herzegovina strive to contrib-ute to the achievement of the SDGs:

- Good public-sector governance and management
- Intelligent expansion, and
- Equal-opportunity society.

In addition to the three development directions mentioned in the SDG framework, two horizontal topics were identified that are particularly important for contextualizing Agenda 2030 in Bosnia and Her-zegovina, namely "investment in human capital for the future" and the principle "No one should be ex-cluded."

The European Union has established a long-term aim of lowering CO2 emissions from the construc-tion industry by 80-95% by 2050. Bosnia and Herzegovina is seeking to align with EU policies and practices as a nation aspiring to EU membership. The EU's 2030 climate and energy framework outlines three pri-mary objectives to be met by 2030: a 40% decrease in greenhouse gas emissions (relative to 1990 levels), a 32% share of energy from renewable sources, and a 32.5% increase in energy efficiency. To fulfill the Paris Agreement’s responsibilities more effectively, the European Commission approved the European Green Plan, a package of policies and actions aimed at making the EU carbon neutral by 2050.

The European Green Plan also includes a Western Balkans Green Agenda. Bosnia and Herzegovina signed the Declaration on the Green Agenda for the Western Balkans on November 10, 2020, at the Summit in Sofia, with which it committed to implementing measures in the areas of climate change pre-vention and environmental impact, energy development, mobility and circular economy, biodiversity development, sustainable agriculture, and food production. With this, Bosnia and Herzegovina has com-mitted to working with the EU and other Declaration signatory states toward the goal of achieving carbon neutrality on the continent by 2050, by implementing a strict climate policy and reforming the energy and transportation sectors, and especially, among other things, to prioritize and improve energy efficiency in all sectors, as well as support private and public building renovation schemes, and ensure adequacy.

Bosnia and Herzegovina's participation in the Energy Community is particularly significant in this re-gard since the Energy Community's aims are to enhance the use of renewable energy sources and the stability of the energy supply of the nations who have signed the EC Treaty. The Energy Community's highest institution is the Council of Ministers of the European Union (hereinafter: the Council of Minis-ters). The Ministry of Justice is responsible for ensuring that the signatory nations to the EC Treaty adhere to the EC Treaty's goals, particularly in terms of harmonization with EU legal norms.

As a result, the integrated National Energy and Climate Plan (National Energy and Climate Plan - NECP) for the period 2021 to 2030 must include a description of the intended policies and initiatives, as well as the required investments, to accomplish the specified targets. The accomplishment of the objec-tives should be articulated in terms of the NECP's five aspects, which will assure both a secure energy supply and economic development:

1. supply security
2. energy market
3. energy conservation
4. carbon reduction
5. innovation, research, and competitiveness

The energy planning process in Bosnia and Herzegovina, its entities, assures target implementation continuity. The drafting of the NECP is currently ongoing. It expected to be submitted to the Energy Com-munity Secretariat for review and adopted by end of 2022, followed by official adoption in Bosnia and Herzegovina.

2.4.2 Population and labour market

In this chapter, we will take a high-level look at the structure of Bosnia and Herzegovina (BIH) as well as its fundamental macroeconomic developments. In the context of economic development and stand-ard, as well as future dynamics in economy, which are highly associated with the energy sector, macroe-conomic statistics are an essential part in the preparation of the case studies. There are three administra-tive divisions within Bosnia and Herzegovina: the Federation of Bosnia and Herzegovina (50.95%), and the Republika Srpska (48.09%), and the Brcko District of Bosnia and Herzegovina (0.096%). The Constitution of Bosnia and Herzegovina has been harmonized with the Constitutions of both the Federation and the Republika Srpska, the two organizations that have their own Constitutions. The population of BIH is 3.531.159 (Agency for Statistics of Bosnia and Herzegovina).

The Federation of Bosnia and Herzegovina is divided into ten cantons and 79 municipalities. Both the House of Representatives and the House of the Peoples have legislative authority in the Federation of Bosnia and Herzegovina. The President, one of two Vice Presidents, and the Government of the Federa-tion of Bosnia and Herzegovina are responsible for carrying out the country's executive functions. The administrative center is the city of Sarajevo.

The National Assembly of the Republika Srpska and the Council of the Peoples are the two bodies re-sponsible for making laws in the Republika Srpska. The Council of the Peoples must approve any legisla-tion or other rules passed by the National Assembly that directly affects the vital national interests of any of the constituent peoples. The President is responsible for presenting Republika Srpska, while the Gov-ernment oversees executive functions.

Both Entities of Bosnia and Herzegovina, including Brcko District, has its own multiethnic government with its own legislature, executive board, jurisdiction, and police force.

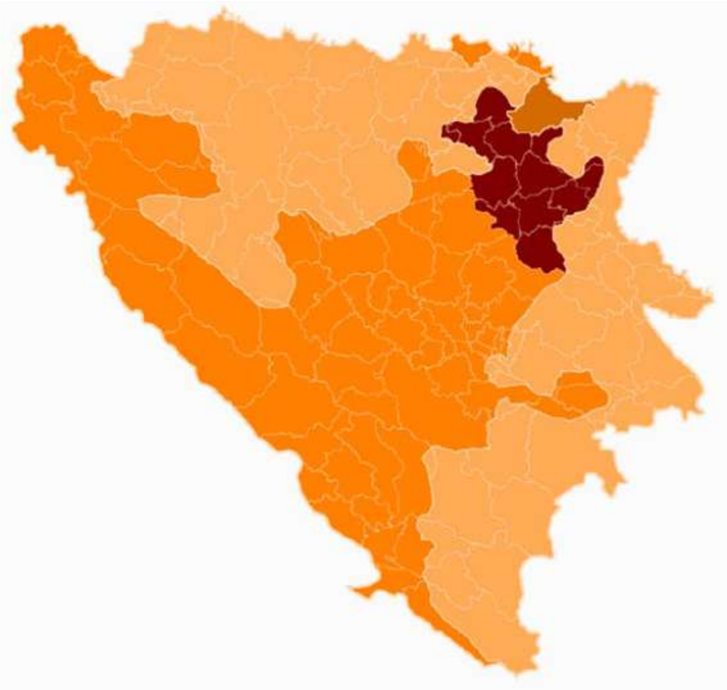

Figure 1. The spatial distribution and the structure of mining employees by subregion and job position in 2019 (Wikipedia, nd).

In July 2022 the number of registered unemployed in BiH amounted to 361 774, out of which there were 209 754 women. As compared to June 2022, the number of registered unemployed persons in-creased by 0,6% (the number of men increased by 0,3% and women by 0,8%). As compared to July 2021, the number of registered unemployed decreased by 8,5% (the number of men decreased by 9,3% and women by 7,9%).

Among the unemployed, those with a bachelor's degree or above make up the biggest group (114 821), followed by those with an associate degree or less (103 081) and those with no education (98 983). Semi-skilled workers (5,649) and college graduates (6,195) have the lowest unemployment rates. There were 209 754 females, or 58% of the total, who were officially unemployed. Females with a post-secondary education (66 580), low-skilled workers (58 340), and high-skilled and skilled professionals (53 923), make up the majority of the unemployed population.

The Tuzla Canton is the most populated canton in the Federation of Bosnia and Herzegovina, and it takes up 10.17 percent of the territory of the Federation of BiH and 5.18 percent of the territory of Bosnia and Herzegovina. The most recent estimates place the population of Tuzla Canton at 445,000, or almost 20% of the total population of FBiH.

Most recent estimates place the population density of Tuzla Canton at 165.7 dwellings/km2, making it one of the most populous cantons in Bosnia and Herzegovina. Tuzla Canton has a population density that is more than double the national average of 83.9 people per square kilometer. With 373.0 people per square kilometer, Tuzla is the canton capital with the highest population density. Roughly 27,000 busi-nesses, or roughly 18% of all businesses in FBiH, call Tuzla Canton home. Research of this kind is crucial to the expansion and improvement of the labor market because of the size and development of the canton, the number of residents, and the number of businesses.

Production of primary coal in Bosnia and Herzegovina reached 6,815 metric tons in 2020. Though primary coal output in Bosnia and Herzegovina has varied greatly in recent years, it has generally de-creased from 2001 to 2020, with a projected low of 6,815 thousand short tons in 2020. Large quantities of lignite and brown coal may be found across the nation. On average, open pits and casts produce around 15 metric tons per year.

It has been reported that 6,800 people are employed in the mines in the Federation of Bosnia and Herzegovina (FBiH) by the Federal Ministry of Energy, Mining, and Industry. Two thousand of them have some kind of disability. Throughout the course of the previous year, workers at all seven mines in FBiH (which are governed by Elektroprivreda BiH) staged demonstrations to call for increased pay and greater adherence to the performance rules. The issues that miners encounter on a regular basis have come to light.

Strikes have been used by miners to seek better working conditions and protections for their union after years of struggle in an already challenging sector. A miner's position is rounded out by their incon-sistent pay, unsafe working conditions, and risk of losing their job altogether.

The demonstration outside the FBiH government building was sparked by these events. The mines owed the tax authorities and the health and pension insurance funds in FBiH a total of nearly 500 million KM, demonstrating the gravity of the issue. After many days, however, an agreement was struck with Elektroprivreda BiH, and the strike ended.

Underground coal mining in Bosnia and Herzegovina is declining and is likely to continue to do so. Authorities have "swept" this issue under the rug for what seems like an age-old cause, maintaining social harmony. The demand for power from clean sources in the European market means that Bosnia and Herzegovina will eventually have to comply.

2.4.3 Socioeconomic development

The country of Bosnia and Herzegovina has gone a long way since the mid-1990s and is now consid-ered an upper middle-income nation. In the midst of a period of poor development and the global finan-cial crisis, it is currently a viable candidate nation for EU membership and is implementing a new growth strategy.

Since the late 1800s, the Tuzla Basin in northern Bosnia and Herzegovina has been an industrial backbone in Eastern Europe. To numerous neighboring power plants, notably Bosnia's biggest (715 MW) steam-electric plant in Tuzla and the adjoining coke-production facility in Lukavac, the region is a major source of lignite (brown coal) and sub-bituminous coal.

Coal mining and coal use for power generation and home heating have left their marks on the local environment. Large-scale surface mines (sometimes termed "open pit," or "strip mines") in the Kreka-Banovici-Djurdjevik region are seen in this nearly natural-color view from NASA's Terra satellite on Sep-tember 21, 2003. Green (brighter than it would normally look) describes the color of vegetation, pur-ple/gray/light purple describes the color of barren or urbanized terrain, and purple/blue describes the color of water.

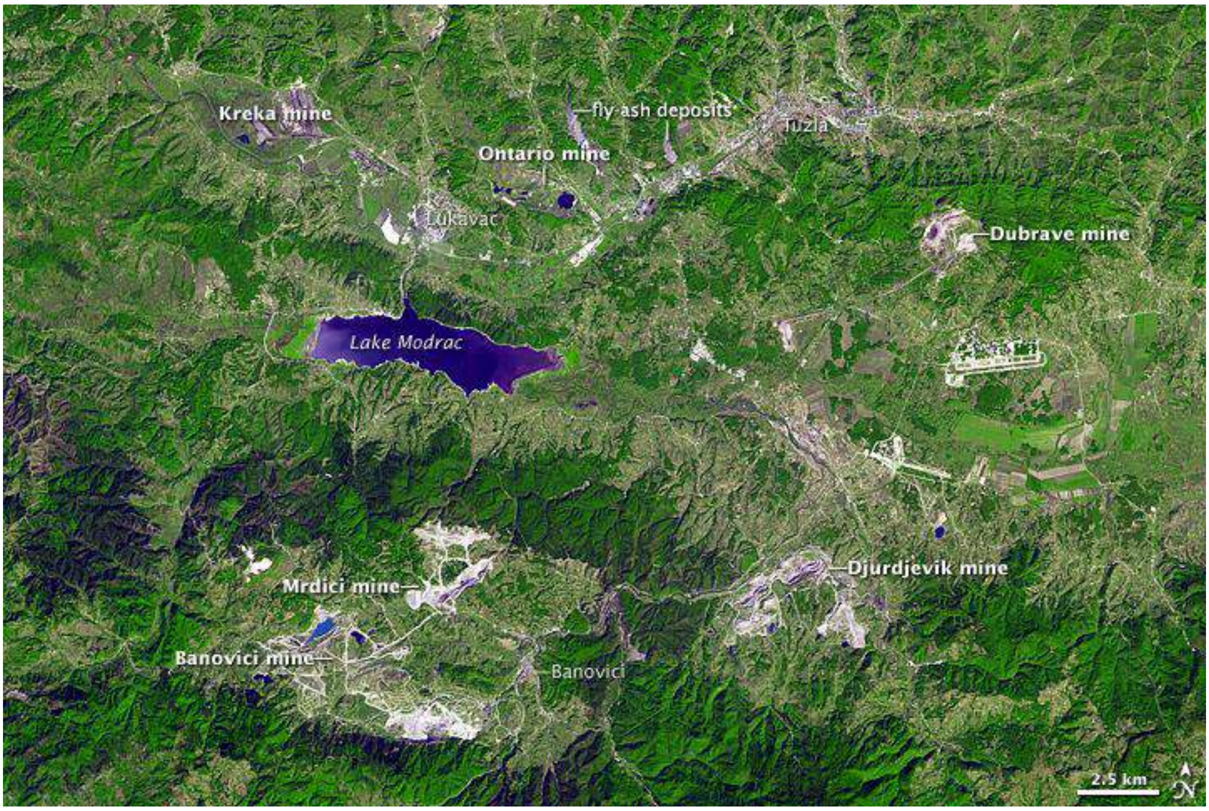

Figure 2: Tuzla Basin. Source: NASA’s Terra satellite, Amer Smailbegovic

Tailings from many huge mines may be seen strewn over the image. Starting to the southeast of Tu-zla, a chain of four big open pit mines producing brown coal—named Dubrave, Djurdjevik, Mrdici, and Banovici—begins to unfold in a clockwise direction. The Kreka strip mine, which is used to extract lignite, can be seen in the image's top left corner. Fly-ash deposits, seen by the purple splotches east of the de-funct Ontario Strip Mine, are the waste product of the Tuzla power plant's coal combustion.

Soil deterioration, topographic changes, and air and water pollution have resulted from the mining industry's shift from underground to surface mining. Open pit mining has destroyed at least 20,000 hec-tares (about 50,000 acres) of land throughout the nation, according to scientists at the University of Tuzla, with most of the harm happening in the Tuzla Basin. As part of a new agreement between towns and local business to make industrial operations in the Tuzla Basin more ecologically sustainable, efforts will be made to remediate some of the worst pollution hotspots in the region.

In Bosnia and Herzegovina, there are 11 coal mines and 5 power plants with the total capacity of 2008 MW.

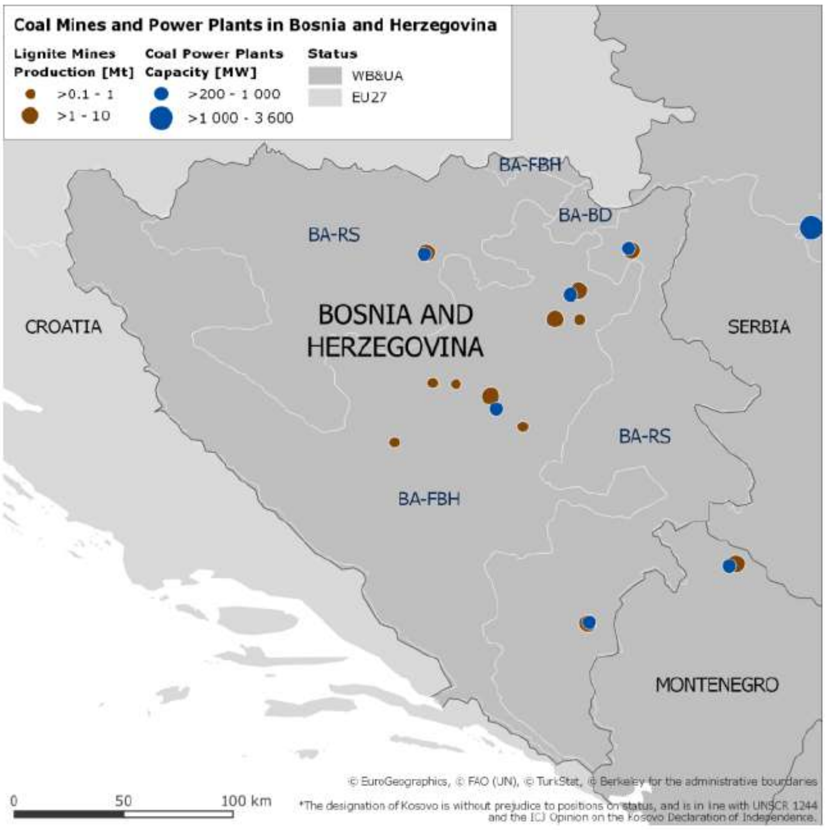

Figure 2: Coal Mines and Power Plants in Bosnia and Herzegovina. Source: JRC, 2021

The Entities Working Group Scenario, Indicative Plan, Cost-optimized Indicative Plan, and Mild RES Plan with Energy Efficiency are the four scenarios in which Bosnia and Herzegovina has established pro-jected decommissioning years for all coal-fired power facilities by 2030 (BA

Energy Strategy 2017). The share of jobs at risk is between 35% and 55% in Bosnia and Herzegovina until 2030. According to the gov-ernment and EPBiH, most of the redundant workforce will be administrative personnel who will be pro-vided pre-qualifications. Some will be moved to EPBiH's new enterprises, while others will be provided severance pay and all due benefits.

2.4.4 Modernization of Banja Luka's district heating system

Following the devastating earthquake in 1970, the Banja Luka Restoration Directorate formed the dis-trict heating company "Toplana" to begin providing district heating to the city. Since then, progress has been made to increase the city's district heating and the installed power of boilers. The major hot water network, which stretches for 45 km, and the secondary heating network, which stretches for around 110 km from substations to customers, both underwent construction at the same time as the growth of boiler units. The fuel oil reservoirs were constructed with a capacity of 12,530 m3, or for storing 11,500 t of fuel oil, which, from a technical and technological standpoint, ensures a constant supply, the generation of enough energy, and the preservation of enough intermediate stocks of fuel oil. The Banja Luka district heating system is the largest district heating system in the Republika Srpska and Bosnia and Herzegovina, with 228 MW of installed sources of energy.

Eighty percent of energy purchasers are homes, or residential customers; this amounts to almost a third of the city of Banja Luka's residential fund, or 1,078,000 m2 of heating space with 19,500–20,000 residential units, or linked consumption of 162 MW. About 650 unique businesses account for the re-maining 20% of electricity consumers, using 41 MW of linked load to power their operations. The district heating system in Banja Luka, which relied on the use of high-cost crude oil, experiences significant ener-gy loss during transmission and end-use. This causes the city to incur unsustainable debt, while also pro-ducing unnecessarily high amounts of greenhouse gas emissions.

As the district heating system employs wood chips as its renewable energy source (RES), Banja Luka has been included to the lists of smart and green towns in the area and Europe. Using biomass, or wood chips, ensures the project's long-term viability by lowering operating costs and minimizing environmental damage. Banja Luka residents also benefit from the added convenience of a heating service that operates around the clock.

Those living in Banja Luka who were tied into the city's district heating network have been fighting an unsustainable heating system for 20 years. The district heating company's losses had been increasing over time, necessitating funding from the city's general fund.

During the previous heating season, the former district heating business owed BAM 80 million in debt (EUR 40.9 million). Another important issue was the absence of continual monitoring of energy flow and energy management, which led to frequent changes in service quality and substantial distribution losses.

In May of 2017, a new firm called Eko Toplane Banja Luka was established specifically to address these issues. A new, wood chip-fired heating plant was constructed and put into service in phases in a record-breaking 7.5 months. The new heating plant has a 49 MW installed capacity, and its cascade boiler system is expandable, making it an appropriate management solution for a wide variety of ambient tem-peratures while still maintaining high levels of energy efficiency.

According to the representatives from Eko Toplane, a new era of combining renewable energy sources and clean energy technology began, all of which was supported by a cutting-edge management setting.

The GHS-W 5000 boiler unit, which burns wood chips, is used in the Eko Toplane project. It is paired with a filter unit that eliminates pollutants from fossil fuels and passes the strictest criteria for particulate matter. During the 2017/2018 season, the testing phase, the plant's full capacity was never utilized, but the commencement of its operation ensured a considerable decrease in the use of fuel oil, a fossil fuel.

In the future, the eradication of fossil fuels is the ultimate aim, according to Eko Toplane (except dur-ing extreme cold snaps, which never last longer than 5-10 days within a heating season).

Domestic electric engineering, mechanical engineering, and construction industries carried out the whole of the new heating plant building project. It's worth noting that the project's success is due in large part to the knowledge and experience of Americans.

During the past decade, the project's foundational technology has been developed in partnership with some of Europe's and the region's most prestigious institutions and universities, including the Insti-tute of Nuclear Sciences Vina, the University of Belgrade, the KTH Royal Institute in Stockholm, and the technological, mechanical, and electrical engineering faculties at the University of Belgrade and the Uni-versity of Banja Luka.

The biomass heating facility has several positive effects for Banja Luka. In the first place, the yearly cost of fuel oil will drop by more than BAM 10 million (EUR 5.11 million), saving the society a significant amount of money. Directly, the lower cost of fuel for the new heating plant results in a BAM 10 million (EUR 5.11 million) savings, and indirectly, the BAM 10 million (EUR 5.11 million) spent on the purchase of wood products from domestic producers in the local community helps drive local economic growth and enhances residents' quality of life.

A ten-year arrangement to acquire wood products from the state-owned forest management firm Sume Srpske ensures the project's financial stability and sustainability. In addition, underutilized wood scrap will be put to good use, expanding the biomass industry.

Eko Toplane's new heating plant is entirely compliant with the requirements set out by the Energy Community, which establishes the foundation for cities' energy sovereignty as including three factors: energy security, self-sustainability, and financial security. A yearly decrease of 70,000 tons of CO2 emis-sions would significantly improve the quality of the environment in Banja Luka thanks to the facility.

The new heating plant also has a 24-hour heating schedule, which is a great convenience for the people of Banja Luka. According to Eko Toplane, there has been an increase in the number of customers reconnecting to the heating network, and in the number of newly unconnected residential structures showing interest in joining to the district heating system.

In order to reduce air pollution, improve system reliability, and implement full business process au-tomation to cut down on network losses, the next step for the Eko Toplane district heating company is to expand and reconstruct the distribution network to bring heat from the district heating system to as much of Banja Luka as possible. Since the business now offers superior heat distribution and services, reconnecting the numerous customers who have been cut off is a priority.

Since this project's execution offers a reliable energy source, the building and commissioning of a new biomass heating plant is only the first step towards modernizing Banja Luka's heating system. Over the following several seasons, Eko Toplane hopes to completely automate the district heating network and achieve complete control over the quality of energy services by putting a premium on optimizing the distribution network.

This shows that change and modernization is possible and that live without coal-fired power plants is not a dream, on the contrary.

In general, district heating systems rely heavily on fossil fuels like natural gas and coal, as energy costs continue to rise, BIH will need to make strategic decisions about modernizing and decarbonizing these systems to ensure they can continue to provide affordable heating to their residents. Therefore, decarbonization pathway for Bosnia and Herzegovina is the uptake of renewables and other carbon-neutral heat sources to be included into already-existing district heating systems (DHS), these systems may be a tremendous boon in the effort to decarbonize the heating and cooling industry.To make a just transition to a low-carbon economy, Bosnia and Herzegovina must reduce its reliance on fossil fuels via a method that leaves no one behind.

2.5 Narratives

2.5.1 Three mainstream narratives

The viewpoints of stakeholders directly touched by the energy transition are emphasized in the mainstream narratives in BiH. These narratives acknowledge the social, economic, and environmental repercussions of switching to renewable energy sources but also highlight the significance of coal as an energy source and major contribution to the country's economy. It will be critical for BiH to strike a balance between the needs of various interest groups and those of the general public in order to achieve a just energy transition that benefits all citizens.

Narratives in BiH center on the experiences of those who will be most directly affected by the energy transition. These groups include coal and mining companies, their employees, labor unions, and communities that rely heavily on the industry. Three interconnected themes emerge from the dominating narrative, highlighting the importance of coal to the regional socioeconomic system from the perspectives of many actors.

The on-stream narrative explores the coal's value as both a fuel and a major economic factor for the nation. It makes the case that coal is necessary for safeguarding our ability to generate and use our own energy. Coal is seen as a strategic resource by the government, which views it as fundamental to the nation's energy security, hence this thread is consistent with official policy.

Coal-reliant employees and communities' social and economic ramifications throughout the energy transition is the subject of the alternative narrative. Transitioning to renewable energy sources, according to this narrative, might lead to job losses and economic instability, especially in coal-dependent areas. It also stresses the need of a fair transition that protects the interests of employees and communities that may be impacted.

Environmental concerns are emphasized as a result of the energy transition in the decarbonization and renewables narrative. Combating climate change and lowering emissions of greenhouse gases requires a shift to renewable energy sources. It contends that the shift to renewable energy sources will lead to a cleaner and more sustainable future and highlights the need to strike a balance between economic growth and environmental conservation.

2.5.2 Mainstream business-as-usual narrative

Several nations have taken steps to decarbonize their energy systems, demonstrating widespread in-terest in the issue of the energy transition. Electricity in Bosnia and Herzegovina (BIH) is produced almost exclusively from coal. In this study, we want to examine the dominant narratives that provide context for the experiences of Bosnia and Herzegovina's key players in the energy transition.

Coal's Role in the Nation's Energy Future:

The first common narrative emphasizes coal's significance in ensuring the safety of the country's supply of electricity. Central to the narrative is the prevalence of coal use in Bosnia and Herzegovina's power generation. When coal is mined in the United States, it ensures the country's energy sovereignty (also geopolitical). Around 65% of all electricity is produced by coal-fired power plants, making it a major contributor to the energy mix. With the exception of coal, BIH does not generate or rely heavily on any other fossil fuels in its energy sector. Coal is the backbone of the system and the fuel that ensures the nation's energy supply.

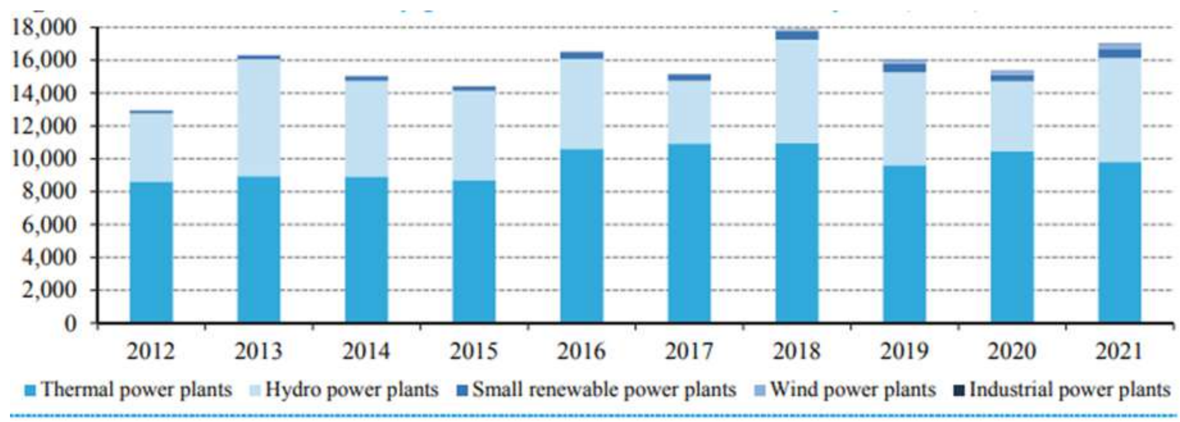

Figure 3. Breakdown of electricity generation in BIH over the last ten years (GWh). Source: State Electricity Regulatory Commission (SERC).

In 2016, thermal (coal) power plants in Bosnia and Herzegovina saw an increase of 300 MW in their installed capacity. Located around 70 kilometers east of Banja Luka in Republika Srpska, the Sta-nari Thermal Power Plant (or Stanari TPP) generates 300 Megawatts of electricity for the region. Yet the non-governmental organization (NGO) community sees the Stanari TPP as a bad example that shouldn't serve as a template for future regional projects. Emissions from the Stanari thermal power station are expected to be two to ten times higher than the European Union's authorized limits, according to a review of the project's environmental licence and its compliance with European Union regulations. The same holds true, which creates an issue since BiH, as a member of the European Energy Community, is obligated to adopt EU laws.

Effects of the Energy Revolution on Neighborhood Companies:

This narrative is told from the perspective of regional representatives from coal and mining corpora-tions, labor unions, and sectoral business environment agencies. The possible effect of the transition to decarbonization on the region's highly concentrated corporate sector is depicted as a threat to the inter-ests of local company owners. Mining companies have been reducing production, adopting new business models, or refocusing on exports in order to satisfy energy and climate policy goals. Here, the case for transformation is being presented from outside the sector.

Conclusion:

In sum, the dominant narrative in Bosnia and Herzegovina points to coal as the key to the country's energy independence. The country's overwhelming dependence on coal, however, has major environ-mental implications and makes it difficult for it to follow laws set by the European Union. Achieving ener-gy and climate policy goals will need a difficult but essential shift to decarbonization for local companies. A successful energy transition in Bosnia and Herzegovina requires a well-rounded strategy that takes into account the needs of all relevant parties.

Most of BiH's coal-fired plants from the Yugoslav era will reach the end of their useful life within the next 5-10 years, therefore, the country is looking for ways to modernize its power grid and construct new facilities, preferably using renewable energy sources like hydropower and wind power, but coal is also an option. Companies from both China and Russia have shown interest in several power generation pro-jects, but just one has been realized. The Stanari coal-fired power station in the RS was built by the Chi-nese firm Dongfang International Company in 2016. China Development Bank (CDB), Dongfang Interna-tional Corporation (DFC), Energy Futures Trading (EFT) Group, and the government of the RS all worked together on the project.

The expected cost to build the 450 MW coal-fired unit, dubbed “Tuzla 7,” at EPBiH’s Tuzla power plant is over $850 million (Government of FBIH). In April 2014, EPBiH selected a consortium comprising of China's Gezhouba Group and Guangdong Electric Power Design Institute to complete the project. As a result, the greatest post-war investment in BiH's energy industry has been put on hold, and its develop-ment has been stalled. It is still unknown when or even if the project will get underway.

2.5.3 Alternative (on-stream and off-stream) narratives

Coal's status as Bosnia's principal energy source and an integral part of the country's energy security has come under scrutiny in recent years. Stakeholders are coming around to the idea that the energy industry has to be decarbonized in the face of mounting pressure from energy and climate policy. Alt-hough the future of the Tuzla area is generally agreed upon, there are two competing narratives about the changeover timeline and energy carriers.

Both narratives are concerned with preserving the area's industrial economic status, but they take different tactics to doing so. The first emerging on-stream narrative suggests a shift that is both evolu-tionary and gradual, with the ongoing use of hard coal in gasification operations and carbo-chemical plants. A second counter-off-stream narrative emphasizes the need for a more immediate end to coal mining and the establishment of national supply chains for sectors that contribute to energy transition and the circular economy.

An on-stream narrative of a slow, evolutionary transition to greener energy sources is the first to sur-face in the Tuzla region. This method recognizes the need to shift toward more sustainable and environ-mental friendly solutions while simultaneously acknowledging the relevance of coal to the region's eco-nomic and energy security.

To achieve this, new carbon capture and storage technologies might be developed without interrupt-ing the use of hard coal in gasification operations and carbo-chemical plants (CCS). Using this method, coal might still be used while lessening its negative effects on the environment.

The on-stream narrative also stresses the need of switching to natural gas and other energy sources. The region's reliance on coal may be lowered and energy security bolstered by the progressive incorpora-tion of these sources into the energy mix.

Although an off-stream narrative with a rapid and dramatic transition away from coal might have se-vere economic and social consequences, a gradual and evolutionary strategy would allow for the devel-opment of new technologies and infrastructure. By doing so, we can secure the future of our current workforce and economic structures while also paving the way for innovative new ones.

Overall, the progressive and evolutionary shift towards cleaner energy sources is a balanced and re-alistic strategy that takes into consideration the economic and energy demands of the area and addresses the important environmental concerns of our time.

According to the dominant narrative, coal is essential to Bosnia's ability to be energy independent and maintain energy security. For the sake of the country's geopolitical stability, the mining and use of hard coal in the gasification process and carbo-chemical plants are seen as a guarantee of energy security and independence. One source claims that coal-fired power facilities in Bosnia account for around 65% of the country's total electricity output. Coal, therefore, is considered the fuel that secures the nation's en-ergy supply and supports the whole energy infrastructure.

A faster transition away from coal is essential to achieve energy and climate policy goals, according to the off-stream narrative. The narrative focuses on the need to establish national supply chains for sectors that contribute to energy transition and a circular economy. New industries that do not rely on coal are being developed, such as renewable energy, energy efficiency, and sustainable transportation. One of the main points of the counternarrative is that putting a stop to coal mining would have positive effects on locals' health by lowering levels of air pollution and the likelihood of respiratory illnesses.

Tuzla, Bosnia, has the bulk of its energy needs met by coal-fired power stations that use domestically mined coal. However significant levels of air pollution have been blamed on the region's coal-fired power facilities, causing public anxiety. The emissions from the Stanari thermal power station in Bosnia are es-timated to be two to ten times higher than the limits allowed by the European Union, according to a re-view of the facility's environmental licenses. Considering Bosnia's commitment to complying with EU laws as a member of the European Energy Community, the country's continuous dependence on coal extrac-tion and consumption is untenable.

Finally, the once-popular view that coal is "Bosnia's black gold" is no longer a likely prospect for re-gional prosperity. Although while everyone agrees that the energy industry must be decarbonized, there are still two competing visions for the future of the Tuzla area. The off-stream narrative urges a more immediate end to coal mining and the establishment of national supply chains for sectors supporting energy transition and a circular economy, whereas the on-stream narrative promotes a gradual and evo-lutionary transformation. Both narratives stress the need of preserving the region's current industrial economic makeup, but they take different paths to do it.

2.5.4 Decarbonization and renewables off-stream narrative

Electricity generation must be decarbonized to reduce climate change and environmental damage caused by burning fossil fuels. Decarbonization of the global economy was established as a joint target by the Paris Agreement of 2015. In spite of this, the Energy Community (EnC) Contracting Parties continue to rely on fossil fuels for energy production, suggesting that decarbonization is not yet the prevalent para-digm in these nations. The largest barrier to EnC energy transition is the political-economic paradigm that depends on thermal power plants (TPP) powered by easily available coal. Hence, decarbonization neces-sitates a radical departure from the present energy paradigm, which in turn necessitates a rebalancing of power and resources among several competing economic and political stakeholders on a global and local scale. Rebalancing power and resources among competing economic and political players in Bosnia and Herzegovina is complicated and multidimensional and needs a planned and comprehensive approach. Possible strategies:

- Encouraging dialogue and cooperation: Stakeholders may identify common ground and work toward shared objectives by encouraging communication and collaboration. Provide venues or platforms for stakeholders to discuss their opinions and strive toward mutually beneficial solutions.

- Strenthening institutions: Bosnia and Herzegovina's economic and political decision-makers might be strengthened. Transparency, accountability, and rent-seeking behaviour may be needed.

- Economic development: Economic growth may generate new possibilities and minimize resource rivalry. This might mean investing in growing industries like renewable energy or high-tech manufacturing.

- Reducing external dependence: Bosnia and Herzegovina has traditionally relied on other external players for economic and political help. Less dependency might help domestic stakeholders realign power and resources. Strengthening institutions, diversifying the economy, and lowering foreign assistance may help.

- Resolving underlying social and political issues might lessen competition and provide a more stable and equal environment for economic and political decision-making. Ethnic and regional divides, inequality, discrimination, and prejudice may be addressed.

A consensus on energy policy across stakeholders whose interests often clash is necessary for this transition to occur. A change in the existing energy paradigm requires the development possibilities that enable the realization of this dramatic revolution. As there is no universally accepted blueprint for an energy transition, Bosnia and Herzegovina (BIH) must come up with its own vision, objectives, and strate-gies. The majority of the present energy shift in BIH is being driven by the need of harmonizing with EU energy and climate policies in order to gain EU admittance. However the governments' hesitation to em-brace decarbonization and acknowledge the economic advantages of this process is reflected in the ab-sence of a comprehensive strategy for the future of the energy sector in BIH until 2050. To avoid negative effects on employment and economic activity, the transition to decarbonization must be accompanied with "just transition" measures.

Some nations have successfully implemented the fourth industrial revolution, which is characterized by digitalization, decarbonization, automation, and the use of artificial intelligence, and which has sparked a new growth cycle. Yet, certain nations, especially those whose economies are highly dependent on fossil fuels, are strongly opposing the decarbonization of the power business. There may be unintend-ed consequences for employment and economic activity as these nations make the transition to decar-bonization. Hence, just transition efforts must be implemented as part of the decarbonization process. Increased energy efficiency and the digitalization of the power grid are two positive outcomes of change that might stimulate economic expansion.

Most of the energy produced in the EU after 2030 will come from solar photovoltaic (PV) and wind power installations. Its temporal unpredictability and intermittency, however, provide special difficulties for power grid balance. The inherent unpredictability of renewable energy sources may be lessened by expanding the areas where they are applied. Because of this, it is more cost-effective to achieve regional balance, which may be achieved by connecting national markets. It is necessary to increase the genera-tion portfolio's adaptability in order to use intermittent renewable energy sources. Increasing the utiliza-tion of hydropower plants in BIH might turn Central Europe into an exporter of balancing services. In the future, electric heating technologies like heat pumps and adaptable cogeneration plants will provide the same degree of flexibility.

If all EnC countries are able to complete the energy transition successfully, the EnC will be in a posi-tion to provide balancing services to the rest of Europe, particularly the countries in the region's center. As an example, in the 1970s and 1980s, the association of power utilities of Yugoslavia (JUGEL) facilitated a successful energy exchange between this region and the countries of Central Europe. The next time national energy and climate policies are being formulated, this kind of expansion potential may be in-cluded in.

Environmental and climatic damage may be reduced if we make the switch from traditional electrical power systems that burn fossil fuels to decarbonization. As a result of the numerous conflicting economic and political interests, decarbonization necessitates a radical transformation in the present energy para-digm and a redistribution of power and resources.

2.6 Key policy interventions supporting decarbonization in BIH

The European Union (EU) renewed its support for the Western Balkans region in May 2022, allocating EUR 9 billion in grants and EUR 20 billion in investments to back the region's Green Agenda. Promoting sustainable economic development and lowering greenhouse gas emissions, the Green Agenda for the Western Balkans is an all-encompassing strategy for climate action, pollution control, nature and biodi-versity protection, and regional integration. The purpose of this paper is to provide an overview of the Green Agenda for the Western Balkans, its economic and environmental advantages, and the difficulties the area has in putting the plan into action.

In July 2021, heads of state and government from the Western Balkans signed the Sofia Declaration, pledging their support for the Green Agenda Action Plan. As a result, a 30-billion-euro Economic and In-vestment Plan was approved for the region, with the intention of making the EU's goals of sustainable development, efficient use of resources, protection of the environment, and action on climate change central to the area's economic policies and practices. Carbon pricing, coal phase-out plans, regional inte-gration, pollution control, and environmental preservation are just few of the measures included in the plan to ensure a sustainable future for the planet.

Western Balkans Guarantee Facility: The European Union has committed EUR 29 billion in invest-ments to the area. The leaders of the European Union have urged the countries in the region to embrace the economic and social reforms that would bring about greater competitiveness and a more complete digital transformation. Together with the EUR 600 million planned under the Instrument for Pre-Accession Support, the EU has also allocated EUR 1.1 billion by the end of 2022 to assist implement the Economic and Investment Plan (IPA).

Several obstacles stand in the way of a smooth rollout of the Green Agenda Action Plan in the West-ern Balkans. For instance, substantial changes are required in the EU's energy and climate policy if the area is to meet its goal of decreasing greenhouse gas emissions by 55% by the end of the decade. Since coal is now used to provide a large portion of the region's electricity, its eventual depletion is predicted to have far-reaching economic and employment consequences. The European Union (EU) has stressed the significance of tackling these difficulties and emphasizing energy security with decarbonization, through making use of renewable or less carbon-intensive fuels.

The leaders of the 27-nation bloc have committed to providing technical and financial support for the creation of a carbon pricing policy in order to conform to the European Union's (EU's) Carbon Border Adjustment Mechanism (CBAM), which is essentially a tax on carbon dioxide for imported goods and electricity. The year 2024 has been set as the deadline for full conformity with the EU Emissions Trading Scheme (ETS). Decarbonization chapter targets year 2025 for compliance with European Climate Law and its objective of climate neutrality, while year 2024 is defined for compliance with EU Emissions Trading System and the implementation of new carbon pricing mechanisms.

Sustainable economic development and decreased emissions of greenhouse gases are two of the goals of the Green Agenda for the Western Balkans, which is why it is such an all-encompassing strategy. Carbon pricing, coal phase-out plans, regional integration, pollution control, and environmental preserva-tion are just few of the measures included in the plan to ensure a sustainable future for the planet. In spite of this, the area has major difficulties in carrying out the plan, especially in respect to the elimination of coal and the introduction of renewable energy sources. The European Union (EU) has committed sub-stantial expenditures and technical and financial assistance to support the plan's execution, highlighting the need of prioritizing energy security alongside decarbonization. Achieving the goals of the Green Agen-da.

2.7 Summary of key findings

BiH is in the midst of a difficult energy transition, moving from a traditional, mostly fossil fuels-based economy to a renewable energy sector. Highlighting the structural changes in the regional economy and the transition narratives from diverse stakeholder groups. According to our research, coal is still quite important in the energy industry. The decision to completely stop using coal by 2030, however, repre-sents a tipping point in the evolution away from it. This case study recommends that the government diversify its energy sources by using solar and wind power and that it establish a favorable environment for investors in order to effectively manage integrated energy and climate change.

Bosnia and Herzegovina is a significant and relevant case study. Firstly, it is located at the crossroads of various cultures, civilizations, and faiths, creating a one-of-a-kind melting pot of diversity. This diversity has not always been easy to handle, since the nation saw a war in the 1990s, leaving deep wounds and unsolved difficulties. Second, Bosnia and Herzegovina's energy industry represents a microcosm of the worldwide energy transition dilemma. Coal is a significant source of greenhouse gas emissions and air pollution in the country's energy mix. As a result, transitioning to cleaner energy sources is critical for the country's long-term prosperity and compliance with international climate commitments.

Bosnia and Herzegovina is strategically placed at the crossroads of various geopolitical and economic objectives. The nation has always maintained strong connections with Russia, but it is now attempting to align with the European Union, posing a conundrum for officials. In addition, the nation serves as a major transit center for natural gas and oil pipelines, making it a potential battlefield for energy security.

The challenge for BiH in this setting is navigating this complicated web of interests and aspirations while maintaining a sustainable and equitable growth path. This necessitates a coordinated effort on the part of all stakeholders, including the government, civil society, academia, and the commercial sector, to collaborate and strive toward a single goal.

Tipping plus principles about accelerating structural change are especially applicable in this context because they offer a framework for tackling structural impediments to change and unleashing the poten-tial for innovation and transformation. Addressing concerns such as policy consistency, institutional ca-pacity, market processes, and social inclusion are all part of this.

The Ukraine war's effects on BiH are complicated. Russia's ties with the West have been greatly af-fected by the Ukrainian war. BiH, bordering Serbia in the Balkans, is caught up in this geopolitical battle.

The Ukraine conflict may boost energy security in BiH. Energy security may become a major concern during geopolitical conflicts, as illustrated by Ukraine. If engulfed in a regional war, BiH, which relies large-ly on coal for electricity, may encounter problems. Hence, BiH may hasten the shift to cleaner and more varied energy sources.

Geopolitical pressure from Russia and China may rise as BiH is a unique occurrence of a global socio-energy systems crossroads, which might lead to severe struggle for influence and resources. The Ukraini-an war might make BiH a geopolitical prize and energy transit center. The Ukraine crisis may underscore the need for a concerted international response to accelerate structural reform and promote a more sus-tainable and democratic development route in BiH. The war has revealed that the energy sector may be a crucial battlefield in geopolitical disputes, thus greater help may be needed to establish local, decentral-ized energy systems that are less sensitive to foreign forces. In the face of possible foreign involvement, promoting democratic institutions and civil society in BiH may become even more important. Therefore, the focus on narratives 2, and especially 3 is key to the energy independence, security, and sustainability of Bosnia and Herzegovina.

Summary of key findings:

- Coal is still very important to the energy industry in BiH, accounting for over 65% of the country's total power generation.
- Coal-based electricity, which is heavily subsidized by the state, really has a greater genuine cost than is often recognized.
- BiH needs to balance the needs of various interest groups and those of the general public to achieve a just energy transition.
- Three interconnected themes emerge from the narratives: coal’s value as a fuel and

economic factor, social and economic ramifications of the transition, and environmental concerns.

- In certain parts of the nation, hydropower and bioenergy are already widely used, but the country as a whole may benefit from using more renewable energy sources like solar and wind.
- The effective deployment of cutting-edge technology depends on the creation of a conducive regulatory climate for investors.
- Commitment to solving the problem may be shown via the creation and submission of national energy and climate plans and targets.
- Natural gas, assuming enough markets, finance, and knowledge, might serve as a bridge fuel in the gradual decarbonization of coal-intensive areas.
- In order to convert energy-intensive sectors toward climate-neutrality, coordinated activities such as creating markets for climate-neutral goods, developing innovative technologies, and assuring availability of climate-neutral energy and feedstock at internationally competitive costs are required.
- Implementing the Energy Union in its entirety will help Bosnia and Herzegovina by increasing energy security, easing market integration and the energy transition, improving energy efficiency, and increasing the use of renewable energy sources.
- The European Union (EU) should invest in the capacity development of energy regulators and transmission system operators in order to secure full participation in EU-level networks.
- Renewable energy can diversify the country's energy mix and lessen dependency on coal.
- The green agenda can boost renewable energy jobs and economic prosperity.
- Renewable energy improves air and water quality, lowering health risks.
- The green agenda may boost Bosnia and Herzegovina's worldwide standing by making it a climate change leader.

Bosnia and Herzegovina has reached a critical juncture in its energy transformation with the decision to completely phase out coal by 2030. Nevertheless, there are still obstacles to be solved, such as expand-ing the availability of renewable energy sources, improving the investment climate, and establishing a strong legal and institutional foundation. This case study recommends a number of actions for BiH to take, including building markets for climate-neutral goods and increasing the use of renewable energy, as well as preparing and submitting National

Energy and Climate Plans and Objectives. The effective transi-tion of BiH toward carbon neutrality also depends on the implementation of the Energy Union.

There is a complicated interaction between social tipping points, negative tipping points like the war that took place in the 1990s, and ecological tipping points in the example of Bosnia and Herzegovina. So-cial tipping points, which are critical moments where even small changes can lead to significant shifts in social behavior and systems, played a significant role in the beginning of the Bosnian War. Social tipping points are critical moments where even small changes can lead to significant shifts in social behavior and systems.

The conflict had a terrible impact on the environment, including the destruction of ecosystems, the loss of biodiversity, and pollution. These negative environmental effects were caused by the war. On the other hand, positive social tipping points, such as reaching a collaborative agreement between different ethnic groups in the country, could have positive ecological impacts by promoting sustainable practices and reducing harmful environmental practices. This is because reaching a collaborative agreement be-tween different ethnic groups in the country is an example of a positive social tipping point. As a result, reaching positive social tipping points is essential for preventing negative ecological tipping points and fostering a more sustainable future in Bosnia and Herzegovina. [UNDP IDA project]

In conclusion, BiH is an interesting case study for the rest of the globe because it represents a unique intersection of global socio-energy systems. The country's shift to cleaner energy sources and sustainable development is vital for its own future, but it also has regional and global ramifications. The Tipping plus principles of accelerated structural transformation offer a valuable framework for tackling the transition's difficulties and possibilities.

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3 Case study 3: Alberta, Canada

From resource extraction to negative emissions in the Lower Athabasca region Alberta, Canada

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3.1 Introduction

The Study area includes the fossil fuel mining and extraction industries of Alberta (Oilsands region and Coal region) as this is the mainstream economic driver and energy production narrative of the region and the country. Within Canada, the oil, gas, and coal deposits are concentrated in western Canada, specifically Alberta. These resources have generated significant economic wealth and prosperity and in turn a tendency to vote conservative to maintain the status quo. This paper explores the environmental, social and economic conditions trends that have entrenched Alberta within this fossil fuel dependent narrative over the last half century and identifies emerging trends with potential to either support the status quo narrative or tip towards alternative energy narrative pathways. This study focuses on four key stakeholder groups/characters within Alberta's energy narrative, the government of Alberta, oil and gas companies, the oil and gas industry workers, and indigenous peoples.

3.1.1 CCIR description

Alberta is one of the three most fossil fuel rich regions of the world. Physical and cultural signs of the oil, gas, and coal mining industry are ubiquitous across the entire province (Figure 1). Three major oilsands deposits, Athabasca, Cold Lake, and Peace River oil sands, are located across the north-eastern portion of the province (Figure 2). Collectively, these three regions cover 142,200 km² of land and represent the world's fourth largest oil reserves, after Venezuela, Saudi Arabia and Iran (Government of Alberta, 2022a). The central and southern portions of Alberta are rich in coal deposits which extend across almost half of the province (Figure 3).

Figure 7 Typical Alberta landscape including agricultural fields, Rocky Mountains to the west and numerous fossil fuel extraction facilities dotting the landscape (Alamy, 2022)

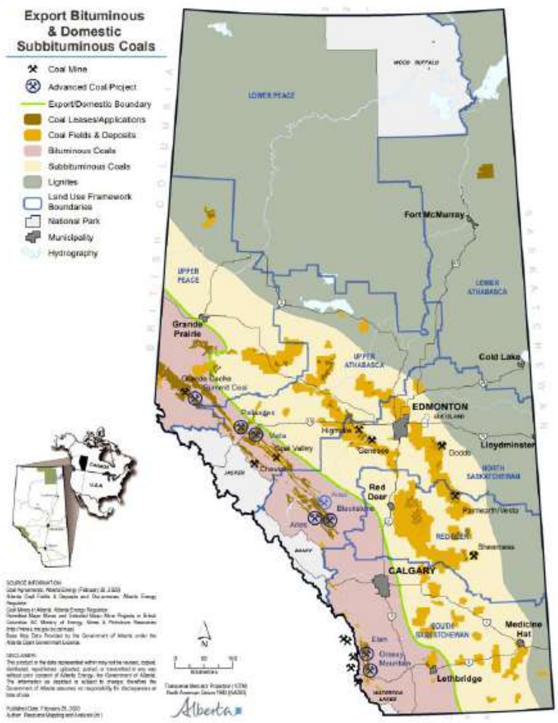


Figure 2: Oil Sands Areas in Alberta (AER, 2022). Figure 3: A map of Alberta showing coal tenure activity (dark brown), and coal mines and projects, as of February 2020. Coal fields (light brown) and approximate coal rank distribution (coloured bands) are also shown. An interactive, real-time version of the coal tenure on this map is available at www.alberta.ca/interactive-energy-maps.aspx

3.1.2 Societal problem description

Canada is the tenth largest greenhouse gas emissions nation in the world (Government of Canada, 2022). This standing is largely attributed to Alberta oil and gas extraction (mining, transportation, and processing) which alone contributes to approximately 14% of national emissions in 2018 (Environment and Climate change Canada, 2020 pg.7). Despite the significant and disproportionate production of greenhouse gas emissions generated by this sector, Alberta oilsands developments is expected to continue growing due to its vast economic potential and increasing global demands (Environment and Climate change Canada, 2020 pg.22)

Historically the governments of Canada and Alberta have made numerous commitments (e.g., Rio de Janeiro Earth Summit (1992), Kyoto Protocol (1998), Government of Canada Action Plan on Climate Change commits (2000), *Kyoto Protocol Implementation Act* (2007), and the Paris Accord, 2015) and efforts through investment in carbon emissions reduction technologies (e.g., carbon capture and storage). However, Alberta's economic dependence on and cultural identity associated with the oil, gas and coal mining industry sectors has embedded significant resistance towards alternative clean-energy transitions (renewable technologies). For example In 2021, Oilsands alone paid the Alberta government over $11 million in royalties (Alberta Government, 2022b).

Because of increasing global and local scrutiny of the environmental and climactic impacts associated with Alberta's oil, gas, and coal mining industries, industry members and associates have become increasingly defensive and combative across both political and social media platforms. Political lobbying and social media campaigns such as "I Love Canadian Oil and Gas" have emerged in retaliation towards Alberta energy sector scrutiny (Figure 4). These platforms have resorted to using fear-based tactics to spread disinformation about climate change facts and the impacts of climate change policy on Canada's economy (Global News, October 18, 2019a). One adverting campaign published by the Canadian Energy Citizens (funded by Canada's Oil and Natural Gas Producers) indicated that Canadians have only two options "kill jobs" or support Canadas $45 billion oil and gas industry. These advertisements also suggest that not supporting this industry is considered "Anti-Canadian" (Global News, October 18, 2019b).

Figure 8: Billboard located near downtown Calgary (Alberta's economic hub) on February 17, 2022. Photo credit Chelsey Greene

Few issues facing Canada have become as nationally divisive as climate change and the future of the nation's energy industry. Polls have shown Alberta to be the most divisive and polarized province between those individuals concerned about climate change and those individuals who deny the possibility of human-caused climate change (Marshall *et al.*, 2018). These differences in opinion often correlate with occupational group (oil and gas industry vs. non-oil and gas industry), residence region (urban vs. rural), and political values (conservative vs. Liberal) (Marshall *et al.*, 2018, p.g.4).

To better unify and align Alberta residence towards a more diversified economy and encourage economic growth outside of the fossil fuel energy sector Marshall et al., (2018) recommends appealing to Albertan's entrepreneurial and gritty identity by framing clean technology and renewable energy projects as "building" a transition towards something new and positive rather than "away" from something old or bad. Marshall et al., (2018) also recommends that renewable energy projects be presented as Alberta's next "economic and innovation boom" to align with to Alberta's historic economic and cultural narratives.

One of the self-reported shortcomings identified in the Marshall et al., (2018) *Alberta Narrative*

Project research project was that despite best intentions, the researchers did not effectively engage with Alberta's first nations peoples. To better address raised concerns, the research team recommends that future studies take different approaches to collaborate with indigenous community research partners. The general feedback from three indigenous participants was that 1) the study design did not accurately represent the diversity of voices within the diverse communities of indigenous peoples across the province and 2) The study interviewers lacked an understanding of indigenous people's relationship to the land and how knowledge is shared and transferred within their cultures. These methodological limitations resulted in many of the indigenous people contacted for the research project to choose not to participate.

Alberta's capacity to embrace transition towards a clean energy economy is largely influenced by, effective government policies that limit GHG emissions, incentivise low carbon technologies, and support carbon sequestering land management practises (e.g., land reclamation, regenerative agriculture, agroforestry). The Alberta government has gradually made steps towards acknowledging the importance and need for more sustainable land management and industrial practises and less reliance on the fossil fuel industry through policies and guidance documents. During the early 2000s, the government of Alberta recognized that the capacity of Alberta's landscapes to maintain healthy land, air, water and habitat quality was approaching a "**tipping point**" (Government of Alberta, 2008 pg.2). In 2008, a formal provincial land use framework (Figure 5) was established to support more integrated land use decision making that balances economic, environmental, and social values of the province's main economic regions. One of the clearest signals for supporting a green energy transition in the last decade was the province's commitment to closing coal mines by 2023.

Figure 9: Land-Use Planning Map of Alberta

3.1.3 Research problem

Alberta productive sectors are heavily linked to extractive industries mostly for exporting energy products out of province and abroad. Canada's and particularly Alberta's social, economic, and environmental systems have increasingly become unsustainable as a result of Alberta's drive and dependency on fossil-fuel based energy development since the mid-1900s. This situation is threatening the wellbeing and health of both Canada's and Alberta's citizens and environment. Canada and Alberta landscapes have reached a "tipping point" (Government of Alberta, 2008). This research uses the Narrative Inquiry methodology to explores how shifts and events in Alberta's social, environmental, economic, and technological conditions and trends within the provincial socio-ecological landscape may direct transition towards or away from a fossil-fuel based economy.

3.1.4 Research questions

- Who are the current and emerging voices that will lead Alberta's energy transition?
- What factors are supporting or inhibiting transition towards or away from the mainstream energy narrative?

3.2 Research approach

The narrative inquiry methodology focuses on the concept of the human experience as the prime focal point. The role of the researcher is to uncover each person's story. "A narrative typically focuses on studying a single person, gathering data through the collection of stories, reporting individual experiences, and discussing the meaning of those experiences for the individual" (Creswell, 2015, pg. 504). According to Creswell (2015), seven major steps make up the narrative inquiry study process (Table 1). At this stage in the Study, we are applying Steps 1-4 and future development of this Study will implement Steps 5-7.

Narrative Inquiry seeks to uncover the story behind events and the actors involved in them by situating actors within broader social contexts. Prior to engaging with stakeholders directly, we are exploring the broader contexts of energy system policies and institutions from which the stakeholders operate within. From there we wish to link our analysis of broader institutions and individual stakeholders by developing policy recommendations that integrate both perspectives and values (Figure 6).

Table 5: Seven Steps of Narrative Inquiry according to Creswell (2015)

Narrative Inquiry Step	Applied Narrative Inquiry Findings and Actions
Step 1: Identify the Phenomenon to explore that addresses a problem	On a global scale Canada and Alberta are major producers of greenhouse gas emissions (Government of Canada, 2022) Alberta's ecosystems and landscapes have reached a tipping point from land use competition (oil and gas mining industry, forestry, recreation, farmers, ranchers, real estate development, etc) (Government of Alberta, 2008)
Step 2: Purposefully select and individual	Government entities (e.g., Government of Alberta, Government of Canada) Oil, gas, coal mining industry (industry associations, industry

	leaders) Clean energy Think Tanks (e.g., Pembina Institute) Citizens (Alberta labour and immigration, 2021, social media platforms)
Step 3: Collect stories from that individual: personal and social experiences	Government documents Interviews Reports News articles Social media posts Academic literature Company annual reports
Step 4: Re-story or retell the individual's story	Share the characters story and information within the cultural, political, economic and technological context of the time the story or literature was generated. Identify theme that weave through multiple narratives.
Step 5: Collaborate with the participant story teller in all phase of research	Next phase of research (2023)
Step 6: Write a story about the participants personal and social experiences	Next phase of research (2023)
Step 7: Validate the accuracy of the report.	Next phase of research (2023)

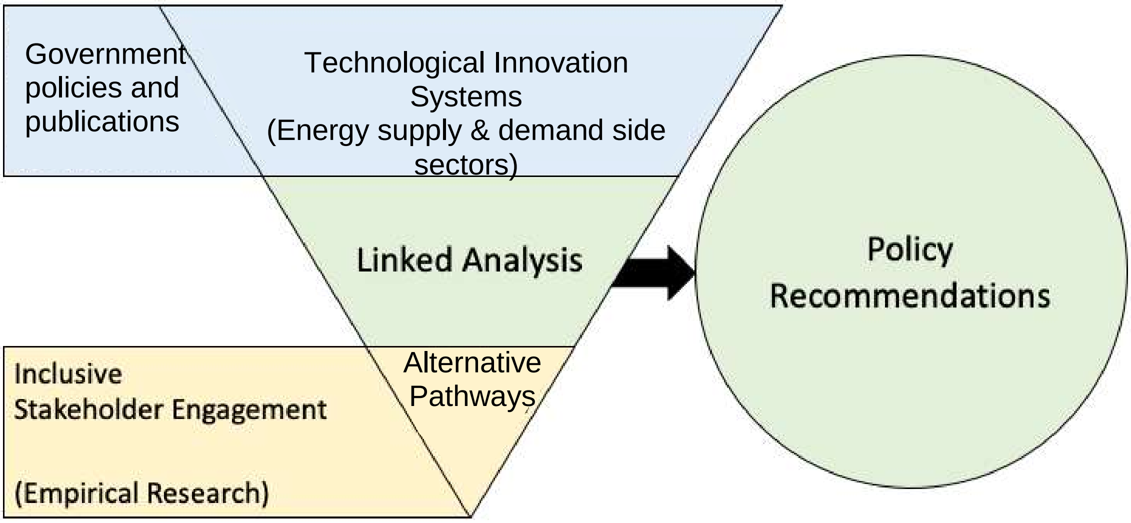


Figure 6: Framework (based on Lieu et al. in publication) for integrating top down (institutions) and bottom up (individual stakeholder mainstream and onstream narratives) research approaches to develop energy policy recommendations that integrate the values and needs of both perspectives.

3.2.1 Qualitative methods

Step 1: Anchor myself into my research context by reviewing research background/purpose documents.

Reviewed Tipping+ guidance documents and narrative inquiry methodology literature

Step 2a: Positionality/Self-reflection on personal research lens and biases I'm bringing into this narrative research

February 3, 2022 Chelsey: I am a 39-year-old female who grew up in rural Alberta and studied environmental science at both Alberta (B.Sc.) and Ontario (MES) universities. For the last 15 years, I have been primarily living in Calgary, Alberta and writing technical biophysical environmental consulting reports and socio-ecological research documents. These experiences have shaped me to take a categorical and process driven approach to collecting and summarizing literature and research data. In recent years, my perspectives on the interrelationships between ecology, society, and the human spirit have been strongly influenced by the work of Indigenous ecologist Dr. Robin Wall Kimmerer The following outlines my research process for learning how to conduct narrative

transdisciplinary research work.

Figure 10: Self-reflection on personal research lens and biases I'm bringing into this narrative research

Step 2b: Journaled on my preliminary thoughts on my perspective and biases of the historical factors and cultural pressures that support carbon-intensive mainstream resource extraction and energy production to continue.

This exercise was to gain insight into my current opinion and biased to my own cultural experience, biases, and prejudice.

February 4, 2022 Since 19XX coal mining and oilsands reserves have been the primary economic driver and represented over XX% of the GDP in 20XX. Much of Alberta's population is invested on the continued dominance of this economic sector for their continued prosperity. This has led to … Entrenched Momentum, resistance to change - government royalties Demographics of oilsands workers Predominantly young men (25-35) with limited education and transferable skills Since 1970's these workers have benefited from highest salaries in the country Alberta Culture Edmonton Oilers Resistance to low carbon transformation Government Re-training programs in other industries specifically design for Oil and gas workers

Figure 11: Preconceived Mainstream Narrative Draft

Step 3: design a systematic approach to my data collection, fill in my knowledge gaps, and gain more perspective on my biases.

Step 3.1: Used Tipping guidance documents to create a data collection template for capturing relevant data

Mainstream 1

WP1 geography & demography

WP2 culture & social psychology

WP3 policy, politics & governance

WP4 economics

Mainstream 2

WP1 geography & demography

WP2 culture & social psychology

WP3 policy, politics & governance

WP4 economics

Step 4: Data collection

Phase 1

Gathered data on both facts (official government reports) and feelings (news articles, social media posts) about carbon intensive natural resource extraction and power generation

Data collection: risks elicitation (environmental, economic, political), shareholder perception of risks, risk severity

Methods: literature review, conceptual mapping, interviews, workshops

Took "stream of consciousness" approach to data collection by copying and pasting links to all the resources, ideas, organizations, events etc. related the mainstream for future that I could think of for future in-depth exploration.

Phase2

Consulted with friends and colleagues knowledgeable in narrative research to better understand how narrative approaches to research are different from the empirical scientific approaches that I am familiar with.

Phase 3

Populated literature quotes in respective template categories

Phase 4

Coding data/ideas/opinions - looking for themes and trends in tone/ perspectives/ arguments/

justifications for decisions

Luis: I am a 35-year-old mestizo cis male from Venezuela. I see my cultural background heavily influenced by a mix of Indigenous, African, and European values resulting from the colonization of the Americas. I was born and raised in Maracaibo, Venezuela – a 3 MM people city on the western border with Colombia, and along the coast of one of the largest lakes in South America. This city is a stronghold of Oil and Gas in Venezuela and grew up surrounded by the oil bonanza. My parents were both 1st generation university grads and both dedicated to education. Trained as a Chemical Engineer, dedicated my early training to science and technology from an applied science perspective. Moved to Canada in 2014 to pursue a PhD in Engineering dedicated to CO2 and waste utilization. My approach to science is optimistic but I am becoming more critical of how socio-economic factors affect the technology development process within the global green transition efforts.

3.3 Narratives

3.3.1 Mainstream narrative

Alberta’s Mainstream Cultural Identity

Fossil fuel-based resource extraction (oilsands crude petroleum, natural gas, coal) and energy production (coal fired electricity plants) are iconic elements of Alberta’s economy and cultural identity. Numerous expressions of Alberta’s energy resource focused cultural identity are represented across the province in the form professional hockey team names (the Edmonton Oilers and the Calgary flames) to icons and symbols within our municipal crests and flags of the dozens of towns and cities founded on this resource (Figures 8a through 8c) and music. In 2004, poplar local country music artist Corb Lund released a song titled “Roughest Neck Around” celebrating the oilsands workers who commonly hold the “Rough Neck” position on the oilrigs and bring “the power to the people” (YouTube, 2007).

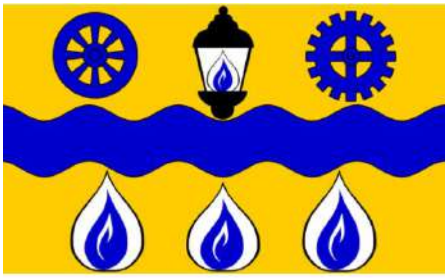


Figure 8a: City of Medicine Hat flag

Figure 8b: City of Grande Prairie

Figure 8c: City of Lethbridge

with natural gas flames along the bottom	flag with oil derricks in the background	coat of arms with a coal miners pick

History of Mainstream Narrative Establishment

Fossil fuel resources are embedded within the geology and landscape of the entire province. Oilsands deposits are concentrated in north-eastern Alberta, while coal deposits are located across the central and southern portions of the province. Coal mining began in southern Alberta during the 1800s which catalysed industrialization, rail expansion, energy production, and economic prosperity across western Canada. The dominance of coal as Alberta's primary economic and development driver was overtaken by the oil and gas sector after World War II (reference). Oilsands production began in the 1940s and overtook coal as the province's primary electricity source during the 1970s. Since then, the oil and gas industry has experienced rapid growth and international recognition for energy production. In 2020, The Mining and Oil and Gas Extraction industry sector accounted for approximately 26% of Alberta's Gross Domestic Product (GDP) and 5.9% of total employment (Alberta labour and immigration, 2021). As of 2018, Alberta's largest single source of greenhouse gas emissions was coal fired electrical generation facilities (Government of Alberta, 2018 pg. 21)

Character 1: The Alberta Government Land Management/Governance Departments

During the early 2000s, the Alberta government recognized that the environmental and social impacts caused by competing interests for land development and access was not sustainable and was approaching a "tipping point". In response, the first provincial wide provincial-wide Land Use Framework (LUF) was published in 2008 to formalize land use planning and coordinate land use decisions between provincial, municipal, and rural governments. The *Alberta Land Stewardship Act* (2009) supports the LUF and establishes the legal basis for the development of regional plans. To support regional decision making, the LUF divides the province into seven land use regions, Lower Athabasca, Upper Athabasca, Lower Peace, Upper Peace, North Saskatchewan, Red Deer, South Saskatchewan based on the boundaries of municipal districts and Alberta's seven major river basins (Figure 5). The LUF established a Land-use secretariat and regional advisory council for each region. The objective of the LUF was to shift the cultural sentiment away from the exploitive "if it doesn't pay, it doesn't stay," land use management mentality to more effectively balancing competing economic, environmental, and social demands by;

Managing cumulative effects of multiple development projects across the province,

Developing conservation and land stewardship strategies, Promoting efficient land use to reduce development footprints,

Establishing a provincial environmental monitoring system, and

Including aboriginal people in land-use planning.

Preparation of this plan coincided with development of Alberta’s 2008 Climate Change Strategy.

To date, only two of the seven regional Land-Use plans are complete, the Lower Athabasca Regional Plan (2012-2022) and the South Saskatchewan regional plan (2014-2024). These two regions were likely prioritized because they have the highest level of development and economic activity in the province. Both plans share a vision of continued growth of the Mining and Oil and Gas Extraction industry sector in Alberta. The following excerpts highlight the role that the government intended this sector to play in these regions economies and development plans. Rather than committing to reducing provincial mining and extraction rates and total carbon emissions, the regional climate change mitigation strategies were to rely on anticipated energy efficiency improvements from modern technology and innovation (pg. 48), a mainstream strategy that will only be effective if carbon capture and storage technologies are successful and remove barriers to new investments in renewable energy (pg. 47).

The following excerpt from the two regional land use plans highlight intention to status quo of continued growth and development of fossil fuel-based energy industry rather than transition towards low carbon future. The lack of commitment to constraining the oil and gas industry is attributed in part to the massive source of government royalties this industry generates. For the eighth fiscal year in a row, bitumen royalty made the largest contribution to provincial resource royalty revenue. In 2016 to 2017, bitumen revenue totalled $1.48 billion, or 47.9% of the non-renewable resource revenue (Government of Alberta, 2022c).

South Saskatchewan Regional Plan (2014-2024)

“Solidify Alberta as a world centre for resource-based and resource-related industries” (pg. 43)

“The South Saskatchewan Region has a long history of strong economic growth, largely in the agriculture and oil and gas sectors, […] It is expected that this trend will continue” (pg. 43)

“Growth of all energy sectors is crucial for the regional and provincial economies and maintaining a positive investment climate is critical to the success of these industries. Securing long-term opportunities for development of the region’s energy resources will support provincial and international sources of supply and will help leverage our traditional energy commodities by accessing new and expanded markets for processed and refined products. This must be supported by the alignment of policy direction across planning regions which will facilitate access to and distribution of these resources." (pg. 47)

Lower Athabasca Regional Plan (2012-2022)

"Alberta's Provincial Energy Strategy calls for our province to be "a global energy leader, recognized as a responsible world-class energy supplier, an energy technology champion, a sophisticated energy consumer and a solid global environmental citizen." The national and international significance of the oil sands resource means that oil sands development will continue to be a centrepiece of Alberta's energy mix, and a dominant activity in the region" (pg. 23)

Both of these regional plans

Character 2: Energy Workers

Since the 1950s the Mining and Oil and Gas Extraction industry has driven much of Alberta's development and prosperity. Today The Canadian oil and gas sector directly and indirectly employs over 140,000 Canadians (Government of Alberta, 2022c). This industry has attracted much investment and immigration from neighbouring provinces and has provided workers substantially higher than average wages compared to other regional industries (Government of Alberta, 2018). For example, in 2019 the average of a Canadian oil and gas worker annual salary of $124,679 was more than double the average Canadian worker salary of $56,783 (Kaplan, 2022).

When the question "*Why do you work on the oilsands?*" was posted on the social media platform Reddit sub-page "I AmA Canadian Oilsands Worker, AMA" on January 9, 2012 (Reddit, 2012) (Figure 7) one respondent stated simply "It's the most money I can make being an average Canadian so I can pay my bills, build my home and enjoy my life" (Figure 8). On a similar Reddit thread "*Albertans of reddit, how do you feel about the oilsands?"* (May 19, 2014) (Reddit, 2014), one respondent shared "*[…] the most beautiful thing about the oil and gas industry: the barrier to entry is simple. You need a driver's licence, steel toe boots, and H_2S ticket and a willingness to go where the work is an do it.*" (Figure 9). In other words, this industry has historically given financial and career growth opportunities to Albertans who would otherwise not have access.

However, these significantly higher wages and opportunities provided by the Mining and Oil and Gas Extraction industry have not benefited all Albertan's equally. This industry's work force has disproportionately employed Caucasian men between the ages of 25-55 (Alberta Labour and Immigration, 2021 pg. 9). In 2020, only 23.8 % of Mining and Oil and Gas Extraction industry employees were women, the lowest percentage across all industry sectors in Alberta (Alberta labour and Immigration, 2021). The lack of diversity in values and perspectives that comes from one gender dominating the energy industry is likely to perpetuate Alberta's mainstream energy narrative and limit adoption of new and emerging energy pathways (Lieu et al 2020). In recent years some efforts have been made to address gender and racial inequality in the industry and diversity has started to improve (Kaplan, 2022). However the current diversity stats for this industry remain distantly middle-aged white male compared to Alberta and Canada employment diversity averages.

Figure 12: Screenshot of IAmA Canadian Oilsands Worker AMA (ask me anything) (Reddit 2012)

Figure 13: Conversation within the "IAmA Canadian Oilsands Worker" ask me anything thread

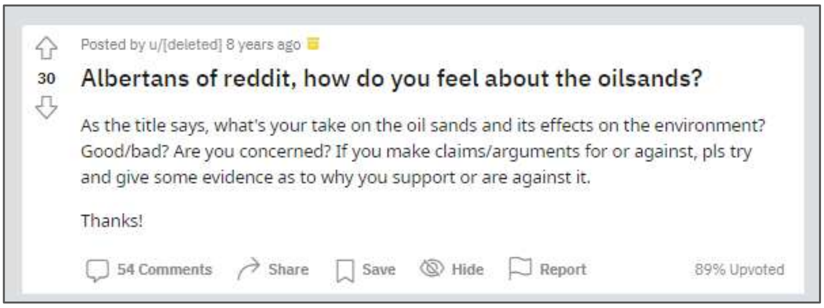
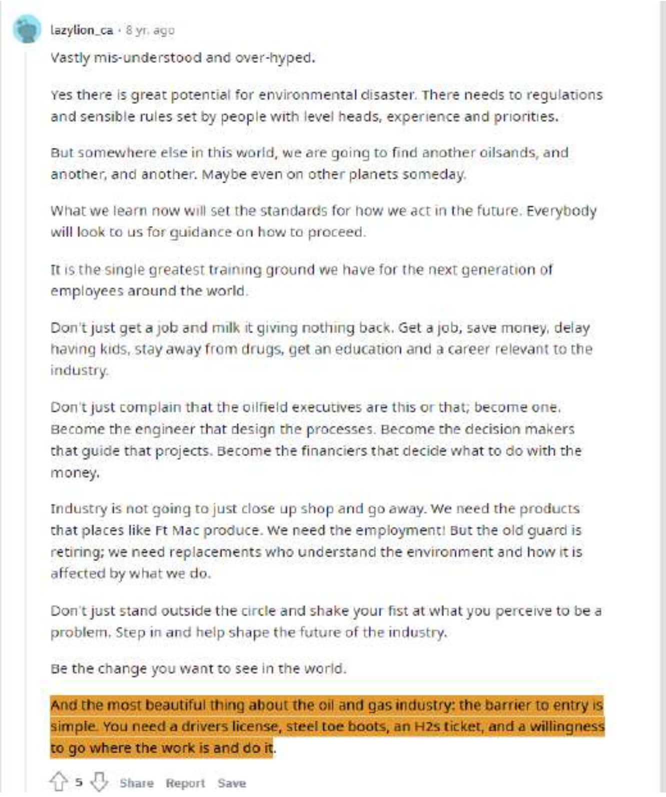


Figure 14: Question posed to the Alberta Reddit community about how they feel about working in the oilsands.



lazylion_ca · 8 yr. ago

Vastly mis-understood and over-hyped.

Yes there is great potential for environmental disaster. There needs to regulations and sensible rules set by people with level heads, experience and priorities.

But somewhere else in this world, we are going to find another oilsands, and another, and another. Maybe even on other planets someday.

What we learn now will set the standards for how we act in the future. Everybody will look to us for guidance on how to proceed.

It is the single greatest training ground we have for the next generation of employees around the world.

Don't just get a job and milk it giving nothing back. Get a job, save money, delay having kids, stay away from drugs, get an education and a career relevant to the industry.

Don't just complain that the oilfield executives are this or that; become one. Become the engineer that design the processes. Become the decision makers that guide that projects. Become the financiers that decide what to do with the money.

Industry is not going to just close up shop and go away. We need the products that places like Ft Mac produce. We need the employment! But the old guard is retiring; we need replacements who understand the environment and how it is affected by what we do.

Don't just stand outside the circle and shake your fist at what you perceive to be a problem. Step in and help shape the future of the industry.

Be the change you want to see in the world.

And the most beautiful thing about the oil and gas industry: the barrier to entry is simple. You need a drivers license, steel toe boots, an H2s ticket, and a willingness to go where the work is and do it.

5 Share Report Save

Figure 15: First response to the question posted on Reddit "Albertans of reddit: how do you feel about working in the oil sands?" May 2014.

Canadian Oil and Gas Sector Worker Demographics

According to the Canadian Energy Centre (2022) diversity within the Canadian Oil and Gas sector workforce in 2019 is summarized as follows,

26% have a university degree or higher

70% were male who earned an average annual salary of $124,679

30% were women who earned an average annual salary of $110,975

35% were immigrants who earned an average annual salary of $132,747

24% were visible minorities who earned an average salary of $114,988

6.3% were indigenous who earned an average annual salary of $115,237

According to Alberta Labour and Immigration (2021) only 23.8 of the mining oil and gas extraction industry in 2020 were women compared to 45.9% across all Alberta industries.

Character 3: Oil and Gas Companies

Two of the top five largest employers in Alberta operate in the oil and gas sector, Suncor (13,000+) and Precision Drilling (4,400+) (Immigroup, 2022) Other prominent oil and gas companies include Shell Canada Limited, Canadian Natural Resources Ltd., Syncrude Canada Ltd., Husky Oil Operations Limited, Ovintiv Canada ULC., and ConocoPhillips Canada Resources Corp. Oil and Gas companies are one of the highest contributors to Alberta's economy. According to Statistics Canada's National Economic Accounts, the Mining and Oil and Gas Extraction industry accounted for approximately 26% of Alberta's Gross Domestic Product in 2020 (Alberta labour and Immigration, 2021). These economic contributions through both government royalties and taxes give this industry more political lobbying power to maintain the mainstream energy pathway. Over the past five years, ownership of oilsands production has become concentrated in four companies: Cenovus Energy, Canadian Natural Resources Limited (CNRL), Imperial Oil Limited and Suncor Energy (the big four). Combined, these companies generate 84% of Alberta's oilsands production this concentration of power. In the 2015 book *Alberta Oil and the Decline of Democracy in Canada*, Shrivastava and Stefanick explore how this monopoly of corporate power has controlled Alberta's energy pathway narrative over the last few decades and prevented transitions toward more sustainable and equitable futures. To address federal Paris accord commitments and maintain Alberta's mainstream energy narrative, the top five top oil and gas producers Canadian Natural, Cenovas, ConocoPhillips, Imperial, MEG Energy, and Suncor, have joined the Pathways Alliance (https://pathwaysalliance.ca/). The Pathways Alliance is supporting Canada's goal of net zero greenhouse gas emissions by 2050 by co-investing with the government on developing technologies such as carbon capture utilization and storage and switching to lower carbon fossil fuels such as hydrogen. So far, the Alberta government is investing $1.24 billion over 15 years in two large-scale carbon capture and storage projects: The Alberta Carbon Trunk Line and the Quest Project (Government of Alberta 2022c).

Character 4: Indigenous Peoples

The Alberta oilsands are located on traditional territories of approximately 24 Indigenous and Metis communities. Some example communities include; Mikisew Cree First Nation, Athabasca Chipewyan First Nation, Fort McKay First Nation, Fort McMurray No. 468 First Nation and Chipewyan Prairie Dene First Nation. Therefore, the oilsands development in this region not only impacts the environment, it also directly impacts on the socioeconomic welfare of these communities (J. Lieu et al. 2019). Because of the cultural diversity between indigenous people's communities across the oilsands region, the full spectrum of their values and views are generally not represented. To date, little research has been conducted to capture northern Alberta's indigenous peoples lived experiences compared to the >500 of technical biophysical reports and peer-reviewed journal articles published on the region. Because the environmental impact observations of Indigenous residents have yet to be substantiated by government, Indigenous people's concerns are often dismissed as anecdotal (Natcher, et al. 2020). Meaningful inclusion of indigenous peoples in land development decisions is important because these resource developments impacts local culture and traditional livlihoods.

As part of the Indigenous reconciliation process, several Alberta oil and gas companies have started mandating that Indigenous-owned oil and gas services companies are selected over non-indigenous owned companies. These policies have begun to integrate indigenous peoples into the mainstream oil and gas narrative by providing economic, social and community benefits for Indigenous peoples through resource development. In the past few years, Indigenous-owned businesses have seed significant growth in contracts with the oil sands industry. Oil sands producer spending with Indigenous-owned businesses reached a record $2.36 billion in 2019, according to the latest data from the Canadian Association of Petroleum Producers. That continues an increasing trend from $1.54 billion in 2017 and $2.02 billion in 2018 (CAAP 2021).

However not all indigenous peoples wish to engage with or benefit from the economic opportunities from the oilsands development equally as the economic benefit come with significant cultural and community health costs. One recent 2020 Cultural Consensus Analysis study conducted in the Peace and Athabasca Regions of the oilsands found regional variability with regard to community members perceived impacts that the oilsands industry impacts on the environment and the associated risks of water and food contamination. Therefore, it is imperative that the wide variety of north Alberta's indigenous peoples values and opinions must not be distilled down to once homogeneous indigenous voice.

3.3.2 Alternative (on-stream and/or off-stream) narrative: the hydrogen economy, technology

The energy sector heavily dominated by oil and gas as well as chemical production. These sectors are mostly located in the Oil Sands region (lower-Athabasca) as well as the industrial heartland near Edmonton. These sectors have become prominent since ~1960-1980 after heavy investment of federal and provincial governments in developing the Alberta Oil Sands. Current propositions involve leveraging from existing production and carbon capture and underground storage (CCUS) infrastructure to export hydrogen. Carbon capture and storage and hydrogen technology providers predominantly the same large engineering firms traditionally involved in the energy sector. However, some of these areas are newer and pushed by client demand driven by local policy. Hydrogen fuel has the potential to be less carbon intensive depending on the energy used to drive the electrolysis processes to produce it. Natural gas-based hydrogen fuel production would be considered mainstream, hygro-electricity would be considered on-stream and renewables would be considered off stream. Currently innovation and technology investments are mainly onstream and on-stream narratives.

3.3.3 Alternative (on-stream and/or off-stream) narrative: stakeholders and institutions

Dominant stakeholder groups include industry and government, which are mostly lead by Caucasian men. These stakeholders are mainly located in urban areas such as Calgary, Edmonton and Fort McMurray. They have been traditionally dominant since the colonization of the territory by the British crown. Major colonizer/settler population in the region can be dated to late 1800, linked to finding of gold and the construction of the railways across the country.

Recent development has included partnerships with Indigenous peoples that have seen becoming shareholders as opportunities to have a seat on the table. However, this has been reported to perpetuate inequalities within the peoples themselves – those pro-business and those against development. Great concerns from indigenous peoples and environmental activities remain around environmental degradation as a result of resource extraction. Both for settler and indigenous stakeholders, females are under-represented. This has been addressed through specific programs to attract and retain female team members. However, this group, along with other minorities, are still significantly under-represented.

As dominant institutions, private for-profit companies are the strongest among all in the sector. Then, governmental institutions in charge of the control and regulatory processes, such as the Alberta Energy Regulator, have a strong historical presence in addition to the provincial government and its ministries. Other institutions involve partnerships with post-secondary institutions such as Universities and Polytechnique. Other important players are the Indigenous council which represents the local government within Indigenous reserve lands which cover almost all of Alberta’s territory. Indigenous councils normally seek to defend the rights of Indigenous peoples that normally occur via collaboration, mediation and litigation in or out of court. The legal institutions of Alberta also play a major role in resource development. To a lesser degree, environmental NGOs and Oil and Gas lobby groups also play a role in reporting and influencing public opinion about the sector. These institutions have been dominant since 1960-1980 as Oil and Gas extraction replaced agriculture as the main economic driver of the province.

3.3.4 Alternative (on-stream and/or off-stream) narrative: ideologies

Ideologically, Alberta is a Christian conservative stronghold. Capitalism and free-market values are dominant. Also, government intervention is not very welcome. Right-wing ideology from the US is welcome and shared by people in the region. These ideologies could be linked to English colonialism – Canada never fought for independence from the British crown and it is to date part of the commonwealth – as well as heavy influence from the US political system and dominant narratives. These ideologies have been dominant since colonization time and expansion of settlements in western Canada around mid-1800s.

3.3.5 Alternative (on-stream and/or off-stream) narrative: policies

Dominant policies in this sector cover resource extraction, export, and royalty frameworks. In parallel, environmental policies for land, water, and ecosystem protection are in place. However, it is Alberta's jurisdiction to oversee resource extraction and environmental protection, while handling public pressure from economic development. Therefore, the economic benefit has been dominant over negative environmental impacts. These policies cover the whole province. The federal government has limited inherence in these matters unless they involve cross-province or international trading. More recently, federal policies around climate and GHG emissions reductions have required Alberta to develop its own policies or subject to implement the federal ones. Specific frameworks for land, water, and resource management are in place for the region. These policies have become dominant since the growth of the oil and gas sector 1960-1980.

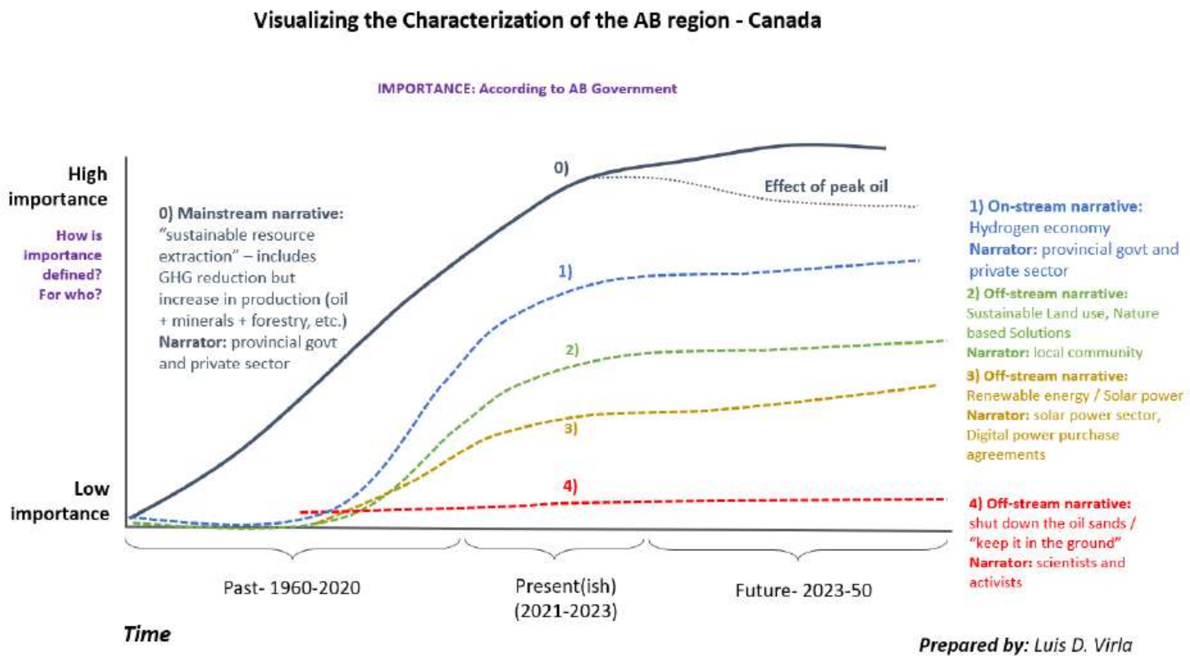
3.3.6 Alternative (on-stream and/or off-stream) narrative: contextual factors

Green growth pledges and commitments to the energy transitions have added pressure to Alberta since its products may face more challenges in the international market. Our own research has found that Canada's climate target are heavily reliant in US targets and policies. Since 99% of the Oil Sands production is exported to the US, a clear climate strategy in the US is expected to impact the sector directly. Also, the potential decrease of global oil market place the Alberta Oil Sands in disadvantage due to its lower quality and higher costs. Alberta have tried to label its oil as "the most ethical" asking countries to consider the origin of their oil imports while Canada ranks as one of the countries with higher democratic performance.

On the other hand, recent stimulus for a hydrogen economy where "blue hydrogen" (hydrogen produced from fossil fuels but removing GHG emissions using CCS) have motivated Alberta to play a role considering the use of its resources to participate in the hydrogen economy. Current freight transportation and public transit projects are being ousted in the province to demonstrate the possibility for Alberta to compete at this level. However, now Alberta's hydrogen will have to compete with hydrogen produced with other technologies within Canada such as using hydro (British Columbia and Quebec) or nuclear (Ontario). In addition, also competing with international new producers such as Chile and Morroco, capable to produce low-cost low-carbon hydrogen.

Other expected challenges are associated with transportation of the energy products as Alberta us Land-locked and requires agreement with neighbouring provinces to move their products via rail or to ports for exports.

Other aspects of this narrative involves the question of how much would this contribute to a just transition. From the surface, it seems that though this pathway could lead into a lower-carbon activities will maintain the power in current dominate stakeholder groups. Also, it could perpetuate the power structure already existing where only large organization with large capital power would be the ones able to participate while not many small, distribute groups would have access to facilities or capital to produce hydrogen, leaving behind those traditionally neglected by incumbent systems.



3.4 Trends and indicators for sustainable transformations

The mainstream narrative of resource extraction is still entrenched within the Alberta culture. If plans to rely on technology to mitigate climate change and achieve local, regional, and international carbon emissions targets, carbon capture and storage technologies are required at massive scales. The established dominant stakeholders are positioning to maintain their control over the energy sector by retrofitting old and existing facilities to produce, store and transport hydrogen. However, many fundamental engineering and physics challenges need to be overcome for hydrogen-based economy to be viable at large scale. Because this energy transition would keep existing dominant stakeholders in positions of power, billions of dollars of investment are being funnels in to hydrogen economy research and development. New investment is also arriving for renewable solar and wind projects in Alberta, however at much smaller scale than hydrogen and have greater applicability for remote peoples.

Indicators

- Total value of energy infrastructure investments
- Number of proposed energy projects
- Government research grants and low interest business loans

Table 2: Indicators and trends derived from the narratives

Observed in:	Name of the narrative or other factors	Trends observed in the narrative (qualitative description)	Indicator(s) that helps describe the trend (way to measure)	Indicator discipline(s) e.g. economics, policy, etc.
Mainstream narrative	Resource extraction	Continue growth, expressed concerns with climate but not clear action plan, increased risks associated with the global energy	Royalties, barrels produced, GHG emissions, jobs, investment	Economy, Political, Environmental Science

		transition, driven by revenue generation for shareholders		
On-stream narrative	Alberta hydrogen roadmap	increased technological risks associated with the global energy transition towards hydrogen, driven by revenue generation potential for shareholders. This is not yet a proven technology and investors are taking a risk on the engineering challenges being overcome at large industrial scales.	Royalties, barrels produced, GHG emissions, jobs, investment	Economy, Political, Environmental Science
Off-stream narrative	Sustainable land-use	Sustainable land management is not yet seen as climate mitigation alternative energy source and has not gained enough traction to alter the course of Alberta's energy pathway.	Royalties, GHG emissions removed, jobs, investment, biodiversity, health, water	Economy, Political, Environmental Science

Factors not derived from narratives				

3.5 Summary of key findings

Mainstream narrative foreseen dominant, especially as oil price increases and not specific indication of the US reducing oil imports or implementing country-wide mechanisms to restrict GHG emissions

The Energy Transition concept is becoming more common in Alberta. However, the strategies that use this term seem to perpetuate the status quo. The on-stream narrative of hydrogen is presented as a Segway for Alberta to enter the low-carbon economy but in practice it may be just maintaining the power structures where Oil and Gas continues to be a dominant sector in Alberta's economy

Off-stream narratives associated with sustainable land use and the growth of renewable energy in the province give indications of unexpected growth and potential. However, these are not yet part of the mainstream discussions and/or are not directly mentioned by specific policies. These narratives seem more likely due to market push and new economic opportunities, but they may be perceived as still high-risk/low-return options compared to the incumbent sectors.

3.5.1 Key enablers and barriers to a potential tipping point

Enablers

- Government policy that incentivizes behaviours and practises away from mainstream energy narratives

Government grants and investment towards off Stream Energy narratives

Barriers

- Attachment to existing infrastructure i.e. sunken cost fallacy/bias
- Resistance to distributed power by current energy monopoly

3.5.2 Indicators of tipping points

Positive TPP:

Enablers: stronger global commitments to 1.5 C climate targets, more push for federal and provincial climate policies, lower costs of renewables, further deployment of digital power purchase agreements (DPPAs), development of valuation structures for nature-based solutions

Barriers: lack of awareness of global progression on climate policies, comprehensive plans for risk mitigation, policy misalignment within the policy mix

Negative TPP:

Enablers: high oil price, lack of commitments on energy transitions from other countries (especially the US), increased inflation due to COVID-19

Barriers: Countries meet 1.5 C targets, increased market push for green products

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4 Case study 4: Moravian-Silesian Region, Czech Republic

Pathways, drivers and barriers of the low-carbon transition of Czech coal mining regions

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4.1 Introduction

4.1.1 CCIR description

Two case study regions are subject of investigation in the Czech Republic, including Moravian-Silesian Region (as an example of coal intensive region under transformation) and South-Moravian Region (as an example of former coal mining region which has managed to transform economically and structurally relatively successfully over the two decades). These two administrative regions (NUTS3) consist of a total of 13 districts (LAU1/NUTS4), of which 5 districts have been significantly affected by coal mining in the recent past (Brno-countryside, Hodonin, Frydek-Mistek, Ostrava-city, and Karvina), while coal mining is still taking place in one district of these (Karvina).

The Moravian-Silesian Region (hereinafter MSR) is one of the 14 administrative regions (NUTS3) of the Czech Republic (see Fig. 1). The total population of the region is slightly below 1.2 million (2021), which makes it the fourth most populous region in the Czech Republic. The region is consisting of 6 districts (LAU1), out of which 3 districts (Ostrava, Karviná, Frýdek-Místek) have been significantly affected by coal-mining.

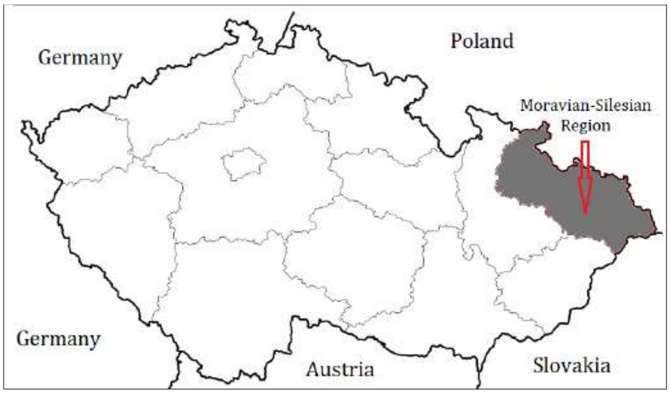


Figure. 1: Location of the Region in the Czech Republic. Source: Authors´ elaboration

MSR is one of the most industrialized and urbanized regions in Central Europe. From the environmental point of view, urban parts of the region are heavily affected by the air contaminations originating from local industrial activities (and from the industries in the nearby Katowice industrial agglomeration) whose level is frequently multiple times crossed and cause the major health issues for local population. The region´s capital Ostrava used to be called the "Steel Heart of the Republic" as a reflection of its importance in the Czechoslovak economy. MSR belongs to the three coal regions in the Czech Republic, which are considered as structurally affected.

Post-industrial change of the region have been gradually evolving from the middle of 1990s when the first coal mines and heavy industries were decommissioned which was followed by the rise of social problems. In the eastern part of the region, the coal mining is still taking places (the mines are state-owned), however the mining should be finished until the end of 2022. The region is typical by a strong population decline. The main driving force behind the population loses is the outmigration of primarily younger population which causes dynamic ageing of the population and challenges for their prospective health and social care.

From the functional point of view, Ostrava agglomeration is the urban core of the region where employment possibilities are primarily concentrated. The Ostrava labour market attracts the people from all the region (the peripheries are typical by a lack of job opportunities). Recently, the ITC sector has been well developing in Ostrava and the city became the third largest cluster of ITC industries in the Czech Republic (after Prague and Brno). On the other hand, the vast majority of the jobs available are still for low-skilled and low-educated labour force. It is very typical that the graduates from local universities are leaving the region to work and live in other parts of the Czech Republic with more attractive job offers.

The region identifies itself with the industrial and mining tradition (in the early 1990s more than 120 thousand people worked in the coal mining sector and another tenth thousands in heavy industries). The reflection of this historical period is materialised in the occurrence of a high number of unused industrial sites (brownfields) that were recently abandoned, waiting for the new use and create enormous barriers for compact urban development. The region´s energy sector has been based for almost two centuries on coal that forms important element of its identity. Coal mining has played a major role not only in the economy but also in the social and culture life of communities. Its position is also interconnected with worries of losing regional identity, which has been built over years and over generations. Strongly rooted identity and other insecurities (e.g.

unemployment and loss of social stability) are therefore potential reasons that may block or slow down an effective implementation of tipping points.

The South-Moravian Region (hereinafter SMR) is located in the South East of the Czech Republic and shares a border with Austria and Slovakia (see Fig. 2). It is the fourth largest in area and third largest in number of inhabitants among the regions in the Czech Republic. The region is consisting of 7 districts (LAU1), of which two have been affected by coal mining. The mining of black coal in the Brno-venkov district was stopped in 1992 and the mining of lignite in Hodonín district stopped in 2009.

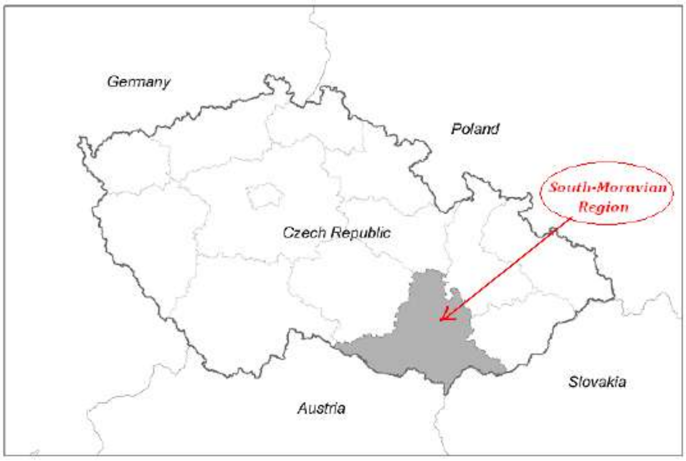


Figure. 2: Location of the Region in the Czech Republic. Source: Authors´ elaboration

The South-Moravian Region is not considered a carbon region but a transformed region. In the past, coal mining took place in two localities. Black coal was mined in the area of the Rosice-Oslavany coal basin (about 20 km west of the regional capital Brno) and it was terminated in 1992. Residual coal reserves in the amount of approximately 26 million tons were written off by a decision of the Ministry of Economic Policy and Development of the Czech Republic on 22 May 1991. Lignite was mined in the area of South-Moravian lignite basin and it was terminated in 2009 due to economic unprofitability.

South-Moravian Region has been traditionally dominated by engineering and textiles industries (and coal mining), but over the past decades a dramatic decline of textile manufacturing and engineering changed the balance and new sectors are favored (i.e., high-tech industries). Much of this change has been due to the foreign direct investments (either through joint-ventures, takeovers or greenfields investments). The region has a high share of employment rate in the science and in management sectors and executive positions. The region is very effective in the regeneration and re-use of abandoned post-industrial and post-mining areas (brownfields). The SM region has the highest installed capacity of solar energy (448 MW) in the country (almost 25% of the country´s installed capacity of PVs), however, the realizable potential of wind energy (about 350 MW) is far from being effectively utilized (only 10 MW installed, mainly due to landscape impacts). Green economy might be an answer to the further economic restructuring, good practice examples and transfer of knowledge are necessary.

4.1.2 Societal problem description

The current energy policy of the Czech Republic remains highly dependent on traditional resources. Overall, electricity generation is based primarily on thermal power plants burning coal [47%], gas and other fuels [8%], nuclear power plants [33%], with a mix of renewable energy sources at a mere 12% (ERU 2021). Active coal mining currently affects the area of six districts in three regions (see Fig. 3).

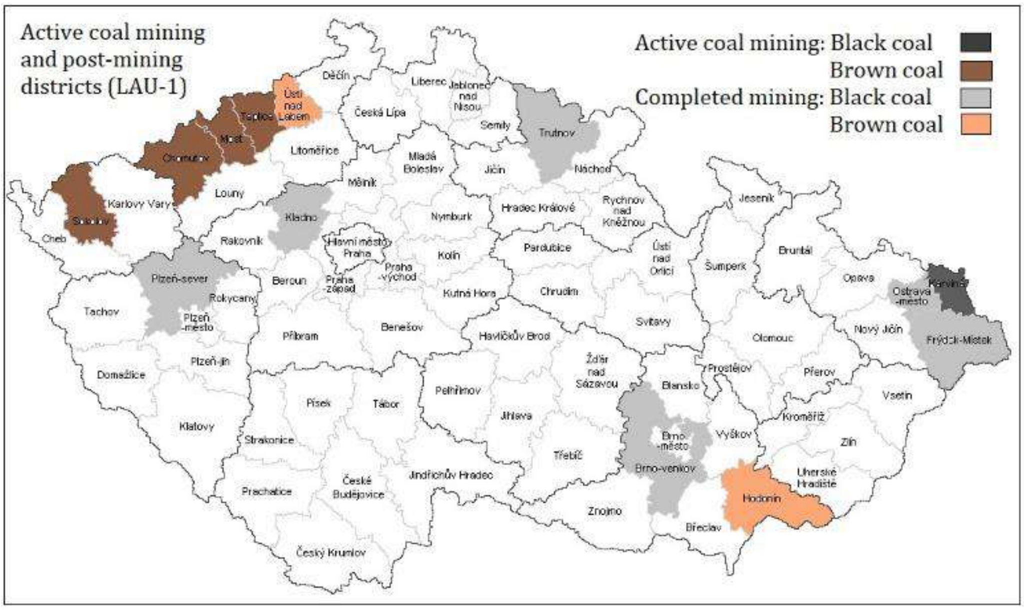


Figure. 3: Coal-mining and post-mining districts in the Czech Republic. Source: Authors´ elaboration

Several studies (see e.g., Kubáňová, 2007, Frantál and Nováková, 2014, Frantál, 2017) documented that coal mining regions are in comparison to other Czech regions characterized by many negative attributes, including the highest concentration of areas of deteriorated air quality, the lower life expectancy, a higher than average occurrence of allergic diseases, the highest rate of abortions and infant mortality, the highest unemployment rates, the lower percentage of people with university degrees, a lower than average percentage of business activity, etc.

4.1.3 Research problem

The coal industry has been frequently associated with the "resource curse" theory (Freudenburg and Gramling, 1998; Perdue and Pavela, 2012), stressing that resource-dependent regions whose development has been strongly dependent on the extraction of natural resources (specifically non-renewable resources such as fossil fuels and minerals) are characterized by economic vulnerability, demographic instability, negative health and socioeconomic impacts, increasing geographic isolation, imbalances of scale and power with respect to extractive industries, and the absence of realistic alternatives for diversified development. In the context of economic and social impacts of coal mining on local communities, Petrova and Marinova (2013) speak about the culture of transiency and dependency.

However, the coal mining regions are not uniform and homogenous entities (the effect of scale and location). There are significant differences (e.g., in the rate of unemployment, job supply, migration, etc.) both between districts within coal mining and post-mining regions and compared to districts located in other parts of the country (differences between peripheral, borderland and metropolitan areas). For example, in the mining regions, which show on average more negative socioeconomic indicators, there are districts with significantly better values, and on the contrary, in the overall prosperous regions there are districts that are in some respects among the worst in the country (see Tab. 1).

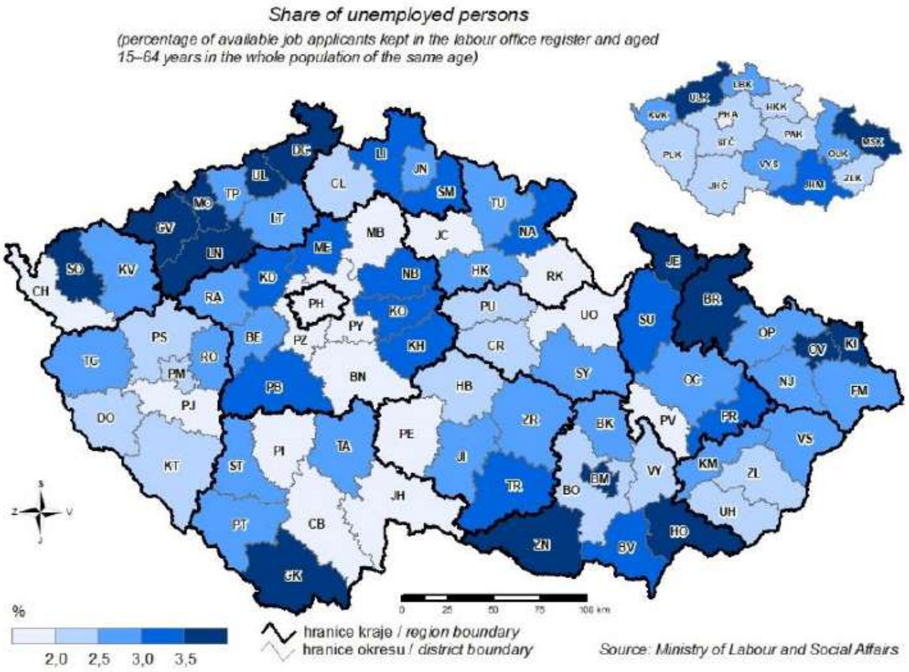


Figure. 3. Differences in the rate of unemployment (2021) between regions and districts. Source: Czech Statistical Office (2022)

Table. 1: Differences between case study regions and their districts in selected indicators

Region: Districts	Type of district [1]	Mean age (years)	Aging index	Life expectancy at birth (2016-2020)	Abortions per 100 births	Change of population 1990-2021 (%)	Emissions of air pollutants (tons/km^2)	Unemployment rate (%)	People with university education (%)	People with basic education (%)	Crime rate	Voter turnout (%)	Support for populist parties (%)
South-Moravian Region:		**42,7**	**126**	**76,1**	**25**	**4,7**	**7,1**	**3,9**	**17**	**14**	**13,3**	**66**	**37**
Blansko	0	43,0	127	76,1	24	-0,6	7,2	3,0	16	12	9,3	69	36
Brno-město	0	41,8	130	77,0	23	1,5	12,4	4,6	32	10	28,4	65	29
Brno-venkov	1	41,3	101	76,6	18	45,3	9,0	2,9	19	12	11,1	71	33
Břeclav	0	43,3	134	75,5	29	-9,6	3,4	3,6	13	16	12,4	66	37
Hodonín	1	44,3	149	75,8	27	-8,9	7,0	5,2	12	15	9,6	65	39
Vyškov	0	42,2	114	75,8	26	5,2	4,2	2,4	16	13	7,7	67	37
Znojmo	0	42,8	128	75,7	25	-0,1	6,4	5,4	11	17	14,4	63	45
Moravian-Silesian Region:		**43,4**	**136**	**74,3**	**30**	**-11,3**	**122,4**	**5,0**	**15**	**15**	**17,7**	**61**	**47**

Bruntál	0	44,3	154	73,3	41	-21,9	6,2	6,5	10	17	16,2	58	52
Frýdek-Místek	1	43,0	126	75,2	26	-8,2	123,8	3,2	17	13	12,8	64	43
Karviná	2	44,2	147	73,4	36	-18,2	70,8	8,5	12	16	19,6	56	53
Nový Jičín	0	42,7	124	74,8	25	-8,5	17,4	3,2	14	14	13,9	65	42
Opava	0	43,1	128	75,2	24	-5,6	8,4	3,0	16	14	12,6	65	45
Ostrava-město	1	43,2	138	73,8	30	-5,3	507,6	5,6	19	15	31,2	58	46

Note: [1] Type of district: 0 = non-mining, 1 = post-mining, 2 = active mining, the data are valid for 2021 if not otherwise specified. Source of data: Czech Statistical Office (2022), authors´ calculations.

Thus a comparative analysis at lower spatial levels is needed to identify specific differences between coal mining and non-mining regions and their determinants. We applied the concept of spatial differentiation (the production of geographical difference) (Bridge & Gailing, 2020) on the theories of resource curse (Badeeb et al., 2017, Betz et al., 2015), diffusion of innovations (Brown & Cox, 1971) and spatial energy justice (Bouzarovski & Simcock, 2017). Since the capacity to transform economy and take up different renewable energy technologies and other innovations is related to geographical conditions, the locations, landscapes and territorialisations associated with low carbon energy transitions generate specific patterns of uneven development (cf. Bridge et al., 2013, Frantál and Nováková, 2019).

4.1.4 Research questions

The aim of the multilevel explorative geographical analysis focusing on socioeconomic development trajectories (from the fall of communism in 1989 to the present) and successful projects of economic transformation and post-mining landscape revitalization within these two regions was to explore and evaluate the key processes and socio-structural forces in their development and to identify specific factors (indicators) that lead to positive tipping points in low carbon energy transition considering different regional and local conditions and capacities.

The research questions that have driven our research were defined as follows:

- What are the principal differences between coal mining, post-mining and other regions, by which indicators these differences can be described and measured?
- How regions differ in the sense of the adoption of renewable energy technologies?
- What are the main factors and barriers that have enabled or slowed down the socioeconomic transformation of coal mining regions?

- What are the key factors (conditions, circumstances, actors, agencies) that are determinants and contributors to successful projects of post-mining regeneration?

4.2 Research approach

We have applied a multi-level and mixed methods research strategy. The research activities related to partial research questions have been realized at two hierarchical spatial levels, including (i) national/regional level and (ii) local level.

4.2.1 Research at the national/regional level

An explorative spatial and statistical analysis at national and regional level was provided. We have collected, digitalized (from old printed yearbooks), sorted and classified longitudinal statistical data for all Czech districts (NUTS4/LAU1), including selected available geographical, environmental, demographic, and socio-economic indicators for the period 1990-2021 (see Table 1). Inspired by similar studies from the US and Australia (see e.g., Nord and Luloff, 1993, Tonts, Plummer, and Lawrie, 2012, Williams and Nikijuluw, 2020). A rigorous explorative statistical analysis has been provided, to identify significant relationships between specific indicators and regional development trajectories, using correlation analysis, and the differences and similarities between specific districts have been analysed using Analysis of Variance (ANOVA), regression modelling and hierarchical cluster analysis in SPSS programme ver. 24.

Table. 2: The list of indicators (variables) included in statistical analysis

Variable	Measure
Geography and environment	
Area	Total area (km^2)
Peripheral location	District is located on the country´s border (yes//no)
Urbanization	Share of urban population on total population (%)
Agricultural land	Share of agricultural land on total area (%)
Forests	Share of forests on total area (%)
Landscape protected areas	Share of national parks and protected landscape areas on total area (%)
Coefficient of ecological stability	Ratio of areas of stable and unstable landscape-forming elements
Specific emissions of pollutants I	Concentration of particulate matter (PM) emissions (tons/km^2)
Specific emissions of pollutants II	Concentration of carbon monoxide (CO) emissions (tons/km^2)
Population & health	
Population density	Population per km^2
Population change	Change (%) in the number of inhabitants compared to the given year
Index of aging	Number of persons aged 65+ per 100 persons aged 0-14
Life expectancy	Male life expectancy at birth (2016-2020)

Infant mortality	Infant mortality (‰)
Abortions	Number of abortions per 100 births
Congenital malformations	Live births with congenital malformation per 10,000 live births
Respiratory diseases	Deaths of respiratory diseases per 100,000 population
Labour market and economy	
Employment in industry	Share of employees in industry (%)
Unemployment rate	Unemployment rate (%)
Job vacancy rate	Number of job applicants per 1 job vacancy
Business activity	Total business units registered per 1,000 population
Average monthly wage	Average monthly wage (CZK)
Property value	Average price of flats (millions CZK)
Tourism potential	Number of overnight stays in tourist accommodation per capita
Social capital & cohesion	
Education level	Share of persons with basic or no formal education (%)
Share of natives	People with permanent living at the place of their birth [%]
Share of ethnic minorities	Share of Roma ethnic people (%)
Homelessness	Number of homeless people per 1,000 population
Crime rate	Ascertained offences per 1,000 population
Voter turnout	Turnout in parliamentary elections (%)
Support of populism	Share of people voting for populist parties (SPD+ANO) (%)
Energy production	
Coal energy capacity	Installed capacity of coal power plants (MW)
Wind resources	Realizable potential of wind energy (MW)
Wind energy capacity	Installed capacity of wind power plants (MW)
Solar energy capacity	Installed capacity of solar/photovoltaic power plants (MW)
Biogas energy capacity	Installed capacity of biogas/AD plants (MW)

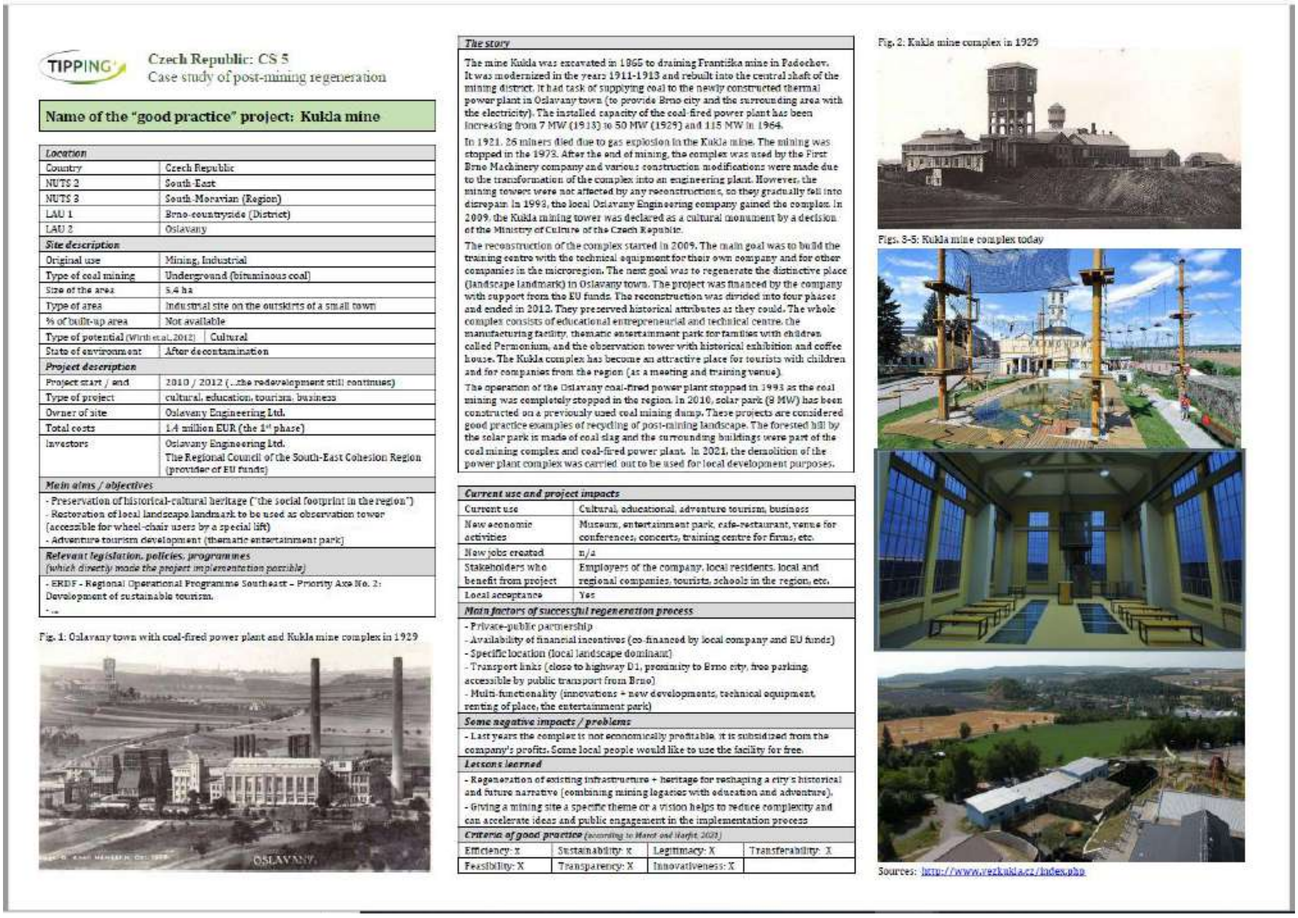
Notes: (i) The categorization of variables is only indicative as some variables may belong to several categories; Sources of data: Czech Statistical Office (2022); Ministry of Agriculture (2011); Public Register of Land (pLPIS); State Administration of Land Surveying and Cadastre (2011), Czech Wind Energy Association (2022), Czech Energy Regulatory Office (2021).

4.2.2 Research at the local level

The research at local level have a form of multiple-cases comparative analysis of selected projects (selected as typical examples of "good practice" regeneration projects). Case studies were identified and projects data inventoried according to available project documents, media research and interviews with relevant experts in the field.

In the first step we gathered a collection of projects which are considered as successful regeneration projects or so called ´good/bad practices´. Case studies (projects) were identified and selected according to the review of available literature/media search (academic papers and reports, national, regional and local newspapers, TV programs, websites of protest civic associations, etc.) and consultation with experts (researchers, representatives of energy companies). In total, we have selected 20 case studies for which we summarized basic information (name, location, technology, size, financing and ownership patterns, timeline, etc.).

Then we have applied a reconstructive analysis (Jobert et al., 2007, Frantál et al., 2018) to explore and retrospectively reconstruct the history, development and outcomes of projects, based on the analysis of available documents and semi-structured interviews with key actors about their roles in and perceptions of the projects, conflict issues and outcomes. Personal interviews with actors could not be conducted in all cases (due to the refusal to participate in research, but also due to the fact that specific people no longer work in their positions they held at the time of project implementation). In these cases, adequate information was obtained from the available documents. In general, we followed the methodological principle of the saturation (Saunders et al. 2018) which is commonly taken to indicate that, on the basis of the data that have been collected and analyzed hitherto, further data collection is unnecessary. For each case study a detailed description (characteristics) and a "narration" was provided (see Fig. 4 for an example of complete "passport" of one project).



Czech Republic: CS 5
Case study of post-mining regeneration

Name of the "good practice" project: Kukla mine

Location	
Country	Czech Republic
NUTS 2	South-East
NUTS 3	South-Moravian (Region)
LAU 1	Brno-countryside (District)
LAU 2	Oslavany
Site description	
Original use	Mining, Industrial
Type of coal mining	Underground (bituminous coal)
Size of the area	5.4 ha
Type of area	Industrial site on the outskirts of a small town
% of built-up area	Not available
Type of potential (Wirth et al. 2012)	Cultural
State of environment	After decontamination
Project description	
Project start / end	2010 / 2012 (...the redevelopment still continues)
Type of project	cultural, education, tourism, business
Owner of site	Oslavany Engineering Ltd.
Total costs	1.4 million EUR (the 1st phase)
Investors	Oslavany Engineering Ltd. The Regional Council of the South-East Cohesion Region (provider of EU funds)

Main aims / objectives

- Preservation of historical-cultural heritage ("the social footprint in the region")
- Restoration of local landscape landmark to be used as observation tower (accessible for wheel-chair users by a special lift)
- Adventure tourism development (thematic entertainment park)

Relevant legislation, policies, programmes
(which directly made the project implementation possible)

- ERDF - Regional Operational Programme Southeast – Priority Axe No. 2: Development of sustainable tourism.
- ...

Fig. 1: Oslavany town with coal-fired power plant and Kukla mine complex in 1929

The story

The mine Kukla was excavated in 1865 to draining Františka mine in Padochov. It was modernized in the years 1911-1913 and rebuilt into the central shaft of the mining district. It had task of supplying coal to the newly constructed thermal power plant in Oslavany town (to provide Brno city and the surrounding area with the electricity). The installed capacity of the coal-fired power plant has been increasing from 7 MW (1913) to 50 MW (1929) and 115 MW in 1964.

In 1921, 26 miners died due to gas explosion in the Kukla mine. The mining was stopped in the 1973. After the end of mining, the complex was used by the First Brno Machinery company and various construction modifications were made due to the transformation of the complex into an engineering plant. However, the mining towers were not affected by any reconstructions, so they gradually fell into disrepair. In 1993, the local Oslavany Engineering company gained the complex. In 2009, the Kukla mining tower was declared as a cultural monument by a decision of the Ministry of Culture of the Czech Republic.

The reconstruction of the complex started in 2009. The main goal was to build the training centre with the technical equipment for their own company and for other companies in the microregion. The next goal was to regenerate the distinctive place (landscape landmark) in Oslavany town. The project was financed by the company with support from the EU funds. The reconstruction was divided into four phases and ended in 2012. They preserved historical attributes as they could. The whole complex consists of educational entrepreneurial and technical centre, the manufacturing facility, thematic entertainment park for families with children called Permonium, and the observation tower with historical exhibition and coffee house. The Kukla complex has become an attractive place for tourists with children and for companies from the region (as a meeting and training venue).

The operation of the Oslavany coal-fired power plant stopped in 1993 as the coal mining was completely stopped in the region. In 2010, solar park (9 MW) has been constructed on a previously used coal mining dump. These projects are considered good practice examples of recycling of post-mining landscape. The forested hill by the solar park is made of coal slag and the surrounding buildings were part of the coal mining complex and coal-fired power plant. In 2021, the demolition of the power plant complex was carried out to be used for local development purposes.

Current use and project impacts	
Current use	Cultural, educational, adventure tourism, business
New economic activities	Museum, entertainment park, cafe-restaurant, venue for conferences, concerts, training centre for firms, etc.
New jobs created	n/a
Stakeholders who benefit from project	Employers of the company, local residents, local and regional companies, tourists, schools in the region, etc.
Local acceptance	Yes

Main factors of successful regeneration process

- Private-public partnership
- Availability of financial incentives (co-financed by local company and EU funds)
- Specific location (local landscape dominant)
- Transport links (close to highway D1, proximity to Brno city, free parking, accessible by public transport from Brno)
- Multi-functionality (innovations + new developments, technical equipment, renting of place, the entertainment park)

Some negative impacts / problems

- Last years the complex is not economically profitable, it is subsidized from the company's profits. Some local people would like to use the facility for free.

Lessons learned

- Regeneration of existing infrastructure + heritage for reshaping a city's historical and future narrative (combining mining legacies with education and adventure).
- Giving a mining site a specific theme or a vision helps to reduce complexity and can accelerate ideas and public engagement in the implementation process

Criteria of good practice (according to Manzi and Haeflt, 2021)

Efficiency: X	Sustainability: X	Legitimacy: X	Transferability: X
Feasibility: X	Transparency: X	Innovativeness: X	

Fig. 2: Kukla mine complex in 1929

Figs. 3-5: Kukla mine complex today

Sources: http://www.vezkukla.cz/index.php

Figure. 4: Example of the "passport" of project of post-mining regeneration.

The narrations of all case studies were collectively reviewed by the group of authors and analyzed to identify and summarize specific factor of success. The data and information from the case studies have been coded, categorized and converted into a data matrix usable for statistical analysis.

4.3 Narratives

The following sections, including the description of mainstream and alternative narratives is based on the review of literature and interviews with stakeholders (experts from academia, representatives of NGOs, regional politicians, etc.).

4.3.1 Mainstream narratives

During the era of communism (1948-1989), Czechoslovakia - as a member of the former East European COMECON group of countries - was designated the "forge of the socialist camp". Coal was regarded the national "black gold" and the "life blood" of a centrally controlled dominance of metallurgical and energy-intensive heavy industries. In that period, the production of brown coal as the main source of energy increased about five times and electrical power generation about twenty times (CZSO, 2012). The focus on heavy industries and energy production affected overall national economy and resulted in environmental devastation of several regions, particularly in the Northern-Bohemian brown coal basin and Ostrava-Karvina black coal basin.

The mainstream pro-coal discourse has been (and in the coal mining regions still remains) based on the following argumentation:

- Coal mining and coal energy contribute to national energy security and economic competitiveness
- Electricity and heating generated from domestic coal is cheap (in contrast with the subsidized and expensive renewable energy and imported natural gas from Russia)
- Tax revenues from coal mining contribute to state budget and regional/local development
- Coal mining and related industries prevent an increase of regional and local unemployment
- Economic profits from the sale of coal reserves will allow greater investments in landscape reclamation and regeneration projects

- Coal mining forms the cultural identity of regions, can be used for place branding and promoting tourism

4.3.2 Alternative (on-stream and/or off-stream) narrative

On-stream narratives

- Coal has a future: we should not close the mines ultimately and not demolish the underground and above-ground infrastructure. There will be a need for coal and raw materials again, the prices will be higher and thus coal mining will be again economically profitable (- this narrative is now getting stronger due to the global energy crisis and lack of sources due to the war in Ukraine).
- Re-industrialization: to replace coal mining and related industries with other large industrial companies (e.g., car producing companies) through financial incentives.
- Provide work for miners after closure of mines: huge investments (EU, government) into reclamation projects (regeneration of landscape after mining) provided by state-owned coal mining companies (OKD, DIAMO)
- Unemployed miners should receive special support from the state (as a specific profession with im pacts on health condition, etc.)
- The emphasis on preserving historical industrial heritage (preservation of mining complexes as cultural monuments)

Off-stream narratives

- Emphasis on social aspects of transition (i.e., just transition): local residents, employers unions and other stakeholders must take a part in negotiating the conditions and future directions of transition.
- Bottom-up and small-scale approach: ideas and suggestions from local people (representatives of municipalities, local entrepreneurs, NGO´s, various interest groups) should be included in the planning -- those living in the region may have good ideas on how to use the area.
- Do not rely on a few "mega-projects" and large employers (after the end of state incentives, they can move to other countries -- a risk of losing a job would affect again large part of the population), locally rooted small and medium businesses based on creativity and innovativeness of local people are more resilient against

global crises.

- Invest the money (EU funds, private money) for landscape reclamation meaningfully (economic and environmental sustainability of projects)
- Investments into research and innovation in the field of alternative use of coal mines (electricity and heat production from coal mine (methane) gas, carbon capture and storage technologies, etc.). Re-use of coal mines for tourism.
- Investments into tertiary sector and education: universities and research institutions can act as a magnet attracting new initiatives and start-ups (support for the development of creativity of university students and early stage researchers).
- Investments into infrastructure development (transport, housing development, public services) to reduce the peripherality of the region and quality of life (Smart City concept, Eco-innovations). Improved connectivity with other regions.
- Focus on "green technologies" (renewable energy development, smart grids, ecological public transport, electric cars, use of hydrogen etc.).
- Place branding: systematically improve the image of regions (not to build solely on industrial legacy, not to support a traditional view that the region is "very distinctive").
- To develop connections to Poland (Silesia) and support cross-border cooperation. Environmental problems (air pollution) cannot be solved without concerted actions with Polish regions.

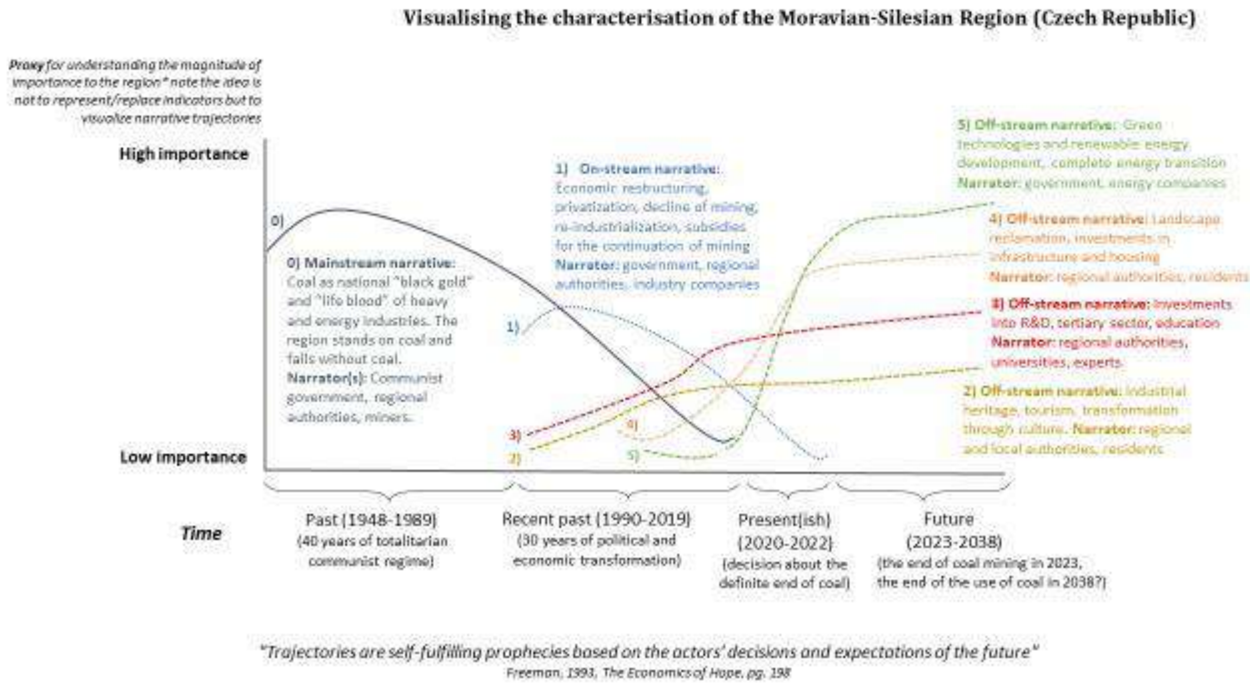


Figure. 5: Visualization of the trajectories of mainstream and alternative narratives

4.4 Trends and indicators for sustainable transformations

In this section we focus on the trends and indicators that help explain the emergence of tipping points or other types of transformation in our case study. During the era of communism (1948-1989) there was a continual increase of the production of both brown coal and black coal in the Czech Republic (see Fig. 1). The peak of the coal production was in the middle of 1980´s. After the break of regime in 1989, a gradual decline in mining has begun, and in many regions the mines were closed for economic reasons. In 1990, the newly-established Federal Ministry of Environment of the Czechoslovak Republic prepared programs to restore the environment of the North Bohemian and Ostrava-Karviná coal basins, the most environmentally affected areas. As a result, all operational coal-fired power plants were required to be desulphurized or shut down (the desulphurization program took place in the period 1992-1998, the most extensive and most rapid one in Europe (ČEZ, 2013)) and the so-called territorial ecological limits for mining were established (Government Decrees No. 331 and 444/1991).

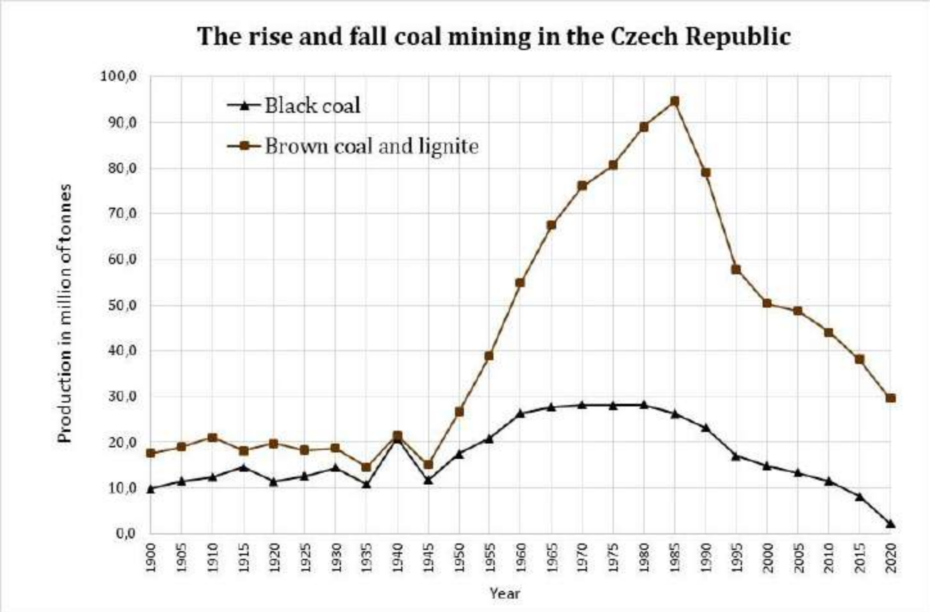


Figure 6: The rise and fall of coal mining in the Czech Republic in the 20th century. Source: Czech Statistical Office (2021), authors´ elaboration

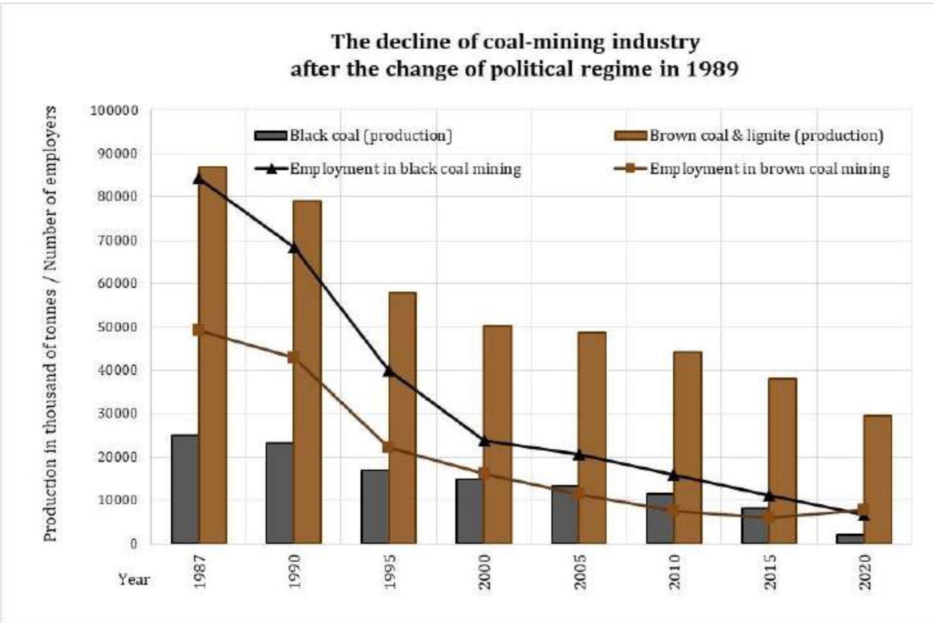


Figure 6: The rise and fall of coal mining in the Czech Republic in the 20th century. Source: Czech Statistical Office (2021), The yearbooks of miners, authors´ elaboration

The decline in coal mining industry has had both positive (environmental) and negative (socio-economic) impacts. The positive effect is documented by the continual reduction of main air pollutants (particular matter, SO2, CO, and NOx) and improving the environment (see Fig. 7). On the other hand, the coal mining regions are still characterized by highly above average unemployment rates, long-term decline of population (mostly by out-migration), and other negative impacts (see Table 3 and Fig. 8).

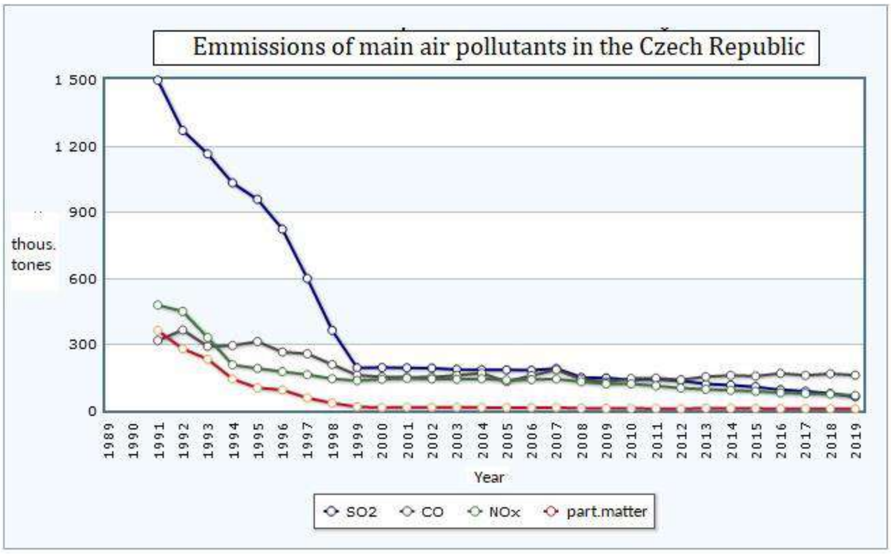


Figure 7. Emissions of main air pollutants (REZZO 1) (in tons/km2) in the Czech Republic. Source: Czech Statistical Office (2020)

Table 3: Differences in selected indicators between coal mining, post-mining and non-mining districts.

Dependent variables	**Mean values for districts**			**Statistics**	
	Non-mining	Post-mining	Active mining	F test	Eta[1]
Environment					
Concentration of PM emissions (tons/km^2) (1991)	3.5	-	35.6	24.077	0.498 ***
Concentration of CO emissions (tons/km^2) (1991)	1.2	-	58.5	6.998	0.296 *
Concentration of PM emissions (tons/km^2) (2011)	0.3	0.8	0.9	10.668	0.476 ***
Concentration of CO emissions (tons/km^2) (2011)	1.4	25.1	12.0	5.615	0.365 *

Population vital statistics and health					
Life expectancy at birth (males) (2006-2020)	75.8	75.4	73.5	14.045	0.527***
Abortions per 100 births (2018)	29.4	29.1	39.7	6.772	0.396**
Infant mortality (‰) (2018)	2.7	3.3	4.7	3.139	0.281*
Total population change between 2021 and 1990 (%)	+ 2.6	+ 4.1	- 11.1	1.007	0.165
Labour market and economy					
Share of employees in industry (%) (1991)	18.9	-	25.0	14.255	0.404***
Share of employees in industry (%) (2001)	12.6	12.6	12.6	0.001	0.006
Unemployment rate (%) (2001)	8.3	10.6	13.5	7.47	0.412**
Unemployment rate (%) (2021)	3.2	4.1	5.9	16.521	0.558***
Average monthly wage (CZK) (1991)	3,718	-	4,146	45.75	0.621***
Average monthly wage (CZK) (2001)	13,114	13,720	13,772	1.818	0.218
Average price of flats (millions CZK) (2008)	1.305	1.211	0.555	9.112	0.447***
Sociocultural capital and social cohesion					
Share of people with basic or no formal education (%)	13.9	14.4	18.6	15.655	0.548***
Share of homeless people (%) (2011)	0.09	0.16	0.12	3.225	0.285*
Crime rate (2018)	13.9	16.0	20.0	4.842	0.342*
Turnout in parliamentary elections (%) (2021)	65.7	63.9	54.4	23.658	0.627***
Support for populist parties (%) (2021)	38.4	40.0	51.3	13.399	0.518***
Wind energy production					
Average realizable potential of wind energy [MW]	33.9	18.9	49,2	1.033	0.166
Average installed capacity of wind energy [MW]	3.2	2.5	23,7	11.244	0.485**

Utilization of the realizable wind potential [%]	10 %	13 %	48 %	-	-

Note: [1] Correlations are significant at (***0.001**0.01; *0.05) Source of data: CZSO (2022), authors´ calculations

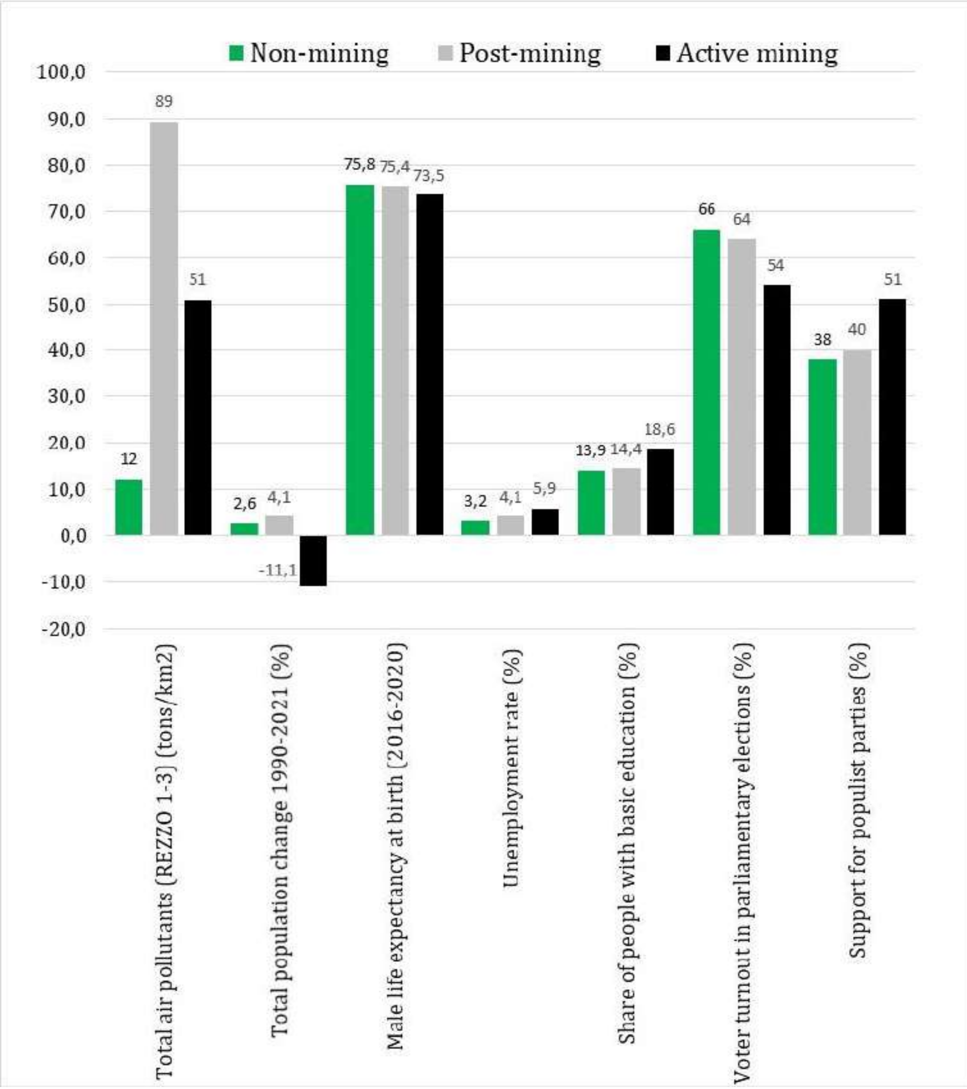


Figure 8: Differences in selected indicators between coal mining, post-mining and non-mining districts. Source of data: Czech Statistical Office (2022), authors´ calculations and elaboration

Table 3: Key indicators and trends derived from the narratives and statistical analysis

Observed in:	Trends observed in the narrative	Indicators that helps describe the trend	Indicator disciplines

Mainstream narrative	- Coal mining decline - Economic decline - Depopulation - Aging of population - Social deprivation	- production of coal - employment in coal mining - unemployment rate - share of homeless people - population change - level of wages - rate of crime	- economic geography - demography - human geography
On-stream narrative	- Re-industralization	- number of employees in industry	- economic geography
Off-stream narrative	- Environmental restoration - Renewable energy development - Energy efficiency - Population revitalization	- Emissions of air pollutants - Wind energy production - Investments into home energy renovations - Population increase - Decrease of aging index	- environm. geography - economic geography - demography

4.5 Summary of key findings

4.5.1 What are the principal differences between coal mining, post-mining and other regions, by which indicators these differences can be described and measured?

There are statistically significant differences between coal mining, post-mining and non-mining regions (respectively districts) particularly as concerns environmental quality (concentration of air pollutions), population vital and health indicators (life expectancy, infant mortality, abortions rate). Significant differences among coal mining, post-mining and non-mining regions are also related to key labour market characteristic, i.e. unemployment rate, business activity, and rate of job vacancies. The high unemployment rate and lack of job opportunities is connected with other negative social phenomena such as a higher rate of crime and out-migration. The coal-affected districts are characterized by higher proportion of people with only basic education and early school leavers. There is a significant negative association between coal mining and the average price of flats. This indicates a generally lower standard of apartments (large proportion of housing estates with prefabricated houses built during 1970s-1980s) and their worse marketability in the context of low demand for living in regions characterized by inferior quality of life - evidence of which is also a significant loss of population during the last three decades.

4.5.2 How regions differ in the sense of the adoption of renewable energy technologies?

While the districts do not significantly differ in the implementation of solar energy, we have identified statistically significant differences in the utilization of wind energy (both the average installed capacity and the relative rate o utilization of realizable of wind potential in districts). The significantly higher installed capacity of wind energy (respectively the rate of utilization can be regarded as demonstrating that local communities and decision makers living in environmentally affected areas (i.e., coal mining regions) are more likely to accept renewable energy technologies.

4.5.3 What are the main factors and barriers that have enabled or slowed down the socioeconomic transformation of coal mining regions?

The decline of population (between 1990 and 2021) and negative labour market indicators (unemployment, low business activity, lack of job opportunities) are not characteristic only for coal mining districts, respectively the variables of coal mining activity and the share of people proved not to be statistically significant in tested regression models. The factors/determinants that significantly affect the outmigration and population decline are peripherality (location of district in borderland area), large rate of urbanization, large share of people working in industrial sector (at the beginning of transformation), low potential for business activity and low wages. The factors that negatively affect the socioeconomic transformation of regions and contribute to long-term higher unemployment and lack of job opportunities proved to be a high level of urbanization, high population density, large share of people with basic or no formal education and low level of business activity.

4.5.4 What are the key factors (conditions, circumstances, actors, agencies) that are determinants and contributors to successful projects of post-mining regeneration?

Existence of ecological burden on site (i.e. the extent of soil or groundwater contamination and the state of desolation) and overall regeneration costs are the most important factors for a successful regeneration of post-mining sites. Clarified ownership relations, availability of site (land, buildings) for sale and development and the price of the property are also crucial success factors. The specific localization of sites (i.e., whether they are located within rural, urban or inner city areas) and transport links (e.g., proximity to highway, airport, or railway station) are among also among the key factors. Availability of financial incentives (EU, national or regional funds) is the key economic factor of successful regeneration. At the local level, the involvement of local communities, stakeholders and public-private collaboration are very important. The key problem concerning the sustainability of regeneration projects is that they are often not economically profitable and must be subsidized from other sources or activities.

4.6 Reflection on inter- and transdisciplinary research approach

4.6.1 What disciplines does your case study and analytical approach draw from? Is it an interdisciplinary or multidisciplinary approach?

Human geography, environmental sociology. Combining quantitative and qualitative methods (desk research, spatial statistical analysis, interviews, focus groups).

4.6.2 What aspect of the research is transdisciplinary and made in co-development with stakeholders

All aspects of our research are transdisciplinary (from framing the research problem (research questions) to analysis and interpretation. In the Czech Republic, we have engaged relevant groups of stakeholders from the beginning of the project. Initial step in getting our stakeholders involved was done even before the project started, when mutual discussions with the representatives of regional authorities, city councils, NGOs, active citizens´ groups and many others were held about our researched topic and how helpful our findings can be for their activities. We acknowledge importance of a long-term communication with our stakeholders, so that our preliminary findings about the sustainability transition of the regions of our interest can be continuously discussed and commented (particularly the alternative narratives for the future development of the transformative case study region (Moravian-Silesian Region).

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5 Case study 5: Balearic Islands, Spain

Balearic Islands, Spain

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eco-union

5.1 Introduction

5.1.1 CCIR description

The Balearic region is characterized by its insularity. It is physically, socially and politically organized in four Islands: Mallorca, Menorca, Ibiza and Formentera. Each of the islands have their own local administration (consell insular) while they are all under the same regional government (Govern Illes Balears) located in Mallorca. They all share two co-official languages, which are Spanish and Catalan. Its total territory accounts for 4.992 Km2. It has a population of 1,210,725 inhabitants, leading to a population density of 243 inhabitants per square kilometre, which is much higher than the average population density of Spain (94 inhabitants per square kilometre) (INEbase, 2022).

The dependency on tourism is also a major characteristic of the region. It is the main economic activity of the region, being the major source of income for all four islands: it accounts for more than 45% of its GDP, it creates jobs for 200.000 workers and in recent years it has generated an annual income of more than 16,000 million euros (Decreto-ley 3/2022 de Medidas urgentes para la sostenibilidad y la circularidad del turismo de las Illes Balears, 2022). According to data from the tourism agency of the Balearic Islands, the percentage of population employed in the tourism sector out of the total number of employed people in the Balearic Islands in 2019, 2018 and 2017 was 25.6%, 27.4% and 26.9% respectively (Agència d'Estrategia Turística de les Illes Balears, 2021). This level of employment contrasts with the average employment levels in other sectors. For example, in 2019, the agriculture, industry and construction sectors together accounted for around 17.59% of the employed persons in 2019, while in 2018 it was 17.50% and during 2017 was 17.13% (Observatori del Treball, 2022).

With more than 625,000 tourist places for a population of 1.2 million inhabitants, the islands support one of the highest tourist densities in the Mediterranean (Hof and Blázquez-Salom, 2015). Each year more than 16 million visitors arrive at the four islands, consuming water, generating waste, collapsing roads and filling idyllic beaches (Hermoso, 2022).

The generation of electricity in the Balearic Islands is also highly dependent on fossil fuels. According to Red Electrica Española , in 2021, only 313GWh of electricity were generated by renewable energy sources, accounting for 3% of the total electricity generated in the region. In other words, 97% of the total MWh generated comes from non-renewable sources. This places the Balearic Islands as the autonomous community with the highest percentage of electricity generated from non-renewable energy sources in Spain (above only the autonomous city of Melilla, with 3%) (Red Eléctrica Española, 2022b). Despite this, the Balearic Islands experienced the largest increase in installed renewable capacity in 2021. At the end of 2021, the region reported a growth of 31.1 % due to a 44.2 % increase in installed solar photovoltaic capacity compared to the previous year (Red Eléctrica Española, 2022b). According to the Balearic government, in July 2022, the absolute record for photovoltaic renewable energy generation was achieved with 48.6 GWh (Govern de les Illes Balears, 2022).

During summer, the population of the Balearic Islands doubles: from the 1,171,543 inhabitants registered in the archipelago to the 2,039,687 people who are part of the floating population in high season (this figure represents the peak of the floating population in the summer of 2019, prior to the pandemic) (Ibestat, 2020). In fact, according to data collected by the Balearic Institute of Statistics (Ibestat, 2022), the demand for energy presents the annual peak in the central months of the year, in summer, coinciding with the period of greatest influx of floating population. According to these data, the average monthly demand of the Balearic Islands during the period 2015-2021 is 479,942 MWh. On the other hand, the average monthly demand for the months of June, July and August of the 2015-2021 period is 604,837 MWh. This implies that during the central months of the year in the Balearic Islands there is a demand, on average, of 26% more energy than the monthly average for the whole year, a fact that indicates a clear correlation between tourism and the floating population and the increase in energy consumption and, consequently, in greenhouse gas emissions (Decreto ley 3/2022 de medidas urgentes para la sostenibilidad y la circularidad del turismo de las Illes Balears, 2022).

Historically, the electricity produced within the region came from 4 thermal power stations but their relevance has been reduced significantly with the installation of an electrical cable connecting the region with the mainland (2011). According to Red Eléctrica Española, a significant portion of the electricity consumed in the archipelago of the Balearic Islands is produced outside the islands. In 2019, 27.99% of the total demanded electricity in the Balearic Islands was produced outside the islands. In 2020, this percentage increased to 28.94% and in 2021, decreased to 21.98%. To date, in 2022, 7.70% of the electricity demand in the Balearic Islands has been supplied by electricity from outside the islands (Red Eléctrica Española, 2022a). The rest of the energy is supplied to the Island through the cable connecting the archipielago with the rest of Spain. Submarine connections between all the islands have also been installed recently enabling the development of an integrated Balearic Islands' electricity system. Nowadays, around 40% of carbon emission comes from electricity generation (natural gas, diesel and coal power plants) and 35% from road traffic, without taking into account (national and international) airlines and shipping emissions (Ley 10/2019 de cambio climático y transición energética, 2019) .

The Balearic cultural identity is sub-divided along the 4 islands (Casanovas Camps, 2008). This is the result of the physical boundaries of the islands but also because of the differentiated historical developments that occurred in each of them. Thus, it is difficult to identify a Balearic community as a whole as each of the inhabitants are emotionally attached to their specific island being the shared Mediterranean Sea the most relevant common concern. The distinction between "us" and "them" is therefore not only reflected on "us" the balearic, "them" the ones from the mainland, but it is also distinguished among the islanders: us the menorquins (Menorca island), them the mallorquins (Mallorca island). Besides, another very important distinction is between "us", the locals and "them", the tourists. In this case "local" will include everyone that is not a tourist, meaning that somebody from Mallorca or Andalucia living and working in Menorca for the summer season becomes one of "us". Insularism will take on a leading role in the development of the political and social life of the Balearic Islands, together with the non-existence of a Balearic identity, since both autonomy and balearic institutions are relatively young to set the basis for a new identity (Carranza, 2021). As has been reflected during the workshop and interviews in June 2022 with actors in the political, energy and ecological transition arena in the Balearic Islands, the different island councils have very different positions on how to carry out the transition and the implementation of the Balearic Islands' climate change law. By way of example, several participants in these workshops and interviews commented that there is a clear lack of political will in Ibiza and Formentera to move forward in the transition.

From this perspective, it is a combination of the formal, perceptual and functional aspects of the Balearic region that allows us to narrate its transition from the approval of the Balearic Climate Change and Energy Transition act in 2019 together with the partial closure of the Es Murterar thermal plan (negotiations of both the closure of the plant and the approval of the law were held simultaneously). Both elements are crucial to understand the beginning of the energy transition in the Balearic Island from coal dependency to renewables. The law applies at a formal level at all the Balearic Islands but its development can only be understood if focusing on the functional aspects.

5.1.2 Societal problem description

Tourist activities generate emissions mainly on two sectors: energy production and transport, therefore, decarbonising these two sectors will translate into a huge reduction of GHGs emissions, which represented 42% and 37% respectively of the CO_2 emissions in the Balearic Islands in 2016, versus only 4,7% for industrial processes, 3,8% for waste management and 2,3 % for agriculture (Decreto-ley 3/2022 de "Medidas urgentes para la sostenibilidad y la circularidad del turismo de las Illes Balears, 2022). Besides CO_2 emissions, other negative consequences of tourism have clearly emerged in recent decades in the Balearic islands which have generated a debate about the need to apply tourism degrowth strategies. For instance, recently, Miquel Mir, Ministry for the Environment and Territory in the Balears Government, mentioned in an interview that there is a need for contention or even degrowth in the islands with regard to tourism activity (Lamata, 2022). Impacts such as the destruction of posidonia due to nautical tourism; water scarcity in a context in which tourism consumes 1 of each 4 liters of water in the island; the massification and degradation of natural resources; the collapse of some key infraestructures such as water treatment plants during peak seasons give arguments to those that want to limit touristic activities (Lamata, 2022); or the excessive number of vehicles in the Balearics, which was according to Balearics Statistics Institute for 2018, 1,030,478 - almost one vehicle for every person living on the islands, occupying the first position in Spain among all the autonomous communities (Sepúlveda, 2019). In fact, also economic and social indicators do not show positive results for tourism. Until the year 2000, the Balearic Islands were the first autonomous community in income per capita in Spain. But in 2019 it was the sixth, even though the number of tourists that visited the region had increased from 11 to 16.5 millions. Other indicators from 2019 also seem to show that the increase of tourism activity has not contributed to more wellbeing in the islands. For instance, access to housing: in the Balearic Islands 16.5 years of full salary were needed to get a house (in Spain, 7.5). School dropout: it was 24% (while in Spain it was 17%). Risk of child poverty: 34% in the Balearic Islands (vs. 27% in Spain, and 18% in the EU). Average salary in the Balearic Islands in 2019: 1,940 euros. In Spain: 1,982 euros (Huguet, 2021).

In this context, the Committee of Experts for energy transition and climate change warns in its report for the year 2021-2022 that the climate emergency has worsened three years after the approval of the Climate Change Act and they urge to take urgent to combat this phenomenon, such as the need to reduce the flow of visitors, who generate a large volume of emissions during their stay in internal displacements, consumption of resources, which must also be imported, and energy consumption (Domblás, 2022). They propose a deep cultural change and a new productive and consumption model which requires the development of other sectors not linked to tourist activity, such as agriculture, food production from an ecological and regenerative perspective, sustainable management of natural resources, manufacturing linked to the recovery of materials, third sector, social care, research and innovation (Domblás, 2022).

The report also shows concern about the fact that the large energy consumers of the Islands, ports and airports, do not fall under the scope of the Climate Change Act since the Balearic government does not hold powers to regulate them. They point out that the great efforts that companies and citizens are making to advance in the energy transition can be severely diminished or even nullified by emissions from ports and airports "if we do not begin to reduce their emissions substantially." (Domblás, 2022)

Currently, left wing parties in the government are starting to apply policies to reduce the level of dependency to tourism, but facing a strong contestation by tourist operators and opposition from right wing political parties. In Formentera, this will be the fourth summer that there is a daily quota of entry vehicles. Only 10,956 vehicles (cars and motorcycles) are allowed access as a result of the serious problems caused by the overcrowding of road traffic on an island of just 12,000 registered inhabitants. The first limiting measure that has been taken in Palma (capital of the Balearic Islands) is the regulation of cruise ships. It is the first city in Spain to do so and the second in Europe, after Dubrovnik (Hermoso, 2022). A maximum of three cruises will be allowed per day and only one will exceed 5,000 passengers. Finally, the Balearic Parliament has just approved in 2022 a pioneering law that establishes mechanisms to gradually eliminate part of the existing 625,000 tourist accommodation beds, primarily those in obsolete one- and two-star hotels. In the long term, about 40,000 accommodation beds will be eliminated (Hermoso, 2022). The objective is to lower the numerical density of visitors without there being an economic decrease. However, the opposition parties, Partido Popular, Ciudadanos and Vox, do not agree with the decrease in touristic places and warn that it will impact negatively on the competitiveness of the island, even part of the hotel sector supports the measures. Managers of the large hotel chains, like Melià or Riu, also defend that some kind of limitation should be promoted (Hermoso, 2022).

5.1.3 Research problem

The successful transition of insular contexts like the Balearic Islands relies on an administrative capacity to engage citizens and enact efficient polycentric decision structures that take into account the cultural, geographic and economic differences of each island. Also, the Climate Change and Energy Transition Act (Ley 10/2019, de cambio climático y transición energética, 2019) poses decentralisation of energy production in the center of the energy transition, requiring high levels of cooperation and coordination among governmental levels, but also energy communities, neighbour associations, companies, etc. This research focuses in particular on the development, approval and implementation of the Climate Change and Energy Transition act (in 2019) as a tipping intervention towards a decarbonised economy. This potential tipping intervention is analysed from a political perspective but also through the level of stakeholder integration in the law's inception and the (political and social) consensus around the adoption of this new law. The high level of ambition of the law, the level of consensus achieved among the political parties and its pioneer and holistic character, addressing the main challenges related to electricity production and mobility, constitute elements of hope to shape the future of the islands towards decarbonisation. However, the research will focus as well on the drawbacks that may hinder or delay the implementation of the law, particularly the ones that pose obstacles to the enhancement of coordination capacities in the regions, such as the existence of very strong and different insular identities and the high reliance on tourism

5.1.4 Research questions

The research questions for this project are:

To what extent the approval of the law on Climate Change and Energy Transition Act may act as a catalyst or tipping intervention in the Balearic Islands in terms of energy transition?

How identity issues may pose a challenge to the full deployment and implementation of the law?

5.2 Research approach

It is commonly accepted that an energy transition to a low-carbon system can only be achieved through efforts at different levels and scales, i.e., policy instruments from public authorities, initiatives from business actors and civic initiatives at local, regional, national and international levels (e.g., Gupta, 2007) . Based on this, the successful implementation of the Climate Change and Energy Act will depend on the administrative capacities of different governmental levels and actors to set coordinated actions between multiple levels of government and move towards a common vision defined, in this case, in the objectives formulated in the law. It will thus depend as well on the capacity of key governmental and non governmental actors to engage citizens and enact efficient polycentric decision structures that take into account the cultural, geographic and economic differences of each island – international, national, regional and local.

The governance picture of the European Union has been shaped in recent years according to the concept of multilevel governance, which can be understood as a "…decision-making processes that engage various independent but interdependent stakeholders" (European Comission, 2015). This is a two-sided process in which authority has shifted both to regional and to international institutions, reducing the level of power held in national governments (Hooghe et al, 2016). In this context, the success of energy transition to low carbon depends on multiple technological and economic factors, but despite the identified feasible technical solutions, their implementation can only be realised through an effective governance mechanism (Dobravek et al, 2021). The multilevel governance theory within the EU is manifested throughout communication and coordination actions of EU policies between different governmental levels: the European, national, regional and local ones; both in a vertical and an horizontal dimension, making the former reference to the interactions among governmental levels and the later reference to interactions among other relevant actors within the same level.

However, the logics of multilevel governance can be understood in a twofold manner. On one hand, there is a functionalist logic that "conceives governance as an instrument for the efficient delivery of goods that individuals cannot provide for themselves. The other, no less powerful, logic is the demand for self-rule by those living in distinctive communities" (Hooghe et al, 2021). With this regard, some authors analyse the effects of territorial identity and the demand for self-rule as determinants for the structure of government (Banting and Kymlicka 2017; Hooghe and Marks 2016). From an identity perspective, the structure of governance should follow the boundaries of communities and not a functional logic determined by the best possible allocation of public goods. The discussion about how identity affects multilevel governance amplifies the analysis from the efficient allocation of public goods, the optimal task allocation or economic self-interest of the actors involved to include conceptions of territorial identity (Rokkan, 1983). In these cases where identity shapes the distribution of powers and tasks among different actors, the question of "Who" may be more influential than the question of "Who gets what", particularly in geographical areas characterised by geographical isolation, such as islands, linguistic distinctiveness, or other distinctiveness parameters that project outside dividing the world into 'them' and 'us', (Hooghe et al, 2021).

In this case study we argue that resistances to the energy transition process can be partly explained by the conceptual category of identity. Identities imply a process of constructing meaning by which stakeholders give priority to a set of cultural attributes over other sources of meaning (Castells, 2000: 29). However, identity is neither one-dimensional nor static, and several of them could be juxtaposed. Concerning social change, Castells differentiates between three types of identity:

Legitimising identity: A set of logic and meaning introduced and propagated by the ruling powers, in order to rationalise, reproduce, and expand existing rule.

Resistance identity: Constructed in response to devaluation and stigmatisation; where social actors build "trenches of resistance" in opposition to the ruling norm. This formation leads to communes or communities of resistance.

Project identity: the construction of a "new identity that redefines their position in society and, by doing so, seeks the transformation of overall social structure"

As a first relevant factor, the identity issue in the Balearic Islands presents particularities with respect to the rest of Autonomous Communities in Spain, due to a very peculiar characteristic, insularity, which is recognised as well in the Statute of Autonomy of the Balearic Islands. It is, therefore, a differential fact which in turn is reflected in certain social behaviours characteristics of the islander, which at the same time translate into singular types of political culture that are configured from the differential anthropological levels in each of the islands, thus generating different and unique identities (Carranza, 2021).

As a second relevant factor with regards to identity, there is the dependence of Balearic inhabitants on tourism as a way of survival for many decades, which has produced a variety of symbolic meanings and cultural attributes that have shaped their identities, becoming legitimising identities (Carranza, 2021). Dependence on tourism has impacted the way of lifes (economically, politically and culturally) and affected social relations, due to its systemic and fundamental character (Bridge et al., 2018). In this context, resistance identities may emerge as an outstanding opposition to the new decarbonisation paradigm which demands posing limits on the impact of tourism activities. In the long term, this may evolve to a process of accommodation or even acceptance towards the creation of new identities related to sustainability transitions and decarbonisation (project identities) as different potential social responses, including economic diversification from tourism. However, up to date, several resistances to energy transition can be identified coming from different societal groups, including CSOs, business associations and political parties. These resistances have been identified in the alternative off-stream narrative.

At this point, we want to analyse how the logic of identity, both in terms of insularity and dependence on tourism, is shaping and affecting the multilevel governance approach to implement the Law on CC and ET.

The following methods have been used to obtain the data needed for this case study:

1. Policy documents, approved laws, planning instruments and statistical sources were analyzed for structuring initial concepts and getting a preliminary understanding of (tipping) events and interventions. In particular, data related to the impact of tourism in the islands, number of workers, number of tourist places, percentage of emissions per sector, percentage of renewables, percentage of imported energy, goals of the Climate Change and Energy Transition Act and planning instruments, governance structure in the Balearic islands, etc. has been gathered from policy documents, statistical sources and approved laws. Those sources were also key to interpret local, regional and national energy regulation framework to better understand the context in which the case study develops.

2. Analysis of local newspapers has been used to detect and contrast discursive dynamics and perceptions of different stakeholders in the process both of approval and implementation of the Climate Change and Energy Transition Act: actors that supported it, actors against it and their arguments, obstacles that emerged in the implementation phase, etc. The focus of the analysis was on the perceptions of stakeholders manifested in the media with regards the implementation of the Climate Change and Energy Transition Act from its approval in February 2019 to this day.

3. Interviews with heterogeneous stakeholders were used to explore opinions about the implementation of the Climate Change and Energy Transition Act, contrasting them with opinions manifested in local newspapers. The interview protocol was developed to elicit participants in discussing their opinions about which were the main obstacles and challenges in the implementation of the law, their political positions, tourism and potential alternative economic pathways, the role of insular identity and dependence on tourism, and how these aspects could affect coordination among regional and local entities in the implementation of the law. Between May and June 2021, a first set of 9 semi-structured interviews were carried out with different actors involved in the energy transition process in the Balearic Island Andorra with the purpose to identify the main issues at stake regarding the approval and implementation phase of the Act. The interviewees were a manager of a national electricity company, a political representative of the Balearic Government, two representatives of environmental NGOs, 3 representatives from insular councils, a manager of a local transport company and a researcher expert in climate policy In May-June 2022, a year later, 6 semi-structured interviews were conducted with a manager of national electricity company, political representative of the Balearic Government, 2 researchers experts in climate policy and economics, a local transport company and an environmental NGO. The one year time span between the first and the second set of interviews allowed us to detect and contrast how the opinions about the implementation phase had evolved and focus more on issues of governance and identity, the impacts of tourism, alternative economic pathways and existing resistances to move on from tourism dependency. All interviews were recorded and transcribed.

4. Two virtual workshops were held, in June 2021 and in June 2022. The first workshop had a scoping purpose, to better identify the main problems in the area, general perceptions from stakeholders and issues at stake. Representatives from a national electricity company, the balearic government, an insular council, an environmental NGO, a local transport company and a federation of business associations participated in this workshop. In the second workshop participants came representing a national electricity company, the balearic government, an insular council, an environmental NGO, a local transport company, 2 researchers experts in climate policy and economics and a representative from a federation of business associations. The second workshop allowed us to go deeper on discourses on governance and identity issues, obstacles to the implementation of the Climate Change and Energy Transition act, the impacts of tourism, alternative economic pathways and existing resistances to move on from tourism dependency. This approach also helped us to detect the evolution in the perceptions and discourses from the first workshop . The content of both workshops was recorded, transcribed and shared among the participating stakeholders for corrections and feedback.

5.3 Narratives

5.3.1 Mainstream narrative: technology and policies

As mentioned, the Balearic region, characterised by its insularity, is a major international tourist destination fully reliant on fossil fuels and on foreign energy sources. The most relevant carbon-intensive sectors in the region are transport, accounting for internal mobility (cars, boats), external transport (aviation, ferries,..) as well as electricity generation, heating and cooling (households, hotels, etc).

Historically, the electricity produced within the region came from 4 thermal power stations - owned and operated by ENDESA, a former national electricity company now part of ENEL italian group - which used a combination of different fossil fuels for its functioning. The primary energy used in the different power plants changed in 2009 when the gas pipeline connecting the region with the mainland was installed. Some power stations started to use natural gas instead of diesel for electricity production.

With the aim of reducing the vulnerabilities of an isolated electrical system as well as reducing the costs of electricity, one of the highest in Spain, due to the low efficiency of national coal, an electrical cable was installed in 2012 connecting the region with the mainland. Since then, the electricity provided by the cable power has tripled, compensating the reduction of electricity production from thermal power plants. However, by reducing the local production, the energy dependence of the islands has increased. Besides, the entry of the cable partly prevented the development of renewables, whose share of the mix has been stagnant for the last 20 years until just recently.

5.3.2 Mainstream narrative: stakeholders and institutions

The main stakeholders involved in the mainstream narrative were the energy company, ENDESA/ENEL, which has been managing the thermal power plants of each island; the regional government and the central government, who moved forward the installation of the gas pipeline and the electric cable to improve the energy security of the islands; and finally, the tourism and travel lobby, who had a role to play pushing for the installation of the cable and thus increasing the connectivity with the mainland in order to reduce the prices of the energy bills without compromising the energy security of the island.

Furthermore, the question on energy is of main interest for all institution levels, from local, regional to national, even though it has been historically driven by a top down approach taking into account its importance in national strategic terms and the fact that it is a very regulated sector. At this point, the installation of the pipeline and the electric cable were seen as necessary improvements to ensure that the islands were receiving enough and affordable energy, and it could be understood as a strategic decision based on a top down approach adopted by the national and regional governments due to the pressure of the tourism lobby, but without a widespread involvement and participation of the local population.

5.3.3 Mainstream narrative: identity aspects

Insularity is configured as a sociological phenomenon since this particular geographical characteristic is usually used by the islanders to defend a differentiated identity and to justify their demands in favor of their economic, social, cultural and political aspirations. At the anthropological level, there is as well a stereotype of the island character, characterised by individualism and the scant tendency to collective expressions, including social participation of any kind (Adán and Payeras, 2016). Insularity also leads to a distinctive, unique psychology, in each of the islands, which hinder the development of the Balearic identity (Carranza, 2021).

In this narrative, the dependence in energy terms of 4 thermal plants, one per island, can be explained due to this strong insular identity. On the other hand, the evolution of this narrative towards the construction of the electrical cable connecting with the mainland could be understood as the connection with the Spanish (national) identity, bypassing the Balearic identity, which is non-existent according to academic research (Carranza, 2021). So, the evolution of this narrative seems to confirm a relationship between the configuration of the different identities in the Balearic islands and the strategic decisions taken with regard to electricity supply. This phenomenon can be perceived as well with regard to other transport infrastructures. In his dissertation, Carranza establishes a connection between how the development of transport infrastructure influences national construction citing Bel (2010, 2011, 2012), among many other factors (Carranza, 2021). From this perspective, infrastructure policy can be considered an instrument related to the promotion of a certain identity policy. He thus sets a parallelism between the existence of more transport connections between Balearic islands and mainland in comparison with the Canarian islands, a region that has a stronger regional identity.

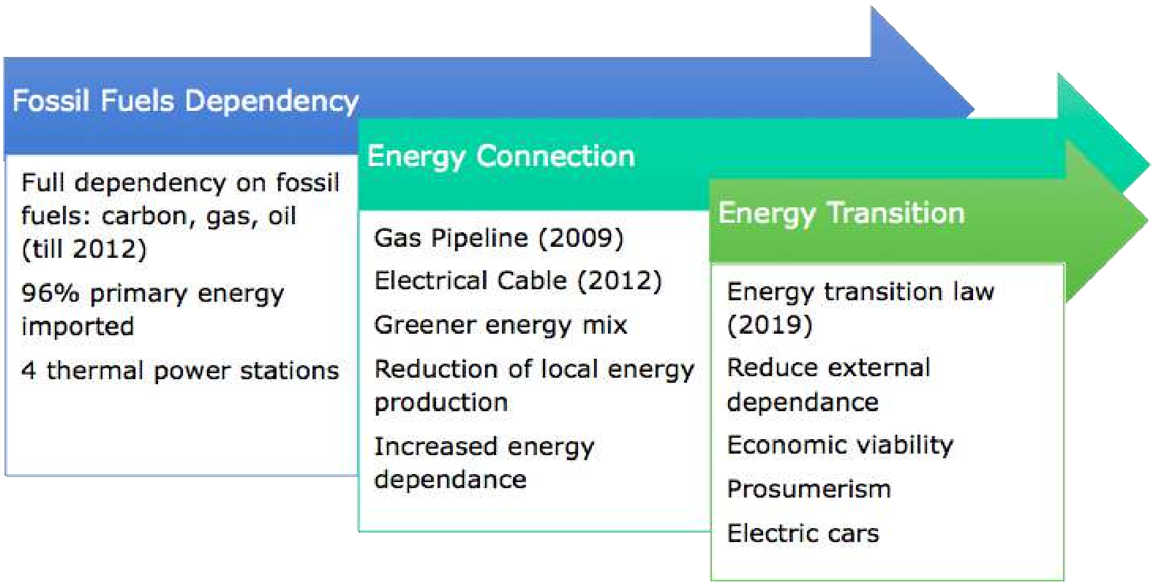
At the same time, all the 4 insular identities have been strongly shaped by the influence of tourism as the main economic activity in the region, which has generated the growth of the construction, hotel and services industries, increasing the migratory flow from the countryside to the cities and attracting workers from the peninsula (Carranza, 2021). According to the surveys, the average rate of births in the Balearic Islands barely reaches 3 out of 4 respondents (Carranza, 2017). In this sense, the importance of tourism operators in this narrative is key since they pushed for the installation of the electric cable and are still pressurizing to increase the electrical connection with the mainland in order to reduce the vulnerabilities of the islands in energy terms and make electricity more affordable .

Local population also has a strong sense of identification towards the tourism sector since it has provided many socioeconomic benefits in the last decades, and they view tourism as an integral part of their identity and a key element for their survival. So it is hard for everyone to move forward to another economic sector.

5.3.4 Alternative on-stream narrative: policies and technology

The Paris Agreement as well as the growing concern about the risks of climate change for islands, allowed for the development and approval of the highly ambitious Climate Change and Energy Transition Act in 2019. This act contains concrete actions for the decarbonisation of the islands, which are mainly dependent on fossil fuels for energy production and transportation.

The main characteristics of the evolution from the mainstream to the the alternative on-stream narrative can be observed in the following graph:



The aim of the Climate Change and Energy Transition Act is to develop a new, more efficient and secure energy model with renewables and without fossil fuels. The main goals are described in the following table:

Table. Objectives of the Climate Change and Energy Transition Act

Goals	Phase 1 – 2030	Phase 2 – 2050
Energy production comes from renewable sources	35%	100% (70% of energy from renewables is locally produced)
GHG reduction	40%	90%

Decrease in energy consumption (energy savings)	23%	40%
Terrestrial mobility	2025: diesels are forbidden to circulate	2035: all new cars are zero-emission (electric)

Compilation based on information from the Act

On energy, the act aims to reach 35% of energy production from renewable sources by 2030 (they represented 7.2% in 2020) (Red Eléctrica de España, 2021). Besides, by 2050 the aim is to be 100% renewable with 70% of energy from renewables being locally produced and the rest imported from the mainland. The energy transition advocates for a decentralisation of the current energy system while decreasing the energy dependence the islands suffer. In terms of the energy model that will be designed, the law has the democratisation of energy as a fundamental pillar for the energy transition, promoting self consumption and the deployment of the grid. On transport, the law focuses mainly on road transportation. The objectives are to forbid diesel cars' circulation by 2025 and by 2035 all new cars will have to generate zero-emissions. Still, the islands will remain very dependent on air travel and ferries that are carbon intensive activities. It remains to be seen how the travel and tourism sector can decrease its C02 emissions to match the climate neutrality goal of the islands.

The law also foresees the gradual but complete closure of the thermal power plants. In fact, the most polluting turbines of the "Es Murterar'' plant closed in 2019 and there have been several restrictions on the amount of hours that the thermal plants can run. They are seen as a backup technology right now, which will run in the months of higher energy consumption (summer) in Mallorca and Menorca (Mir, 2021). The technological shift has already had its impact on the 2020 energy mix in which coal decreased its production by 90%, generating only 6.3% of the energy in 2020 while in 2019 it represented a 45.2% (Red Eléctrica de España, 2021).

Beyond the implementation of the law, it should be highlighted as well that the Balearic Islands have become the first territory in the State to produce green hydrogen. The first molecules were produced last December and the electrolyser that produces hydrogen is already working in tests until it can produce about 300 tons of this material when it is at full capacity from photovoltaic panels, which will mean a reduction in emissions of about 21,000 tons of CO_2 per year.

The hydrogen produced at the Lloseta plant in Mallorca will serve as fuel for the buses of the Palma Municipal Transport Company. It will also be a source of energy for public buildings in the Balearic Islands and for the port of Palma and will be injected into the Redexis gas network once the construction of the first hydroduct in Spain is completed (El País, 2022).

Finally, the Balearic Government has recently released in March 2022 a first draft of the The Energy

Transition and Climate Change Plan which foresees the necessary measures to advance towards greater energy self-sufficiency, so that in 2050 there is the capacity to generate in the territory of the Balearic Islands, through renewable energies, at least 70% of the final energy consumed in this territory.

The Plan provides five-year quotas for the penetration of renewable energies, by technology, for energy savings and efficiency and for reduction of greenhouse emissions, in order to progressively achieve the objectives established in the law.

5.3.5 Alternative on-stream narrative: stakeholders and institutions

This narrative is being designed by the same stakeholders of the mainstream narrative but it represents a complete shift of mentality regarding energy production and consumption because it bets on a full energy transition towards renewable energy sources and a shift towards electric mobility. The combination of three factors lead to an alignment of the majority of the stakeholders to boost an ambitious policy change passing the Climate Change and Energy Transition Act (2019). These were: first, the willingness to reduce external energy dependence; second, the growing concern for protecting the environment from the effects of climate change; and third, the economic viability of developing renewables in the region given the high cost of importing energy.

This narrative is being supported by the major stakeholders such as the national government, the regional government, most of the parties in the Balearic Parliament (the legal text had the favourable vote of the leftist parties, while PP, Cs and PI only voted against some articles), Endesa (electricity utility) and main tourist operators, but also important secondary actors such as NGOs, local councils and other civil society actors (Galvín, 2019). There is opposition to the narrative from some sectors of the tourism industry and NGOs when considering particular RE installations that could compromise the landscape (windfarm) and its economic interests (tour operators, car renting, etc), but even if there are some friction points, they are supporters of the need to work towards the energy transition. This is mainly driven by the particular vulnerability of islands towards sea level raise, other climate change effects and the price of electricity.

However, the regional government has been the main instigator of the Climate Change and Energy Transition Act approved in 2019. The law has created the framework of a governance structure based on the Committee of Experts for the Energy Transition, the Balearic Council for the Climate and the Balearic Institute of Energy. The first 2 bodies have an advisory role and are formed by all relevant stakeholders (public administrations, tourism operators, electricity utilities, Environmental NGOs, trade unions, etc.). In terms of implementation, the Balear Institute of Energy has taken a very active role recognized by the consulted stakeholders promoting a decentralised model based on self consumption and energy communities in the islands, which has exceeded all expectations in the last years. With regards to self consumption, the total evolution of installed power in the Balearic Islands (in kW) has increased by 17.2% compared to 2021, going from 46,067 kW in 2021 to the current 53,968 in the first quarter of 2022 (Europa Press, 2022).

However, the regional government needs to account on insular councils to implement the law, since they hold very relevant powers with regards to territorial planning. In fact, the law establishes the obligation of the insular councils to approve territorial plans 2 years after the approval of the law in order to decide, among others, in which spaces renewables can be located. With this regard, the Menorca Insular Council has led a very aligned position with the regional government and has taken the energy transition and climate change quite seriously. According to the governmental and CSOs consulted stakeholders, Menorca has a very strong notion of self-government which has led to create the Socio-Environmental Observatory of Menorca (OBSAM), with the aim of being an instrument of collection and analysis of local information establishing indicators to monitor the environmental, economic and social impacts in the island. Besides, according to these sources, both politicians and technicians at high levels of the Menorca Insular Council are very committed to move forward an ambitious energy transition based on data analysed by the OSAM. With this regard, they point out that Menorca has a strong tradition of dialogue and communication with the regional government and other actors (institutions, civil society, private entities) which is allowing for a smooth energy transition in the region in comparison with the other islands.

Besides the need of the regional government to coordinate with insular councils, the new decentralisation approach of the law demands regional authorities to coordinate their actions and measures with other governmental levels such as local councils (who hold for instance powers on local regulations on solar photovoltaics) and other stakeholders such as energy communities, energy suppliers and utilities, neighbour associations, etc. This new decentralised approach represents a shift from the top down approach described in the traditional mainstream narrative to a more bottom up approach. It requires the empowerment of citizens, local institutions and entities and a capillarity focus on capacity building that necessarily relies on coordination capacities by all the relevant stakeholders.

5.3.6 Alternative on-stream narrative: identity aspects

The leadership of the regional government with regard the approval and implementation of the law suggests a shift with the mainstream narrative, where insularic identity first (1 thermal plant per island) and the Spanish national identity secondly (connection of the electric cable to the mainland) together with the strong dependence on tourism played major roles. In this narrative, the non-existence of a Balearic regional identity seems to constitute an obstacle since, as we will see below, some insular councils do not fully recognize regional authority and play an opposition role in terms of implementation of the law.

5.3.7 Alternative off-stream narrative: policies and technology

As mentioned above, the on-stream alternative narrative is supported by a wide range of stakeholders, reflected in the approval of the law by a vast majority of the Balearic Parliament. However, there is still opposition to the implementation of some parts of the law by some segments of the society. Such opposition does not account for an alternative narrative, but by scattered positions which are not aligned with the on-stream narrative and pose drawbacks and/or obstacles to the full implementation of the law.

For instance, some automobile companies denounced the law to the European Commision and the SpanishEconomic Ministry because according to them infringes articles related to the common market and believe that the measures proposed are "arbitrary, inappropriate and disproportionate", that they lack "technical or scientific support", and that they generate a negative impact on the sector (Galvín, 2019). According to the law, which does not apply to citizens who reside in the Balearic Islands and who can use their car until the end of its useful life, as of 2025, those who go with a car or a diesel motorcycle by maritime transport will not be able to circulate with their vehicle on the islands. The same fate will have gasoline cars, motorcycles and vans from 2035. On the other hand, rental companies will have to make a significant effort to renew their fleet, which will have to be 100% electric by 2035 (Galvín, 2019).

As another example of opposition to the alternative mainstream narrative, Balearic environmental groups such as the Spanish Society of Ecological Agriculture, Amics de la Terra, Terraferida, the GOB and Apaema called for a moratorium on photovoltaic parks on rural land in 2021. They propose that before new parks are installed a series of measures have to be implemented to guarantee a democratic and fair energy transition that is not based on energy speculation on rural land. The entities point out that these installations suppose, in addition to a significant occupation of rural land, the installation of kilometers of new electrical lines or the installation of energy transformer substations (Europa Press, 2021).

5.3.8 Alternative off-stream narrative: Institutions and stakeholders

Besides these opposing narratives, one of the key obstacles according to the consulted stakeholders regarding the implementation of the law are the different positions and perceptions by the insular councils. As explained, each island has its own government, identity and its own cultural factors which have led to the design of a different approach towards the energy transition.

The Council of Menorca has showed its alignment with the law as explained above, but the other insular councils have followed different approaches to the energy transition:

Mallorca: It is the most degraded island due to the implementation of an aggressive touristic model that has built huge infrastructure without proper environmental impact assessment. In this context, there is a large part of the civil society opposed to the energy transition if it is not based on a decentralised and democratic model. In this sense, there is a strong concern regarding the growing amount of large solar farms. Consulted stakeholders mention that the Council of Mallorca is delayed with regards to the approval of land planification instruments required by the law on CC and ET.

Eivissa: The Council of Eivissa is governed by the right wing party PP. They have not prioritised the energy transition and usually claim that they do not hold powers related to energy transition to avoid taking action. They have not even started to adopt any planification instrument regarding the energy transition.

Formentera: Formentera is 80% a protected territory. The preservation of the landscape is of high priority for this island and the insular council has adopted planning instruments but they are very restrictive with regards to the installation of solar panels.

5.3.9 Alternative off-stream narrative: Identity aspects

In general, the perception is that in Eivissa and Formentera insular councils and tourism operators based on these islands do not want to assume the costs of the energy transition installing renewables since this may affect tourism development and have negative economic consequences. When asked, some of them suggest increasing the electricity connection with other islands and the mainland so that other territories take over the costs of the energy transition. In the course of the second workshop, the business association was clearly opposed to developing wind projects in the island, since it affects the landscape and consequently tourism activities. Additionally, the high level of tourism dependency in the area presents a challenge to the implementation of the law, since, as stated above, the inhabitants see tourism as their way of survival, and they are reluctant to modify some inherited habits. All these constitute resistance identities to oppose the new framework—the global decarbonisation process.

5.4 Trends and indicators for sustainable transformations

Firstly, the international context at the time (2015-2019) of the development of policies aimed at mitigating climate change was highly favourable with the recent adoption of the Paris Agreement. In addition, the engagement of all political forces at the time is also considered a key factor, with full consensus in government and a high level of support at parliamentary level. Finally, the climate of responsibility that is established at both the social and political level in relation to the need to act against climate change is relevant. This has its origin partly in the international context mentioned above and partly in response to the special situation of vulnerability of the islands to climate change.

Overall, the region seems to have a good capacity to undertake the energy transition due to its advanced economic position. Additionally, the closure of the polluting power plants do not mean a direct setback for the economy as most of the energy is imported. Nevertheless, a large investment is required to generate local RE which source needs to be defined.

The stakeholders are in general aligned towards the energy transition, however the investment needed to develop RE in the islands is considerable as RE installations are almost non-existent at the moment and a lot of uncertainties remain on how to finance, build and operate them.

The approval of the Climate Change and Energy transition Act may be understood as a tipping intervention in the energy transition process. The high level of ambition of the law, the level of consensus achieved among the political parties and its pioneer and holistic character, addressing the main challenges related to electricity production and mobility, constitute elements of hope to shape the future of the islands towards decarbonisation. According to the stakeholders consulted from the Balearic government and CSOs, the law has created the adequate framework with the right incentives to boost renewable energies in the islands and has generated the needed momentum for a shift in stakeholders' mentality towards the need to adopt decarbonisation policies. Proof of that is the 31,1% growth in the deployment of renewable energies due to a 44.2 % increase in installed solar photovoltaic capacity compared to the previous year (Red Eléctrica Española, 2022b)

However, as explained, the approval of the act represents a shift in terms of the traditional mainstream narrative regarding both the actors and/or identities leading the process, the need to reduce or limit dependence on tourism and the governance approach for energy transition, which in the new narrative is more focused on a bottom up approach. All these factors emerge as new challenges in the governance approach for the energy transition. In this context, the issue of insular identity in the Balearic Islands has become one of the main drawbacks to accelerate the energy transition process, since it poses obstacles to the needed vertical coordination among different governmental levels, particularly when the authority of the Balearic regional government is not fully recognised due to lack of a Balearic identity and due to strong insular identities. Some stakeholders from the regional government and the academia point out that the highly different levels of prioritisation towards energy transition by the insular councils is one if not the biggest obstacles for the energy transition in Balears. According to them, the main institutions and stakeholders from Eivissa and Formentera perceive the regional law as imposed by an external actor, as if they would not be part of it.

Also, the dependence on international and national tourism could create a major drawback to finance and support the energy transition. The Covid-19, has represented a step back on the civil society opposition towards the intensive and aggressive touristic model developed in the islands, especially Mallorca, during the last years. The Covid-19 was the perfect opportunity to work towards the diversification of the economy, however, this has not happened. The period spent by tourism operators without developing their economic activity, has created a sense of urgency after the pandemy to recover the activity and has delayed any potential debate about limiting tourism activity for environmental or energy transition reasons. From this point of view, the Balearic government does not hold power to regulate emissions both in airports and ports, probably the most crucial aspect in the economy of an island deeply dependent on tourism, so as mentioned by the Commitee of Experts, the great efforts that companies and citizens are making to advance in the energy transition can be severely diminished or even nullified by emissions from ports and airports if decisive action is not taken. With this regard, the Committee proposes a deep cultural change and a new productive and consumption model which requires the development of other sectors not linked to tourist activity, such as agriculture, food production from an ecological and regenerative perspective, sustainable management of natural resources, manufacturing linked to the recovery of materials, third sector, social care, research and innovation (Domblás, 2022).

According to the consulted actors, Balearic society has not internalised the seriousness of climate change and the changes needed to mitigate it, particularly regarding the need to reduce their overdependence on tourism. On many occasions it is perceived that fighting climate change is merely a matter of installing photovoltaic panels. In this context, measures oriented to limit or reduce tourism activity in order to speed up the energy transition do not generate social acceptance and generate resistance identities.

Besides the already mentioned tourism dependency problem, through the interviews and workshops conducted by eco-union in 2021 and 2022, additional barriers and challenges were identified that hindered the implementation of the climate change law and the deployment of decarbonisation initiatives. On the one hand, conflicts related to land use pose obstacles to the deployment of renewable energy infrastructure due to limited space; bureaucracy delays the installation of new renewable parks; the excessive ratio of cars per capita, one of the highest in the EU, is a challenge for the mobility transition; as well as the lack of charging electric stations or lack of infrastructure deployment for electrification in general. Consulted stakeholders also pointed out relevant institutional and social barriers: in particular, some insular councils are not committed to a profound energy transition and there is lack of social acceptance to adapt to climate change: the population does not yet perceive the severity of climate change consequences and they are still reluctant to change habits and their way of life accordingly.

Table 1: Indicators and trends derived from the narratives

Observed in:	Name of the narrative or other factors	Trends observed in the narrative (qualitative description)	Indicator(s) that helps describe the trend (way to measure)	Indicator discipline(s) e.g. economics, policy, etc.
Mainstream narrative	Upstream and downstream fossil fuel dependence	Fear of energy dependence and high prices of energy in the island pushed for an energy transition	Energy prices Thermal Power Plant electricity generated	Economics
On-stream narrative	Transition towards decarbonised energy production and transportation	The regional government has taken the lead by passing the Climate change and Energy Transition Act with highly ambitious measures, actions and objectives to reach climate neutrality by 2050 taking into account that the economy of the islands is highly reliant on international tourism. However, insular identity, lack of coordination between regional government and insular councils and high dependency on the tourism sector constitute major obstacles for the full deployment of the law.	Green jobs created Number of electrical vehicles/combustion vehicles New industries/sectors in the region Renewable energy installed capacity Plans and strategies approved by insular councils aligned with the regional government energy transition policy	Economics Economics Economics Economics Public policy

Off-stream narrative	There is still opposition to the implementation of the law by some segments of the society. Such opposition does not account for an alternative narrative, but by scattered positions which are not aligned with the mainstream narrative and may pose drawbacks and/or obstacles to the full implementation of the law.	This opposition comes from strong insular identities or excessive dependency on the tourism paradigm.	Evolution of the insular identity % of tourism activity in GDP	Anthropology, Psychology Economics

5.5 Summary of key findings

The present paper has focused on the analysis of the development, approval and implementation of the Climate Change and Energy Transition Act (in 2019) as a tipping intervention towards a decarbonised economy in the Balearic Islands. The high level of ambition of the law, the level of consensus achieved among the political parties and its pioneer and holistic character, addressing the main challenges related to electricity production and mobility, constitute elements of hope to shape the future of the islands towards decarbonisation. However, the research has focused as well on the assessment of the obstacles to the enhancement of coordination capacities in the regions that could make the implementation of the law challenging , such as the existence of very strong and different insular identities and the high reliance on tourism.

The research questions for this paper are:

To which extent the approval of the law on Climate Change and Energy Transition Act may act as a catalyst or tipping intervention in the Balearic Iislands in terms of energy transition?

How identity issues may pose a challenge to the full deployment and implementation of the law?

In this context, the paper has analysed how the logic of identity, both in terms of insularity and dependence on tourism, is shaping and affecting the multilevel governance approach to implement the Climate Change and Energy Transition Act.

The potential major tipping intervention is the Balearic law for Climate Change and Energy Transition which the regional government passed in 2019. Its main goals are:

● 10% RE production in 2023 (starting from 3% in 2019), 30% RE production in 2030 and 100% RE production in 2050 (70% of RE produced locally in the island)

● By 2030, 23% decrease of energy consumption and 40% energy consumption decrease by 2050.

● By 2030, 40% less carbon emissions and by 2050, 90% less carbon emissions (vs 1990)

● By 2035, all new cars (including hire fleets) to be zero-emissions (electric)

It is worth mentioning that these goals are now being revisited as the regional government advocates to reach full decarbonisation by 2040. Besides, one of the key provisions of this law, is the progressive closure of all polluting coal/diesel plants starting from 2020 in Mallorca (Es Murterar), Menorca (Maó) and Eivissa.

The fact that may enable to define the law as a positive tipping intervention is that, the perception of most of all stakeholders is that the transition offers a series of benefits for the region at various levels. On the one hand, the particularly high cost of fossil fuels on the islands makes the development of renewables economically viable and positive, as they move from importing primary energy to generating it locally, thus opening up new employment opportunities. On the other hand, on a social level, the promotion of local energy generation enhances social empowerment through self-consumption, which leads to a greater socialisation of energy. And finally on an ecological level, the development of renewable energies leads to a very high reduction of CO2 emissions. Furthermore, due to the consumption characteristics of the region, it is observed that the transition in the islands is closely linked to two sectors: energy production and transport, which means that by acting on these two sectors the overall impact is very high. At a strategic level, the energy transition and the fight against climate change offer an opportunity to rethink key issues in the islands, such as economic diversification and territorial planning.

However, there are some obstacles to overcome in order to define the law as a positive tipping intervention. On a technological level, the energy system derived from renewables is more complex than the traditional system, currently presenting different challenges that need to be managed, such as installations, grid balancing, synchronisation and batteries. Similarly, the transition goes beyond the technological challenge and requires a systemic change that will lead to new, more responsible energy consumption patterns and the development of more sustainable mobility. Most stakeholders agree on the need to improve communication and coordination between administrations, companies and CSOs as a key aspect to overcome in order to make this systemic change possible. With this regard, the non-existence of a Balearic Island and the presence of very strong insular identities make this process more challenging, particularly when the process is led by the regional government and insular councils play in some cases an opposition role. Besides, the limited space available in the region is also a key confrontation point, since on the one hand it does not allow to take advantage of economies of scale, and on the other hand, land use is a particularly sensitive issue due to the lack of proper regulation..Finally, excessive dependency on tourism poses an additional challenge. This reliance on tourism is part as well of the identity of the Balearic inhabitants, their way of survival, around which they have constructed their social imaginary and cultural attributes, so resistant identities emerge when new decarbonisation paradigms are promoted, particularly those that have to do with measures that seek to limit or reduce tourism activity in the island. For instance, the proposals to decarbonise road mobility have generated strong criticism among car rental companies as it directly affects their current business model.

With this regard, most stakeholders agree that it is necessary to dedicate efforts to social pedagogy in order to highlight the urgency and importance of the implementation of the law, focusing on the different levels of public administrations so that the climate perspective reaches all of them. With these efforts oriented to social pedagogy to describe the benefits of the implementation of the law, stakeholders should be able to construct or visualise convincing economic alternatives to tourism based on the new proposals in order to move from a resistance to a new project identity based on the decarbonisation paradigm. In any case, thanks to the approval of the law, new processes of awareness have been activated in the area that may generate new levels of accommodation and acceptance and the formulation of new project identities based on alternative paths to create and construct new culture attributes and social imaginaries that go beyond tourism.

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6 Case study 6: Aragon-Teruel, Spain

Aragon-Teruel, Spain

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eco-union

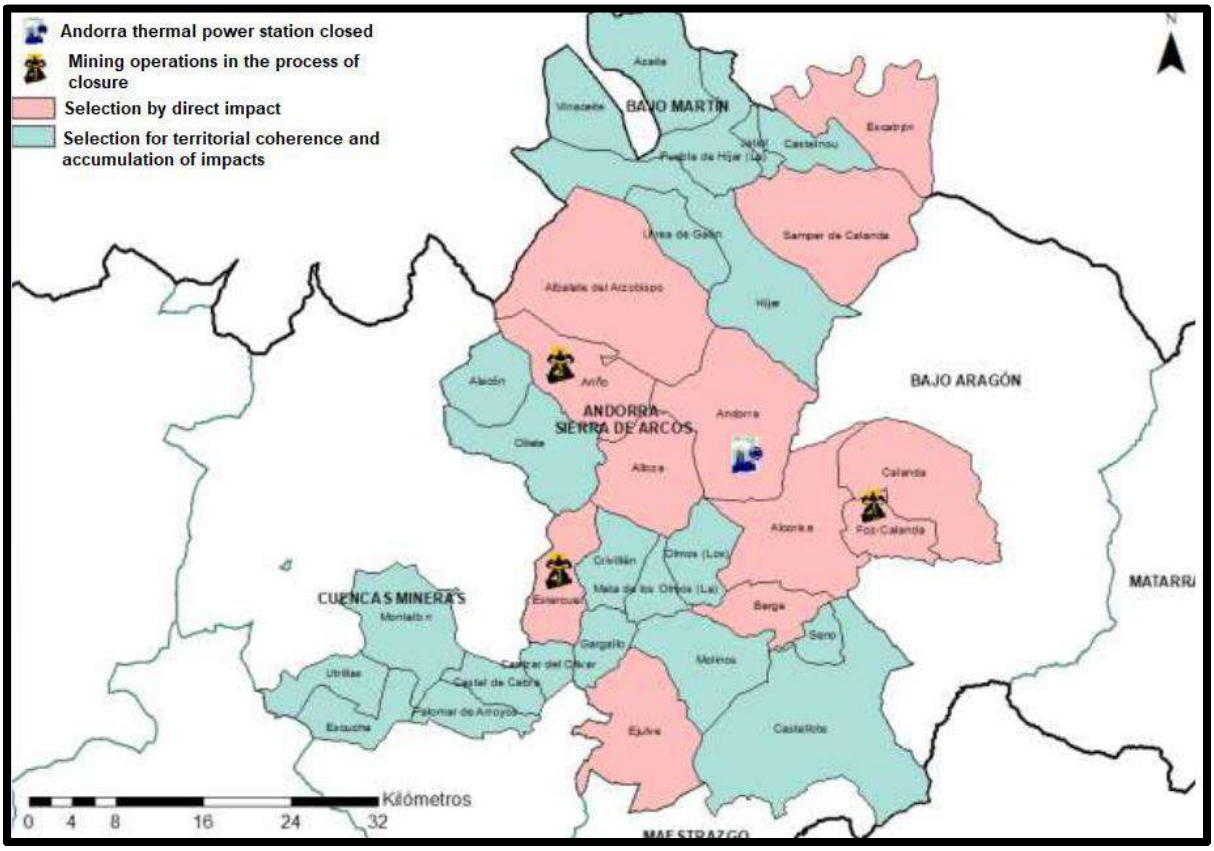
6.1 Introduction

6.1.1 CCIR description

Teruel is a province of Spain within the Autonomous Community of Aragón. Its territory covers 14.809 km and its population in 2021 was 133.109 inhabitants (Caracterización y diagnóstico del Convenio de Transición Justa de Aragón, 2020). Teruel is one of the less densely populated regions of Spain, with 9 inhabitants per square kilometre. The region of study is under the Just transition Agreement for Andorra-Mining Regions, which is the official name of Aragon’s JTA. The Just transition Agreement for Andorra-Mining Regions, is the first JTA to be developed within the framework of the Just Transition Strategy, the provisions of Law 7/2021 on climate change and energy transition, and the Recovery, Transformation and Resilience Plan to ensure that the decommissioning of the Andorra thermal power station will mean new opportunities for economic, social and environmental development in the area (El MITECO lanza el primer concurso de Transición Justa de acceso a la red eléctrica para el nudo de la central de Andorra, en Teruel, 2021). Furthermore, given the closure of mines and thermal stations, this agreement developed a special plan, called Urgent Action Plan, to respond to the social, labour and economic effects of the closings (Caracterización y diagnóstico del Convenio de Transición Justa de Aragón, 2020). The agreements are managed by the Just Transition Institute, an autonomous body of the Ministry for Ecological Transition and the Demographic Challenge (MITECO). For the purpose of this project, only the region included in the Just Transition Agreement (from now on JTA) of Aragón will be taken into account .The main reason for selecting this region as the boundary of the study is due to its unique and complex nature regarding the energy transition in Spain and for being a pioneer project in Spain. With this regard, the focus is on one of the areas that would be most affected by EU/national phase-out and decarbonisation policies in terms of socio-economic impact. From this experience, some learning lessons could be extracted for other Spanish coal regions in transition.

This region has a population of 31.509 people , spread over 11 regions and includes 34 municipalities. Approximately 71% of the population of the 34 municipalities included in the Just Transition Agreement of Aragon are concentrated in 7 localities: Andorra (23.71%), Calanda (11.90%), Alcorisa (10.37%), Utrillas (9.45%), Albalate del Arzobispo (6.28%), Híjar (5.46%) and Montalbán (3.91%) (Caracterización y diagnóstico del Convenio de Transición Justa de Aragón, 2020). Besides the low density, this region has lost 13% of its population since 1998, being the youth cohort the one with a higher decline (childhood rate of 15% in 1998 to 12% in 2019, and youth rates from 20% to 15%). On the opposite end, the population of the area is ageing at a rampant rate with a ratio of old population (over 65 years old) of 20% of the total population.

Figure 1. Area of study and under the effect of the Just transition Agreement for Andorra-Mining Regions



(Source: Just transition Institute)

The region of study is a traditional coal and carbon intensive region (CCIR), originally defined by its functionality: extract coal from local coal mines (the last mine was closed in 2019) and use it to generate electricity in the local thermal power plant of 1.101,4 MW fired with coal, which was closed in 2020. ENDESA-Enel, the company in charge of running the plant, requested in 2018 the government to close the facility (Endesa presenta la solicitud de cierre de las centrales de Compostilla y Andorra por ser inviable abordar las inversiones medioambientales, 2018). Nonetheless, the dependence of coal and carbon in the region has been rapidly decreasing since the beginning of the century due to the progressive closure of local mines. In 1994, 65% of existing jobs had already been lost both in underground mining and in open pit mining. The national production of coal falls from 26,468 thousand tons per year in 1997 to 8,432 thousand tons per year in 2010 (reduction of 68%), and the production of the province of Teruel from 3,531 thousand tons per year in 1997 to 2,339 thousands of tons per year in 2010 (34% reduction) (Caracterización y diagnóstico del Convenio de Transición Justa de Aragón, 2020).

One of the catalysts of this decline was Spain's entry into the European Union (1986). This led to the adoption of European coal and energy regulations which were more demanding from the environmental point of view and it increased the costs of production. It also implied the exposure of national coal to the EU market and the need to compete with cheaper production facilities. FInally, the EU announced the end of coal subsidies by 2025 (Caracterización y diagnóstico del Convenio de Transición Justa de Aragón, 2020).

The total number of workers affected by the closure amounts to 532, with 204 being part of the Endesa workforce and 328 employed by subcontractors. The local population still perceives coal and the Thermal Power Plant as the traditional source of income and jobs in the region, however, since the 2010s the service sector is the one that generates more employment opportunities in the region. To put it in context, in 2018, around 71% of employment in Aragón, 66% in the province of Teruel and between 46% and 64% in the case study area corresponds to the services sector. It must be taken into account, however, that the activity of many of the companies in the services sector depends to a large extent on the operation of the mining facilities and the thermal power plant, so the closure of said facilities will seriously affect the sector. The second sector in terms of job creation in the Andorra-Sierra de Arcos region is the extractive industry, energy and water, representing almost 20% of total employment, fundamentally related to the Andorra Thermal Power Plant and several coal mines (Ariño and Estercuel) (Caracterización y diagnóstico del Convenio de Transición Justa de Aragón, 2020). In fact, the city of Andorra is the one generating most service sector job opportunities while the rest of the villages (all below 1.000 inhabitants) rely on the primary and the secondary sector as their main source of income. This is because bigger municipalities in Teruel (Andorra, Alcorisa, Calanda and Utrillas) tend to concentrate the business fabric to the detriment of the smaller towns due to better connectivity and internet service.

Notwithstanding, the analysis of the distribution of the Gross Added Value by economic sectors in the region of the case study shows the enormous importance of the extractive industries, energy and water sectors. In 2010 it accounted for 46% of the Gross Added Value (GAV)of the Andorra-Sierra de Arcos region and around 44% of the GAV of the Bajo Martín region, remaining at 21% in the Cuencas Mineras region. This participation experienced a decline in 2018: approximately 6.5% in the region of Andorra-Sierra de Arcos (which means 43%), from 32% in the region of Bajo Martín (where it is located in a 30%) and 6% in the region of Cuencas Mineras (where it is reduced to 15%). However, its weight in the GAV of these counties continued to be very high.

Still, now that the last mining pits and the Plant are closed, some inhabitants of the region feel abandoned due to the lagging in the implementation of new projects that would support a "post-coal" new regional identity. This perception has been manifested both in the developed interviews and workshop, but it can be perceived as well in local media, expressing words such as disappointment, grief, anger, sadness, among others (Moreno, 2020).

These new projects, basically the implementation of the Just Transition Agreement and the so-called Nudo Mudéjar , are still pending and have not been materialised. The Just Transition Agreement has as priority objectives the maintenance and creation of activity and employment, the settlement of the population in rural territories or in areas with facilities in closure and the promotion of diversification consistent with the socio-economic context. In the framework of the agreement an Urgent Action Plan will be implemented to respond to the social, labour and economic effects of the closings. The Just Transition Agreements will take into account the need to improve employability and working conditions of women and groups with problems of access to the labour market, such as the long-term unemployed, people with disabilities or population at risk of exclusion. In addition, a particular effort is made to involve the youth, who must have the opportunity to participate in the decisions that may affect their lives in it, and that by shaping their vision of the territory they can find incentives to stay.

This Agreement has been already negotiated between public administrations and social agents and is based on the results of a diagnosis and a participatory process, but it has not yet been signed due to bureaucratic delays, even though related protocols of implementation signed by public administrations are in progress.

With regard to the so-called Núdo Mudejar project, large energy operators, international investors and local companies are competing for access to the energy evacuation network for the 1,202 megawatts that were freed up with the closure of the thermal power plant in Andorra in June 2020 to be generated through renewables plants. The contest has already begun with the presentation of guarantees by the companies, worth more than one billion euros, before the Ministry for the Ecological Transition and the Demographic Challenge (MITECO). Endesa, through its renewable subsidiary Enel Green Power España, has been the provisional winner of the just transition tender in Andorra (Teruel), obtaining the right to connect 953 megawatts (MW) and the option to confirm up to 1,200 total MW , according to the decision of the technical panel of the Just Transition contest that has selected the provisional winners in October 2022. The project includes the hybridization of solar and wind renewable projects, energy storage and the development of green hydrogen projects to decarbonise the area's industries.This industrial development goes hand in hand with a social plan that is intended to last over time, with the creation of more than 3,500 jobs during the construction of the projects, generating 300 direct permanent jobs in the area for the operation of these facilities (Endesa se adjudica el megaconcurso del Nudo Mudéjar de Andorra (Teruel) 2022).

However, this feeling of abandonment due to the lack of materialisations of the above mentioned projects (still not operating) can be extrapolated to the whole province of Teruel, which, according to the political party "Teruel Existe", has largely been abandoned by the Spanish government. This political party aims to defend the region from the lack of political inaction during the last decades and the abandonment of the so called "Emptied Spain" (areas with lack of infrastructures, people, services, etc.) Even though they have been politically active since 1999, they entered the Congress of Deputies for the first time in 2019 and supported the current Prime Minister of Spain in exchange for the construction of several infrastructures the region is lacking. They are the representatives of several local organisations, trade unions and independent individuals that want better opportunities for their abandoned regions. Therefore, most of their plans are on infrastructures, mainly highways and railways, since the region is rather disconnected.

So, even if the functionality of the region shaped its identity, at present, the sense of belonging corresponds more to the perception of being a former mining region in "transition" towards a new identity not yet well defined. This shift had its visual representation last May 2022, when after 40 years in operation, the cooling towers of the coal-fired power plant were demolished. This has had a huge emotional effect on the local population, since they could be considered signs of identity and the demolition of this industrial emblem is full of symbolism for the inhabitants of this territory (heras, 2020). It represents a final farewell to a way of life around coal that has already ceased to exist without the promised just transition to a new economy having yet materialised to date.

In the course of the development of interviews and workshops, feelings of nostalgia, resignation and a certain sadness were manifested, but there is also a growing aura of hope as large-scale business investments begin to be glimpsed which could mean an opportunity for prosperity.

6.1.2 Societal problem description

6.1.3 Research problem

The regional energy transition, supported by EU and national policies and investments, has created a window of opportunity for systemic transformation but its success depends on whether and how the EU and national funds will take into account Just Transition criteria and the local cultural factors, like the dependence on Endesa and the lack of SME fabric, are applied. If these criteria and context are taken into account during the implementation of new projects in the region, there is an opportunity to have a just energy transition for the region as well as revert and positively affect current negative demographic trends.

This research will shed light on locally perceived conditions for a successful energy transition in formerly deprived coal mine areas. Stakeholders' perceptions, coming from former workers from the coal plant, trade unions, business and environmental organisations, Andorra city council, Just Transition Institute, government officials and academic researchers, on the energy transition model being proposed by the central government, will be analysed.

6.1.4 Research questions

Taking into account that the Andorra area has been highly dependent on coal for a long period of time and that its inhabitants have constructed an identity around that imaginary, the following research question seeks to be responded:

- ¿How is the community (symbolically) coping with the energy transition and decarbonization process boosted by European and national authorities in the region of

Andorra, Teruel also in terms of identity and cultural attributes? Are they resisting or accepting the new narrative based on energy transition and the development of alternative sustainable economic activities?

6.2 Research approach

The transformation processes that coal and carbon dependent regions like Teruel are or have to undergo, are transdisciplinary and transversal. The identification of social-ecological tipping points (STEP), which integrate both biophysical and social interactions and entail fundamental changes in the original system's conditions is the objective of this case study. These changes however, can be positive or negative for our society. Back in 2016, R.E. Kopp et al. defined beneficial tipping points as those that "increase societal resilience and reduce climate change damages via mitigation or adaptation, whereas harmful social tipping points are more likely to occur where there are low levels of societal resilience, under which societal risks increase because of failure to effectively adapt or mitigate". In 2018, J.D. Tàbara et al, defined positive tipping points as emergent properties of systems that would allow the reaching of evolutionary-like transformative solutions to successfully tackle the present socio-climate quandary.

Even if STEPs cannot be fully predicted ex-ante, the identification of tipping events and tipping interventions is the first step. In this case, the supposed positive tipping points would be related to those contexts in which the local population and main stakeholders shift their perceptions leaving behind an identity associated with coal and start to become identified with a new social imaginary related to decarbonisation, just transition and clean energy production, which essentially manifests as a new project identity due, among other things, to its irreversibility. On the other hand, keeping active or reactivating a resistance identity based on the coal imaginary could be considered as a negative tipping point, for instance proposing to reactivate the thermal power plant due to the European energy crisis caused by the Russian-Ukrainian war. This possibility was mentioned by a representative from a trade union during the second workshop held in June 2022, who said that the closure of the plant had been too precipitous because of the current situation related to energy demand and high energy price inflation. The problem is enabling the positive tipping points, since there is a lack of field and systematic comparative work to study how they may enable positive and systemic transformation in social-ecological systems. With this regard, shifts or changes of identities linked to coal and mining landscapes and construction of new project identities may have the potential to act as emergent properties of systems conducive to transformative solutions. Identities imply a process of constructing meaning by which stakeholders give priority to a set of cultural attributes over other sources of meaning (Castells, 2000: 29). However, identity is neither one-dimensional nor static, and several of them could be juxtaposed. Concerning social change, Castells differentiates between three types of identity:

Legitimising identity: A set of logic and meaning introduced and propagated by the ruling powers, in order to rationalise, reproduce, and expand existing rule.

Resistance identity: Constructed in response to devaluation and stigmatisation; where social actors build "trenches of resistance" in opposition to the ruling norm. This formation leads to communes or communities of resistance.

Project identity: the construction of a "new identity that redefines their position in society and, by doing so, seeks the transformation of overall social structure"

As a matter of fact, coal infrastructures have produced a variety of symbolic meanings and cultural attributes that have shaped the identities of the inhabitants of regions like Andorra, where the main economic activity has been related to coal in the last decades and have become legitimising identities, according to Castells definition. Such infrastructures usually impact the way of lifes (economically, politically and culturally) and affect social relations, due to their systemic and fundamental character (Bridge et al., 2018). In CCIRs, the relationship between workers and mines and coal infrastructures are so intense that the closure has been even seen as a betrayal of the community (Grubert and Algee-Hewitt, 2017). In this context, resistance identities may emerge as an outstanding opposition to the new decarbonisation paradigm, but this may evolve to a process of accommodation or even acceptance towards the creation of new identities related to sustainability transitions and decarbonisation (project identities) as different potential social responses.

This project will try to find out if the inhabitants of Andorra are in an evolutive process with regard to the shaping of their cultural attributes and social meanings from the social imaginaries of coal (legitimising identities that have become resistance identities) to a new project identity based on decarbonisation and energy transitions, or if on the contrary there is still a resistance identity formulated as a response to an unwanted change. It will further develop an analysis to whether such evolution in their identities and social imaginaries may imply or not a positive fundamental change which triggers a chain of events which are beneficial from the energy transition point of view.

6.3 Narratives

6.3.1 Mainstream narrative: technology

The region of Teruel is a "typical" carbon-intensive region. The Thermal Power Plant that functioned partially on local coal, partly on imported coal, is located in Andorra (Teruel) and the three last mining pits were located in the villages of Ariño, Foz-Calanda and Estercuel. The sector has been dominant in the region since the 50s, but the Andorra power station was built in the 70s and was a key element in the economic development of the area in the 1980s, when the Aliaga power station was closed.

There is a general consensus in the view of local stakeholders that the Thermal Power Plant of Andorra and the coal extraction constitute a key part of the identity of the region. This is also reflected in the media (Rajadel, 2020) and in the opinion of local experts (Sanz-Hernández, 2013). For instance, Andorran María Luisa Grau Tello, curator of the IAACC Pablo Serrano and member of the Aragonese Observatory of Art in the Public Sphere group, studies mining activity in the province of Teruel through documentation. Her conclusions state that: Andorra's social landscape was decisively determined by seventy years of extractive activity. "And so, in addition to being an economic engine, carbon, after colonizing the entrails of men through their lungs and skin, has ended up becoming part of the Andorran identity, which today is collapsing in the face of new environmental policies" (artigas, 2019).

There was a huge immigration process from the rest of Spain to Teruel and its mining basins and they developed the community identity around the coal mining. Coal and especially the thermal power plant was the sector generating the most employment until the 90s, and the region became strongly dependent on it, partly because of the benefits granted by the energy company, and partly due to the underdevelopment of alternative economic sectors.

6.3.2 Mainstream narrative: stakeholders and institutions

The energy company, Endesa, and its mother company, Enel (Italian company) are the dominant stakeholder in the region since the beginning of the construction of the Thermal Power Plant. This dominance created a severe dependence of the local population and administrations on the revenues provided by the energy company.

There has been opposition by the civil society and trade unions to the closure of the Thermal Power Plant and the mining pits due to the fear of losing job opportunities and exceptional conditions in terms of salaries, working conditions, pension schemes, etc. This fear comes from the observation of other transition processes in other regions of Teruel which have mostly failed at diversifying the economy and generating new job opportunities. It also comes from a lack of materialisation of the promised projects in the area, which local stakeholders are expecting with a mix of hope, uncertainty and fear that they are just mere promises (Escriche, 2020).

Historically, according to opinions from trade union representatives, there is a perception that at a state level, the Government, no matter if left or right, has mostly abandoned the mining regions. Since the entrance of Spain to the European Union (1986), coal has been a declining sector, due to the lack of competitiveness of Spanish coal. There have been several transition phases in different mining areas, most of which have failed at creating an alternative business fabric to keep the jobs positions generated by coal mining. This feeling of abandonment and unrealised economic policy promises appeared frequently throughout the interviews and workshops formulated by trade union representatives, but also from cultural and business associations that,for instance, complained about the opacity and bad management of support plans in the past (called MINER investment funds). They have also criticised the lack of participation in the design of support schemes and the fact that policies were top down oriented. All these have led to feelings of mistrust and scepticism about proclaimed and announced future projects, creating a distance between local stakeholders and governments.

Local administrations, namely municipalities, have high knowledge about the local necessities nonetheless, have little power for influencing the creation of new job opportunities besides local initiatives. Also, the closure of the Thermal Power Plant has significantly reduced the taxes collected by the municipality, conditioning even further their capacity to generate employment. Moreover, the job creation capacities of these administrations are further hampered by the context of depopulation, lack of local services, limited training offer and the difficulties of connection.

6.3.3 Mainstream narrative: ideologies

At the local level, the municipality of Andorra has traditionally had a left-wing mayor. After 20 years, in 2019, the mayor changed from the Izquierda Unida (IU) political party to the PSOE, more centre-left. Also at regional level, the Autonomous Community of Aragón has been governed by left-wing parties (PSOE and IU).

At the national level there has been more fluctuation between left and right wing parties, however, until the election of the PSOE in 2019, no government had paid much attention to the situation of the coal mining regions, which have been suffering close-down phases since the 90s.

Local population has a strong sense of belonging to a mining community and it is hard for everyone to understand and move forward to another economic sector (Quílez, 2020). They have viewed coal mining and the thermal plant, for a long time, as an integral part of their identity and a key for their survival (Sanz-Hernández, 2013; Della Bosca and Gillespie, 2018). In Spain, there have been five coal-mining restructuring plans between 1990 and 2018 that have implied a severe decrease in workforce and production, a reduction of 20-25% of the population over the past 25 years in the coalfields in Asturias, Castilla-León and Teruel, Aragón and a complete social and cultural transformation process (Sanz-Hernandez, 2020). In the interviews, the representative of the Just Transition Institute reminded the importance of funding and keeping the cultural and industrial heritage associated with coal using European funds for that. For instance, it should be highlighted the role of the Andorra Mining Museum, which is very active in keeping and maintaining the memories associated with the coal industry. Some groups such as the Association of Aragones Studies have even asked for cataloguing the The Thermal Power Plant of Andorra as part of the Aragonese cultural heritage.

6.3.4 Mainstream narrative: policies

Endesa created a monopolistic economic sector in Andorra and the municipalities around that generated a strong dependence of the local population on this company. Free electricity bills, huge early retirements, paid studies for the children of the workers are only some of the advantages that the workers of the Andorra Thermal Power Plant had. Now that the plant is closed, the local population suffers from a feeling of being abandoned. Also Endesa created a dependence for the local municipality through the amount of taxes paid, which represented ⅓ of the municipal budget, besides several donations done annually which made possible the infrastructures that Andorra has right now like the swimming pool or the sports centre, which are of high quality. All these had implications with regard to better municipal services, sports and leisure centers, etc.

This relation of dependence is based on an individual and social connection that has given the inhabitants of Andorra and the surrounding areas a sense of place attachment and proportioned feelings of safety, security and trust in the future linked to the fact that there were no relevant economic alternatives (Sanz-Hernandez, 2020).

6.3.5 Mainstream narrative: others

The energy policy in Spain in the last 20 years has lacked continuity since the right wing party, Partido Popular (PP), and left wing one, Partido Socialista (PSOE), have alternated ruling the government with 2 very different approaches that have not contributed to send a clear sign to both the population and key stakeholders, which have been always expecting how things will change in the next election. It has combined pro-transition models promoted by PSOE such as the promotion of feed in tariffs with policies that blocked those transitions by PP like the removal of support for renewables and the so called sun tax which clearly disincentivized renewables. This has delayed the change of model and the construction by the population of new cultural attributes related to decarbonisation.

6.3.6 Alternative on-stream narrative: technology

The main on-stream technology narrative is the substitution of the Thermal Power Plant electricity generation by the installation of large-scale renewable energy projects (mainly solar and wind) with a just transition vision focused on the creation of as many job positions as lost during the closure phase. With the closure of the Andorra Thermal Power Plant, access to the Electricity Grid to evacuate the energy produced by the plant was freed. To grant the evacuation rights of the 1,200MW that were left free at the connection point known as Nudo Mudéjar, the Institute for Just Transition has called for a tender in which 11 projects of one or several electricity renewables generation modules have been submitted by different companies. These projects must use renewable energy sources, and may incorporate hybrid installations and storage systems. They must be located in the municipalities included in the Just Transition Agreement of Aragon, with a maximum 20% of the total area in adjoining municipalities. To evaluate the tenders, the following criteria have be applied:

- criteria associated with generation technology award up to 20 points;
- socioeconomic impact criteria, up to 55 points;
- project maturity, up to 15 points;
- minimization of environmental impact a maximum of 10 points

According to the recent decision (October 2022) of the technical panel of the Just Transition contest, Endesa, through its renewable subsidiary Enel Green Power España, has been the provisional winner of the tender in Andorra (Teruel), obtaining the right to connect 953 megawatts (MW) and the option to confirm up to 1,200 total MW .

6.3.7 Alternative on-stream narrative: stakeholders and institutions

The energy company, Endesa, jointly with the central government are the main stakeholders writing this narrative. Even though the Just Transition Institute has decided to call for a tender in which other companies may submit their projects in a competitive framework, Endesa is the provisional winner with a project that includes the hybridization of solar and wind renewable projects, energy storage and the development of green hydrogen projects to decarbonise the area's industries (Endesa se adjudica el megaconcurso del Nudo Mudéjar de Andorra (Teruel) 2022).

Trade Unions, former workers of the thermal plant and business associations have received the news about the publication and provisional resolution of the tender with a mix of hope for recovering the lost jobs and fear that it just means a new unfulfilled promise since they have not yet seen the new projects materialised in the area. They are afraid that the new jobs will come too late and long after the dismantling process of the thermal plant, which is currently underway and requires an important amount of workforce.

The central government has been highly supportive of this transition towards large-scale renewable energy production; however the local population as well as local CSOs and NGO are increasingly concerned about the proliferation of large-scale projects in the region which do not generate lasting job positions (J. H. P., 2021). These organisations also fear the possible negative impacts of large-scale energy projects on agriculture and ecosystems.

At a state level, the election of the progressive government in 2019 has marked a change in the approach taken by the Government in relation to the mining regions in Spain. The Just Transition Institute, has been created in place of the Institute for the Reconstruction of Carbon Mining and Alternative Development of Mining Basins. The Just Transition Institute is an autonomous body of the Ministry for Ecological Transition and the Demographic Challenge. Its aim is to identify and adopt measures that guarantee workers and territories affected by the transition to a greener, low-carbon economy fair and supportive treatment, minimising negative impacts on employment and the depopulation of these territories. This organism is being actively involved in the transition processes of coal regions in contrast to the abandonment suffered for years.

One of the phases of the design of a Just Transition Convention is the implementation of a public participation process that allows for the involvement of the different actors of the territory of each of the zones in the elaboration of the respective Agreement. According to the Institute for Just Transition, the public participation process carried out for the drafting of the Teruel Just Transition Agreement involved 67 actors of the territory and 173 proposals were collected (Convenios de transición justa. Actualización marzo 2022, 2022)..

However, the pandemy had a negative effect and delayed the participatory processes. The representatives of the environmental organizations in the workshop complained about the lack of involvement in these processes of the local population, specially of farmers, and the fact that there was no devolution (a workshop to provide feedback on the participatory process is still pending). While other actors, like a trade union representative and the Just Transition Institute, manifested in the workhsops and interviews that this is the first time that local stakeholders have been engaged in a real participatory process and believe that most of the relevant actors have been consulted.

6.3.8 Alternative on-stream narrative: ideologies

The preconceived idea of transition in Teruel has been based on the switch towards the generation of renewable energy focusing on the installation of large-scale solar and wind projects to substitute the electricity generated by the Thermal Power Plant while creating at least as much employment as it used to exist during the normal functioning time of the thermal plant. This is the public compromise (El MITECO apoya el proceso de Transición Justa en Teruel con ayudas directas a personas, municipios e iniciativas empresariales, 2021) . It remains to be seen what is the impact of the future policies related to the Just Transition Agreement, Nudo Mudéjar and decarbonising policies as a whole with regard to the generation of new cultural attributes and new imaginaries (new energyscape). In any case, the closure of the plan and the symbolic impact of the demolition of the towers have made the transition an irreversible process and thus questions the legitimacy of coal identities (Sanz-Hernandez, 2020). Even though there are still some resistances in place, attachment to the coal landscape is becoming more and more questioned and most of the stakeholders have started to manifest a clear will to move forward in the debate and accept the irreversibility of the transition. Sentences by a former coal worker in the 2nd Workshop held in June 2022 such as "I don't want to talk more about coal, I want to focus on the future" point in this direction. However, public debate on how to carry out a just transition is ongoing and the promises of new jobs and development related to the Just Transition Agreement and Nudo Mudejar play a key role. With this regard, many stakeholders (from trade unions but also from environmental NGOs and local public administrations) criticise that the new economic alternatives are taking too long to materialise and that "we should not demolish existing options before building up new alternatives". With this regard, stakeholders should be able to construct or visualise convincing economic alternatives (Mayes et al., 2014; Marshall, 2016) based on the new proposals in order to move from a resistance to a new project identity. In this context, resistance identities need three elements for their maintenance: a) opposition to the extinction of coal) the refusal to change identity and become something different and c) the lack of alternative futures without carbon (Sanz-Hernandez, 2020). Now that the process of decarbonisation is inevitable and that new alternative economic paths related to the Nudo Mudejar and the Just Transition

Agreement have emerged and are very present in the public debate, new processes of awareness have been activated in the area that may led to new levels of acceptance and the formulation of new project identities, but this will depend on the force and intensity of the presented alternative paths to create and construct new culture attributes and social imaginaries.

6.3.9 Alternative on-stream narrative: policies

The Just Transition Institute has designed a Just Transition Strategy which has the aim of generating at least the amount of jobs destroyed by the phase-out of the coal sector. In practice, in the region of Teruel, the government has done a Diagnosis and Characterization report and is working on a Just Transition Agreement that has to set the framework for the development of new economic sectors and boost the region. The Just transition Strategy is partially financed by the Recovery and Resilience funds provided by the European Commission as a post-pandemic recovery package and partially by the annual Spanish budget.

The Just Transition Agreement (JTA) covers 34 municipalities in the province of Teruel and is being designed as part of the Urgent Just Transition Action Plan which aims to support and finance the short-term development of the territories affected by the closure of power plants between 2019 and 2021. Still, the JTA is yet to be signed one year and a half after the closure of the Thermal Power Plant.

Also, the central government has chosen Teruel as the pilot region for the development of the Just Transition Strategy, therefore the success or failure of the transition in this region can set a precedent for similar processes in the rest of the region. As a first move into this strategy, the Just Transition Institute closed the first auction for the access of the evacuation node of the Thermal Power Plant, the so-called Nudo Mudéjar. As requirements to get the 1.200 MW or part of them, the companies have to comply with several Just Transition criteria and they have been awarded more or less points depending on the creation of green jobs (especially for women and youth), promotion of self-consumption and energy communities, generation of municipal income, etc. as well as strict technical and environmental standards. Besides, the projects have submitted a diversified industrial plan to be developed in the region. So, even though the focus is on large scale renewables, the tender has taken into account other aspects related to alternative off stream narratives that will be defined later.

6.3.10 Other contextual factors

The pandemy generated by the covid-19 virus has certainly had an impact on the transition at different levels. On one side, it paralysed several participatory processes scheduled for the first pandemic months. This has increased the perception by the local population that the government is acting on its own without taking into account the local population's real needs, as it has been reflected in the interviews and the workshop

On the other hand, the pandemy has postponed and delayed even more the implementation of new projects in the region jeopardising its implementation. Representatives of business associations, trade unions and local administrations, throughout the interviews and workshops, have manifested the sense of frustration and anger that the delay in the materialization of new projects due to bureaucratic processes has caused among the population. The fact that after 2 years and a half of the closure of the Plant, the Just Transition Agreement is still to be signed is the vivid image of this issue and is slowing down the transition process while increasing the uncertainty and the desperation of the local population.

The Russian-Ukrainian war may represent a setback in the process of energy transition in Europe. Currently, some member states have already reactivated some coal-fired power plants in order to mitigate the effects of energy shortages. Even representatives from trade unions have complained that the phase out process has been too quick in Andorra, and that a minimum functioning should be guaranteed for strategic coal reserves (Navarro, 2022). However, with regard to the coal plant in Andorra, Teruel, the demolition of the towers and the current process of dismantling of the plant seems to have an irreversible effect and no public debate has been opened up to date regarding this possibility.

6.3.11 Alternative off-stream narrative: technologies

Basically this narrative seeks to push people out of this dependency from one or several non local companies and make the local population understand that they can also generate employment and jobs. For this transition to be successful, it is key to diversify the economy and invest in local small and medium sized firms so as to create a complex and resilient net of companies and leave behind the bubble generated by Endesa. The technologies promoted, as explained by the stakeholders in the 1st and 2nd Workshops, should be those related to different sectors and economic activities that have been identified with potential to complement energy production in the area and diversify the economy care activities, clay related industries such as ceramics or bioconstruction, ecological agriculture and livestock, water efficiency technologies, rural tourism, etc. This approach could be understood also as complementary to the mainstream alternative, since, as stated above, the focus of the Just Transition Agreement and the Nudo Mudejar tender is also on diversification of the economy, but in that case is a more top-down oriented approach driven basically by the Just Transition Institute and some large companies, while in this narrative the focus would be more bottom up and would rely on the empowerment of the local population.

The proposal of this alternative approach to disengage from the dependency on big companies was one of the main conclusions held by the stakeholders that participated in the 1st virtual workshop held in 2021 and also during the face-to-face workshop held in June 2022, which established as the main challenge "on the one hand, making the transition look like something positive for the region and the population, and on the other, convincing the locals that they cannot depend on a company, that the population should have an active role in it, not only through participatory processes, but also through investments in SMEs oriented to develop a more complex and resilient business fabric".

Besides, there is an opposition movement to large scale renewable energy projects that according to some groups are invading Teruel and Aragón. The local population as well as environmental NGOs and trade unions believe that these large projects do not generate long-term job positions. Therefore, their installation would only delay by some years the lack of job opportunities. These voices defend that a decentralised production of renewable energy, for example through energy communities and self-consumption installations would, on one hand reduce the need for large scale projects, and on the other part, be part of the economic diversification by providing an additional source of income to the civil society. This diversification is expected to create a more resilient economy and move out of the big company dependence model that has carved the current situation of Teruel.

6.4 Alternative on-stream narrative: Stakeholders and institutions

The academia sector and the environmental organisations are the most critical ones with the mainstream narrative and the ones raising the voice and advocating for the construction of a new business fabric in the region. Throughout the interviews and workshops held in 2021 and 20221, voices from the academy argued that there was very little self-criticism about the responsibility of the inhabitants of Andorra and counties. These voices claimed that local inhabitants should "change the mentality" and understand that a substitute for Endesa was not going to appear. They said that the bubble of huge salaries, early retirements had bursted and the population should work on accepting that the future of the region also depends on the citizens, not on one or a few companies that come from abroad: "we must promote entrepreneurship in young people from now on.

What is happening is not a misfortune, it is an opportunity to value the capacities that the population has.”

Besides the academia sector, there are the voices of the labour unions and civil society organisations that agree with this alternative narrative. They also propose that the process of building a new and decentralised business fabric has to put the emphasis on the usage of the local infrastructure that is available but currently unused. An example would be the railway to Tarragona or Teruel's airport. Both infrastructures would facilitate the arrival of raw materials and/or the export of renewable energy components produced in the former mining basin, or serve as testing infrastructure (comments from some trade unions and CSOs during the 1st virtual workshop).

Recently, a platform very critical with the development of large scale projects named “Plataforma a favor de los paisajes de Teruel” has been created. They protest against wind and solar farm sprawl under the slogan “Renewables yes, but not like this”. They claim that the massive deployment of “oversized” renewable energy projects and connection infrastructure requires too much land, destroys the landscape, leads to irreversible loss of biodiversity and hampers sustainable local development. The alternative, the platform proposes, lies in promoting a model based on distributed energy, self-consumption and energy efficiency. They participated in a demonstration in October 2021 in Madrid together with over 180 citizen organisations to protest for the proliferation of large-scale wind and solar farms in rural Spain (Djunisic, 2021). The protests were also supported by the political group Teruel Existe, a platform representing the economic interests of Teruel province in Spain’s region of Aragon and that has expressed their views against the dismantling of the thermal plant (Arnal, 2021).

On the other hand, civil society is quite reluctant on starting new business on their own as they are not used to it and they still believe that big tractor projects are needed to attract other small business units. That is the view expressed by other trade unions and business associations during the workshops. Throughout the interviews and workshops, some barriers to local entrepreneurship were identified such as: fear of people to risk personal capital, huge tradition on being employed by a big employer and "waiting for the job to come'', lack of labour force, youth exodus, bad internet quality, poor formative offer, difficulties for "bringing" trainers and instructors to small towns like Andorra. Also, a large part of the population in the area benefits from early retirements which have been mostly invested in second houses in the mountain or at the beach, instead of being invested in local projects. Also representatives of the academia manifested that even the younger generations think that the region is “dead” because there are no job opportunities, still neither of them think about the option of generating their own income and only consider seeking a job outside the town.

Regarding this narrative, the local administration thinks that diversifying the economy is the way to go but they are not taking the lead in creating new projects nor in adopting new technologies like solar panels in public buildings. Probably this is still a collateral effect of the long dependency on Endesa as well as on the decrease of the municipal budget due to closure of the mines and the thermal plant.

The central administration is a strong supporter of the mainstream narrative, and even if they have introduced just transition criteria in the evacuation node auction that point to the need to diversify the economy, still they rely on large companies to install them so that they can act as tractors of smaller projects. The idea is that these large companies will need small entrepreneurs to pursue their activities but this is yet to be seen.

6.5 Alternative on-stream narrative: ideologies

The main alternative narrative to the substitution of coal for large-renewable energy projects is to empower the local population and make them responsible for the transition process. As expressed by academia and rural development associations in the workshop, the population of the region was used to the patriarchy of Endesa and expects the transition to bring a substitute that generates, at least, the same economic benefits. But, the time has come to do some self-criticism and demand some responsibilities to the local population about the current situation. This narrative defends the implementation of a decentralised economic fabric created by the local population which also attracts foreign investment.

6.6 Alternative off-stream narrative: policy

There are no current policies in place to implement this alternative and off-stream narratives. Voices in the labour union and environmental NGO as well as some local associations are pushing for the exploitation of unused infrastructure but this is hardly taking the attention of institutions at any level

6.7 Trends and indicators for sustainable transformations

The European regulations have made it more costly to run coal thermal power plants and have triggered the closure of several plants in Spain. These policies have pushed for a transition, but the position taken by the Spanish Government since 2019 regarding the ecological transition has been very relevant in this sense. The election of a progressive government has meant a turning point for the coal regions not only for the closure of most mines and thermal power plants but also for the design of a just transition plan for these regions.

More in detail, a trend that may evoque a sustained change is the incorporation of just transition criteria into the projects that are to be implemented in the Just Transition Region through the Nudo Mudejar initiative. This initiative has been observed for the first time in the launch of the first auction to access the Andorra power plant node. To gain part of the 1.200 MW of the evacuation node, companies have to comply with several Just Transition criteria (create green job opportunities and training, promote self-consumption and energy communities, generation of municipal income, etc.) as well as strict technical and environmental standards. Besides, the projects have to set the basis for the construction of a diversified industrial production in the region.

The introduction of the just transition criteria can help to fixate the population, slowing down or reversing the depopulation process in the region, as well as to create job opportunities with gender perspective and to attract young and prepared population to the region. The emergence of telework is postulated as a positive tool to fixate population in centres such as Andorra, although the current connection problems to the Internet play a detrimental role in this matter.

However, at this point, after the denial phase about the coal end of cycle and its substitution by other technologies giving place to new project ideas and alternatives have started to emerge, Stirling (2014) advocates that 2 approaches are possible: transition and transformation. The above described mainstream alternative narrative in which basically the same actors as usual take the lead merely substituting coal technology by large scale renewable projects in the Nudo Mudejar initiative could be understood as a transition approach. This approach is based on compensatory policies such as early-retirement packages and top down policies (tender leaded by the Just Transition Institute) oriented to substitute coal by another main activity, but the result of these strategies have proved not efficient enough in the past since many stakeholders feel that they play the role of "losers" in this transition (van Steenbergen and Schipper, 2017), due to their lack of participation in the new territorial projects and sense of belonging. On the other hand, the described off stream narrative could be understood as "transformative", in which individuals become aware that they are necessary actors in this change (Moreau et al., 2017; Sanz-Hernández et al., 2019). In this narrative, all stakeholders play a more active role and are not expecting a large company to replace ENDESA and go back to their former situation so that they can again play a more passive role as workers, public administrations or small businesses dependent on a big company. This approach is more in tune with moving from a resistance identity to a new project identity based on the construction of a new territorial project.

6.8 Summary of key findings

One of the criticisms of the mainstream narrative elaborated basically from academia and some NGOs is to pursue a substitute for Endesa so as to maintain the dependence on one or few big companies. The Endesa Transition Plan as well as the projects presented to the auction of the evacuation node include the development of renewable energy components' industry and of complementary technologies like battery storage or green hydrogen. If materialised, these projects will translate into the development of new industries in the region. This development has a structural transitional capacity because it will enable the creation of new job positions in research and innovation in a large variety of disciplines, but it lacks the structural transformational capacity that it may have if accompanied with the off-stream narrative, which implies a higher level of empowerment and entrepreneurship of the main stakeholders and the local population

It can be said that the region of Teruel already had its tipping event (the carbon phase-out is finalised and from a symbolic point of view the demolition of the towers has a profound meaning) in the coal power sector but the development of renewable energy projects is still in an embryonic state, therefore this event cannot yet be considered a positive STEP since its effects are yet to be observed. On the other hand, there has been an evolution from a legitimising identity based exclusively on the coal and mining social imaginary, to a new project's identity that is currently in process of generation based on decarbonisation and renewable energies cultural attributes. This could be understood as well as a tipping point, since it may pose the conditions for the development of alternative economic and more sustainable pathways in the region.

To really transform the region and to become a positive STEP, so, reversing the current demographic trends as well as to end with the dependence of a large company, the development of new industries must go hand in hand with the diversification of job opportunities by enabling for the establishment of a solid network of small and medium-sized local businesses. For example, the combination of solar panels with agriculture could help boost agronomic activity in the region. Also the development of other technologies like green hydrogen can help maintain jobs after solar and wind farms have been installed. So, renewable energies have to be developed with other technologies, since they alone cannot ensure that the transition will be fair for everyone. In fact, the development of new sectors will indeed strengthen the region's economy. On one hand, more population will require more services (better internet connection, transportation, health, education, recreation etc.). On the other side, new sectors will be developed to match population demands. In order for that to happen, public authorities should take into consideration identity issues, accompanying and supporting local communities and dealing with the emotional aspects of transformation (e.g. creating hope, managing loss and grief) until a transformed identity emerges more favourable to the acceptance of new diversified projects working across sectors, based on local entrepreneurship, and less dependent on one single economic sector.

Despite the quantity of plans and projects designed for the region, civil society cannot see yet a bright future for them in Teruel. This is mainly due to the inaction and lack of execution of projects nearly two years after the closure of the Thermal Power Plant. Even if this is partly due to the pandemy effects, the government promised the signature of the Just Transition Agreement, which would guide the transition of the region, but this is yet to happen. Additionally, some environmental NGOs and local organisations claim that some voices of the local population have barely been taken into account without widely covering the demands of the population, for example on the usage of local natural resources and infrastructure as a vertex for the transition. Even if there have been some participatory processes, the transition is being designed from the top. However, some positive interactions between top designed and bottom initiatives seem to emerge in the context of the 2 main initiatives promoted by the Institute of Just Transition:

- The signature of the Just Transition Agreements: Teruel is expected to be the first carbon-dependent region in Spain to sign them. It should include the final list of projects that are to promote and enable the development of the new Teruel's diversified economic activity.

- The energy evacuation node auction results. The seven projects presented to the auction are varied and the details are not public. However, according to the media most of these projects are linked to R+D+i, some of which involve the University of Zaragoza, and others are related to the agrifood industry and sustainable mobility projects. All of them have to include a plan to boost job creation (particularly for youth and women) as well as establish mechanisms to reverse the depopulation in the region. As said, Endesa, through its renewable subsidiary Enel Green Power España, has been the provisional winner of the tender, with a project includes the hybridization of solar and wind renewable projects, energy storage and the development of green hydrogen projects to decarbonise the area's industries.

If both events accomplish their objective of boosting the economic development of the region, it could mean the end of the depopulation process the region has been suffering from for the last 10 years and put an end to the monopolistic dominance of a big company.

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7 Case study 7: Megalopolis, Greece

Megalopolis, Greece

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Abbreviations

CCIR	Coal and Carbon-Intensive Region
CO_2	Carbon Dioxide
DH	District Heating
DREEM	Dynamic high-Resolution dEmand-sidE Management model
ETS	Emissions Trading System
EU	European Union
GDP	Gross Domestic Product
GVA	Gross Value Added
LPG	Liquefied Petroleum Gas
NECP	National Energy and Climate Plan
PPC	Public Power Corporation
RES	Renewable Energy Sources
WP	Work Package

7.1 Introduction

7.1.1 CCIR description

7.1.2 Societal problem description

A key part of the National Energy and Climate Plan (NECP) is to gradually phase out the use of lignite in power generation, **which includes the decommissioning of all existing lignite units in Greece by 2023** (Hellenic Ministry of Environment and Energy, 2019b). Megalopolis is one of the directly affected areas, as the only remaining lignite-fuelled power plant still in operation, the "Megalopolis IV" lignite unit, will be withdrawn by 2023. Precisely, the energy, mining, and water supply sector, which is directly related to lignite production, accounted for 33% of the Gross Value Added (GVA) in the Arcadian regional unit (where Megalopolis belongs) in 2019 (**Table *6***). This percentage is significantly higher than the corresponding sector's contribution to the GVA of the other regional units of Peloponnese, while also being one of the highest figures when compared to the shares of other sectors in the GVA of Arcadia.

Table 6. Gross value added per sector (in % per total gross value added for each regional unit, base year: 2019. Source: (Hellenic Statistical Auhtority, 2019)

Regional Unit	Agriculture, forestry, fishing	Energy, mining, water supply	Processing	Construction	Trade, hotels, catering, transport, communications	Financial & insurance activities	Other services	Total
Argolis	12,02%	3,65%	15,96%	1,62%	27,21%	2,98%	36,56%	100 %
Arcadia	6,21%	32,62%	5,96%	1,89%	17,52%	2,32%	33,47%	100 %
Corinth	5,70%	8,76%	16,89%	2,02%	24,93%	3,01%	38,69%	100 %
Laconia	15,90%	1,22%	11,33%	2,00%	27,13%	3,53%	38,89%	100 %
Messenia	12,02%	1,35%	10,93%	1,81%	23,09%	2,82%	48,00%	100 %
Peloponnese	9,94%	9,25%	12,46%	1,87%	23,84%	2,90%	39,73%	100 %

At the same time, the regional unit of Arcadia generated 64% of the total GVA of the Peloponnese region's energy, mining, and water supply sector in 2019, through the lignite-related activities of the respective companies belonging to this sector (**Table 7**). This highlights the concentration of the sector's business activities in the larger area of Arcadia.

Table 7. Gross value added per sector (in % per total gross value added for each sector, base year: 2019. Source: (Hellenic Statistical Auhtority, 2019)

Regional Unit	Agriculture, forestry, fishing	Energy, mining, water supply	Processing	Construction	Trade, hotels, catering, transport, communications	Financial & insurance activities	Other services	Total
Argolis	21,76%	7,10%	23,05%	15,61%	20,54%	18,45%	16,56%	18,00 %
Arcadia	11,33%	63,98%	8,69%	18,36%	13,34%	14,51%	15,29%	18,15 %
Corinth	14,18%	23,41%	33,51%	26,76%	25,86%	25,64%	24,08%	24,73 %
Laconia	22,27%	1,84%	12,66%	14,88%	15,85%	16,94%	13,63%	13,93 %
Messenia	30,46%	3,67%	22,10%	24,38%	24,41%	24,46%	30,44%	25,20 %
Peloponnese	100%	100%	100%	100%	100%	100%	100%	100%

Specifically, according to **Table *8***, the regional unit of Arcadia occupied about half of the Peloponnese region's workforce in the energy, mining, and water supply sector in 2019, occupying about 1.6 thousand workers.

Table 8. Sectoral employment structure (in thousands), base year: 2019, Source: (Eurostat, 2022a)

Regional Unit	Agriculture, forestry, fishing	Energy, mining, water supply	Processing	Construction	Trade, hotels, catering, transport, communications	Financial & insurance activities	Other services	Total
Argolis	9,00	0,33	2,11	2,57	13,60	0,37	13,11	41,09
Arcadia	6,67	1,58	1,56	1,90	10,08	0,27	8,39	30,45
Corinth	11,07	0,41	3,84	2,53	13,30	0,89	15,33	47,38
Laconia	10,55	0,23	1,44	1,70	10,41	0,36	8,94	33,64
Messenia	18,46	0,69	2,53	2,98	18,21	0,63	15,35	58,85
Peloponnese	55,75	3,23	11,49	11,69	65,60	2,53	61,12	211,40

Moreover, at the same year, the lignite activity in Megalopolis contributed directly and indirectly to the economy of Arcadia by about €497 million, provided about 4 thousand jobs (~60% of total lignite-related jobs in Peloponnese), and supported the operation of 370 businesses, whose turnover was estimated to exceed €120 million (**Table *9***).

Table 9. Direct, indirect and induced effects of lignite activity, base year: 2019. Source: (Hellenic Statistical Authority, 2019)

Regional Unit	GVA (in million €)	Employment (in thousands)	Number of businesses	Business turnover (in million €)
Argolis	50,49	0,58	337	75,24
Arcadia	496,59	3,94	370	120,39
Corinth	166,58	0,72	265	70,27
Laconia	13,07	0,40	220	48,06
Messenia	26,09	1,20	307	61,18
Peloponnese	752,81	6,84	1.499	375,15

Thus, the profound dependence of Megalopolis' economy to the lignite industry, reveals the challenge of transitioning the Megalopolis region to a new economic model after the shutdown of its remaining lignite unit. Moreover, the "Megalopolis III" lignite unit (which is in major malfunction since 2021) supplied the Megalopolis District Heating (DH) system with thermal energy for space heating and domestic hot water, with the DH distribution network covering about 30% of the city's building stock. The DH system started operating in 2007, and was based on the acquisition of thermal energy by the "Megalopolis III" power plant, which is located at a distance of 4.5 km from the city center and gave a thermal power of 20 MW_{th} (South East European Energy Institute (IENE), 2020). Therefore, in parallel with the lignite phase-out plan, special attention needs to be paid on the adequate and punctual replacement of the DH system to cover the heating and domestic hot water needs of the Megalopolis' building stock.

7.1.3 Research problem

There is no evidence on which deliberate and targeted interventions could boost a social-ecological system towards a more just and sustainable trajectory (Tàbara *et al.*, 2021), especially in the short term, when the consequences of the transition process would be more intense. Building renovations with special emphasis on the deployment of heat pumps to cover the heating and cooling needs of households can benefit the economy, society, and environment (Ziolo *et al.*, 2020). Yet, the diffusion rate of heat pumps in the residential sector remains low in the European Union (EU) (Buildings Performance Institute Europe, 2022).

According to the existing Just Transition Development Plan of lignite areas, a gas distribution network is under construction in Megalopolis and its residents will be exempted from connection fees. Furthermore, the cost of replacing existing heating boilers and relevant equipment with natural gas ones will be subsidized (Hellenic Ministry of Environment and Energy, 2020a). However, due to the latest developments and amid an energy price crisis, the existing plan for the energy transition of the residential sector of Megalopolis may need to be revised, as the decision to invest in natural gas infrastructure could cause a lock-in effect (negative tipping point), exposing households to high energy costs and potential gas shortages for the next decades. This comes in line with scientific literature, which mentions that the further expansion of natural gas infrastructure and consumption exacerbates infrastructural and institutional lock in effects, which can decelerate the energy transition, causing stranded assets and detainments in renewable energy investments, entailed by harmful environmental and economic consequences (Kemfert *et al.*, 2022).

In this study, we investigate how the 2022 energy crisis could highlight the value of an alternative, post-lignite development trajectory for the residential sector of Megalopolis, which does not rely on the use of transitional fossil fuels. In this direction, we utilize energy modelling tools to assess different heating investment scenarios deriving from selected energy transition narratives for the residential sector of Megalopolis.

7.1.4 Research questions

We aim at answering the following research questions: (i) "How do different decarbonization pathways of the residential heating sector in Megalopolis perform in terms of energy consumption reduction, environmental footprint, and potential extra charge on households?" and (ii) "How does the natural gas price shock of 2022 affect the tradeoff between immediate electrification and gas as a transition fuel?"

7.2 Research approach

To formulate our research questions and energy transition narratives for the potential transformation of Megalopolis, we conducted an online workshop on July 28th, 2021, titled "Decarbonisation in Megalopolis: Winners and losers, or Just Transition?" with a total of

12 stakeholders. These stakeholders represented the energy industry, the policymaking sphere, non-governmental organisations active in the region, academia, and regional authorities. The workshop consisted of an opening plenary session with an introduction presenting the objectives of the event, embedded in the broader TIPPING$^+$ framework. This was followed by two presentation rounds, given by participants representing academia, policymaking, the energy industry and a non-governmental organization, about key challenges and issues related to the transition of Megalopolis, each one accompanied by a roundtable discussion where all stakeholders provided further feedback given their situated positions.

7.3 Qualitative and quantitative methods

To answer the abovementioned research questions, the Dynamic high-Resolution dEmand-sidE Management (DREEM) model, a hybrid bottom-up model that combines the key features of both statistical and engineering models, is utilised. DREEM is a demand-side management model, focused on the residential sector, which assesses the benefits and limitations of demand-flexibility, primarily for consumers, and for other entities. The novelty of the DREEM model lies mainly in its modularity (Figure 16), as its structure is decomposed into individual modules characterised by the main principles of component - and modular - based system modelling approach, namely "the interdependence of decisions within modules; the independence of decisions between modules; and the hierarchical dependence of modules on components embodying standards and design rules" (Stavrakas and Flamos, 2020).

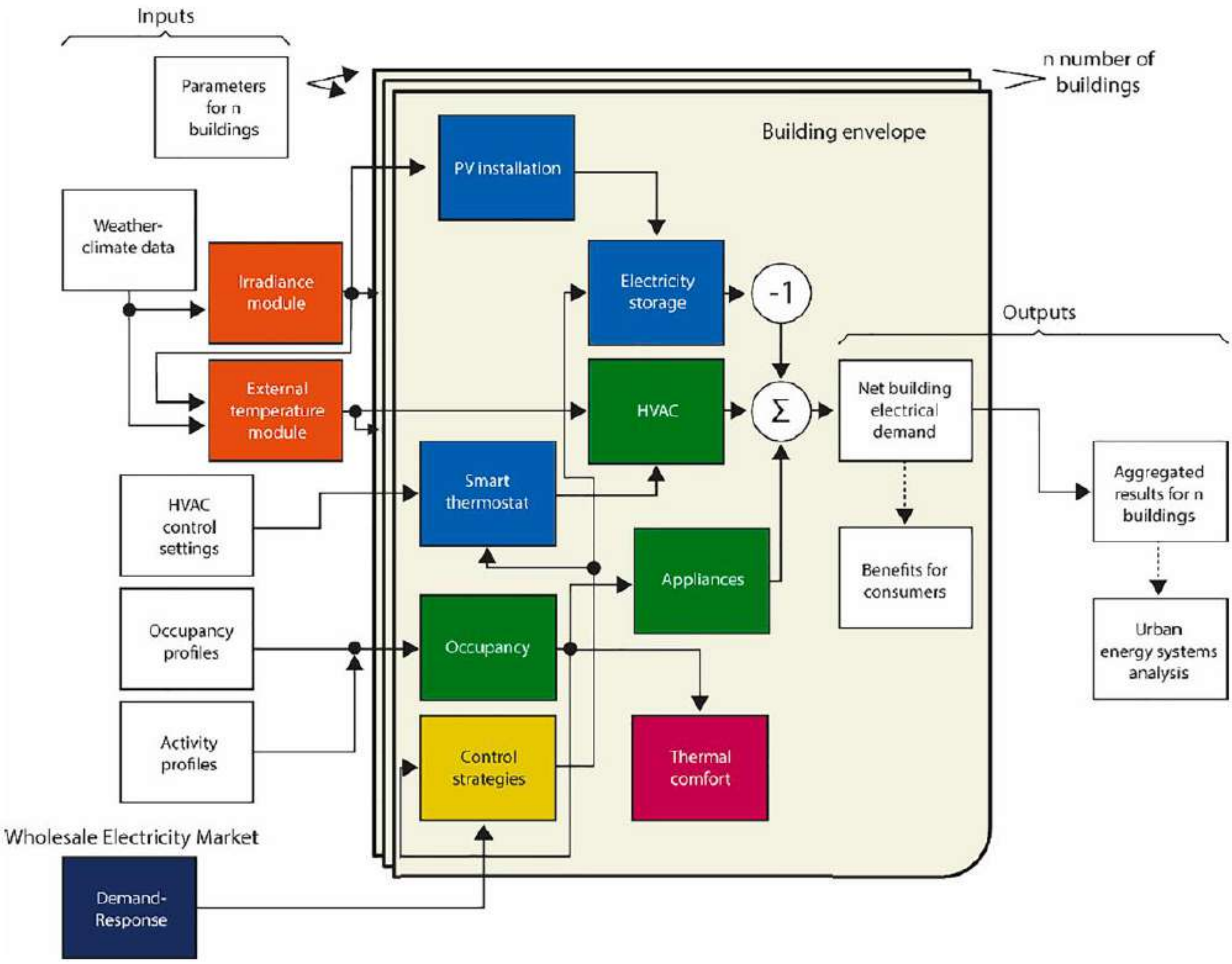


Figure 16. Architecture of the DREEM model. Source: (Stavrakas and Flamos, 2020)

This modular approach allows for increased flexibility in terms of possible system configurations and computational efficiency towards a wide range of scenarios, studying different aspects of end-use. It also provides the ability to incorporate future technological breakthroughs in a detailed manner, such as the inclusion of heat pumps, in view of energy transitions envisioning the full electrification of the heating sector. The model supports the capability of producing output for a group of buildings and could also serve as a basis for modelling domestic energy demand within the broader field of urban, national or regional energy systems analysis. In this study, DREEM is used to model the residential heating sector of Megalopolis.

7.4 Narratives

7.4.1 Mainstream narrative

The need to use domestic resources and the traditionally low cost of lignite were the reasons why, back in the 1950s, Greece turned to lignite combustion, as the backbone of its electricity system (Heinrich-Böll-Stiftung Greece, 2015). The utilization of lignite in power generation was of strategic importance for the PPC (the only national power utility at the time), as the low cost of its extraction guaranteed a stable and easily monitored price, and offered both stability and security in the availability of fuel supplies to the Greek energy system for decades (Kavouridis, 2008). Furthermore, the utilization of lignite provided thousands of jobs throughout the Greek countryside, where high rates of unemployment prevailed, and thus contributed significantly to the growth of the Greek Gross Domestic Product (Greek Public Power Corporation, 2010). Until 1973, the legislative framework regarding lignite mining was constituted by individual decisions for granting lignite exploration and exploitation rights (Hellenic Republic, 2008). That year, the strategic political decision to base the Greek power generation system on lignite was taken right after the oil crisis (Kavouridis, 2008).

The second largest Greek lignite centre was established in Megalopolis along with the surface mines of Thoknia, Choremio, Kyparissia and Marathousa. In 1957, the Megalopolis lignite deposit was examined for the first time, and the findings were promising. The exploitation of the deposit in the area began in 1970 by the PPC, and it was a unique case on a global scale because it was the first time that low-quality lignite was mined and used for electricity production (Greek Public Power Corporation, 2022a). Since then, the importance of lignite has made Megalopolis a primarily coal-dependent economy and the prosperity of the area is largely reliant on the lignite power plants' operation. According to a recent survey, 33.9% of people in the regional unit of Arcadia answered that their income depends on the power plants operating in the region, while in the Municipality of Megalopolis the same figure exceeds 66% (Δούση et al., 2020). In numbers, the coal-related industry of Megalopolis occupies around 850 direct jobs, 200 intra-regional indirect, and 560 inter-regional indirect jobs (Marinakis et al., 2020). Around 50% of the PPC employees are employed in mines and about 30% in power plants (Hellenic Ministry of Environment and Energy, 2020a).

Annual lignite production in Megalopolis followed an increasing trend between the 1970s until 2002, following the decision of the Greek government to base the Greek power generation system on lignite (Figure 17). Production remained stable at 13-14 million tonnes per year until 2008, when a slight gradual decline began, followed by a sharp decrease after 2019. This steady-then-decline trajectory of lignite production is attributed to the introduction and gradual expansion of natural gas use for electricity generation, as well as the gradual increase in renewable energy sources (RES) capacity. Eventually, this declining trajectory of lignite extraction and use set the footsteps for the lignite phase-out decision published in the Greek NECP in 2019.

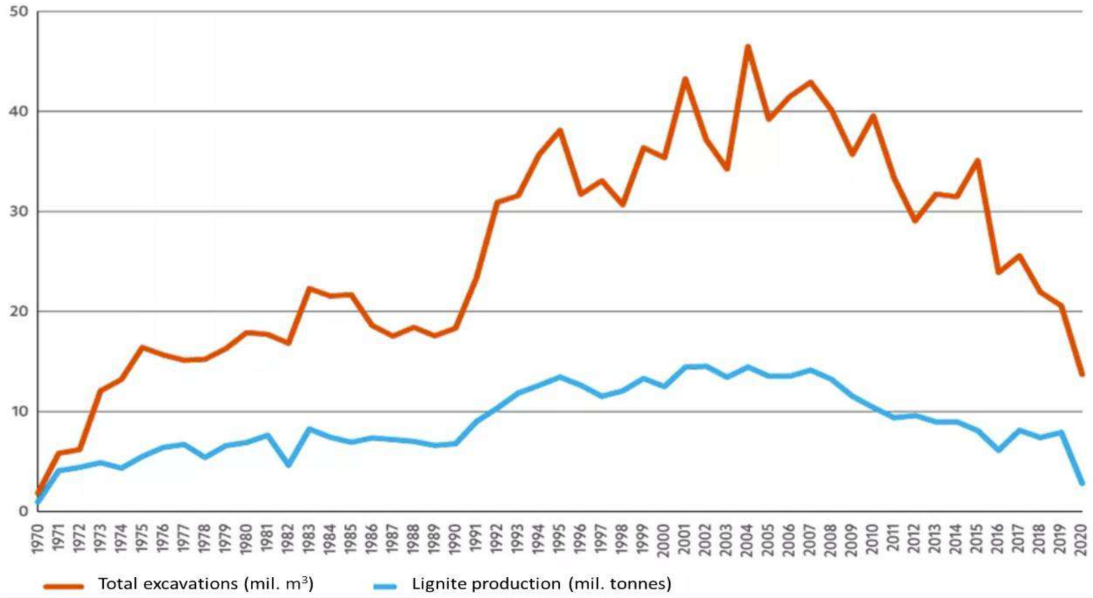


Figure 17. Chronological evolution of lignite production and total excavations in Megalopolis mines (1970-2020). Source: (Greek Public Power Corporation, 2022b)

The lignite phase-out decision of 2019 was triggered by a variety of parameters, mostly relevant to the EU's climate and environmental policy as mentioned in Mantzaris (2021). Indicatively, the listed reasons include:

The European Directive for the EU Emissions Trading System (EU ETS)1, which forced lignite units to pay for every tonne of Carbon Dioxide (CO2) emitted, especially after 2019 where the EU ETS price started to increase significantly (Figure 18).

The Industrial Emissions Directive2 of 2016, in parallel with the imposition of stricter emission limits for sulphur dioxide, nitrogen oxides, microparticles, heavy metals and other pollutant gases in 2017, forcing lignite units to implement expensive upgrades, burdening them with additional costs.

The European Regulation on the operation of the electricity market3, which abolished subsidies to the lignite industry.

The increasing competitiveness of renewable electricity compared to lignite-generated electricity.

On top of the above, the declining quality of the lignite fields in Megalopolis and Ptolemaida (1000 – 1300 kcal/kg) and the increasing stripping ratio (from 2.68 m3/tonne

[1] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32003L0087&from=EN
[2] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32010L0075
[3] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019R0943

in 1991 to 4.59 – 6.36 m3/tonne in 2016 –2017), contributed to a decline in lignite share to the electricity mix (Marinakis et al., 2020).

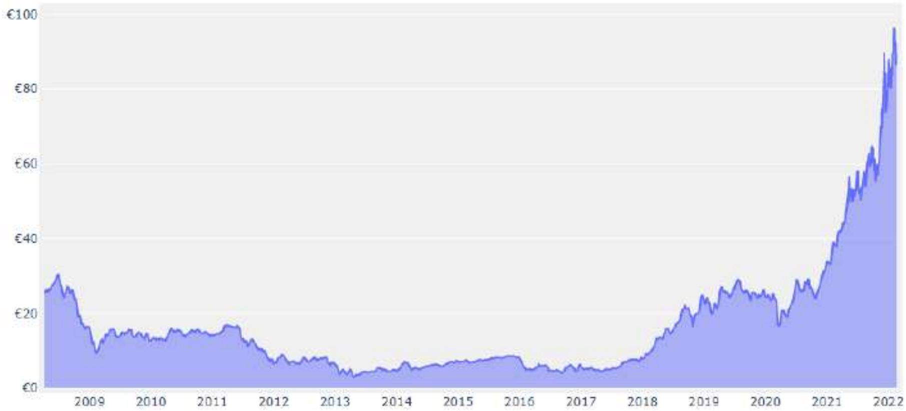


Figure 18. Evolution of CO2 emission allowance price. Source: (Trading Economics, 2022)

Accordingly, following the above, the national electricity generation from lignite dropped by 64.2% from 2018 until 2021 (Figure 19), and the electricity generation from the lignite power plants of Megalopolis fell by 54.7%.

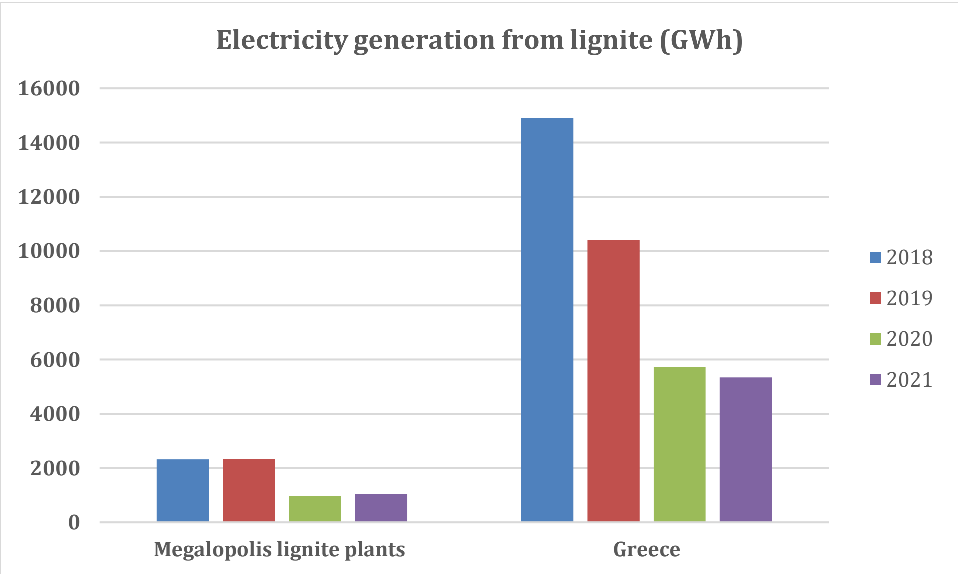


Figure 19. Contribution of Megalopolis lignite power plants to the national electricity generation from lignite. Source: (Independent Power Transmission Operator, 2022).

However, as shown in Figure 20, the fall in lignite-fuelled power generation in Megalopolis was offset by almost a tripling in gas-fuelled electricity generation from the natural gas power plant of Megalopolis, ("Megalopolis V" power plant), from 2015 until 2021. This indicates the position of imported natural gas as an intermediate fuel towards the clean energy transition of Greece, as mentioned in the Greek National Energy and Climate Plan (Hellenic Ministry of Environment and Energy, 2019b).

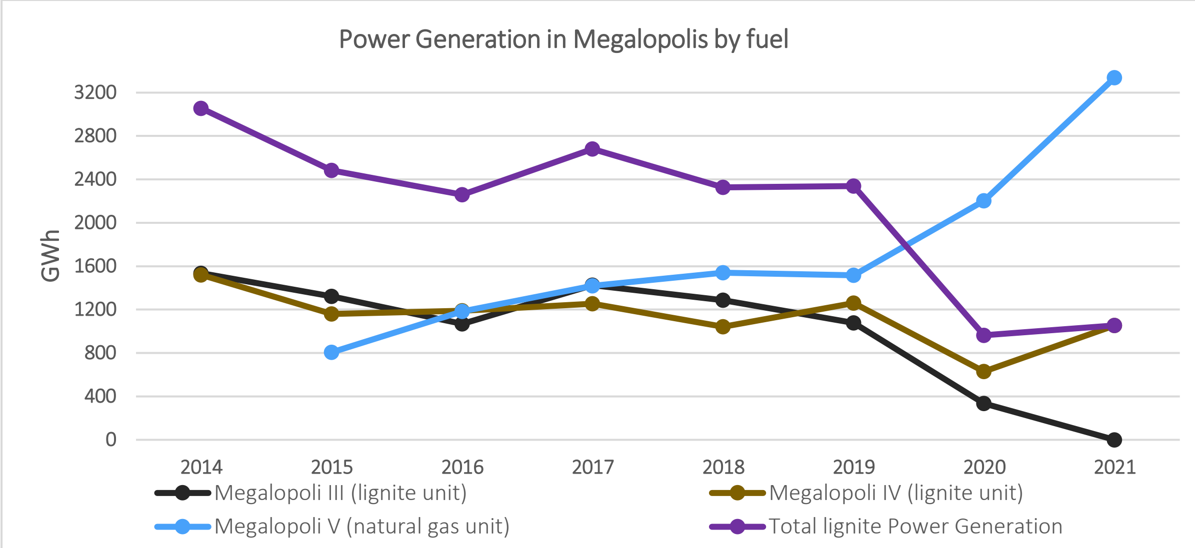


Figure 20. Power Generation in Megalopolis by fuel. Source: (Independent Power Transmission Operator, 2022)

Considering the above, at the time of the lignite phase-out decision (i.e., 2019), the competitiveness of natural gas price (Figure 21) and the increased power generation efficiency of natural gas-fuelled plants, made electricity generated with natural gas an attractive option. Nevertheless, the recent developments with the Russian war against Ukraine and the consequent energy crisis, that has led to the skyrocketing of natural gas prices in 2022, may cause the postponement of the decommissioning of the lignite activities to minimize the risks of power shortages (energypress.gr, 2022). These developments have also resulted in the publication of the REpowerEU plan by the European Commission, which aims to reduce EU's dependence on Russian fossil fuels and fast forward the green transition (European Commission, 2022). This is particularly relevant for Greece, since all gas is imported and about 38% of it comes from Russia (Eurostat, 2022b). In turn, this raises questions about the future of newly built natural gas assets, including the "Megalopolis V" power plant and the natural gas distribution network in Megalopolis which is intended to power gas boilers in Megalopolis' households.

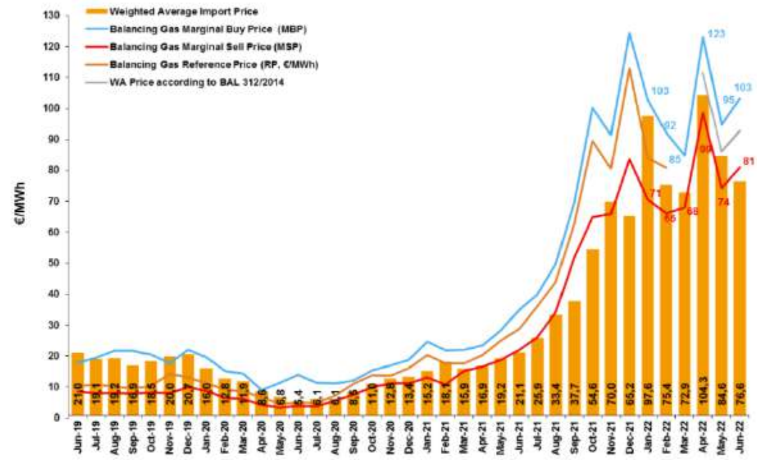


Figure 21. Evolution of natural gas price in Greece. Source: (Regulatory Authority for Energy, 2022)

8.5 Stakeholders' perspectives for a post-lignite Megalopolis

Participants in the 1st stakeholder workshop held on July 2021, shared their perspectives on potential economic opportunities during the delignitisation process. The greatest challenge concerning the transition seems to be its timing, as the transformation of Megalopolis, from a largely lignite-based economy to a more diversified and sustainable one cannot apparently be accomplished by 2023, when the withdrawal of the lignite units will be completed (The Green Tank, 2020). As stated by an academic stakeholder, the development of new professional skills and job vacancies by 2023 is a critical challenge for the just transition of Megalopolis, as 5,000 jobs are expected to be lost by then. A stakeholder from a civil, non-profit organization mentioned several opportunities for regional development, such as the establishment of RES projects, tourism development (e.g., an international motocross ring, rafting), alternative forms of agriculture, the reconstruction of museums and educational institutions, the optimization of the road network, and the construction of a business park in Megalopolis to host the industries that plan to relocate. These proposals coincide with several of the investments assessed in the Greek plan for the just transition of lignite regions (Hellenic Ministry of Environment and Energy, 2020b). A stakeholder from policy also stated that land restoration plays an important role in addressing unemployment during the first post-lignite phase (i.e., right after the lignite phase-out), as it is estimated to create 400 job vacancies.

Furthermore, stakeholders stated that establishing a secure, concrete legal and licensing framework for RES, while providing a low-risk environment, are significant steps toward ensuring an appealing environment for investments and that photovoltaic parks could be built by local small businesses to create job opportunities. Experts also emphasized the importance of energy efficiency, and the need to emphasize in the Just Transition Master Plan the upgrading of the energy performance of existing buildings in Peloponnese. They stated that the NECP will be updated, and that natural gas will most likely not be eligible for grants as a building heating option, emphasizing the importance of prioritizing RES investments. During the discussion, experts also mentioned existing proposals for developing energy communities while providing special tax exemptions to attract foreign investments. In this regard, they stated that optimizing energy consumption by forming energy communities could solve the problem of building heating and suggested that each affected municipality forms an energy community to provide cheap or even free green power to those in the region suffering from energy poverty.

8.5.1 Alternative (on-stream and/or off-stream) narratives

8.5.2 On-stream

The On-stream narrative follows the trends of the Greek plan for the just transition of lignite regions (Hellenic Ministry of Environment and Energy, 2020b) which also comply with the voices of many stakeholders who participated in the 1st stakeholder workshop. The Greek plan for the just transition of lignite regions is a development roadmap for the Region of Western Macedonia and the Municipality of Megalopolis. For Megalopolis, it aims to reconstruct the region according to a new economic model, and to cover the deficit of the old productivity model, through the creation of value in different sectors, taking into account the natural and diverse comparative advantages of Megalopolis. It is based on four growth pillars: (i) Clean energy, (ii) Industry, small industry and trade, (iii) Smart agriculture, and (iv) Sustainable tourism.

In the energy pillar, all Megalopolis lignite power plants will have been decommissioned by 2023 (Hellenic Ministry of Environment and Energy, 2020a). Nonetheless, Megalopolis will remain a semantic energy centre, as the "Megalopolis V" power plant will keep operating with natural gas, and new investments in Renewable Energy Sources (RES) will be materialised. Specifically, there is expressed interest for the constructions of 500MW of photovoltaic installations, with 50MW of them already underway by PPC (Hellenic Ministry of Environment and Energy, 2020b).

Furthermore, in order to substitute the loss of the DH system which will follow the closing down of lignite units, a gas distribution network is under construction. This will cover the heating needs of both the customers which are already connected with the district heating network, and of new ones who will apply for connection with the natural gas distribution network. For the transition period, district heating will operate with a Liquefied Petroleum Gas (LPG) boiler (Hellenic Ministry of Environment and Energy, 2020b).

Apart from the energy-pillar, Megalopolis will also be developed along three additional pillars mentioned in the Greek plan for the just transition of lignite regions:

Industry, small industry, and trade: Construction of a business park, with an already expressed interest by a pharmaceutical industry for a novel-investment which could create up to 400 job vacancies.

Smart agricultural production: Development of intelligent livestock and animal feed units, as well as smart agricultural units producing exportable products, with emphasis on alternative forms of cultivation, e.g., hydroponics.

Sustainable tourism: Construction of a novel adventure park, promotion of motorsport and setting up an industrial heritage museum.

8.5.3 Off-stream

Considering the recent developments with the Russian war against Ukraine and the consequent energy crisis, the On-stream scenario for the development of Megalopolis could be at risk. In this respect, the Off-stream scenario depicts the voices of those stakeholders that during the 1st Workshop emphasised on local energy communities, energy efficiency, and electrification.

The Greek updated plan for the just transition of lignite regions so far focuses on clean energy investments that are exclusively targeted on large-scale projects (Hellenic Ministry of Environment and Energy, 2020b), thus creating a gap in terms of small-scale investments which could contribute to the augmented participation of local people in the energy transition of the region (Dellavalle and Czako, 2022). The integration of the "Energy Efficiency First" principle, the mitigation of households' energy poverty through energy upgrades, and collectively driven energy actions for engaging and empowering younger generations could potentially lead to a more just and green transition away from lignite in Megalopolis. Indicatively, as expressed during the 1st stakeholder workshop, an ambitious energy efficiency supporting scheme for households could boost the economic activity in the region, especially during the first years of the transition.

Therefore, in the Off-stream scenario, both lignite power plants are shutdown in Megalopolis, but with an extended phase-out plan to mitigate the risks of security of electricity supply due to the energy crisis. This extended lignite phase-out period gives the opportunity to the Megalopolis region for prioritised and accelerated RES investments (both small and large-scale), limiting the use of imported natural gas for power generation as an intermediate fuel. Furthermore, the extended operation of lignite power plants ensures a prolonged operation of the DH system. In parallel, the electrification of the heating sector is promoted from the beginning, phasing-out the DH by 2028.

In terms of the other development pillars (i.e., industry and trade, smart agriculture and sustainable tourism), the On-stream scenario assumptions apply to the Off-stream scenario too, as the "greener" development path of the Off-stream scenario could boost investment propensity for other sectors as well.

Figure 22 summarizes the narrative descriptions for the transition of Megalopolis. It depicts a downward trend in lignite mining and use for power generation, as well as the upward trend for alternative narratives mainly focused on the energy sector, but touching on other economic sectors as well.

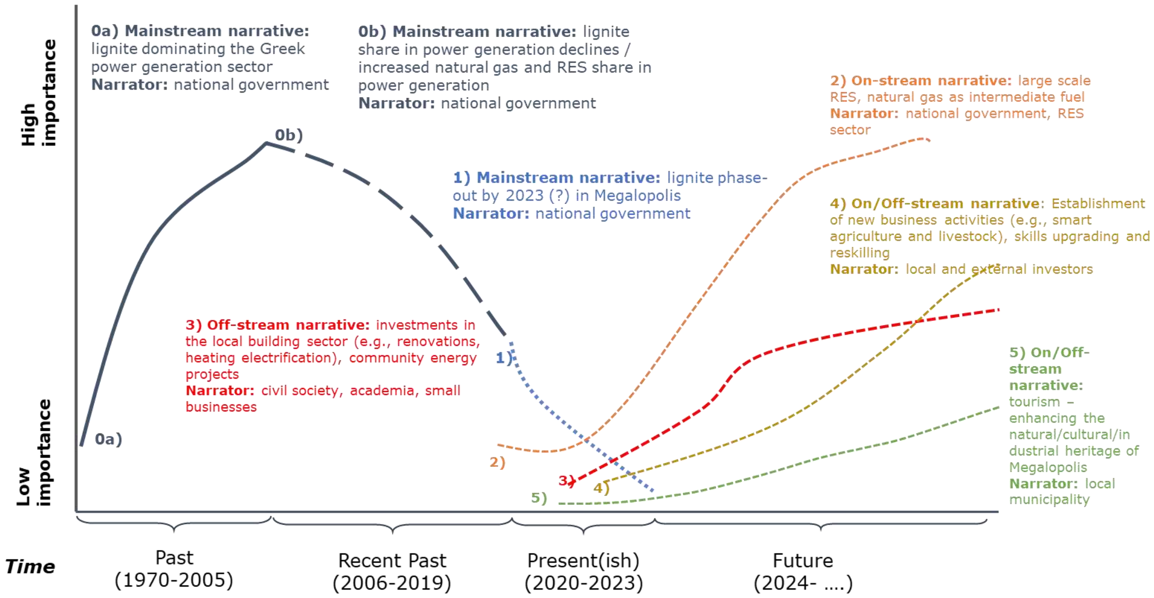


Figure 22. Visualisation of the narratives for the transition of the Megalopolis region.

Table 10 provides an overview of the main indicators derived from the narratives that best describe the energy transition drivers in Megalopolis. These indicators belong to different disciplines, namely economic, technological, policy, and environmental.

Table 10. Contextual factors and trends derived from the narratives related to sustainable transformations.

Contextual factor	Discipline	Trend

CO_2 emission allowances price	Policy, economic & environmental	Upward
SO_2, NOx, and other pollutants gases' emission limits	Policy & environmental	Downward
Natural gas price	Economic	Upwards and unstable
Gas supply reserves adequacy	Policy	Uncertain with potential downward trend
REPowerEU Plan for reduction of dependency on imported natural gas	Policy	Upward
Cost competitiveness of wind and photovoltaic parks	Technological & economic	Downward
New green investments	Economic, Technological	Upward
Abolition of subsidies to the lignite industry	Policy & economic	-
Lignite production	Policy & technological	Downward
Lower heating value	Technological	Downward
Stripping ratio	Technological	Upward

8.6 Scenario specification for the energy transition of the residential sector of Megalopolis

The citizens of Megalopolis will have to endure the impact of the energy transition of the region after the closing down of the lignite power plants, at least in the short term. This impact is going to be threefold: (i) potential loss of jobs, (ii) increased electricity prices due to increasing natural gas prices, and (iii) uncertainty about the diverse heating options and their corresponding cost, which until now was largely provided by the lignite-fueled, district heating system. In this respect, Megalopolis could become a less attractive place to live, since not only the income of the citizens will be at risk, but also the cost of living will increase at the same time.

In this study, we explore how investing in electrification affects the transition impacts of Megalopolis, compared to using natural gas as a transition fuel. In other words, we compare the energy consumption reduction, environmental footprint, and potential extra charge on households for residential heating, deriving from the On-stream and the Off-stream scenario. We focus on the residential sector of Megalopolis, which numbers a total of 3,545 households, and we explore three transition scenarios towards 2050, simulated with the DREEM model. The first two scenarios are aligned with the On-stream narrative and the existing plan of substituting district heating4 and oil heating installations with natural gas in the short term. This means that natural gas is used as the transition fuel

[4] As implied by the initial plan, after the decommissioning of the "Megalopolis III" lignite unit, which supplied the DH system with thermal energy, in 2022, an LPG container was installed in order to secure the seamless operation of the DH system for the transition period (Hellenic Ministry of Environment and Energy, 2020a).

before the electrification of the residential heating sector begins, with different speeds between the two scenarios. The third scenario is based on the Off-stream narrative, and stakeholders' feedback regarding the viability of using natural gas as a transition fuel. In this scenario, natural gas is not considered as an intermediate option for the energy transition of the residential sector of Megalopolis. Instead, in order to accelerate its decarbonization, the deployment of heat pumps (i.e., direct electrification) is prioritized from the beginning. The existing energy mix of the heating system of the residential sector in Megalopolis is presented in Table 11.

Table 11. Existing heating system energy mix in Megalopolis residential building stock (Hellenic Statistical Authority, 2011).

Existing heating system energy mix	
Technology	*Number of households*
Oil	1,514
Electric Heating System	1,407
Heat Pumps	23
Natural Gas	0
District Heating	432
Biomass	169

All dwellings built before 2000 that have their heating technology substituted are also renovated through envelope/ windows upgrades.

In dwellings built before 1981: exterior wall insulation & window replacements.

In dwellings built during the period 1981-2000: building envelope insulations only.

Moreover, to assess the financial viability of each scenario, beyond fuel and renovation costs, we include in our analysis, the costs resulting from the EU ETS, as buildings are among the sectors that will be part of the newly introduced expanded coverage of the EU ETS (Koasidis et al., 2022). Precisely, two cases of the evolution of the ETS price are investigated:

- constant ETS price at 30€/tn CO2 for the whole period of the transition (2025-2050)
- changing ETS price with the following trend: 2025 at 30€/tn CO2, 2026-2030 at 50€/tn CO2, and 2031-2050 at 100€/tn CO2

Fuel and technological costs deployed in this study are presented in Table 12 and

Table 13 accordingly. Recent data regarding the current costs were obtained from the Hellenic Association for Energy Economics (2022), and were projected towards 2050 based on the 2050 Long Term Strategy (Hellenic Ministry of Environment and Energy, 2019a) upward trend.

Table 12. Projected fuel costs for households towards 2050.

Fuel costs for households (€/MWh)				
	2022	**2030**	**2040**	**2050**
Oil (Diesel heating oil)	140.9	190.4	209.0	227.5
Electricity	210.4	200.9	189.0	177.0
Natural gas	142.8	167.8	184.5	201.1
Biomass	61.2	61.2	61.2	61.2
District Heating	7.45	-	-	-

Table 13. Technological costs for building renovations.

Technological costs (€)				
	2022	**2030**	**2040**	**2050**
Natural Gas boiler	5,000	4,904	4,713.4	4,713.4
Heat Pump	12,000	7,680	4,086.7	4,086.7
Envelope and windows upgrade	5,000	5,000	5,000	5,000

The specifications of the scenarios simulated with DREEM are visually illustrated in the following figures:

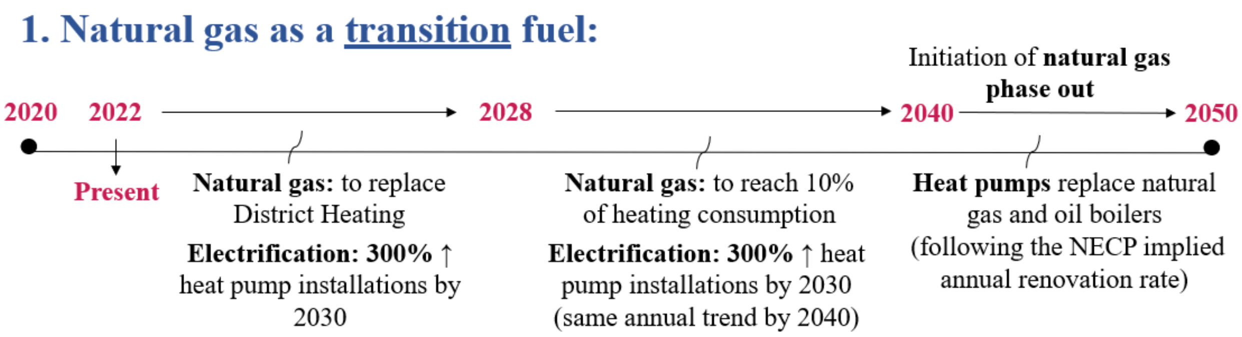


Figure 23. Simulation scenario 1: Investing in natural gas as a transition fuel

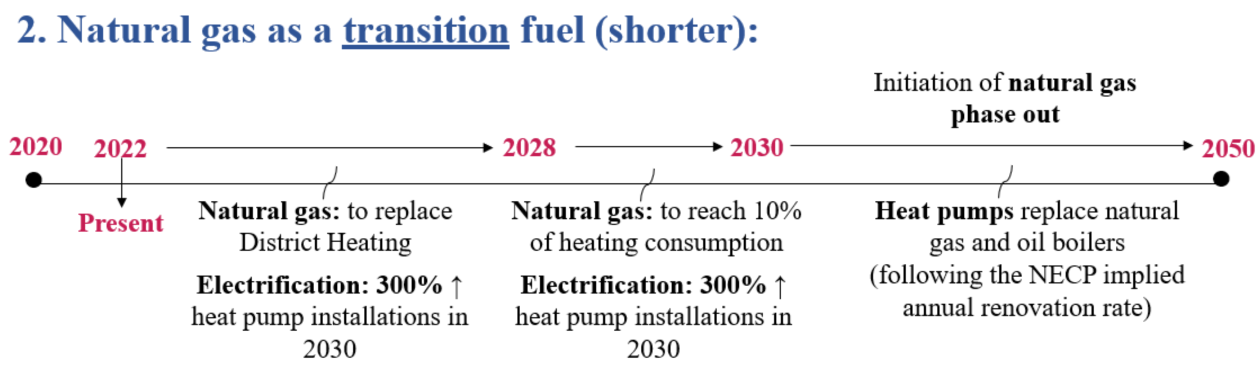


Figure 24. Simulation scenario 2: Investing in natural gas as a transition fuel (shorter)

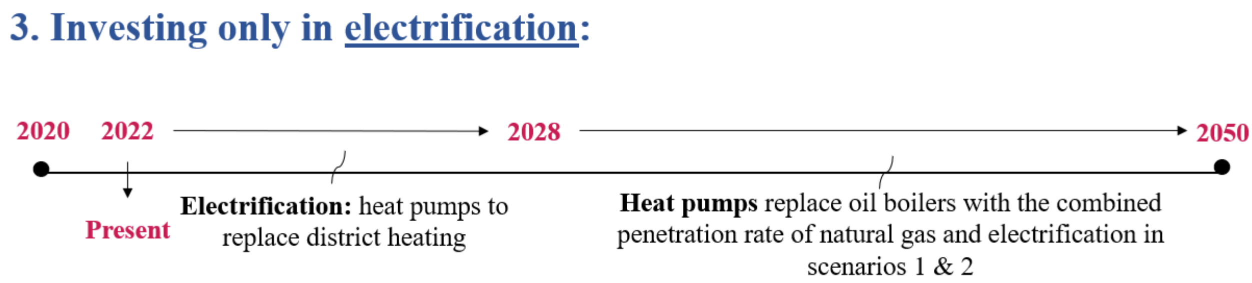


Figure 25. Simulation scenario 3: Investing only in electrificatio

8.7 Summary of key findings

The simulation results of the 3 scenarios described in the previous section provides us with useful findings regarding the energy transition in the residential sector of Megalopolis. As shown in Figure 26, our findings indicate that in 2050 the On-stream scenarios (scenarios 1 and 2) lead to approximately the same final energy consumption (62% and 60.7% of the initial respectively), while the Off-stream, scenario 3 leads to a greater reduction of the final energy consumption (48% of the initial), due to the earlier replacement of fossil fuel-based heating with heat pumps.

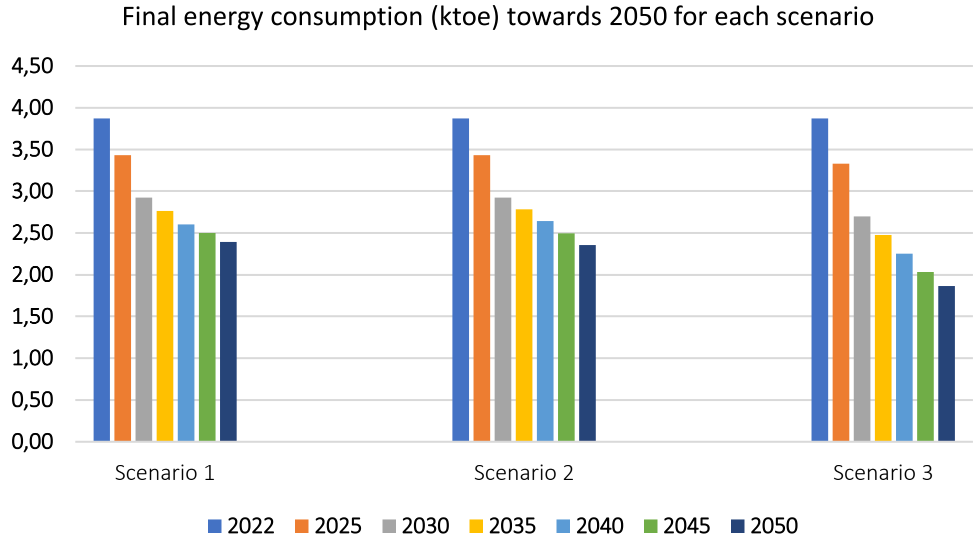
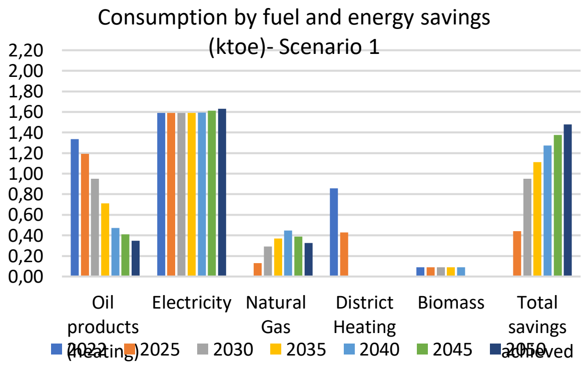
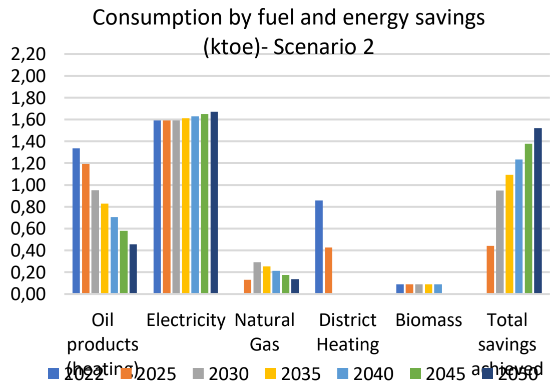


Figure 26. Final energy consumption towards 2050 in the residential sector of Megalopolis – Cross-*scenario*

Figure 27 presents the evolution of the energy mix in the residential sector of Megalopolis towards 2050. An interesting observation is the fact that investing in electrification from the beginning (Off-stream, scenario 3) leads to decarbonisation levels by 2050 (i.e., fossil fuel consumption is almost eliminated), while the On-stream scenarios lead to 0.67 ktoe and 0.59 ktoe of fossil fuel consumption, respectively. It is important to note that in order to completely phase out DH until 2028, an annual renovation rate of the Megalopolis building stock equal to 2.5% should be followed, which is 250% higher than the one implied by the NECP.





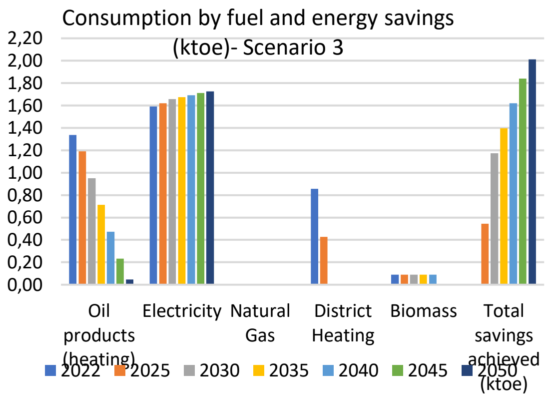


Figure 27. Consumption by fuel and energy savings (ktoe) towards 2050. Cross-scenario comparison.

To what concerns the environmental footprint of each scenario, the CO2 emissions are used as an indicator. As shown in Figure 28, the Off-stream scenario, which promotes electrification from the beginning, has the most positive effect and leads to the lowest CO2 emissions in 2050, equal to 425 tnCO2. Whereas the On-stream scenarios 1 and 2 lead to more than quadruple emissions compared to the Off-stream, equal to 2,031 tnCO2 and 1,895 tnCO2, respectively. An interesting finding is that during the period 2030-2040, the scenario 1 leads to slightly lower emissions compared to the other On-stream scenario (scenario 2), which features natural gas as an intermediate technology for a shorter time. This is because during the period 2030-2040, in scenario 1 oil boilers (which is the most emission-intensive technology) are substituted by both natural gas and heat pumps, thus achieving high decarbonization rate. While in scenario 2, heat pumps replace both natural gas and oil boilers, thus dividing the decarbonization effort between the most emission-intensive and the 2nd most emission intensive technology. Therefore, the remaining emission-intensive oil boilers are more in scenario 2, thus leading to a decreased decarbonization outcome with respect to scenario 1.

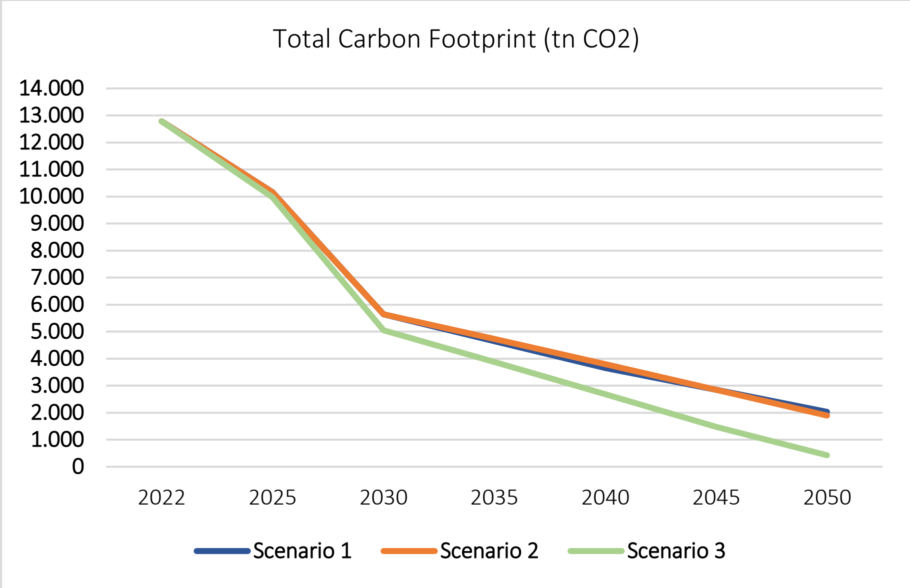


Figure 28. Environmental footprint (tnCO2) towards 2050. Cross-scenario comparison.

In terms of costs, each of the three scenarios entail different fuel and renovation costs. As shown in Table 14 and Table 15, focusing on investing only in electrification (Off-stream, scenario 3), compared to utilising natural gas as a transition fuel (On-stream, scenarios 1 and 2) leads to reduced annual fuel costs, and thus to increased annual fuel cost savings. Scenario 1 leads to a total of €24.85M fuel savings towards 2050, scenario 2 saves €23.72M fuel costs in the same period, while scenario 3 saves €44.02M in total, which is almost double the savings of the On-stream scenarios. The lower cost savings of scenario 2 compared to scenario 1 are justified by the higher number of oil boilers which remain during the period 2030-2040, which are less efficient than gas boilers.

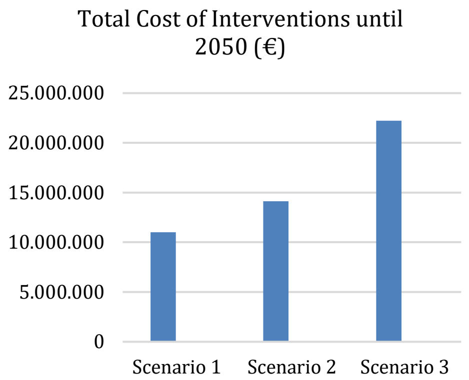
Table 14. Annual fuel costs of the residential sector of Megalopolis towards 2050. Cross-scenario comparison.

Fuel costs (€)	2022	2025	2030	2035	2040	2045	2050
No renovations	6.22M	6.44M	6.81M	6.85M	6.88M	6.91M	6.95M
Scenario 1	6.22M	6.37M	6.46M	6.08M	5.67M	5.40M	5.11M
Scenario 2	6.22M	6.37M	6.46M	6.16M	5.82M	5.44M	5.03M
Scenario 3	6.22M	6.21M	6.04M	5.51M	4.93M	4.29M	3.74M

Table 15. Annual fuel costs savings (compared to 2022) of the residential sector of Megalopolis towards 2050. Cross-scenario comparison.

Fuel costs savings (€)	2022	2025	2030	2035	2040	2045	2050
Scenario 1	-	0.07M	0.36M	0.77M	1.21M	1.51M	1.84M
Scenario 2	-	0.07M	0.36M	0.69M	1.06M	1.47M	1.92M
Scenario 3	-	0.23M	0.77M	1.33M	1.95M	2.62M	3.21M

Concerning the renovation costs, as shown in Figure 29, the scenario that focuses more on investing in electrification instead of natural gas entails higher costs due to the increased investment costs of heat pumps compared to the other technologies, especially in the short term where the effort to completely phase-out DH is higher. In fact, the earlier the phase out of fossil-fuels, the higher the annual investment costs (scenario 1 is the least-costlier and scenario 3 is the costlier). The total cost difference between the Off-stream and the On-Stream scenarios is mainly attributed to the period 2022-2030, as during this period the scenario that promotes electrification endures the higher cost difference among the heating technologies as shown in Table 13. Of course, it should be pointed out that infrastructure and other indirect costs are not included in the renovation costs. Only costs to be paid by consumers/households are included.



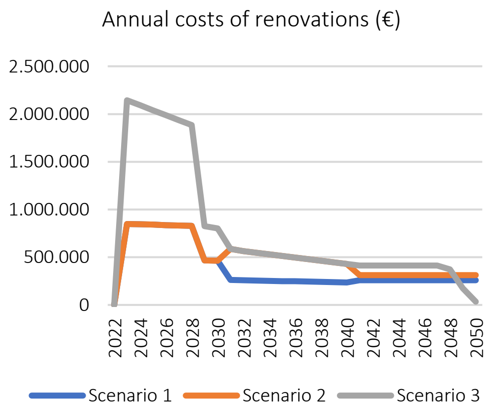


Figure 29. Total and annual renovation costs towards 2050. Cross-scenario comparison.

Finally, to account also for the inclusion of the residential sector in an expanded ETS, two cases for the evolution of the ETS price are investigated as mentioned in the previous section: (i) constant ETS price at 30€/tn CO2 for the whole period of the transition (2025-2050), (ii) changing ETS price with the following trend: 2025 at 30€/tn CO2, 2026-2030 at 50€/tn CO2, and 2031-2050 at 100€/tn CO2. Figure 30 suggests that in both cases of the ETS price evolution, the ETS-related costs are reduced when investing only in heat pumps (Off-stream, scenario 3). Indicatively, in the case of the increasing ETS prices, if compared, Scenario 1 and Scenario 2 lead to total ETS related costs of €6,32M and 6,36M by 2050 respectively, while Scenario 3 leads to €3.87M, reducing the total cost by almost 39%. Moreover, we notice that for the period 2030-2040 the annual ETS costs of scenario 2 are higher compared to scenario 1, following the trends of the CO2 emissions described above.

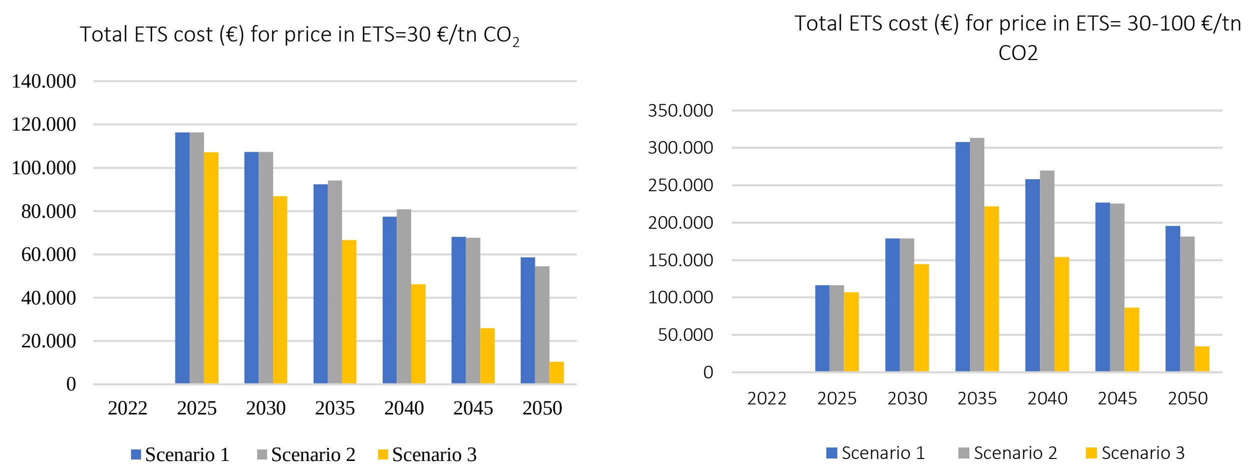


Figure 30. ETS relevant costs for the two cases of ETS price evolution. Cross-scenario comparison.

To extract a robust and useful comparison regarding the financial viability of each energy transition scenario we aggregated the individual costs (i.e., ETS relevant, fuel, and renovation costs), firstly at the household and then at the local - municipal level. Figure 31 presents the potential extra charge at the household level if the ETS, fuel, and renovation costs of each energy transition scenario are equally distributed to each household of the region, for both cases of the evolution of the ETS price. In both cases of the ETS assumptions, all scenarios present an increased extra charge until 2030, which is triggered by the investment cost needed to substitute DH, but in the long term all scenarios lead to reduced overall annual energy costs per household compared to not proceeding in any renovation at all. Furthermore, after 2030, investing only in electrification (Off-stream, scenario 3) leads to lower annual costs for electricity and fuels, counterbalancing the notably higher renovation costs in the period 2023 – 2028 in scenario 3.

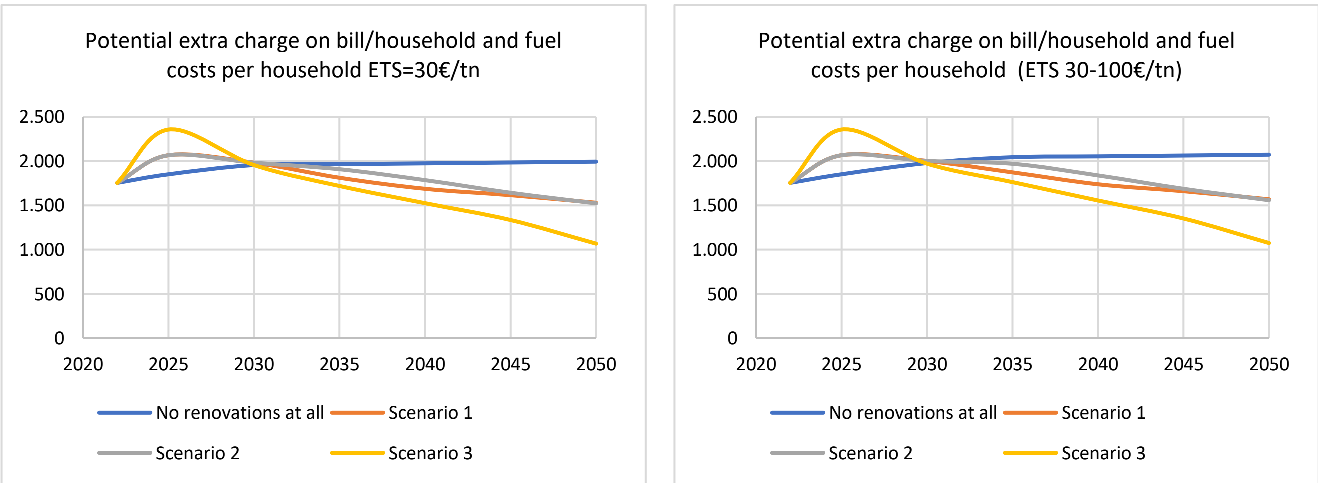


Figure 31. Potential extra charge on bill/household and fuel costs per household in the two cases

of the ETS prices evolution. Cross-scenario comparison.

Most interestingly, as shown in Table 16, the Off-stream scenario which leads to increased renovation costs in the short-term compared to the On-stream scenarios, results in the lowest total cost during the transition period at the household and municipal levels. Besides, another noteworthy observation is that when investing in natural gas as a transition fuel (scenarios 1 and 2), the earlier the phase-out the higher the total costs at the household and municipal levels, validating the argument that investing in fossil fuels may result in a new lock-in which could be costly to avoid.

Table 16. Total costs savings at the household and Megalopolis municipal level towards 2050, for the two cases of the evolution of the ETS prices. Cross-scenario comparison.

Total costs (ETS relevant, fuel, and renovation costs) towards 2050 (€).	**Household level (ETS=30€/tn)**	**Local level (ETS=30€/tn)**	**Household level (ETS=30-100€/tn)**	**Local level (ETS=30-100€/tn)**
No renovations	56,260	199.4M.	57,945	205.4M.
Scenario 1	52,121	184.8M.	53,267	188.8M.
Scenario 2	53,318	189.0M.	54,471	193.1M.
Scenario 3	49,653	176.0M.	50,329	178.4M.

Overall, the investment in electrification from the beginning (Off-stream scenario) leads to lower total costs (sum of ETS, fuel, and renovation costs) at both the household and the local-municipal level, in comparison to investing in natural gas as a transition fuel. Specifically, our findings show that investing in electrification leads to lower ETS and fuel costs and higher renovation costs in the long run, but the attained ETS and fuel cost savings under this scenario, surpass the extra renovation cost. Therefore, investing in electrification from the beginning is the most efficient scenario in terms of energy consumption reduction, environmental footprint, and potential extra charge on households. On the contrary, households' extra charge from the replacement of existing oil boilers with gas boilers may amplify the energy poverty phenomenon in the region due to double investments that would need to burden the consumers in the long run.

8.8 Key enablers and barriers to a potential tipping point

The 2022 increases in natural gas and electricity prices changed radically the EU's energy landscape and could be considered as a tipping event that may enable positive "sectorial tipping points" at different administrative levels. Specifically, in our case, a pathway shift in the energy transition of the residential sector of Megalopolis could be triggered by gas supply uncertainty and soaring prices. Amid this uncertain geopolitical situation, doubts are raised about whether the existing plan for the residential heating sector of Megalopolis, which promotes the expansion of the natural gas distribution network in the region, should be followed or whether pushing forward for the direct electrification of the residential sector could be a wiser option. Our analysis suggests that following the existing plan may result in a natural gas lock-in effect, exposing Megalopolis households to costly energy bills for decades. Instead, we show that direct electrification is the most efficient option in terms of energy consumption, energy costs for households and environmental footprint. This result complies with the intension of the REPowerEU plan to double the diffusion rate of heat pumps and reach 10 million installation by the next 5 years (European Commission, 2022).

Therefore, the recent developments could be considered as the tipping event that may pronounce a positive "sectorial tipping point" (Tàbara et al., 2021), in this case meaning a shift in the energy consumption vision of the residential heating sector of Megalopolis. Yet, could this sectorial tipping point trigger a "systemic tipping point" which impacts a whole chain of interconnected systems, throughout a whole sort of personal, organisational and political arrangements (Tàbara et al., 2021)? For example, some of the main issues identified by the different groups of stakeholders consulted, beyond the doubts about using natural gas as a transition fuel, concern the reskilling of the local workforce and the creation of new job opportunities. While this is uncertain to predict, as implied by Constantini et. al (2018), energy efficiency related policy schemes might have different impacts on employment dynamics depending on the sector and country. Nevertheless, the promotion of energy efficiency and the expediting of structural transformation toward less energy-intensive growth through targeted policies should be deemed a development priority that could contribute not only to the climate goals but to the boost of long-term growth (Rajbhandari and Zhang, 2018).

For instance, under the current uncertain conditions regarding the energy strategy of the EU and Greece, investing in energy efficiency and electrification seems the most reliable option in view of a decentralized, RES based electricity system. The implementation of energy efficiency and heating upgrade schemes will boost the construction sector in the region, especially during the implementation phase which coincides with the critical phase of the Megalopolis transition period. Since the construction sector contributes to a considerable amount of low and highly skilled jobs, mainly during the implementation phase (Zambotti, Pezzutto and Bisello, 2019), this would imply a boost in Megalopolis' job opportunities.

Finally, considering that the high annual costs of renovation, as well as the need for courageous political decision to change the existing plan are the main barriers for the implementation of direct electrification from 2023 onwards, the available funding options under the Just Transition Mechanism could be a unique opportunity for regions in transition to finance and implement tailor-oriented energy efficiency support programmes.

Table 17 summarizes the key enablers and barriers that could trigger or hinder a shift of the Megalopolis residential sector away from natural gas and towards electrification

Table 17. Key enablers and barriers that could trigger or hinder a positive tipping point in the heating sector of Megalopolis

Contextual factor	Enabler/Barrier	Discipline	Trend
Natural gas price	Enabler	Economic	Upwards and unstable
Gas supply reserves adequacy	Enabler	Policy	Uncertain with potential downward trend
REPowerEU Plan for reduction of dependency on imported natural gas	Enabler	Policy	Upward
Renovation costs	Barrier	Economic	Downwards but still expensive
Political commitment for electrification	Enabler/Barrier	Policy	-
Funding Mechanisms	Enabler	Economic/Policy	Upward

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9 Case study 8: Indonesia

The role of transformative network and vision in driving Collective Pro-sustainability Actions towards Positive Socio-Ecological Tipping Points: the case of Indonesia

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9.5 Introduction

9.5.1 CCIR description

As the formal region, Banten and Bali Province has definite boundaries. Each province is led by a governor. Banten province covers 9,662 km2 at the most western part of Java Island with its capital Serang City, consisting of 4 regencies and 4 municipalities. This province is relatively young, the expansion of West Java Province started in 2000. The autonomy of the province was founded by the belief of the local people that the land was the only area not conquered during Dutch colonialism. Banten people feel special about this history; hence they had been fighting to be a province since Independence Day (1945), yet achieved in 2000. Banten is recognised as the centre of cultural development, starting from Hinduism in 15th century, then becoming an important part of Islamic development in West Java. Nowadays, the majority population is Muslims that influence the culture of the province. Hence, the governance is influenced by religious values, which are Islamic. On the other hand, Bali Province is the leading tourist island in Indonesia. Religion also plays a significant role in defining social norms and values among Balinese people. Hinduism and Sanskrit values influence later the social attitude of the Balinese. The province covers 5,780 km2 encompassing eight regencies and one municipality.

As functional region, Banten province is known as the region of an economic hub, home to around 12.9 million people and thousands of medium and large industries (Rahayuningsih, 2017), including the biggest coal power plant installation (see Figure 3), petrochemical, and steel production plant of the country. Banten and Bali are connected through electricity interconnection grid, namely JAMALI (Java-Madura-Bali) grid. The electricity from Banten is usually acts as regional balance in western Java in addition to secure overall Java-Bali electricity provision especially during peak hour. Until 2020, 50% of electricity generated in Banten (total 8,994 MW) is distributed to Java island and Bali (Banten Local Government, personal communication, 2021). Hence, Banten operates as the electricity provider for Java and Bali Island. Moreover, almost half of Bali's electricity demand is supplied from Java Island, mainly from coal power plants through a sea cable. The map of its interconnection is shown in Figure 1.

Figure 1. Java-Bali Electricity Interconnection Grid (JAMALI grid)

Also, Banten as an economic hub attracts migration movement domestically, as shown in Figure 2. The largest settlement is the Tangerang District (29% of the total inhabitants) that plays a major part in the migration movement followed by Tangerang Municipality (BPS Banten, 2019b, 2019a). These two districts are the centre of labour-intensive processing industry, thus attracting migration movement domestically and internationally. In total, around 3% of the total population were migrants in 2017. People from Jakarta, South Sumatra, West Java and Central Java Province are the main domestic migrants of Banten (BPS Banten, 2017). On the other hand, migration flows in Bali mainly revolves within the region due to massive tourism development. Outside migrants only accounts around 3% from the total migration of Bali in 2016 (BPS Bali, 2016).

Figure 2. Domestic migration flow for Banten Province (BPS Banten, 2017)

9.5.2 Societal problem description

As a country, Indonesia is ranked world's fifth largest emitter of greenhouse gases due to the land conversion of its forests and carbon-rich peatlands and extensive use of coal (Friedrich et al., 2017; Resosudarmo et al., 2013). This country utilizes two types of energy: 'dirty' energy (e.g. fossil fuels, traditional biomass) and clean energy (e.g. hydropower, geothermal, solar PV, biogas). The 'dirty' and 'clean' energy refers to Papageorgiou et al. (2013) who defined 'dirty' and 'clean' energy depends on how the use of an energy source affects the atmospheric concentration of CO2. Shinn (2018) elaborated that 'dirty' or non-renewable energy sources are available in limited amounts, take a long time to replenish and they have harmful impacts on environment and human health. Despite the emergence of climate change impacts in Indonesia, the country is seemingly moving in the opposite direction by highly relying on fossil fuels (coal, oil, and natural gas) to support its economic growth. Banten and Bali Province are two provinces located in Indonesia. These two areas are among the top five provinces in Indonesia where coal power plants have been built, shown in Figure 3.

The electricity demand of Banten Province is supplied by coal power plants (around 19 units) located in the area e.g., Suralaya coal power plants Unit 1-8 and Labuhan coal power plant (Byers et al., 2018). These coal power plants are also the backbone of Java-Bali connection (JAMALI grid), around 50% electricity generation is distributed to the grid. Although Banten's economy is mainly driven by manufacturing industry, this province has the oldest and highest coal power generations (Figure 3). Banten is also an industrial region, home for thousands of medium and large industries including the biggest steel production plant of the country (Yusuf et al., 2021). On the other hand, Bali is recognised with projected rapid economic growth due to tourism sector (Hasibi, 2021). To meet its energy demand, Bali has seven power generation plants that are fossil fuel-based. However, as its energy consumption exceeds its energy supply capacity, Bali Province is coupled with the Java grid (mainly from East Java). This suggests that Bali's energy security is insecure. Overall, both provinces' electricity generation is still dominated by fossil fuels (i.e. coal, gas, and oil), as depicted in Figure 4. With the increasing energy demand of the regions, more coal power plants are expected to be built in the next decades (Pardiansyah & Untoro, 2019), as depicted in Figure 5.

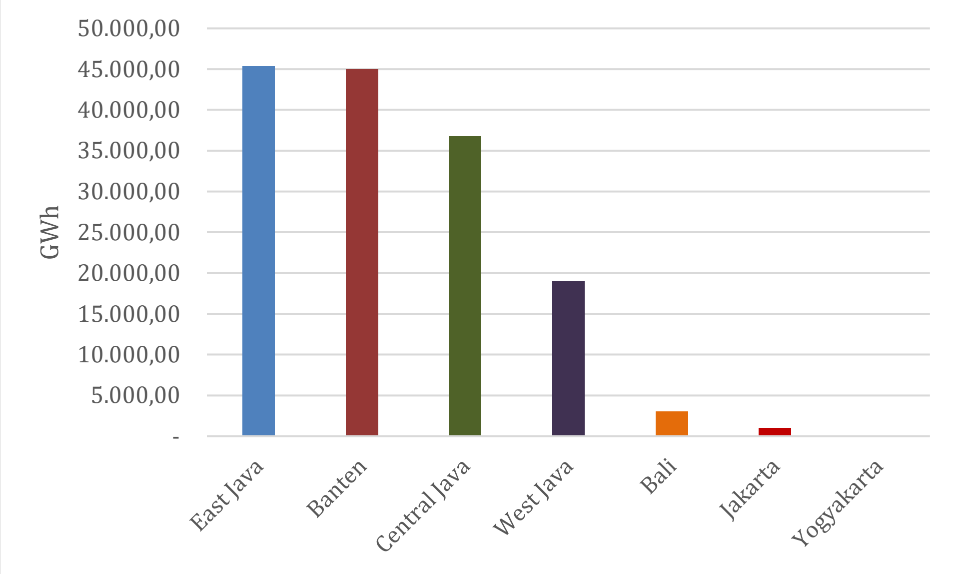

Figure 3. Electricity generation from coal in Java-Bali per province in 2018

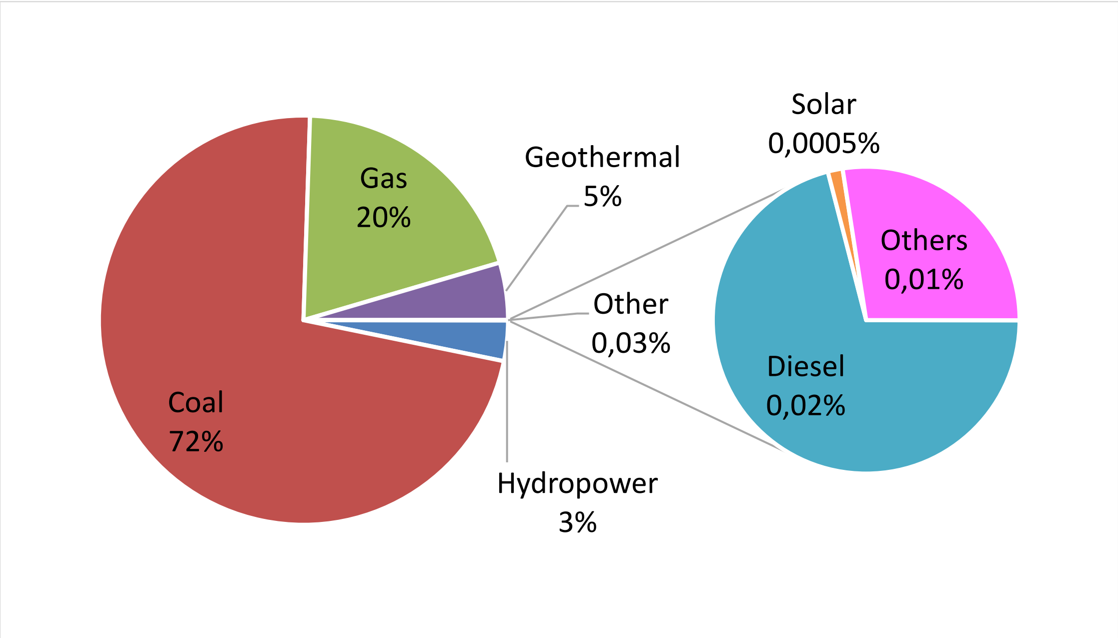

Figure 4. Electricity Mix of Java-Bali Connection in 2018 (BPS Indonesia, 2020)

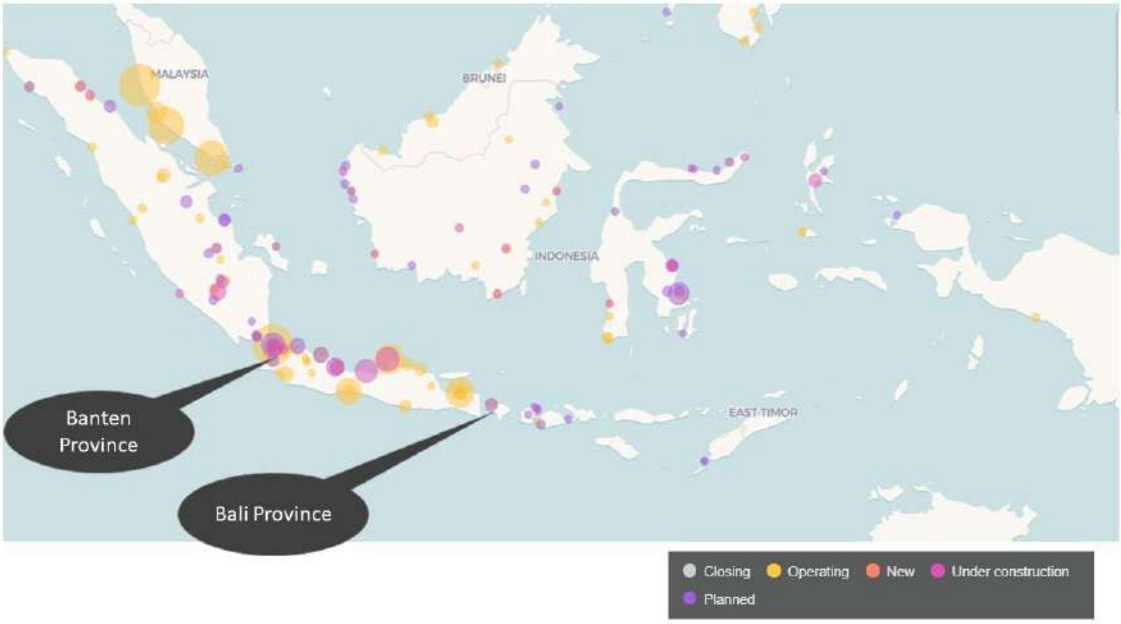

Figure 5. The location of coal power plants in Indonesia until 2019 (Source: Carbon Brief 2020)

9.5.3 Research problem

To understand the transformation process in the context, we utilised geography discipline to set a spatial boundary for our case study as coal and carbon intensive regions and how these areas are interrelated. In transformation studies, the concept of 'region' has been linked in order to comprehend the scale of transformation (e.g., Hettne & Söderbaum (2000). A growing number of scholars argue that 'region' is not a distinct scale in the stratified spatial system of the state, but rather a product and reflection of perpetual and contested sense creation in a vast network of social relations that coalesce in 'regions'. For instance, Hettne & Söderbaum (2000) suggested region consists of 'large imagined communities' and their interactions might create regional transformations. Noteworthy, Anssi Paasi & Kaj Zimmerbauer (2011) demonstrated that regions can have 'borders' but not be strictly 'bounded'. Therefore, our hypothesis is the transformations towards sustainability in these coal and carbon intensive regions can be understood from the agents and their interactions within the regions. These are necessary to comprehend from which state these regions could possibly transform to and what changes. Furthermore, to understand deliberate actions or interventions of the agents, we conform with theory of action by Parsons (Parsons, 1937) in which he established a foundation for all future studies of action in social theory, including the requirement that acts by the agent have a future state of orientation and end. As a result, we believe that transformative visions of agents in coal and carbon-intensive regions (CCIRs) are important to achieving sustainability transitions.

By exploring transformative vision, we utilised the principal of environmental psychology. Transformative vision in the social-ecological system is an output of a psychological process when there is an unpreferable change in the ecological system such as biodiversity degradations or resource depletions. The distress or grief triggers people to seek alternatives to solve the problematic condition, leading to adaptive efforts or transformative actions. Hence, we would like to assert transformative vision could be a precursor of social-ecological tipping points owned by transformative or tipping agents (Moore & Milkoreit, 2020). On the other hand, we recognise the importance of networked agents using sociology (e.g., Newman, 2018), combining with the concept of regions, to generate multi-scale and contiguous impacts of socio-ecological tipping points (Ilona M. Otto et al., 2020; Loftin, 1986) in the respective regions.

In this study, we perceive the transformative vision and the agents' network are powerful agency for transformation in coal and carbon intensive regions (CCIRs). We are interested in human agency is as the capability of numerous organisations and their networks to cause change (Clark & Harley, 2020). Many studies have recognised the importance of actors' agency with their transformative capacities including having transformative vision and networks in enabling transformations (e.g., Westley et al. 2013; Otto et al. 2020). Also, Moore and Milkoreit (2020) suggested that imagination capacity should be owned by the agents to create novelties and challenge the regime towards transformation. Moreover, social networks as part of the agency is pivotal because networks offers the benefits to prepare, mobilize and adapt with changes through for example knowledge sharing, vision building (Waddock, 2020) and resource management (Charli-Joseph et al., 2018). This implies the necessity to incorporate the role of human agency in social tipping points that eventually lead to positive or negative feedbacks in ecological system (Winkelmann et al., 2020). Although there are numerous studies indicating the importance of a shared transformative vision within the agents' network, the extent to which these characteristics could trigger tipping points in CCIRs is still unknown due to the fact that most studies are conducted in developed nations and urban areas (e.g., van der Jagt et al. 2020; Yazar et al. 2020). In other words, many studies are still lacking in providing the empirical understanding of how transformative visions and the agents' network can be used as the indications of the socio-ecological tipping points in the CCIRs towards different trajectories, particularly from emerging economy contexts.

9.5.4 Research questions

Who are the transformative agents that could accelerate SETPs in Banten and Bali Province?

How Q-methodology and social network analysis (SNA) can be utilised as the methods to obtain empirical evidence for identifying transformative agents, their transformative visions and network as the early-warning of social-ecological tipping points in in Banten and Bali Province?

9.6 Research approach

Aligning the concept of regions, network analysis and theory of actions by Parsons, we conform with a simple procedural framework, suggested by Tàbara et al., (2018). The framework presupposed transformative pathways consisted of several positive tipping points, that require key agents with transformative capacities to allow new condition or the transformation to occur. A positive tipping point happens when the reference system is transformed irreversibly in a way that matches or even exceeds a particular vision. A vision of transformation in this case is assumed as the result of policy making process as the main driver, and cumulative effects of multiple interlinked actions – or interlinked systems of transformative solutions. Achieving the vision can occur swiftly if the key agents are equipped with the required transformative capacities to implement pathways of solution towards, in this case, decarbonization (as the result of transformation or new system condition) as described in Figure 6. Noteworthy, multiple tipping points cannot be treated separately as they are dependent one to another: crossing one point will highly affect the likelihood of crossing another, creating either catastrophic or beneficial cascades. Hence, we want to promote the networked system of agents as one of the transformative capacities or a means of early-warning of multiple social tipping points that may affect ecological system (Gangwal et al., 2020; Lenton et al., 2022), in this case towards clean energy.

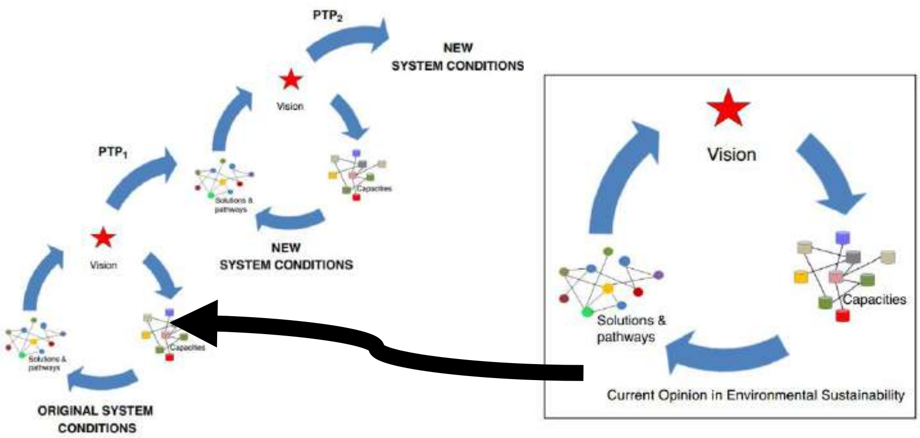

Figure 6. A Principle of Positive Tipping Point (PTP)

Recognising networked social agency and shared transformative visions play a key role in igniting sustainability transformations. This study aims to understand how positive social-ecological tipping points (SETPs) towards clean energy systems emerge as a result of networked coordination activities and the shared vision among local, national and transnational agents. Using narrative analysis, Q-methodology, and network analysis in a participatory sustainability setting, we examined alternative visions, transformative capacities, and modes of interaction that could tip the current energy systems in Banten and Bali, Indonesia, towards clean energy futures. As a result, it is anticipated that understanding the shared transformative vision among the key agents and their networked system will serve as an early warning to induce positive tipping points toward clean energy. Ilona M. Otto et al., (2020) suggested several tipping interventions including the change of value through defining the alternative vision could lead to some tipping interventions such as enabling policy provision and technological innovation for rapid decarbonisation. Therefore, we combined the framework proposed by J David Tàbara et al. (2018) regarding transformative vision with the framework proposed by Ilona M. Otto et al. (2020) about tipping interventions in order to provide empirical evidence of how shared transformative vision plays a crucial role in igniting tipping interventions and subsequently generating a systemic change toward sustainability.

To achieve the objective of our study, we applied a mixed-method approach. The analysis of agents' narratives with the Alternative Pathways Framework was obtained from semi-structured interviews and participatory workshops reveal the existence of different links of collaboration mechanisms and learning feedbacks occurring at different moments in time, most likely to accelerate the tipping of local energy systems towards a clean and sustainable trajectories and configurations. Subsequently, the perspectives on what the transformative vision would be was investigated using Q-methodology by analysing the obtained narratives followed by a survey and focus group discussion. Furthermore, the agents' interactions to operate and transform the region has become an interest in sustainability transition and social-ecological transformation studies (e.g., Barnes et al., 2017; Horcea-Milcu et al., 2020).

9.7 Narratives

Human is unquestionably responsible for ecological changes including global warming, mainly from fossil fuel combustion and agriculture (Arias et al. 2021). Despite the climate change urgency, the world is seemingly moving in the opposite direction by highly relying on fossil fuels, particularly in the world's poor and developing countries. After the Paris Agreement, there is increasing attention to societal transformation in multiple contexts to maintain the global temperature increase by 1.5oC (Roy et al. 2018). There are many studies portraying such transformation as rapid and non-linear change. Some studies also recognise it as social tipping point (e.g., Tàbara et al. 2018; Milkoreit et al. 2018; Otto et al. 2020). Social tipping point dynamics involve a metamorphosis in social process involving networks, behaviours, knowledge, policy technologies, institutional setting, norms and values among the actors (Nyborg et al., 2016).

We deduce that those features belong to the social actors with powerful agency for transformation. Many studies has recognised the importance of actors' agency with their transformative capacities and power in enabling transformations (e.g., Westley et al. 2013; Otto et al. 2020). For example, Moore and Milkoreit (2020) suggested the imagination capacity should be owned by the agents to drive towards transformation. Moreover, social networks, the contributions from sociologists (Newman, 2018, p. 47), as part of the agency is pivotal because networks offer the benefits to prepare, mobilize and adapt with changes through for example knowledge sharing, vision building (Waddock, 2020) and resource management (Charli-Joseph et al., 2018). This implies the necessity to incorporate the role of human agency in socio-ecological tipping points that eventually lead to positive or negative feedbacks in ecological systems (Winkelmann et al., 2020), especially giving more spotlight to exploring transformative vision and understanding transformative agents' network.

To our knowledge, current literature is still lacking in providing the empirical understanding of how the energy system as a social-ecological system could tip towards more sustainable pathways, particularly from emerging economy contexts. Furthermore, the methods to explore transformative visions and agents' network in coal and carbon intensive regions are still limited. Hence, we proposed a mixed method approach.

The mixed-participatory approach encompasses three methodological tools to explain who the agents' that have the agency in triggering social-ecological system through their transformative vision and network. Firstly, we utilised the Alternative Pathways Framework to explore the potential for transformative vision and the potential tipping or transformative agents through narratives. Furthermore, Q-methodology was applied to generate discourses of transformative visions and the transformative agents of the various pertinent stakeholders in Banten and Bali Province. Lastly, Social Network Analysis (SNA) is to understand how transformative visions set by various agents and their power dynamics diffused through their social networks, possibly creating a systemic shift. Hence, we can anticipate that which agents of the contexts could be the drivers or solutions to tip the current unsustainable regions. The information was collective in the form of narratives from pertinent stakeholders within the regions. The profile of the engaged stakeholders are depicted in Figure 7.

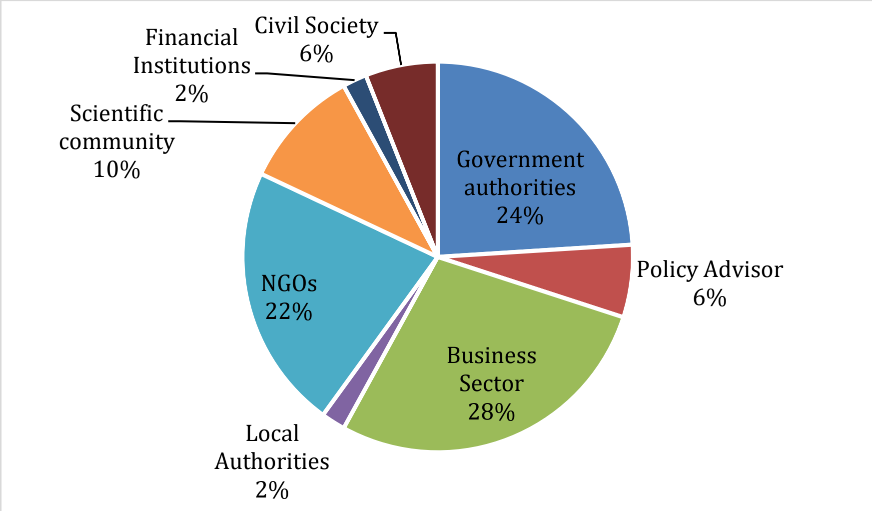

Figure 7. The profile of stakeholders that were interviewed for identifying the transformative network and vision

9.7.1 Mainstream narrative: technology

To maintain the economic growth, fossil fuels (e.g., coal, oil and gas) are the main primary energy source of the country, for instance around 50% electricity comes from coal in 2019, followed by gas and oil, respectively (MEMR, 2020). The electricity demand of Banten Province is mainly supplied by coal power plants (approximately 19 units owned by PLN and IPP), the region with the most installed coal power plants of the country (MEMR, 2020). These coal power plants are also the backbone of Java-Bali connection (JAMALI grid); around 50% electricity generation is distributed to the grid, especially in western Java (PLN, 2020) in addition to maintaining the reliability of Java-Bali network. Although Banten's economy is notably driven by manufacturing industry, this province has the oldest and highest coal power generations in the country and its electricity supply accounts for about 20% to JAMALI grid. Similar to Banten, Bali has seven power generation plants that are fossil fuel-based (i.e. coal, gas, and oil). This province has only one coal power plant since 2015. Since the energy demand is higher than the capacity of its energy supply, the region is then interconnected with Java grid (mainly from East Java). The energy demand mainly comes from tourism and agricultural activities.

9.7.2 Mainstream narrative: stakeholders and institutions

Current mainstream narrative around fossil-fuel is driven by mainly actors in policy and technological context in which the fossil-based technology operates. At policy level, the sector is governed by Ministry of National Development Planning (Bappenas), and Ministry of Energy and Mineral Resources (MEMR) at national level. On the other hand, MEMR is represented in each province, known as Dinas Energi dan Sumber Daya Mineral/ ESDM or Agency of Energy and Mineral Resources. For instance, affairs related to energy sector in Banten is coordinated by the Energy and Mineral Resource Agency (ESDM-Banten) in collaboration with the district until the village government likewise Bali (i.e., ESDM-Bali).

In market system, PLN (state-owned electricity enterprise) is considered the key actor in implementing and maintain the electricity system of the country in addition to the private companies. While private companies are encouraged to produce electricity and sell to PLN; PLN is alone responsible to provide the transmission and distribution infrastructure. Also, PLN has privilege to issue policies and regulations (e.g., electricity tariff, technology choice) to shape the electricity market based on economic and social impacts. In terms of oil and gas, PERTAMINA and PGN manage the downstream and upstream activities. These actors are often mentioned as key players in the sector to initiate a systemic change towards sustainable energy in literature (e.g., (Maulidia et al., 2019; Setyowati, 2020; Shojaeddini et al., 2019) and interviews.

9.7.3 Mainstream narrative: ideologies

9.7.4 Mainstream narrative: policies

Current energy policies allow lush growth of fossil fuels that aims for 100% electrification hence the constructions of new coal and gas power plants are expected at least for the next twenty years. The national energy policy (Government Regulation No. 79/2014) indicates the energy consumption should enhance energy conservation, minimise the use of oil, maximise renewable use, optimise the use of gas and be secured by coal. This implies coal still has perennial position in the country’s electricity system. Furthermore, the PLN’s electricity supply business plan 2019 – 2028 prepares 54.4% electricity generation will come from coal in 2028 (8% reduction compared to 2019) (PLN, 2020). Recently, PLN updated its electricity supply business plan (RUPTL) for 2021 – 2030 with a renewable mix by 2030 of 51.6 percent, compared to 48 percent fossil fuel. This is another anticipated intervention by other stakeholders to demonstrate PLN's commitment to diversifying the country's electricity system, including Banten and Bali Provinces.

9.7.5 Alternative on-stream narratives

In general, the stakeholders who promote on-stream technologies for electricity are mainly dominant stakeholders operating in mainstream systems, such as Ministry of Energy and Mineral Resources (MEMR), PLN as well as the local government. To reduce oil dependency, natural gas use emerges in addition to coal as an alternative while also resolving public concerns on clean air. Other than natural gas, the national government also promotes several less-carbon solutions such as fuel switching, co-firing, hybrid systems, and clean coal technologies (CCT). Fuel switching is deployed at fossil-fuel-based power plants, for example, gas and biofuel use in diesel power plants. As mentioned, the national government still favors coal use to secure the system reliability hence promote technologies and practice to solely reduce the GHG emissions at the power plants such as co-firing with biomass and the clean coal technologies (CCT), i.e., sub-critical and ultra-supercritical boiler. The national government encourages co-firing with biomass at coal power plants and aims to increase the ratio up to 30%. Such practices are encouraged under the regulation of MEMR and Electricity Supply Business Plan by PLN (RUPTL).

At province level, some power plants in Banten and Bali already initiated the on-stream technologies suggested by the national government. In Banten, there are two coal power plants using CCT (about 2,600 MW out of 8,494 MW). Banten coal power plant (CPP) is operated by private sector while PLN operates Jawa No. 7 CPP. Co-firing using biomass up to 5%. On the other hand, Bali government put the diesel power plants on stand-by mode, only to meet the peak hour. In fact, new coal power plants (2,000 MW) with clean coal technology (i.e., subcritical technology) in Banten will be operating for the next two decades to meet the electricity demand of Java and Bali Island.

Nevertheless, the aforementioned solutions then lead to a "carbon lock-in" in the current system. There are technical and policy barriers mentioned during the stakeholder engagements. For instance, the deployment of on-stream technologies such as CCT require bigger space in the existing land. This bears a technical barrier since land acquisition in Indonesia is rather complicated (McCarthy et al., 2012). Furthermore, natural gas use in electricity is still limited due to lack of the gas infrastructure and new reserves are not reported. Furthermore, the regulations for natural gas hampers the domestic use. For instance, the price of gas export is higher than domestic price thus creates a discouragement to supply domestic gas market (Purwanto et al., 2016). On the other hand, co-firing and clean coal technology are a rather new technology in most parts of the world including Indonesia (Roni et al., 2017). However, these technologies are expected to dominate the Indonesian government's additional 35,000MW program to achieve 100% electrification by 2030.

9.7.6 Alternative off-stream narratives

As off-stream narrative towards clean energy, Indonesia has taken several important steps in political and policy perspectives to address climate change that mainly happen due to international pressure such as UNFCCC ratification (1994), Kyoto Protocol ratification (2004), and Paris agreement ratification (2016) in which renewable development becomes one of strategic policy (Maulidia et al., 2019). Despite that, market growth for renewables in Indonesia is reported dilatory even to meet its NDC by 2030 (Burke et al., 2019; Maulidia et al., 2019). Renewables as primary energy hold only up to approximately 11% at national level. The renewables for electricity are mainly geothermal and hydro, and other renewable sources like solar, wind, and bioenergy cover around 8% of the total renewable deployment in Java-Bali connection in 2018.

After showing the continuous commitment to tackling climate change at the global level, there has been a growth of enabling policies promoting the diversification of clean energy into the current electricity system at the national level (Table 2). Commonly, these national policies are then derived to be implemented at the provincial level by the local policies and regulations. Our interviews revealed that the majority of interviewees (both national and local level) suggested that Government Regulation (PP) No. 79/2014 regarding National Energy Policy has a discernible effect on the deployment of renewable technologies. This regulation is supported by Annexe I Presidential Decree No. 22/2017 and Regulation of Ministry of Energy and Mineral Resource (PERMEN ESDM) No. 4/2020 to guide the implementation of renewable deployment at the market level. However, these policies are not able to disrupt the mainstream technologies and only lead in stagnant and isolated development. For instance, local governments of the Banten and Bali Provinces have promising potential to realise the clean energy transition in electricity system despite having abundant renewable energy (e.g., geothermal, hydropower). Banten's local government collaborate with PLN in planning several renewable options such as waste-to-energy, geothermal and micro-hydro power. Although diversification with renewables is possible in this province, transformations will be a long journey:

"…The renewable potentials in Banten include solar energy (particularly solar rooftop), geothermal and biogas for cooking. There is also potential for wind power in the southern area of the province. However, further assessment or research is required to explore the renewable potential of the region whether we can support the electricity system from renewable. Thus, we as an institution are not confident enough to move towards 100% clean energy."[01.Gov.BN, Local government of Banten Province]

"…Other than solar and hydro power, recently PLN found new potential reservoir for geothermal. PLN had started to develop the source (according to a news the location is in Rawa Dano). Also, as I mentioned, there is potential for waste-to-energy and hydro power in the region of Banten. Actually, some local companies plan to do an acquisition with mini hydro companies to diversify our energy mix."[02.Pri.BN]

On the other hand, Bali Government is considered to show strong determination in deploying clean energy, particularly solar energy, to increase the value of the province as the sustainable tourist destination. However, when deploying renewables attention should paid on the social acceptance of the clean energy. Some local stakeholders highlighted that although renewables are getting more accepted to support the region as sustainable tourist destination, certain renewables like hydropower and geothermal are not preferable for Bali Province due to the needs on other economic sectors (e.g., tourism):

"…The energy sources for electricity will be up to PLN. But, if we still want to use fossil fuels, gas is more preferable. Meanwhile, solar energy is expected to be used more and more compared to other renewables, like hydro power. Actually, the potential of hydro power is considerable, however, our field survey showed that it is not feasible because the locations often clash with tourism purpose."[01.Gov.B]

"…For electricity, I think I agree that solar energy is preferable because almost all areas of household and buildings in Bali are exposed by sunlight which implies great opportunity to install solar energy."[02.Pri.B]

Recently, PLN updated its electricity supply business plan (RUPTL) for 2021 – 2030 with a renewable mix by 2030 of 51.6 percent, compared to 48 percent fossil fuel. This is another anticipated intervention by private electricity generation companies to demonstrate PLN's commitment to diversifying the country's electricity system, including Banten and Bali Provinces in the future.

Table 2. National policy instruments supporting the renewables deployment

No.	Policy Number	Title	Description
1	Government Regulation (PP) No. 79/2014	National Energy Policy/KEN	● Energy consumption should enhance energy conservation, minimize the use of oil, maximize renewable use, optimize the use of gas and be secured by coal. ● 23% of renewable in the primary energy mix by 2025 and 31% by 2050
2	Annexe I Presidential Decree No. 22/2017	National Energy General Plan (RUEN)	● Types of renewable to achieve 2025 and 2050 target: geothermal, large scale hydropower, mini and micro-hydro, bioenergy, solar energy, wind, tidal, ocean thermal energy ● The regulation Indonesia set will maintain the use of coal as primary energy source is 30% by 2025 and 25% by 2050
3	Decision of Ministry of Energy and Mineral Resource (Kepmen ESDM) No. 188K/HK.02/MEM.L/2021	Ratification of the electricity supply business plan (RUPTL) 2021 – 2030 by PLN	The renewable mix by 2030 is dominant, which is 51.6% whereas fossil fuel is 48%.

No.	Policy Number	Title	Description
4	Regulation of Ministry of Energy and Mineral Resource (PERMEN ESDM) No. 4/2020	Amendments to the regulation of the Minister of Energy and Mineral Resources No 50/2017 concerning the use of renewable energy sources for the provision of electricity	● The convenience for private companies to develop renewable energy by direct appointment from PLN in energy crisis areas ● Reducing the provision cost of electricity (*Biaya Pokok Penyediaan/BPP)* for renewables
5	Regulation of Ministry of Energy and Mineral Resource (PERMEN ESDM) No. 13/2019	Regulation on the use of rooftop solar power generation systems by consumers of PLN	This regulation regulates the utilization and trade mechanism of solar rooftops by PLN's consumers
6	Law No. 7/2021	The Harmonisation of Tax Regulations	The government recently introduced the regulation of Carbon tax since 2021. Currently, this law applies to only coal power plants to pay carbon tax by IDR 30/kgCO2 (equals to EUR 0.0019/kgCO2) when the power plants exceed the carbon emission allowance.
7	Presidential Decree No. 98/2021	Implementation of Carbon Economic Value for Achieving Nationally Determined Contribution Targets and Control of Greenhouse Gas Emissions in National Development	This regulates carbon pricing as a derivative rule of Law No. 7/2021
8	Government Regulation No. 9/2016	Amendment to Government Regulation Number 18 of 2015 concerning Income Tax Facilities for Investment in Certain Business Fields and/or in Certain Regions	Fiscal Incentives
	Regulation of Investment Coordinating Board No. 1/2019	Details of business fields and types of production of pioneer industries that can be provided with corporate income tax reduction facilities as well as guidelines and procedures for providing corporate income tax reduction facilities	
	Regulation of Investment Coordinating Board No. 6/2018	Guidelines and Procedures for Licensing and Investment Facilities	
	Regulation of Ministry of Finance No. 66/2015	Exemption of import duty on import of capital goods in the framework of development or development of the electricity-generating industry for public interest	
	Regulation of Ministry of Finance PMK No. 35/2018	Provision of Corporate Income Tax Reduction Facility	
	Regulation of Ministry of Energy and Mineral Resource	Criteria and/or requirements for utilization of income tax facilities	

No.	Policy Number	Title	Description
	PERMEN ESDM No. 16/2015	for investment in specific business fields and/or in certain areas in the energy and mineral resources sector	

Overall, Figure 11 and Figure 12 depict the mapping of the current electricity system in terms of technology deployment and the positions of key agents supporting mainstream and alternative technologies, respectively.

9.8 Trends and indicators for sustainable transformations

Production output of electricity (MW)

To indicate a tipping point from a dominant fossil-fuels in the CCIRs towards sustainability, we utilise the number of installed capacities of power plants in which clean energy starts to emerge.

Imagination capacity (visioning)

The possibility among the stakeholders about how they perceive the future towards more sustainable futures. The presence of alternative pathways from the mainstream could trigger interventions towards positive tipping points, in this case towards clean energy in Banten and Bali.

Enabling policies for clean energy development

To align with the visioning of the agents, we listed policies and regulations as the interventions for clean energy development. We perceived policy interventions could lead to tipping points in market . The policies include solar rooftop enforcement, carbon tax and so on.

9.9 Summary of key findings

After looking at both mainstream and alternative narratives, we identified transformative narratives (in the form of visions of alternative futures toward clean energy) and potential key agents who could trigger positive tipping points toward clean energy based on their networked system in the CCIRs.

9.9.1 Identifying key agents in CCIRs to trigger positive tipping points through SNA

The network of the relevant agents in energy sector in Banten and Bali Province is derived from interviews and focus group discussions (Figure 13). By deploying degree centrality, we are able to deduce the potential agents that could steer the current system towards more sustainable paths given the capability of the agents in mobilising the resources. At the national level, the Ministry of Energy and Mineral Resources (MEMR) and the Ministry of National Development Planning (BAPPENAS) are the key agents, given that these agents have the authority to regulate the operation of energy sector including the market. Due to limited resources by MEMR and PLN, the assistance from international agencies like Asian Development Bank (ADB) and UNOPS (United Nations Office for Project Services) Until the province level, PLN is the sole purchaser of electricity in the commercial sector. At the local level, the representatives of central government agencies at province level are crucial to channel the authority of energy from national level (top-down approach), such as BAPPEDA (BAPPENAS' representative at province level), ESDM Banten (Banten's Energy Agency), and ESDM Bali (Bali's Energy Agency). Furthermore, the roles of NGOs as the 'bridge agents' between the government and communities as energy consumers cannot be overlooked. However, some interactions are not equally occurred in both Provinces. Compared to Bali Province, the interactions between the provincial energy agency and the local private sectors are limited. For instance, a few interviewees in Banten claimed that the province's energy planning is currently uncoordinated. Some private-sector green initiatives (for example, solar PV installations) are typically the result of a mandate from national governments rather than local governments.

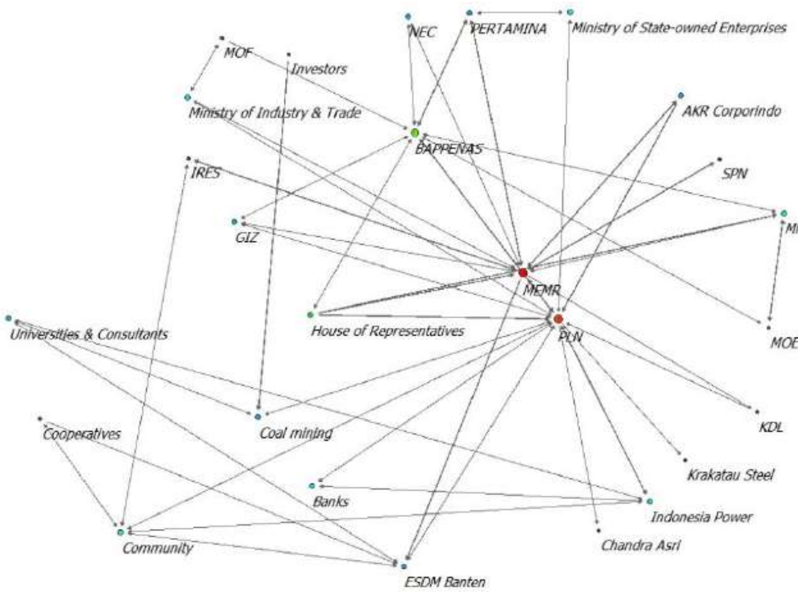

Figure 13. Network of agents in shaping electricity in Banten

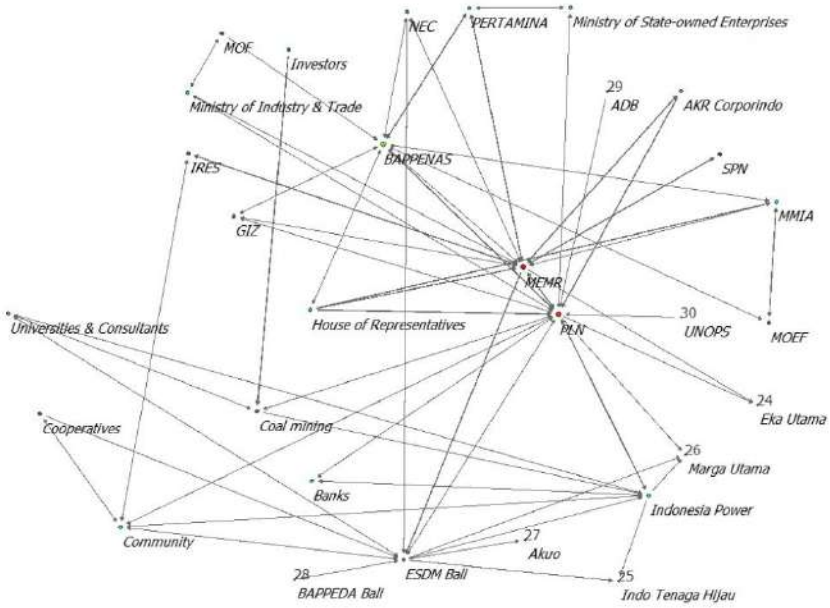

Figure 14. Network of agents in shaping electricity in Bali

9.9.2 Perspectives on transformative vision with Q-methodology

From the narratives collected through stakeholder engagements, the analysis using Q-methodology generates two factors or perspectives on who will ignite the SETPs and how the alternative futures would be in both provinces. From 15 stakeholders participated in the engagements, the profiles of participants were divided into each factor (see Table 3), based on their respective scores on the statements (See Appendix). These perspectives elucidate the variance among the participants' views (Figure 14) based on analysis on eigenvalues using KenQ.

Table 3. Q-methodology participants according to the types of institutions and alignment with 2 factors (perspectives)

Type of stakeholders	Total	Factor 1	Factor 2
Private sector/business	5	3	2
Government	3	3	
NGO/CSO	5	3	2
Research Institutions/University	1	1	
Public/community	1	1	

Perspective 1: "Tipping points are triggered by the government coordination and interventions"

Perspective 1 (P1) emphasised that a systemic change towards clean energy in the country including Banten and Bali Province highly depends on the commitment of government or policy makers to enable clean energy market with their tipping policy interventions such as carbon tax to divest the mainstream technologies (i.e., fossil fuels). Government agencies are viewed as the tipping agent because they have the most access to resources (natural and financial resources) and can easily exert influence over other stakeholders with their policy interventions. The representatives of this perspective are most of the stakeholder groups (i.e., government, NGOs, public/citizen, research institutions/universities). Many stakeholders opined that the existing policies still promote fossil fuels which hinder renewable technology development. In dealing with adverse climate change impacts, this perspective emphasises more concrete ambitions by the government.

Perspective 2: “Tipping points by private sector with renewable diversification”

Perspective 2 (P2) advocates a bottom-up approach. The participants in this perspective asserted that the collective movement or cooperation among private companies, NGOs, and communities are crucial to ignite a systemic change from grassroot level rather than highly depending on the government’s interventions. Private companies are often seen as the innovation sources that make new technologies more competitive. Moreover, the presence of NGOs/CSOs, research institutions, and universities are important as the facilitators or bridge between the government and the communities to equip the communities with adequate knowledge and awareness towards sustainability, whereas they ensure effective policy implementation from the government. This perspective promotes the diversification of renewable energy from solar, wind and bioenergy particularly in decentralised and remote areas which have no access to electricity.

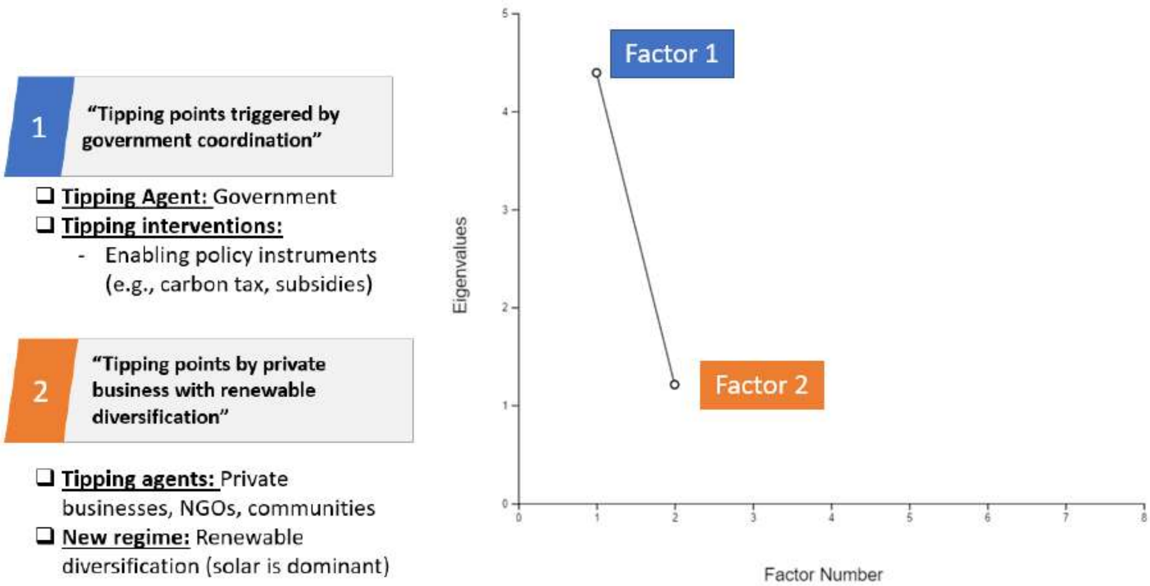

Figure 32. Result of Q-method on the perspectives on transformative visions towards clean energy in Banten and Bali

9.9.3 Discuss Key enablers and barriers to a potential tipping point (positive and/or negative)

Indonesia case study demonstrated the key enablers of tipping points are the existence of the alternative futures towards clean energy and the agents' structure to identify the early-warning positive tipping points. Although all off-stream technologies mentioned provide a renewable alternative to the mainstream narratives (i.e., coal, oil, and gas technologies), their growth in both regions is still in its infancy due to some barriers (technological, economic, social, and political barriers). It is anticipated that these obstacles will create carbon lock-in in these two regions from positive tipping points towards clean energy.

Solar energy is the most preferable clean energy technology to exist in the future in both regions due to its abundance of sunlight and ease of installation. However, some stakeholders have highlighted some technological barriers, such as the immature development of batteries, which raises concerns about the reliability of solar energy as a baseload. Although geothermal and hydropower plants have already been conclusively proven to produce more stable power as baseload, social acceptance is frequently cited as the most difficult challenge of deployment. Also, inclusive interactions between agents are reported missing, especially in Banten Province. Some businesses in the province claimed that there is no clear coordination from the local government regarding the province's energy sector's future plans. As a result, green initiatives such as clean energy deployment and coal phase-out appear to be stalled in Banten Province. As an outcome, we can conclude that the existence of a network that can channel sustainable futures is critical to accelerating interventions that can bring forth the transformations in the regions.

Another barrier positive tipping points towards clean energy in these regions is economic barrier. As the sole buyer of electricity in the nation, PLN sells electricity generated from fossil fuels below the cost of production, thereby preventing the expansion of the renewable energy market. Also, politically, the operation of fossil-fuel power plants is still steered by large institutions and companies thus nurture the fossil fuel utilisations in the country. Although some enabling policies and regulations for clean energy has been introduced, the growth of clean energy installation is stagnant. For instance, we mapped the development of clean energy technologies after Government of Indonesia introduced Government Regulation No. 79/2014. The result revealed that the effect on the growth of clean energy only caused slight increase in technology deployment (see Figure 15). This imply the necessity of other interventions from different aspects in economy and social aspect such as competitive market between clean energy and fossil fuel technologies and the awareness of the community regarding clean energy.

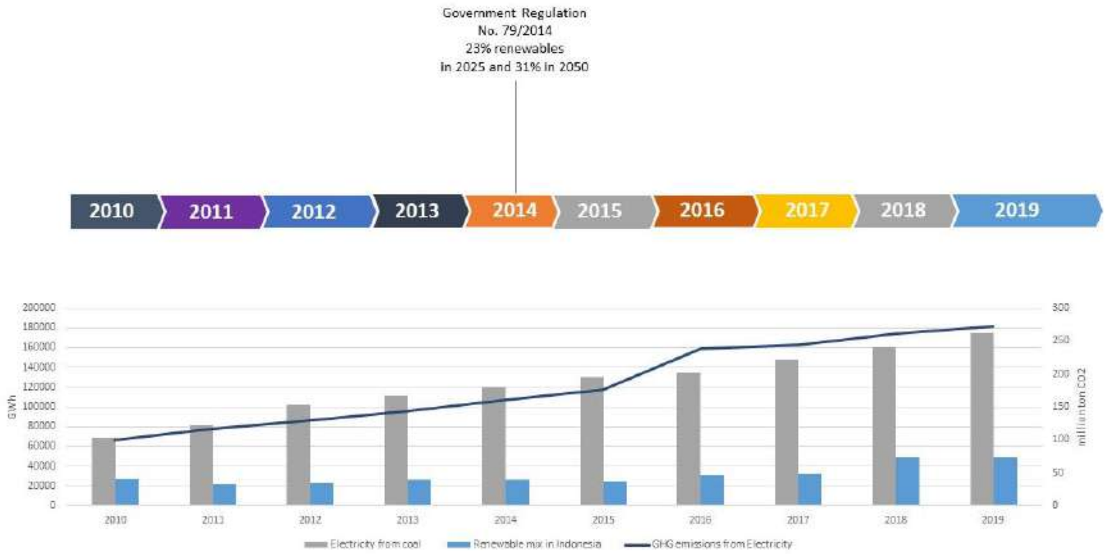

Figure 15. The effect of Government Regulation No. 79/2014 on clean energy development

Despite the barriers of positive tipping points in these regions, there are opportunities to accelerate positive tipping points towards clean energy in the regions, which are strengthening the agents network and unifying the shared visions to generate collective interventions towards sustainability. As depicted in the result, there are shared visions among the key agents, however these agents are not well connected or no interactions despite having complementary capacities to trigger positive tipping points. For example, companies (e.g., L'oreal Indonesia, Nike) who have clean business orientation are not well connected with the source of finance, thus the utilisation of clean energy are exclusive. If the missing links in the network can be addressed, the clean energy utilisation can be expanded to other sectors hence cross-sectoral transformations.

9.10 Reflection on inter- and transdisciplinary research approach

In this study, we utilised geography discipline (i.e., the concept of region) to set a spatial boundary for our case study as coal and carbon intensive regions and how these areas are interrelated. Furthermore, we adopted Hettne & Söderbaum (2000) who perceived region consists of 'large imagined communities' and their interactions might create regional transformations. This indicates that the groups that inhabit a territory can serve as agents in transforming it into new states. Hence, the network and agency theory from socio-political perspectives is integrated to understand the agents' dynamics and how their structures can be transformed. Based on these various disciplines, we argue that this study is transdisciplinary to generate an understanding who the transformative agents are in CCIRs, in this case, Banten and Bali Province.

6.2. What aspect of the research is transdisciplinary, that is the co-designing and/or co-development with stakeholders of:

1) Framing the research problem (research questions in case studies): which stakeholder groups were consulted and how did they contribute to framing the research problem?

Understanding diverse stakeholders' roles, priorities, and needs related to low carbon development is crucial in planning and implementing the transformative interventions for low-carbon development through their transformative vision and network. In the beginning, we utilised the findings from our previous research projects (i.e., TRANSrisk) to identify the pertinent stakeholders in the energy system to be involved in the study. The value chain delineates the actors involved in making and transacting a product or technology to be developed. Then, it is transformed and moved from the primary producer to final consumers, such as biogas operators, power distribution companies, and private businesses whose activities relate to ,e.g., wastewater, and agricultural, municipal, and industrial waste, etc.. The policy environments refer to governments and policymakers that regulates the entire value chain. The business environments include service providers that support policy environment and market chain (e.g., NGOs, financiers, research institutions).

For example, we identified governmental agencies like the Indonesian Ministry of Development Plan (BAPPENAS), the Indonesian Ministry of Energy and Mineral Resources (MEMR), and the National Energy Council are crucial in shaping energy policy in the country supported by local governmental agencies. We captured the perspective of state electricity companies, e.g., PLN, private sectors and farmers groups, as the adopters of clean energy technologies in the country.

There were around 47 stakeholders that we interviewed (Figure 15), and we engaged with more than 200 participants during our workshop to validate our ongoing findings before finalising such as the vision and the interactions among agents. These stakeholders were engaged to define the transformative visions for the respective regions and interactions among the agents in the regions.

2) Analysing the problem and knowledge development: which stakeholder groups were consulted and how did they contribute to analysing the problem or developing knowledge?

Answered in the previous questions

3) Exploring impact: which stakeholder groups were consulted and how did they contribute to the research impact/output? (you might not answer this question until later on this year when discussing potential strategies with stakeholders.

- How does your research project (potentially) contribute to solving the societal problem (described by the stakeholders)?

To provide empirical evidence in collecting transformative vision and network as an early warning for social-ecological tipping points.

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10 Case study 9: Sulcis, Italy

Tipping dynamics, psychosocial patterns, and lock-in mechanisms in Sulcis coal and carbon-intensive region, Italy

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10.5 Introduction

10.5.1 CCIR description

Sulcis region (or Sulcis-Iglesiente area) is a territory in the southwest of Sardinia, one of the twenty administrative regions and two main islands in Italy. It is composed of two geographical areas, the Sulcis Mountains in the inner and upper part, and the coast. Sardinia is a historical mining region, with a millennial activity of metal extraction, and the only remaining coal region in Italy (see Figure 1).

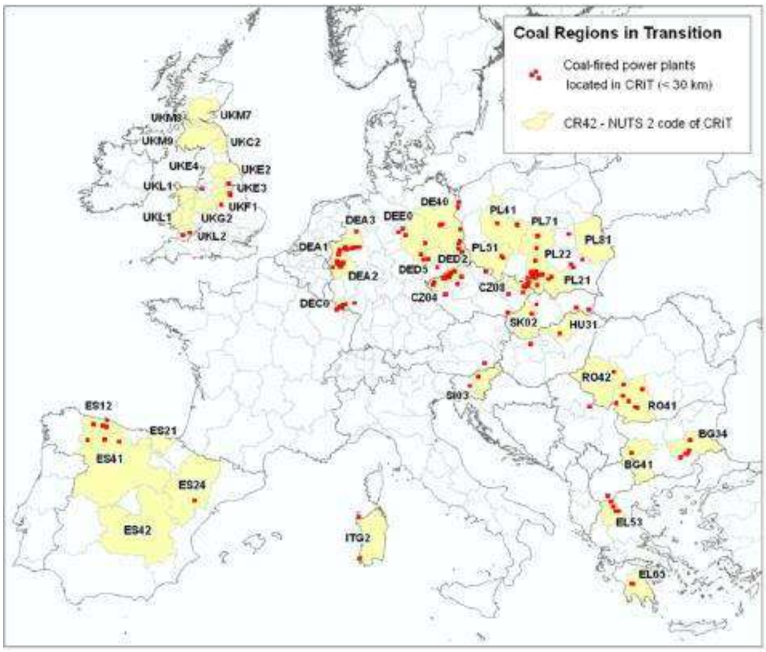

Figure 1. EU coal regions in transition and coal power generation plants. Source: Bódis et al. (2019)

In the national landscape, Sulcis and the broader Sardinia region are emblematic case studies for what concern phase-out and decarbonization policies. Indeed, while being abundant in renewable energy potential (i.e., sun irradiation, windiness, wave motions), the Sardinia region is highly dependent on coal for energy generation (70%). Moreover, it lacks the basic infrastructure for natural gas, making problematic phase-out of coal. On the other side, the territorial development of the Sulcis region has been characterized by extractive activities of metals (mainly non-ferrous metals) and coal. The latter activity fully developed in the 19th century, increasing during the first world war and the fascist period. Carbonia, which means "coal city" and is one of the two main urban centres of Sulcis (Carbonia and Iglesias), was founded during the fascist period to become the Italian energy capital due to its coal reserves. Consequently, the region was affected by intense inward migration dynamics, attracting workersfrom 73 Italian provinces and with a change in resident population that passed from 78.000 to 137.000 residents in 15 years (1936-1951, see figure 2).

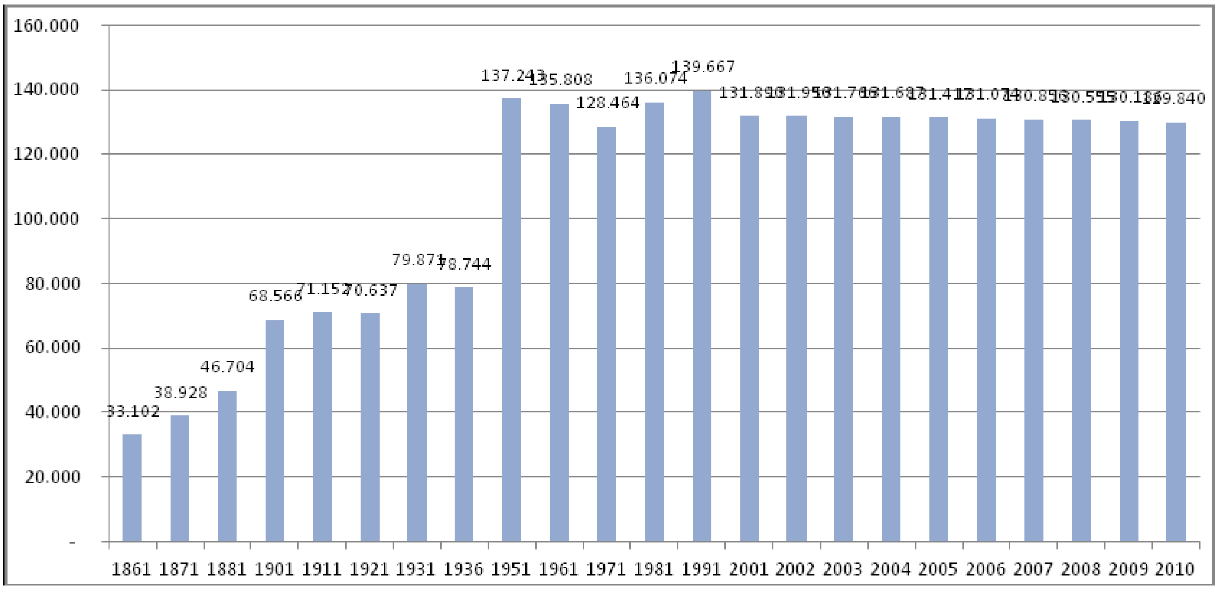

Figure 2. Resident population in the province of Carbonia-Iglesias from 1861 to 2010 (Source: ISTAT – Provincial Council Carbonia Iglesias, 2011)

Therefore, the Sulcis region represents an exemplar case of a coal functional region. Its rationalefor development was based on the production and distribution flows of coal, namely extraction, transport, commerce, and use. The decline and reconversion of the mining industry (coal, plumb,zinc) started in the '50s via the post-war 'Piano di Rinascita' (Rebirth Plan, L. n.588 11th June, 1962), which aimed at financing the industrialization of Sardinia and leading to the developmentof industrial specialized districts and supply chains for the energy-metalliferous industry. In theSulcis area, the industrial pole of Portovesme was developed in the coast (Portoscuso) and characterized by large and energy-intensive metal industries (e.g. ALCOA, EURALLUMINA, PORTOVESME srl), a coal-fired powerplant owned by ENEL (Centrale Elettrica Grazia Deledda, 320 MW), the industrial port, and waste fills to serve industry needs (see figure 3).

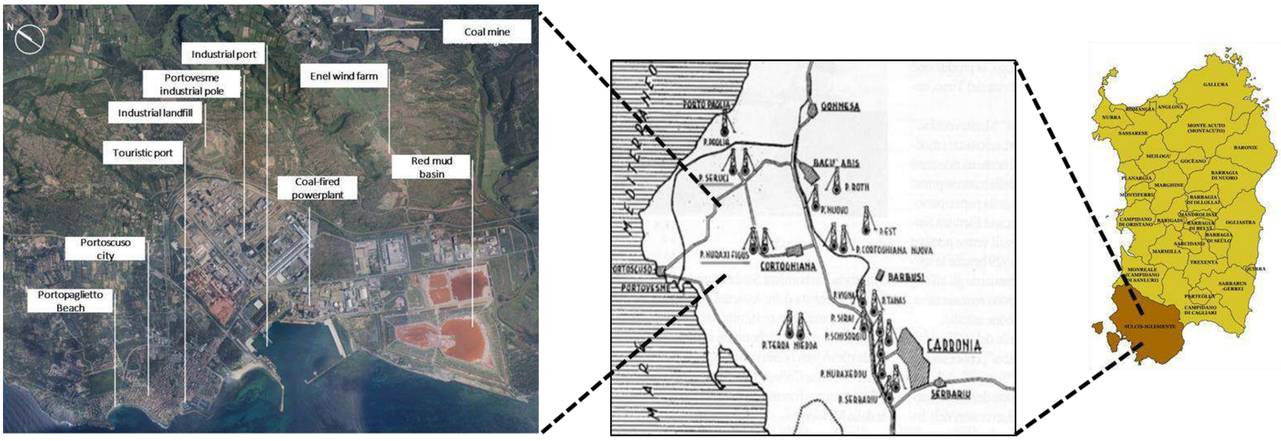

Figure 3. Zooming in the coal and carbon-intensive territory. From right to left: 1. Localization of Sulcis-Iglesiente territory in Sardinia; 2. Localization of the Sulcis coal basin (mines and transport infrastructure); 3. The Portovesme industrial pole (industrial district and related transport, energy and waste infrastructures)

All these distinctive features make the Sulcis region a prototypical example of coal and carbon-intensive area. Energy production and distribution were designed and developed according to the availability of coal and the presence of logistic infrastructures (e.g. port) for its transport (Sulcis coal is highly impure and needs to be mixed for energy generation) and that of metals (import of raw materials and export of processed ones).

Figure 4. A view of Portoscuso's port, the ENEL coal-fired powerplant (Centrale Grazia Deledda) and the wind farm in the background

Therefore, logistic efficiency in transport and the availability of energy at affordable prices were crucial elements for the industrial sustainability and territorial development, making the region economically exposed to cyclical fluctuations of raw materials.

The coal and carbon-intensive region thus coincides with the territory affected by the mining and industrial activities (functional region), which is inside a complex area of industrial crisis[1] identified by the national government (formal region, province of Carbonia-Iglesias, see figure 5).

Figure 5. Area of complex industrial crisis

As documented in several policy reports, while the Portovesme industrial district located in Portoscuso can be conceived as the epicenter of the industrial crisis of Sulcis-Iglesiente, its effects comprise the broader functional region. Therefore, we decided to focus on the broader functional region as it is more exposed to decarbonization policies and related impacts.

Considering that coal and carbon-intensive features are distinctive aspects of the region in terms of the local economy, identity, and memory, we hypothesize that the functional region coincides with the perceptual one based on shared collective experiences and memories about coal and carbon-intensive industry.

Formally, at the administrative level, the role of the province has been inconsistent throughout the years, due to the elimination and changes of provinces in the Italian administrative system (see figure 6 showing the differences in the administrative-geographical compositions in the last 15 years). For this reason, we decided to adopt a multi-scale perspective considering the interaction of National, Regional, and Provincial policies for Sulcis region.

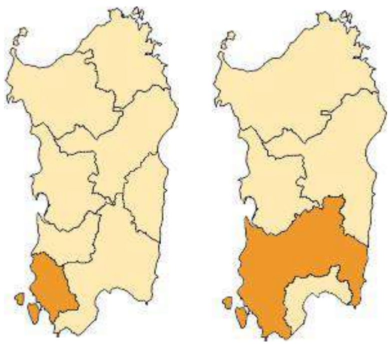

Figure 6. Administrative province of Carbonia-Iglesias/Sulcis-Iglesiente (2005-2016; 2021-today) and of South Sardinia (2017-2021)

10.5.2 Societal problem description

During the last decades, due to energy prices and the global crisis of 2008, which also affectedthe non-ferrous metal industry, the area experienced a severe industrial decline with consequentjob losses. This coincides with a long-lasting crisis at a socio-economic and environmental level.Indeed, regarding the environmental crisis, the area is a National Interest Site (Ministerial Decree 12th March 2003) due to the widespread presence of dismissed mining areas, industrialdistricts, and waste fills (see Figure 7).

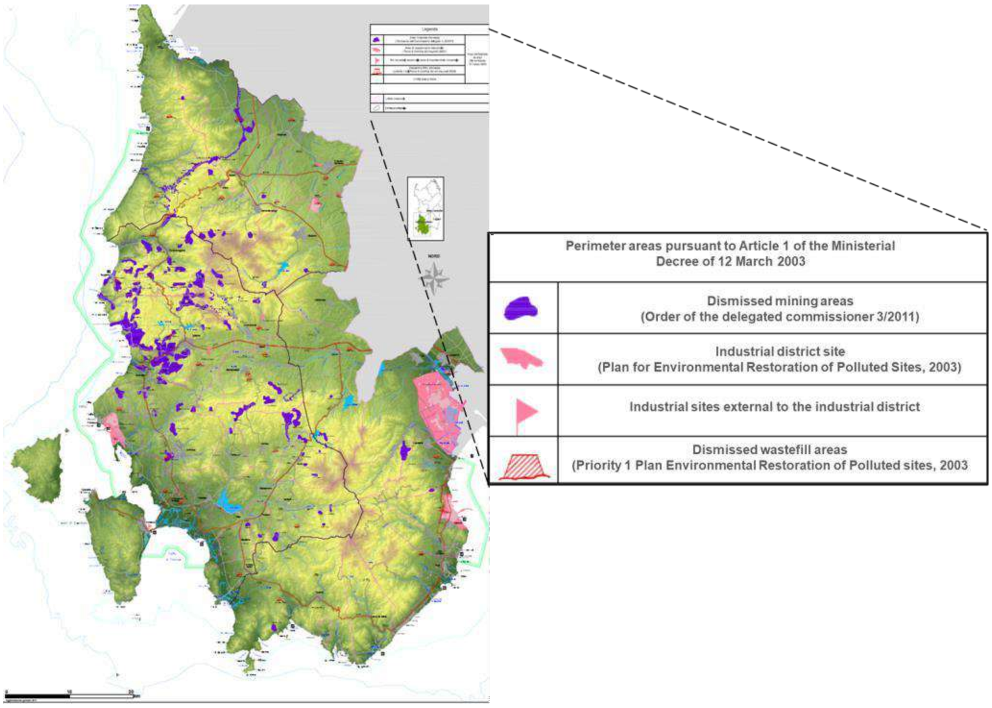

Figure 7 Map of the National Interest Site of Sulcis-Iglesiente and localization of mining, waste, and industrial sites

Environmental assessment reports show that large areas are highly polluted by industrial activity (mining and metal transformation) for what concerns air quality and soil and water ground contamination, with risks about the introduction of heavy metals in the food chain (Russo et al.,2021). For this reason, they are subject to multiple remediation projects though different areas are inevitably compromised. Thus, every attempt for conversion and recovery of the area for productive purposes is impossible without remediating. From a demographic and socio-economicperspective, the region suffered for a long-time job loss, high rates of unemployment, migration, school drops, and a decrease in the resident population, especially for young generations (Provincial Council Carbonia Iglesias, 2011; Sardinian Regional Coordination of the Sulcis Development Plan, 2019).

From 2005 to 2016, resident population decreased from almost 132.000 to around 126.000, andin 2019 (see Figure 8) it reached 124.000 residents (Eurostat, 2019).

Figure 8. Trends of resident population in Carbonia-Iglesias province from 2005 to 2016 (Source: ISTAT). Note that in 2019

the total of residents decreased to 124.329 (Source: Eurostat)

This demographic trend is accompanied by the aging of population due to negative natality-mortality ratio and outward migration of younger generation (see figure 9 and Table 1). As shown in Figure 9 the average age in the population rises from the average of 42.9 years to 47.7years in the period 2006-2017.

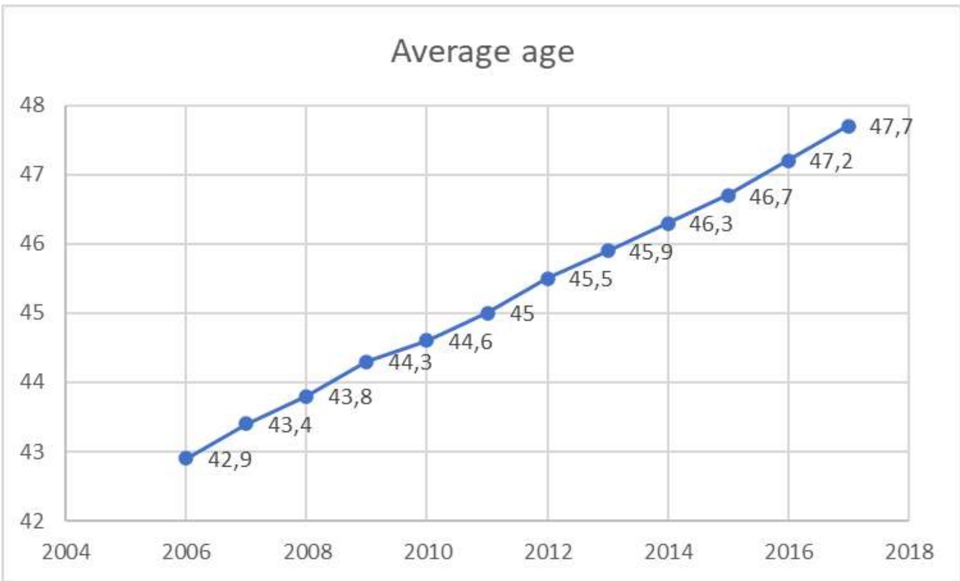

Figure 9. Average age of resident population (2006-2017). Source: ISTAT, our own elaboration

Table 1 shows that in 11 years the age index increase of 61.7% and that in 2017 there were 246,9 elderly people for every 100 young people. In the same period the old-age dependency index increased by 25,7% - showing that in 2017 there were 53.2 not working individuals for every 100 that were working - and the active population turnover index has more than doubledshowing that population in working age is very old[2].

Year	Age Index	Old-age dependency index	Active population turnover index	Structure index of the active population	Birth rate	Mortality index
2006	**152,3**	**42,3**	**99,9**	**108,1**	**6,5**	**8,8**
2007	**161,1**	**42,5**	**105,5**	**111,4**	**6,6**	**9,1**
2008	**169,4**	**43**	**114,1**	**114,8**	**6,4**	**8,8**
2009	**176,8**	**43,4**	**126,4**	**117,5**	**6,8**	**9,5**
2010	**180,8**	**43,7**	**142,5**	**121,5**	**6,9**	**9,4**

2011	**186,3**	**44,4**	**157**	**125,4**	**6,8**	**9,6**
2012	**193,3**	**45,6**	**171,6**	**129,1**	**6,6**	**10,1**
2013	**201,1**	**46,9**	**185,7**	**133,4**	**6,1**	**10,1**

2 Age index represents the degree of aging of a population. It is the percentage ratio between the number of over-65s and the number of young people up to 14 years of age.

Old-age dependency index represents the social and economic load of the non-active population (0-14 years and 65 years and over) on the active one (15-64 years).

Active population turnover index represents the percentage ratio between the population group that is about to retire (60-64 years) and that which is about to enter in the work age (15-19 years). Indicator is less than 100 when active population is younger.

Structure index of the active population represents the degree of aging of the working-age population. It is the percentage ratio between the oldest part of the population of working age (40-64 years) and the youngest (15-39 years).

Year	Age Index	Old-age dependency index	Active population turnover index	Structure index of the active population	Birth rate	Mortality index
2014	**209,9**	**48,5**	**196,8**	**137,6**	**5,7**	**9,9**
2015	**220,9**	**50**	**201,9**	**142,4**	**5,9**	**10,6**
2016	**233,9**	**51,5**	**201,9**	**146,2**	**5,6**	**10,1**
2017	**246,9**	**53,2**	**207,9**	**151,2**	**-**	**-**

Table 1 Main demographic indexes for the Province of Carbonia-Iglesias (2006-2017). Source: ISTAT

Sulcis region has been considered for many years the poorest region in Europe. From data of 2016, compared to the preindustrial crisis 3500 jobs have been lost, of which 65% coming fromindustries (Sardinian Regional Coordination of the Sulcis Development Plan, 2019). From 2008,the Carbonia-Iglesias province registered the most significant decline in employment in percentage terms (-14.8%) and constant increase of layoffs compared to the rest of the region(see figure 10).

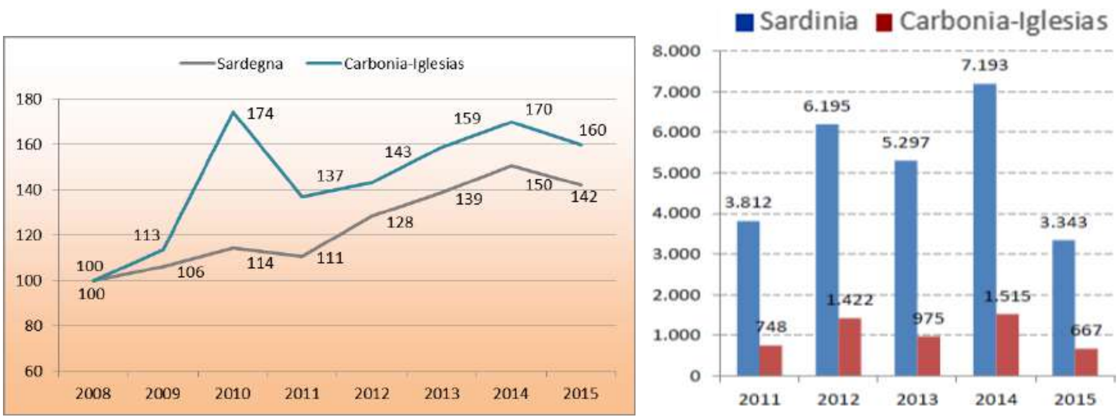

Figure 10. Trend of unemployment and layoff request in Sardinia and in the Province of Carbonia-Iglesias. Left: Absolute and indexed values. Year 2008 = 100. Right: in blue Sardinia, in red Province of Carbonia-Iglesias

Source: Regional Observatory of the Labor Market (2016)

Data on hiring trends in the province show that this significant decline is due to industrial crisis(see Figure 11).

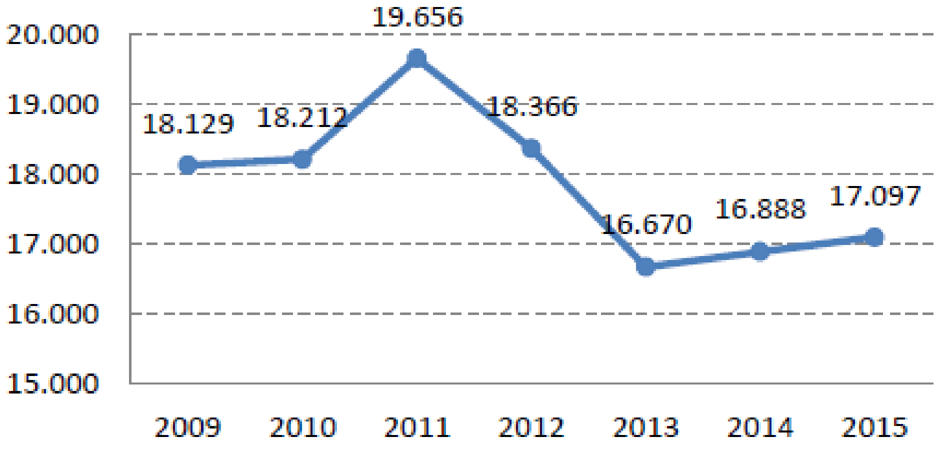

Figure 11.Hiring trend in the Province of Carbonia-Iglesias from 2009 to 2015. Source: Regional Observatory of the Labor Market (2016)

Moreover, it shows a gender imbalance for new contracts, positive for women, and negative formen (see Table 2).

Year	**Male**	**Female**	**Total**
2009	**-527**	**687**	**160**
2010	**-232**	**515**	**283**
2011	**38**	**536**	**574**
2012	**-580**	**691**	**111**
2013	**-295**	**228**	**-67**
2014	**-970**	**117**	**-853**
2015	**-40**	**337**	**297**

Table 2. Employment balance per gender. Source: Regional Observatory of the Labor Market (2016)

This can be explained by the economic trend and the employment balance per sector (see figure12) which shows a negative occupational trend for certain sectors that are mostly male prerogative (agriculture, manufacture, and extractive industry with a loss of around 1500 workers in 2013-2014), and a positive occupational trend for sectors prerogative of female workers, such as education[3], which increased of 572 workers in the same period.

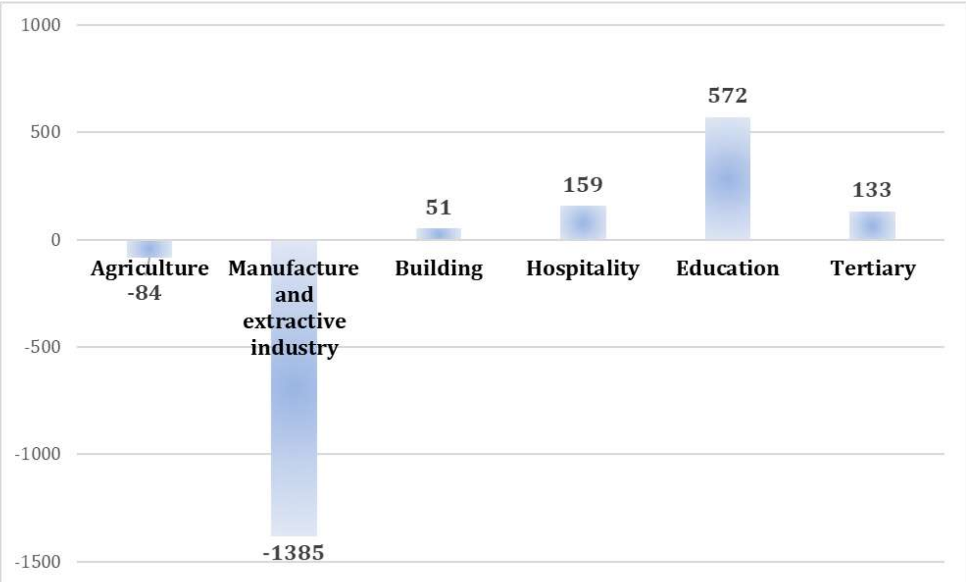

Figure 12 Employment trend per economic sector (2014-2015). Source: Regional Observatory of the Labor Market (2016), , our own elaboration

Beyond the impact of de-industrialization, decarbonization policies can make the region more vulnerable, exacerbating the social crisis, or on the contrary, can trigger positive transformations. The last coal mine, owned by the regional company Carbosulcis, ended its activity in 2018 and the site is currently subject to multiple reconversion projects: creating an energy hub for energy production and storage (CCSU projects, PV and storage facilities), developing a waste facility, and using the site for R&D activities in the fields of experimental physics and natural science. On the other hand, the coal-fired power plant is expected to be phased out by 2025, affecting industries and the overall energy security. The possibility of its re-conversion for natural gas or biomasses has been set aside, while the methanization of the island still represents a controversial and harshly debated project. Previously, the national energy strategy opted to connect the island through a gas pipeline, risking to lock-in infrastructurally and economically the region. This scenario was highly contested by environmental NGOs. Nowadays, the most probable option is the development of coastal deposits of natural gas accompanied by regasification facilities and a postponing of the phase- out of coal-fired powerplants due to the national government strategy to address the gas crisis.In the last few decades, the region has been the beneficiary and subject of multiple investments and plans for relaunching the economy and tackling the socio-economic crisis. First, through an agreement between the National and Regional Governments for a territorial development strategy: the 'Sulcis Plan' (2012, 1.243 million of euro). The plan was based on 71 projects divided into 6 programs: enterprise, fiscality and safeguard of productive-economic texture (41%) school (0,7%), technological research (6,7%), infrastructures (28%), environmental restoration and remediation (24%).

Industrial Reconversion and requalification are accompanied by investments for recovery of affected areas, conversion of dismissed industrial areas, training human capital, promoting energy efficiency and infrastructural development. However, the situation remains characterizedby delays in these transformative projects (e.g. environmental remediation), uncertainties aboutenergy provision and security (phase out coal-fired powerplant, lack of natural gas) and consequently industrial future due to energy price and availability.

Nowadays, due to decarbonization and phase-out policies, the region of Sulcis is also interestedin the Just Transition Mechanism and listed as eligible for the Just Transition Fund. Indeed, the national government indicated Sulcis Iglesiente as a recipient considering the high dependenceon mining and carbon-intensive industries, to mitigate socio-economic impacts induced by the transition.

10.5.3 Research problem

Phase-out processes are extremely delicate phenomena. Coal and carbon-intensive regions must navigate a destabilization-reconfiguration pathway in which phase-out and innovations interact (Rinscheid, Rosenbloom, Markard & Turnheim, 2021). However, these regions are highly susceptible to path dependency and multiple lock-in mechanisms. Decarbonization is often constrained by stakeholders' beliefs, and perceived risks and opportunities of coal phase-out, with low-carbon policies expected to bring uncertainties and negative transformations (Skoczkowski et al., 2020). Energy transition in these contexts involves further difficulties, requiring careful political action and considerable efforts to minimize the negative impacts in the economic and social order, ensuring a just and equitable transition.

However, the risk of reinforcing lock-in and the intrinsic difficulties of breaking path dependency triggering systemic transformations present socio-political and socio-psychological challenges and consequences that so far have been underestimated.

In this regard, the Sulcis region historically based its economic and territorial development and community identity around industrial practices (extraction, transformation) and places (mines, industrial centers located close to coal-based facilities). Thus, the transformation of such places, practices, and sources of income brings risks about losses of jobs and decreased economic well-being and may involve feelings of dispossession and disruptive change in how the community perceives and projects itself due to place attachment, identity, ideologies, and values among others.

The history of the region stresses that despite huge investments and plans the area seems locked. The region is involved in struggles over the old and the new (cf. Johnstone and Hielscher, 2017), suffering path dependency and social and economic vulnerability characterized by de-industrialization, lack of innovation and economic diversification, negative migration dynamics and occupational levels.

In this regard, strategies and projects for coal phase-out and deployment of energy innovations should not only fit with public preferences and democratic governance, thus being socially acceptable and legitimate, but demand to be technically, politically, and economically feasible, requiring including and mediating different interests and needs.

Elaborating shared visions and narratives about transformations is recognized as a critical ingredient to orient strategies and policies to support such changes by providing clear pathways that are acceptable, feasible and viable (see e.g. Buschman & Oels, 2019). Imagined futures can help justify new investments in science and technology, and serve both as the ends of policy and instruments of legitimation (Kuchler & Bridge, 2018), not only describing desirable futures but also delimiting attainable ones. However transformative change doesn't rely merely on replacing sources and technologies for energy generation or source of income, it means also restructuring a different and alternative identity and vision for the territory, a destabilization and reconfiguration of previous schemes, structures and psychosocial patterns, aligning socio- technical innovations and phase-out policies with the socio-cultural environment.

In this regard, we aim to understand the socio-cultural and socio-psychological patterns underlying path dependency and lock-in, examining why the region failed in creating conditions for navigating tipping dynamics (destabilization) and triggering a tipping point (re- configuration), and how carbon-lock-in and path dependency can be broken through tipping interventions aligned with socio-technical imaginaries for system transformations.

From a psychosocial perspective, our review of social science literature on coal and carbon- intensive regions (Biddau, Brondi & Cottone, 2022) shows that more research is needed to understand: a) how social memory relates to anticipatory adaptation, psychological preparedness, or denial, disempowerment and psychosocial lock-in; b) how minority can change the societal norm (e.g. social support for coal or regime stability) determining tipping points in social convention (cf. Centola et al., 2018); c) how phase-out policies and innovations can support the development of new identities and visions for community futures; d) or how emotional states and responses influence coping, leading to adaptive resilience or dysfunctional resilience and lock-in. We attempt to explore these issues specifically analyzing the psychosocial

10.5.4 Research questions

We attempt to explore these issues by trying to answer to the following research questions:

1. What are the interests and narratives at play struggling for future definition and how do they try to stabilize or tip the system (i.e., legitimating or de-legitimating transition)?

2. How do sense of place (e.g., coal-based memory and identity) affect the psychosocial agency and future imagination?

3. Is the region psychologically locked-in? and what are the structural (economic, political, geographical) and psychosocial patterns that sustain path dependency constraining alternative imaginaries and the corridor of possibility?

With the first question, we aim to identify the dominant, marginal, and alternative/radical narratives and stakeholders and how their discourse frames (de)legitimize emerging and existing socio-technical system.

With the second question, we aim to understand the role of the sense of place - as the set of place-based memories, identities, and meanings – in shaping understanding of current transition and imaginaries about desirable one.

Finally, with the third question, we aim to provide an integrative understanding of the transition pathway enlightening the interplay of socio-structural and socio-psychological dynamics and potential applied implications.

10.6 Research approach

10.6.1 Case study theoretical framework(s)

To analyze narratives and answer research questions we adopted a societal psychology approach (Himmelweit and Gaskell, 1990), combining macro-level and micro-level analyses (Lopes & Gaskell, 2015), and connecting individual levels of explanations with the analysis of the relational and societal dynamics that shape and give essence to cognition, behaviour and social phenomena (Bauer & Gaskell, 1999; Castro, 2006; Howarth, 2006; 2013). This perspective stresses that to understand and instigate societal change, this should be considered within its own social and historical context, critically engaging with the politics of change and with societal actors, revealing the multiplicity of factors and perspectives at stake in supporting or resisting change (Howarth et al., 2013).

Transitions are inherently political processes, with different individuals and groups struggling about desirable directions for change and about appropriate ways to govern such processes. As social change always involves competing interests and perspectives engaged in a 'battle of ideas', societal psychology examines the expression, negotiation, and contestation of these multiple perspectives (Cornish & Gillespie, 2009; Jovchelovitch, 2007). By recognising this plurality of viewpoints in context and their related power differentials, societal psychology tries to establish what interests and perspectives are marginalised or dominant and examine social and psychological factors maintaining the status quo or seeking societal change (Jovchelovitch, 2007).

In line with this approach, we adopted Social Representation Theory (SRT - Moscovici, 1961/76) to understand how knowledge is created, contested and transformed by and for individuals and social groups (Howarth, 2006; Jovchelovitch, 1996). Social representations are conceived as sets of ideas, beliefs, values, and practices that are socially elaborated and collectively shared (Jovchelovitch, 1996), a form of social knowledge that generates to make familiar the unfamiliar, that is "symbolic tools which allow group members to make sense of their social world and their relationships to other groups" (Andreouli & Howarth, 2013, p.363). In this perspective, rather than the outcome of individual information processing, knowledge is considered as the outcome of self-other interaction, sensitive to pre-existent knowledge, experienced relations and power differential (Bauer & Gaskell, 1999; Markova, 2003; Howarth, 2006; Jovchelovitch, 2007; Batel & Devine-Wright, 2015)4.

Social representation theory has been successfully used in energy social studies to inquire into symbolic cultivation and people responses about energy system change (e.g. Batel & Devine-Wright, 2015; Devine-Wright et al., 2017), and connected with systemic heuristic frameworks such as the Multi-Level Perspective (MLP) of socio-technical transition studies (Upham et al., 2015, see Figure 13). The potential of the theory lies in its understanding knowledge as both social and individual, constructed in social interaction through communication and embedded in stable institutions, and, at the same time, it is individual as it shapes individual cognition and thoughts (Farr, 1987; Moscovici, 1988). SRT provides different conceptual tools to study the dynamics of symbolic cultivation and sedimentation of representations while acknowledging the role of contextual factors and events.

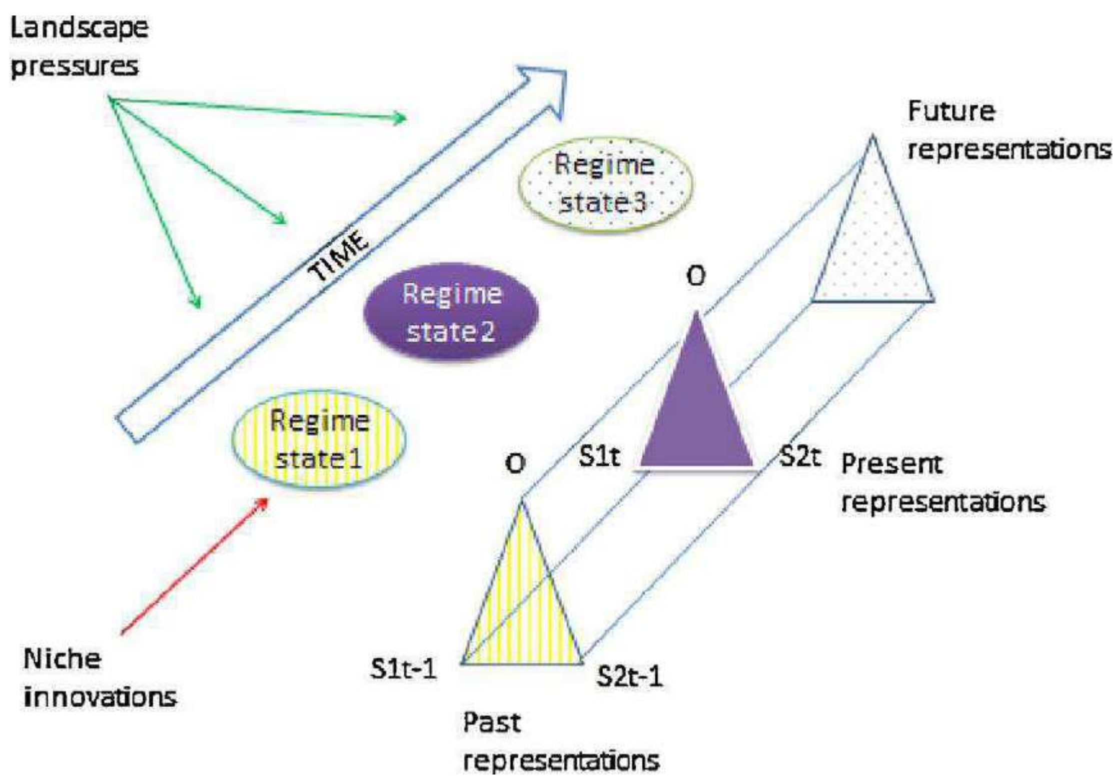

Figure 13. Connecting Social representation Theory with the Multi-Level Perspective of socio-technical transition. Representations of innovations (O: Object) are cultivated in the triangle through the interaction between subjects (S1; S2) in different moments in time.

This process is influenced by landscape pressures and regime influence. (Source: Upham et al., 2015)

Methodologically, we adopted a discursive analytical approach to reveal how society and environmental politics are shaped by and through discursive interaction, examining how some discourses or topics first emerge and how meanings, which are never totally fixed, evolve through processes of contestation and negotiation. Investigating discourse in such a way have the potential to enlighten the plurality of actors that try to shape the definition of the problem and possible solutions, positioning themselves and opponents through discourse. Our analysis is 4 SRs as a set of images, metaphors, narratives that are socially elaborated and collectively shared allowing individuals/group members to make sense, communicate and positioning about the given object inspired by Hajer argumentative discourse analysis (ADA, 1995) - which in turn originated from discursive social psychology (Davies & Harrè, 1990; Billig, 1987).

ADA and SRT are used in parallel in light of their commonalities for illuminating the socio-political and cognitive basis through which problems and solutions are intersubjectively constructed, and common understandings are produced and can transform (Dryzek, 2005; Späth, 2012). Both are interested in how certain meanings (social representations or storylines) are cultivated, negotiated and conveyed within and by subgroups (social milieus5 or discourse coalitions), which come together because of an (assumed) shared worldview and common conceptualization and interests about a given object.

Discourse structuration and institutionalization of ADA, namely how a given conceptualization becomes widely shared, dominant, and powerful/influential, have a parallel in SRT's concepts of hegemonic, emancipated and polemic representations.

Indeed, SRT presupposes that representations and discourse conveyed by the diverse parts in a dispute are not equally valid. Some representations may be hegemonic in a culture (Moscovici, 1988), reified, objectified as facts and deeply sedimented - for example, they can be embedded in legislation and policies (Elcheroth et al., 2011; Castro,2012), in education programmes (Howarth, 2006). Some others can be emancipated, reflecting a heterogenous social environment where different communities constitute their versions of the world, or they can be polemic, constituting the view endorsed by specific (and often minority) groups during controversy (Wagner, 1995). By looking at the way discourses and underlying meanings operate in the public and political sphere, stimulating conflicts and cooperation/coalition between actors, the research looks at the way discourse structuration is enacted for planning and policy-making (Hajer, 1995), revealing the way political influence and change is achieved or not, with emancipated representations becoming institutionalised, and how the institutional change, in turn, is translated and re-presented by competent subjects adapting or resisting effective change in institutional practice and norms (Castro, 2012).

By adopting SRT and a discoursive analytical approach we aimed to map and examine narratives and visions for change, addressing the cognitive and socio-political dynamics across time. To further analyse the pathway and tipping dynamics, our analytical gaze is integrated by community resilience and vulnerability perspective of transition studies (Wilson, 2014; Olsson, Galaz & Boonstra, 2014). Resilience in this view is both an outcome – e.g. improved adaptive capacity of communities - or a pathway/process, e.g., linked to community learning and the willingness to take responsibility and control of their development pathways (Chaskin, 2008; Davoudi et al., 2012). On the other hand, community vulnerability describes the exposure and sensitivity of a community not able to cope with disturbances (Wilson, 2014).

Transitional pathways are conceived as comprising a myriad of transitions or transitional corridors, with the socio-ecological transformation happening through three main phases: preparing for transformation, navigating the transition, and building the resilience of the new direction (Olsson et al. 2004). The first and second phases tend to be linked by a window of opportunity.

Considering resilience as a process implies looking at positive and bad resilience mechanisms (e.g. traps), which means that self-reinforcing social and ecological feedback can create lock-ins that make taking new trajectories and moving to alternative states extremely difficult (Olsson, Galaz & Boonstra, 2014).

In this regard, as pointed out by Wilson (2014, 2015) many communities are stuck in specific pathways because of structural problems that are linked to different mechanisms of lock-in (e.g. political and infrastructural lock-ins, geographical constraints, adherence to conservative norms and conventions). At the community level, socio-psychological lock-ins can be embedded in social memory, cultural resistance, or psychological conservatism, making certain pathways unimaginable and impossible to implement, and undermining the capacity to respond to new problems and opportunities.

In light of path dependency and lock-in effects, transitions are made possible by transitional ruptures (or regime shifts) where the quality of resilience/vulnerability suddenly changes (see

5 Social Milieus: group contexts in which localized systems of meaning are produced and used by members to make sense of their social world and their position within the world (i.e. the symbolic cultivation). Groups will draw upon familiar images and metaphors based on their historical, cultural and educational status.

Figure 14). This happens when pathways are suddenly elevated/lowered toward stronger or weaker levels of resilience breaking path dependency. Positive transitional ruptures are highly dependent on the right timing of the right ideas and are possible if there is enough momentum for change and this change is supported.

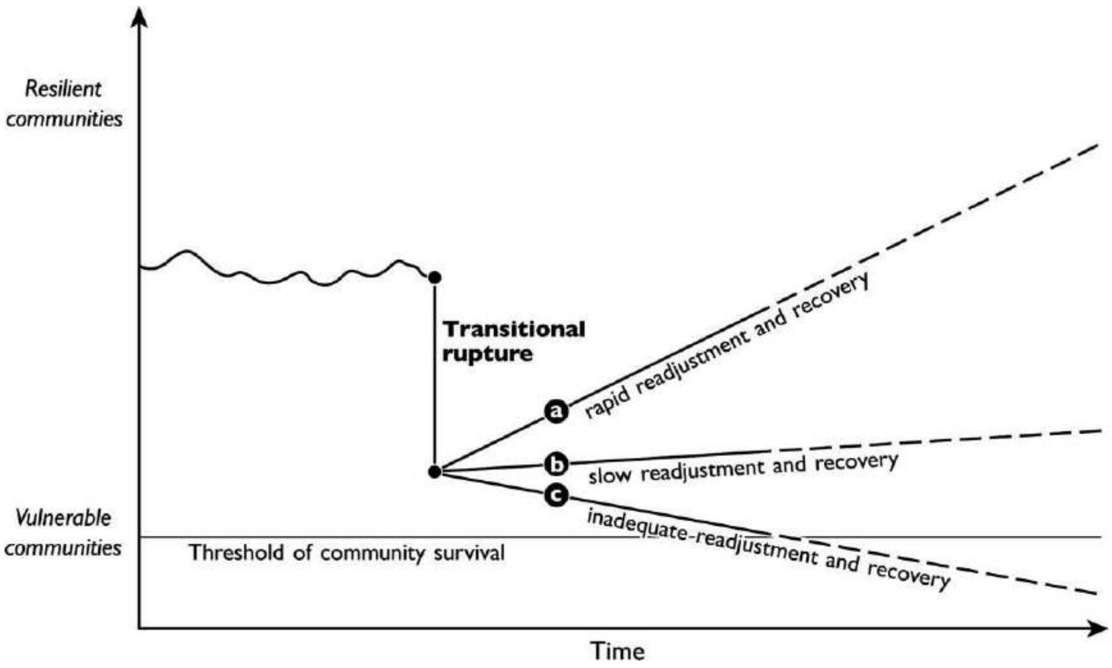

Figure 14 Transitional ruptures and resilience directions (Wilson, 2014)

In line with the societal psychology and discoursive perspective outlined above, in this case study we focused on a few key cultural and psychosocial factors that gradually emerged as the most relevant in understanding system stability (i.e., adaptation, lock-in, path dependency, and the legitimacy of transition) about external pressures and internal impulses for transformation, and what kind of tipping interventions are necessary to break lock-in and support change. Relying on a discursive perspective we examined meaning-making regarding the sense of place (i.e. the set of place meanings, attachments, identities, imaginaries) and innovations (i.e. technological, political-legal, and social innovations). The aim was to enlighten the interplay of socio-ecological and socio-technical components of transition and examine the pathway dynamics to better understand how meaning-making and psychosocial factors are related to socio-ecological feedback, path dependency and transitional corridors and outcomes.

We briefly describe the main psychosocial factors considered in the following paragraphs.

10.7 .2 Sense of place

Resilience scholars agree that the resilience of a community is largely based on human connectedness to place (Folke et al., 2003; Barthel et al., 2010a, 2010b; Tidball et al., 2010). From a socio-psychological perspective, the people-place relationship is based upon meanings that people assign to material environments which are linked with collective processes of belonging, identification, and memory (Bonaiuto, Breakwell & Cano, 1996; Dixon & Durrheim, 2000). Indeed, transition pathways are influenced by complex antecedent histories that must be considered as a starting point for understanding learning, decision-making, and adjustment trajectories (Folke et al., 2003). Memory can affect group-based appraisals and dynamics, change and innovations are influenced by previous knowledge and experience, thus, problematizing these elements opens new ways to understand the success and failure of innovations and transformations (Biddau, Brondi, Cottone, 2022). As stressed by Wilson (2015), the memory of a system – namely the memory linked with individuals as life histories and stakeholder groups as acquired memory - affects the community's adaptive capacity to disturbances. Social memory can both raise resilience and increase vulnerability at the local community level, influencing its coping, adaptation, and transformation (Adger, 2000). Through experiences with the biophysical environment, people develop subjective meanings and bonds that predict specific types of behaviour, and that have a role in the development of identities (Harner, 2001) and in promoting or hindering agency and adaptive capacity (Brown & Westaway, 2011).

On this matter, the sense of place – intended as the meanings and attachments to a setting held by individuals and groups (Tuan, 1977) – can be regarded as a promising research area for two reasons: its ontology interconnects the social and natural world; and it is both an outcome and a driver of socio-ecological processes (Masterson et al., 2017).

In coal regions, the sense of place can reflect a deep cultural relationship with coal (i.e. coal- based community identity, place dependence and attachment, collective memory) that can contribute to path dependency, constraining and shaping future transformative pathways for the region (see also Alexandra, 2017).

In this regard, we examine how the sense of place and related collective memories about coal and carbon-intensive industrial developments play a role in coping with and understanding current transformations (i.e. the coal phase-out and clean energy transition).

1.5.3 Representations and perception of justice

Justice is a key driver for sustainability transformations and a crucial component of public support and political legitimacy. Indeed, forms and experiences of distributional, procedural and recognition injustice intersect during the transformation of energy systems (McCauley et al., 2013).

In this regard, scholars apply justice concepts to energy transition (cf. Walker, 2009; Sovacool et al., 2016; Jenkins et al., 2016) to recognise how injustices emerge, who are affected and/or ignored, and what processes exist to remediate to make evident and reduce such injustices. In so doing, they examined: a) how environmental costs and benefits of the energy system transformation are distributed not only between individuals and social groups but also geographically (between territories) and temporally (e.g. intergenerational justice); b) how equity and fairness of procedures – i.e., the access to information, transparency, legitimacy, access, inclusivity and representativeness of different interests at stake – have a role in energy decision-making and the final outcome (e.g., Lund, 2014); c) how (lack of) recognition or misrecognition of social groups and places - the processes of disrespect, insult and degradation that devalue some people and some place identities in comparison to others" (Walker, 2009, p. 615) - determine procedural (if and how individuals are involved, treated and represented in the decision-making) and distributional injustices (how the decisions reflect the recognition of concerns and opinions of diverse publics fairly distributing costs and benefits) (cf. Yenneti, Day & Golubchikov, 2016).

While there is no doubt about the valence of such a normative approach for understanding and governing current transitions, we should add that communities with histories of disadvantage or powerlessness can be more vulnerable, less resilient, and unable to cope effectively with transformations. Furthermore, memories of environmental injustice can constitute a frame of reference to make sense of transformations (Biddau, Brondi, & Cottone, 2022).

All these elements stress that a historical approach to justice, considering the interplay of injustices in development pathways across time, is highly relevant for understanding how people make sense and respond to current transitions.

In this regard, recent developments in justice literature are extremely relevant for the study of coal regions in transition. First of all, the restorative justice concept introduces the idea and obligation that a just transition needs to identify and respond to those damages that already occurred. This implies repairing it and restoring the dignity and well-being of those involved before embarking on a new transition, and that any injustice should be rectified and be part of preventive and forward-looking action (Heffron & McCauley, 2017). Moreover, the capability approach to justice introduces the idea that externalities from energy system transformations or environmental change can affect multiple dimensions of well-being and human flourishing. Thus, a capability approach to sustainability elucidates the interconnection between human well- being, the natural environment, and socio-technical systems (Hillerbrand, 2015), understanding how environmental changes and transition processes expand or limit the capabilities of individuals, households and communities (Tarekegne, 2020; Joodoin, 2021; Chipango, 2021).

All these normative considerations are of relevance for the case study as many coal regions (including this case study) are interested in the EU just transition mechanism and fund. In this regard, we aimed to elucidate how representations of justice and injustice from previous development pathways influence the understanding of the current state and the visions of transition.

1.5.4 Socio-technical and spatial Imaginaries

Elaborating shared visions about transformations is recognized as a critical ingredient to orient strategies and policies to support such changes by providing clear pathways that are feasible and viable (see e.g. Buschman & Oels, 2018).

In this regard, scholars often inquire about socio-technical imaginaries (Jasanoff & Kim, 2009) because they inform visions of desired futures in which sociotechnical assemblages (encompassing ongoing interactions among human and non-human actors) play a key role. Sociotechnical imaginaries are "collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology" (Jasanoff, 2015, p.4). Imagined futures can help justify new investments in science and technology and serve both as the ends of policy and as instruments of legitimation (Kuchler & Bridge, 2018). These ideas about the future, or "sociotechnical imaginaries," do not just describe desirable futures but also delimit attainable ones. Different studies have explored socio-technical imaginaries but have mainly focused on how technical experts and political systems envisage them rather than engaging citizens or stakeholders.

A particularity about coal regions is that energy transition involves a profound territorial transformation that goes well beyond technological substitution (e.g., from coal-fired power plants to renewable energy). Indeed, many of these regions historically based their economic development and community identity around coal-based practices (e.g., extraction, transformation, transport) and places (mines, industrial clusters located close to coal-based facilities). The transformation of such places and practices brings risks about losses of jobs and consequently economic well-being and may involve feelings of dispossession, disrupting place histories and memories captured in the sites (Duffy & Whyte, 2017) and the related psychosocial dimensions such as place attachment, identity, and values.

Therefore, socio-technical imaginaries are deeply entrenched with spatial imaginaries as the way people perceive, conceive and live space can lead to normative imaginaries and action about territorial transformations based on low-carbon energy (Aiken, 2018). Socio-technical imaginaries involve forms of space and place as part of the desirable vision of the future, as much as spatial imaginaries involve ideas about technology as part of the understanding of positive socio-spatial relations (Chateau, Devine-Wright & Wills, 2021). Watkins (2015) distinguished between three types of spatial imaginaries: place imaginaries, which define a particular and unique space with related ideas about its characteristics (e.g., New Orleans as the birthland of jazz); idealised space, providing idealised representations of places that share general characteristics (e.g. the mine as a peaceful and silent place); and spatial transformation imaginaries, involving representations of processes by which spaces and places change (e.g., "airbnbization" as a form of intense touristification and gentrification).

Chateau et al. (2021) stressed that these imaginaries have a key role in shaping and legitimizing socio-technical change in three ways: energy transition imaginaries can support or disrupt the place imaginaries by embedding socio-technical pathways that act in continuity or discontinuity with the past of a place toward a more desirable future (i.e., reversing the conditions of a stigmatized space, or reinforcing and reproducing its positive characteristics); idealised space can shape siting or planning decisions about renewable energy technologies (e.g., the recreational and economic value of the sea constraining the deployment of offshore wind turbines); and spatial transformation imaginaries shape the sense-making and acceptance of socio-technical change by connecting past experiences (e.g., past intensive exploitation of place for industrial and urban development affects the symbolic coping of energy development).

In this regard, we explored the interplay of socio-technical and socio-spatial imaginaries of transition, regarding how energy can be generated and consumed, i.e. how, when, and where can different types of renewable energy infrastructures be considered acceptable, and how the places, existing infrastructure, and ecological environments can be used or re-deployed to create new activities and revitalize local economy in line with place-based meanings, interests and values.

1.5.5 Research design: data collection and analytical procedure

To map and examine representations, discourses, and visions, addressing the socio-cultural and socio-political dynamics of the transition pathway, we triangulated qualitative and quali-quantitative techniques and different corpora of textual data.

In the research design, we partially followed Hajer's methodological guidelines (2006) for

argumentative discourse analysis and adopted a multi-scale approach (see Sarrica et al., 2018).

At first, we conducted desk research, i.e., a survey of public documents to make a first chronology of events, and identify and map actors and positions in the field. This included a review of grey literature that was used to identify and understand the main discourses about the energy transition.

In particular, we examined:

1. Policy and planning documents from different scales of governance (e.g. 'Sardinian

Environmental and Energy Plan', "National Energy Strategy', the 'Sulcis Plan' and related monitoring reports, and the 'Strategic Provincial Plan')

2. Assessment reports, studies, or advocacy briefs developed by different groups (e.g., 'Dossier of Sulcis-Iglesiente's Crisis'; Bullegas et al., 2020, 'Sardinia Island Zero CO2 – phase-out 2025: decarbonization proposals for Sardinia'; Valbonesi et al., 2021, 'Socio- economic assessment of renewable energy scenario for Sardinia').

Moreover, we carried out a longitudinal analysis of newspaper articles published between January 2011 and February 2021 in national (Ansa), regional (La Nuova Sardegna and Unione Sarda), and local newspapers (La provincial del Sulcis-Iglesiente)

Through newspapers' online database we collected all the articles comprising the keywords 'energy' and 'Sulcis' (search query: "Sulcis AND energ*") published from January 1st of 2011 to February 28th of 2021. After initial screening assessing the pertinence of the articles (i.e., the energy issue is relevant and not only mentioned) the final corpus consisted of 965 selected articles distributed in a non-homogenous way across time and newspapers (see Table 3).

YEAR	ANSA	LA NUOVA SARDEGNA	LA PROVINCIA DEL SULCIS-IGLESIENTE	UNIONE SARDA	TOTAL
2011	1	59	0	10	70
2012	16	150	0	29	195
2013	4	42	12	13	71
2014	4	47	29	13	93
2015	24	66	46	5	141
2016	23	36	19	2	80
2017	11	32	34	3	80
2018	4	13	30	2	49
2019	19	27	58	5	109
2020	12	26	19	6	63
2021	2	5	0	7	14
TOTAL	120	503	247	95	965

Table 3 Distribution of newspaper articles analysed

The analysis of press and public documents was initially used for structuring initial concepts, ideas and categorizations, looking for the employment of storylines, metaphors, consensual and conflicting discourses and getting a preliminary understanding of discursive dynamics and significant (tipping) events.

Then, we conducted interviews with key informants (n=4) chosen because having an overview of the field from different positions (i.e., a journalist, a historian, a policymaker, and a representative of an environmental NGO).

Afterwards, from December 2020 to October 2021, we conducted 26 narrative interviews with key regional stakeholders and informants (N=27) representing heterogeneous perspectives and interest groups (see Table 4).

These comprise political representatives and public officers (n=8) operating at different scales (municipality, province, region), experts from different scientific fields (n=4), such as energy planning, mining, environmental health or social research - workers from industry and trade unions' representatives (n=5), journalists (n=2), representatives of environmental NGOs or local movements (n=6), and firms operating in the environmental and energy field (n=2).

ID	Type of organization	Sector	Role	Date	Lenght
1	Regional EnvironmentalNGO	Environmentalism	Scientific representative	21/12/2020	29:03:00
2	Regional newspaper	Journalism	Journalist (Sulcis reporter)	24/03/2021	54:28:00
3	Youth political organization	Local politics	Local representative	11/05/2021	01:12:54
4	Youth political organization	Local politics	Local representative	04/06/2021	01:15:59
5	Municipality	Local politics	Municipality councillor	01/09/2021	01:31:44
6	Municipality	Local politics	Municipality councillor	23/04/2021	30:17:00
7	Regional EnvironmentalNGO	Environmentalism	President	25/06/2021	01:37:28
8	Local environmentalist association	Environmentalism	Local representative	22/06/2021	50:05:00
9	Local environmentalist association	Environmental activism	Local representative	23/06/2021	49:05:00
10	Network of local movements	Environmental activism	Coordinator	27/07/2021	01:38:52
11	Coal industry	Industry	Worker and trade unionist	18/06/2021	30:27:00
12	University	Science	Sociologist	27/05/2021	43:25:00
13	Environmental health organization	Science	Representative (Medical Doctor)	29/09/2021	01:18:21
14	Regional political auhtority	Regional politics	Public office manager	30/09/2011	02:02:15

Table 4. Stakeholders interviewed

Due to covid-19 pandemic, most interviews were conducted virtually with Zoom. Participants signed a consent form, and all the interviews were video/audio recorded and subsequently verbatim transcribed. The interview protocol contained questions aimed at eliciting narratives about the territorial trajectory across time and incorporating four aspects and related socio- psychological variables (see below):

1. The sense of place, intended as the set of meanings, attachments, and identities related to the place.

2. The perception of environmental risk/degradation and justice

3. Collective memory about territorial development pathways including energy transition (their problems, the most salient moments)

4. Imaginaries and aspirations for transition.

At a first step, textual corpora were submitted to preliminary forms of content analysis.

In the case of newspaper articles, texts were prepared using the software TalTac 2 (Bolasco, Baiocchi & Morrone, 2000) to identify multi-words (e.g., "energy transition", "renewable energy") and perform lemmatization, i.e., grouping the inflected forms of words and reducing them to the word's lemma so they can be analysed as a single item.

Then, texts were analysed using the software IRaMuTeQ (Ratinaud, 2014). We calculated descriptive statistics and the frequency distribution of words and finally we analyse them through the Descending Hierarchical Classification or Reinert method (Reinert, 1983), which consists in classifying words in lexical worlds (topics of words that refer to a class of meaning), i.e. the topics. Lexical worlds (or topics) are the visible traces (lexical) of the latent dimensions that underlie the discourse, called topoi (places of thought) (Reinert, 1998). The texts that compose the corpus are defined Initial Context Units (ICU). A first step allows dividing the corpus into smaller portions, which are the Elementary Context Units (ECU). Lexical worlds are individuated through co-occurrences of words as they appear in portions of a text (ECU).

Put it simply, the Reinert method is a clustering method based on lexical/vocabulary distribution (occurrences and co-occurrences of words within a unit of context) and assumes that words used in similar contexts are associated with lexical worlds. The final objective is to create topics based on similarities and differences in vocabulary distribution (Reinert, 2000). In social research, lexical worlds often refer to frames (Goffman, 1974) or social representations (Moscovici, 1961/76).

Regarding interviews, these have been verbatim transcribed and analysed through thematic discourse analysis (Taylor & Ussher, 2001). In line with social representations theory and argumentative discourse analysis, at the first step we used thematic coding (Braun & Clarke, 2006) as a method for data reduction, systematization and interpretation capturing both explicit and implicit meanings. After coding, we organized our data through themes and analysed discursively the coded portions of text to capture shared, consensual or conflicting discourses representing underlying systems of meaning (Taylor & Ussher, 2001), and the function they serve (i.e., sustaining a particular version of reality, accuse, justify, making evident contrasts).

Therefore, the research examined the inter-textuality of discourses, namely the interaction of discourse with elements of other discourses from which it emerges and interacts (Fairclough, 1992) – e.g., polemic representations are developed and conveyed in opposition to hegemonic or emancipated representations. In this way, the research connects meanings in their context of use, considering the positions criticised or against which given versions of reality are created, acknowledging the counter-position in the analysis (Billig, 1987).

10.8 Narratives

Adopting a discoursive perspective that considers how narratives and discourse coalitions can re-produce or undermine lock-in, the triangulation of findings from different datasets (interviews, newspapers, public documents) reveals the presence of three main narratives and discourse coalitions about the energy transition.

In line with Lieu et al (2020), we defined these narratives as mainstream, alternative on-stream, and alternative off-stream narratives.

In our case, the mainstream narrative re-produces lock-in undermining the phase-out of coal and renewable energy deployment by promoting the survival of the coal regime through carbon capture and storage or mostly promoting a coal-to-gas transition. This narrative supports institutionalized energy discourses that rely on dominant values and assumptions about representations of place (i.e., industrial/coal tradition, culture, and identity) excluding other perspectives and resisting transformative impulses and forces.

The alternative on-stream narrative promotes a sustainable transition through large-scale renewables and circular economy industrial reconversion that adopts a business-as-usual (BAU) model. On energy transition, it involves a technological substitution that reproduces the rules of the game of the existing energy regime (i.e., large, centralized infrastructures, mostly based on private investments and gains, and instrumental views of nature and place). This narrative is supported by incumbents with strong discursive agency operating a narrative co-optation of emerging socio-economic, socio-political and opinion trends (e.g., need to diversify energy supply, coal phase-out decisions).

The alternative off-stream narrative is a counter-narrative in relation to the onstream narrative; in line with Smith and Raven (2012) conceptualization, the on-stream narrative can be considered a "fit and conform narrative", while the off-stream a "stretch and transform" narrative. This narrative assumes the same goal of a 100% renewable energy system but emphasises the potential of a decentralized and community-based energy system as opposed to large-scale renewables owned by private investors (see Fig. 15 showing the main characteristics of these discourses and the coalitions supporting them)6.

We present more in-depth each narrative in the paragraphs below.

10.8.1 Mainstream narrative

The mainstream narrative is characterized by three ideological components that can be labelledas "industrial myth/tradition", "extractivist view of the environment" and "economic dependence". As reported in previous paragraphs, the region severely depends on coal for energy generation and the carbon-intensive industry for its socio-economic stability. These twoaspects are interlinked not only spatially and infrastructurally (coal mine, coal-fired powerplant,and industrial cluster working in synergy) but also politically. Industrial re-opening and reconversion were aspired for different purposes, such as keeping jobs and restoring the sites. This, however, demands a stable and large energy supply at favourable prices. The mainstreamnarrative is mainly conveyed by a discourse coalition comprising the Regional Administration, regional and national unions, workers and large industries, that alternatively pushed for postponing phase-out[7], or timely development of the needed infrastructure for a coal-to-gas transition to support phase-out and secure energy supply with the methane pipeline or coastal deposits with regasification plants (see figure 16).

Figure 16. Project for coastal deposits with regasification plants

Nowadays, it seems that the methane pipeline project has been abandoned and stakeholders present natural gas deposits as necessary for the industry - and rhetorically also for families despite the distribution network for the household is lacking.

This powerful discourse coalition can be seen as culturally hegemonic. It operates at different scales and connects big players (gas-related companies) with political environments (different Regional Administrations in the last decades), intermediary actors (unions), and finally, workers and citizens concerned about the occupational and socio-economic crisis. Their dominance is traceable especially looking at the topics identified in the press or the discourses of intervieweeswho felt forced to take this narrative as a starting point for argumentation - sharing or contestingthe narrative.

According to the mainstream narrative the crisis in southern Sardinia is represented as the inevitable result of the exhaustion of the coal-based economy, the disproportionate cost of labour in Italy, and energy in Sardinia compared to the rest of the country. Thus, phasing out coal without knowing how to replace it means economic damage to the entire regional economy. Economic stakeholders and the Regional Government are aligned in demanding the methanization to reduce the energy costs for industries and families. On the contrary, environmental NGOs oppose such development that risks locking in the regional energy system.

The energy transition is therefore depicted as a way of exploiting the abundant natural resources available, offering local people new economic opportunities instead of old jobs while still proposing fossil infrastructures and sources as a transition material. Moreover, the rationale isto replace coal-based generation through a mix of natural gas and centralized large-scale renewable energy technologies (mainly wind, solar and wave energy) and strengthen the distribution network.

According to the mainstream narrative, local communities are represented as passive agents or emerge only as a barrier to infrastructural and economic development. Citizens are often excluded from the framework or relegated to the background, as the problem is characterized by industrial crises, trade union struggles and territorial development plans protecting and safeguarding industries. Workers emerge only within company crises, while the problems for thecommunities affected by the transformation are simply invisible.

The mainstream narratives are imbued with what we may define as an industrial myth and trap. Industry must be preserved at all costs for preserving the delicate regional situation, and social imagination and planning about the territorial future cannot escape from industrial decline and

dilemma. This ideology is also accompanied by an instrumental and extractivist view of nature and deficit and a passive view of the territory and its community. This is clearly at stake in policyand planning reports such as the Sulcis plan, the national energy and climate policy or the regional energy strategy.

10.8.2 Alternative onstream narrative: Renewable energy transition as a business as-usual technological substitution

This alternative onstream narrative is characterized by an imaginary of a fully renewable energy transition for the island and an alternative territorial development based on the circular economy principle. It claims the environmental and economic unsustainability of a fossil-based scenario, emphasizing aspects such as the public costs for infrastructure development, further pollution and GHG emissions, the intrinsic economic vulnerability due to the cost of materials, and the risk of locking-in infrastructurally and economically the region for a long time (e.g., the deployment and penetration of renewables are difficult due to the deficient grid and the fact it is mainly occupied by electricity from fossils).

This vision has been primarily conveyed by a coalition of major environmental NGOs (operatingat a national or international scale and more concerned with global climate issues) and some research institutions, envisioning and assessing a 100% renewable energy scenario (coalition *Sardegna Rinnovabile*). In recent times (i.e. 2020), the discourse coalition enlarged with powerful stakeholders and institutions with their projects for Sardinia. Among them, ENEL, the main national electricity company pushing forward the "Green electrification" project for Sardinia (cf. Multi-Stakeholders Energy Compact UN, Figure 17), and the national government proposingSardinia as the energy model and Italian green laboratory for energy transition (PNRR – Recovery plan) foreseeing for the upcoming year an increase of 2,600 MW for wind energy and2,200 MW for solar.

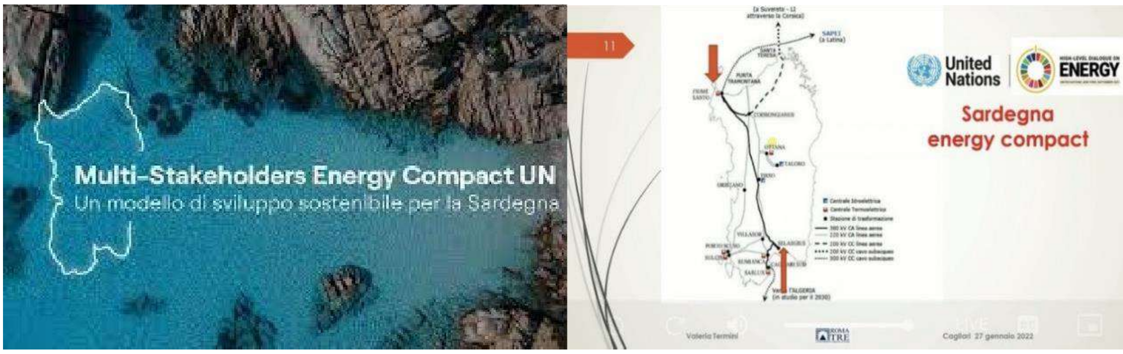

Figure 17. Green electrification project 2022

(promoted by Enel, Multi-stakeholder energy compact UN, National Government)

This view foresees a full transition to renewables through large-scale facilities exploiting the island's abundance of natural resources (wind, wave, sun) to substitute coal-fired power plantsand secure energy supply. Locally in the Sulcis region, an example is represented by the wind farm located in Portoscuso, in operation from 2011 (ENEL – 89,7 MW), or the offshore one planned 35 km from the coast of Portoscuso and involving 42 floating turbines and planned andauthorized in 2019 but subject to contestation (504 MW) (see Figure 18).

Figure 18. Wind offshore and onshore projects in the area of Portoscuso

The green electrification project for the island is increasingly conveyed by an emerging coalitionof actors and groups. The scenario foresees for 2030 the abandonment of fossil fuels and their substitution with renewables, the diffusion of technologies for the electrification of final consumption, such as electric mobility, heating and cooling systems, energy efficiency and electric cooking.

This scenario can be considered onstream as it takes for granted or explicitly promotes a BAU and technocratic model for the energy transition. It foresees mostly private investments and a technological substitution from fossil-based facilities to large-scale renewables integratingstorage solutions and distributing energy through the grid or exporting it to the continent through the submarine powerline. Moreover, this view also involves a 'touristification' of the island and the circular economy reconversion for industries, which however is in line with an instrumental view of natural resources and the territory. In this context, large environmental NGOs adheringto this discourse coalition support large-scale infrastructures and try to persuade citizens to accept them or contribute to energy transition through technology adoption, but also support political administrations in the development of energy communities and districts guided by the rationale of climate mitigation and neutrality.

The characteristic that makes onstream the alternative narrative is that the structure of power,the limited agency and ownership of the local population, the instrumental view of theenvironment, and the business as the usual and technocratic rationale of the pathway envisionedremain unchallenged. Indeed, the region is considered a green laboratory due to its reserves or its demographic characteristics, such as low population density. Stakeholders claim that their vision is socially legitimated due to studies revealing that 94% of Sardinian citizens agree on electrification, environmental restoration, reconversion and use for economic purposes (EMG Acqua Group, 2021[8]).

However, ownership and agency are somehow excluded from this picture. The socio- organizational scheme considers only marginally the contribution of alternative forms of development and management for renewables and natural resources. The territory is described,even when talking about development plans, as something that should be reclaimed from the polluting effects of previous economic activities and preserved and valued to attract tourists or for other productive purposes. The underlying ideology reduces locals to almost invisible actors,whose function is merely to passively accept policies and projects or preserve nature for the

In summary, the main ideology depicts locals as waiting for something to happen from the outside: i.e., tourists will come, investors will arrive, jobs will be created, the State and Region must solve, etc. which implies a deficit and passive view of the population as subject to decisionstaken elsewhere, external economic investments and control over local resources. In this narrative, new jobs are mainly brought from the outside with no sense of ownership and agencyfor the local population. Whereas the value of tourism is recognised, without local ownership andagency, it condemns Sardinia and Sulcis to be a space suitable only for the aesthetic enjoyment by the inhabitants of the "continent" (i.e. Italy), and for agriculture and small commerce.

These aspects are rarely problematized in this narrative and represent the basis of the off-stream narrative, which emphasizes issues about agency and ownership, social justice, and a different people-environment relationship. Locally, the resistant counter-narratives, seem rather an attempt to have a voice in the face of dispossession of lands and sea by mainland stakeholders.

10.8.3 The alternative off-stream narrative: Community-led and place-based energy transition

The alternative off-stream narrative emphasizes the history of exploitation, marginality, subalternity and dependence of Sardinia and Sulcis represented as a form of colonialism (industrial colonialism, military servitude, colonialism of state or energy colonialism).

This narrative is conveyed by a discourse coalition that involves environmental NGOs (those more ‘environmentally conservative’, focused on the protection of the local environment and acting at a local scale), local activist groups and movements, local politics/authorities, and some marginal union. This perspective is summarized also in the advocacy document “Sardinia Zero CO2 Island – phase out 2025: operational proposal for Sardinia decarbonization” (Bullegas et al., 2020). In this narrative, both coal mining and metalworking industries are recognized as vertically imposed decisions in the regional development path and failed models. However, coal mining is recognized as a characteristic feature of the territory and its identity (thus a development that is perceived in line with place-based meaning and material aspects). Stakeholders recognize that the coal industry led to locally developing know-how and capacities (e.g., through dedicated education programs such as the mining school of Carbonia and the nautical school in Carloforte), infrastructural and socio-economic development. The memory of this pathway is charged with emancipatory feelings and achievements, recognizing the value of mining heritage for past and future local development. On the contrary, the development of subsequent carbon-intensive industries is re-presented as a “de-contextualized development” characterized by a lack of ownership and agency and determined by the misrecognition and valorisation of the territory. In this view, industrial development altered the socio-economic diversification of the area at the expense of local traditional activities and capacities (agriculture, farming, fishing). This involves negative social and environmental effects that involve losing territorial identity, knowledge, and tradition, with ecological costs and increasing economic dependence due to the industrial monoculture. All these discourses refer to the mainstream narrative described as a mix of capitalism and colonialism, which conduced to Sulcis' economic subordination and marginalization. Industrialization is represented as “modernization with passive development”, or “innovation without development”. The “industrial myth” or “industrialmirage” is perceived as corruption and passivation of collective consciences. The consequence is the inability to envision a different path or to act for change due to an entrenched social convention and imagination that is constrained by the sense of responsibility toward the community regarding jobs (i.e., occupational blackmail). On the other hand, stakeholders supporting this narrative make salient other forms of colonialism and injustice. First of all, the military servitude and occupation of Sardinia and Sulcis, with the presence of training polygons, consequent pollution (Teulada), or bomb factories (Domusnova). Secondly, energy colonialism or state colonialism, with foreign investors (“lords of sun and wind”) speculating, grabbing land, exploiting local places and resources for making profits, and producing energy to be exported to the rest of the country while producing locally no development. Rhetoric about colonialism, dependence, deprivation, and lack of ownership and agency are all main points of this narrative that is supported and conveyed by regional newspapers (see e.g., Fig 19 reflecting this claim).

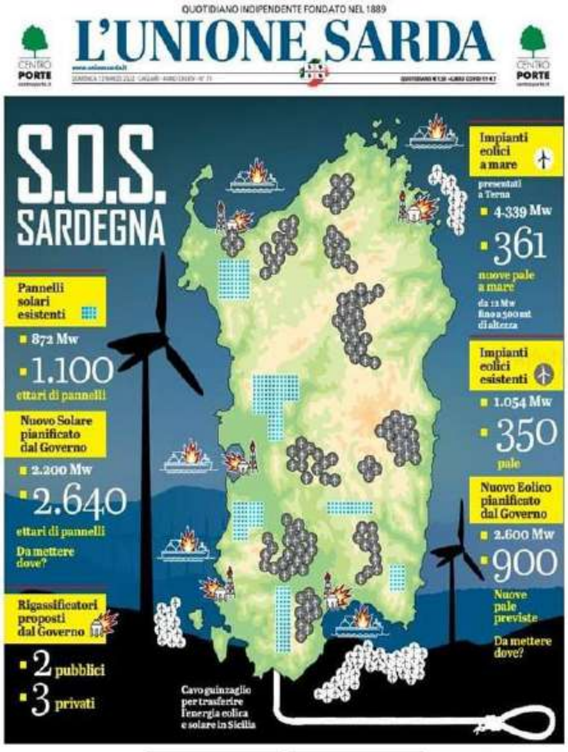

Figure 19. Frontpage of a regional newspaper (March 11th, 2022) depicting energy plans and projects for Sardinia. Note that the noose in the bottom represents the cable that connects Sardinia and Italy

What characterizes both alternative narratives is the reference to the circular economy as a way to transform the system creating an alternative development path solving existing criticalities and creating new economic sectors. This involves converting and reusing sites such as waste fills, mining and industrial areas, improving the processing and recycling practice of materials or innovating in the field of environmental remediation. However, the off-stream narrative conceives them as a way to give back to the community stressing its emancipatory potential (e.g., entirely developing economic sectors, productive chains and creating new jobs and competencies) and the risk of using it as an empty word (which applies also to distributed generation). According to this narrative, renewables need a community vision acknowledging

socio-ecological values, needs and state, and avoiding or reducing impacts on cultural heritage and landscape.

The off-stream narrative emphasizes more elements of agency and ownership for alternative development. It envisions an energy system characterized by distributed generation across the territory, based on self-sufficiency and self-consumption principles, promoting an alternative model for energy management through energy communities or energy districts (e.g. municipality consortiums) coupled with energy efficiency and saving as the primary form of energy generation.

Regarding the socio-technical imaginary, photovoltaic development and siting are recognized as having a great potential (16,3 GW, assessed in a study from the Joint Research Center, see figure 20) sited in built environments (i.e., non-agricultural land, rooftops and mining and industrial areas), while the development of wind energy is considered favouring publicly owned farms or developing (chains providing) community benefits.

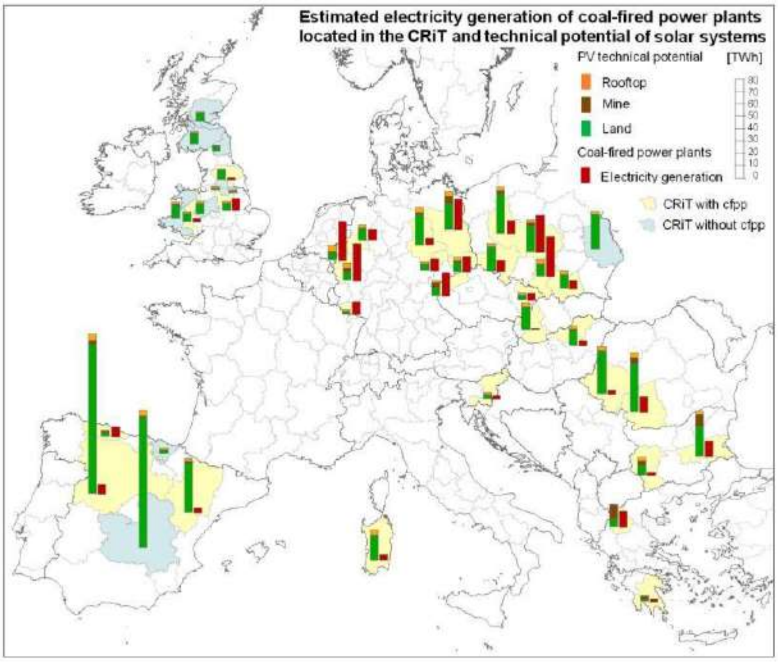

Figure 20. Technical potential of solar systems compared to electricity generated from coal-fired power plants in EU coal regions in transition. Source: Bódis et al. (2019).

Discourses about power generation from renewables are coupled with discourses stressing the revamping of the distribution grid and the development of storage solutions at different scales for addressing intermittency of production (i.e., hydroelectric pumping, batteries).

To conclude, the narrative stresses that previous pathways suffered a lack of ownership and multiple forms of environmental injustice (land dispossession, lack of participation in development decisions, colonialism and dependency relations). Even recent policies and plans (e.g. Sulcis Plan, Methanization) are represented as protecting the status quo and industrial hegemony and legitimacy while disempowering the population. This discourse is amplified and conveyed by local media (e.g. regional newspapers) making visible the conflict between change ambitions and projects and their effects.

10.9 Trends and indicators for sustainable transformations

10.9.1 Trends of pathways (de)legitimation

Starting from a situation of lock-in and path dependency reinforced by the cultural legitimacy of coal and carbon-intensive industry, across the years we observed a transformation of the mainstream narrative (from the survival and adaptation of the coal regime to the coal-to-gas transition) and an increasing trend of regime destabilization and delegitimation by actors with strong discoursive agency that exceeded the boundaries of mainstream discourses supporting continuity (lock-in) for leaping into the alternative ones promoting transition and undermining lock-in (See Figure 21).

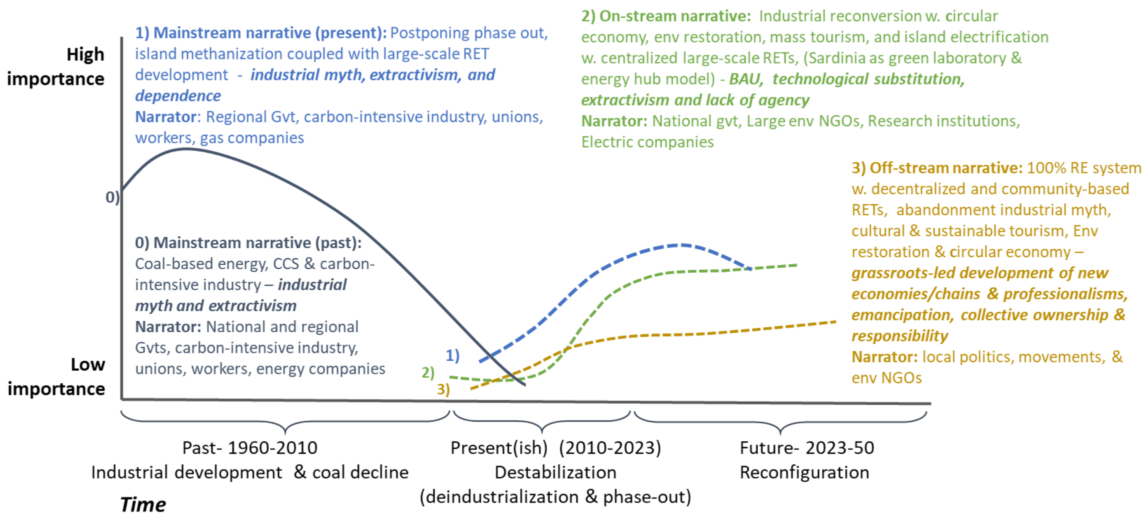

Figure 21. Trend of narratives and their legitimacy across time

Indeed, in recent times the discourse coalition supporting the mainstream narrative lost crucial actors such as the national government and the main national power company that joined and enlarged the alternative onstream discourse coalition.

Regime destabilization can be traced back between 2014 and 2017. In 2014, in line with EU pressures, the national government and regional council approved the closure plan for the coal mine by 2018. In 2017, the government approved the national energy strategy that foresaw thephase-out of coal-fired powerplants and the development of the gas pipeline for Sardinia. This decision exacerbated conflicts and protests over the possibility of infrastructural carbon lock-in due to investment return while fostering the discourse coalition for the renewable energy transition. In 2019, the government approved the national integrated energy and climate plan that foresaw the coal phase-out by 2025 and opened the discussion over what form of coal-to- gas transition to undertake, creating destabilization dynamics over the island energy security and industrial re-opening in Sulcis. Afterwards, in 2021, they abandoned the option of developing the methane pipeline project supporting a lighter coal-to-gas transition and the green electrification for Sardinia.

On the other hand, ENEL (owner of the coal-fired powerplant and main electricity company in Italy) decided to not reconvert/decommission the coal-fired powerplant, and pursue the electrification project for Sardinia, expecting to invest 15 billion euros for developing 4/5 GW of renewable energy projects, storage facilities for 1 GW and creating 10-15.00 new jobs by 2030.

Supported by actors with a strong discoursive agency the alternative onstream narrative is starting to socially consolidate and institutionally sediment in political and business plans, while the off-stream remains marginalized or weakened by mainstream and onstream narratives – despite recent political developments on energy communities at the regional and national levels, which are still in the making.

Observedin:	Name of the narrative or other factors	Trends observed in the narrative (qualitative description)	Indicator(s) that helps describe the trend (way to measure)	Indicator discipline(s) e.g. economics, policy, etc.
Mainstream narrative	Industrial myth, extractivism and colonialism	Destabilization of hegemonic representation	Education level Migration patterns Unemployment rates Unemployment benefits, layoffs and state aid to industry and workers	Geography Economics
On-stream narrative	Circular economy and 100% renewable energy system BAU	Discourse institutionalization/ emancipated representation	Number of companies, projects, employees, and investments in low carbon sector. Public and privateinvestments Start-ups and technologyinnovations. Public opinion trends Funds in education and R&D centres	Economics Socio- psychological
Off-stream narrative	Anticapitalistic, emancipatory, just, and environmentally sensitive transition	Polemic representation Marginalized and weakened by policy processes	Lack of acceptance of renewable plans and projects Lack of civic engagement and transparent information Lack of legal innovations such as on energy communities,idoneous area for siting Lacking public-privatepartnerships Lack of strategic vision (bottom-up visionary discussion processes)	Socio- psychological Political

Table 5. Indicators and trends derived from and to contextualize the narratives

10.10 Summary of key findings

In this case study, we adopted a socio-psychological and discoursive perspective to examine the trajectory and tipping dynamics in a coal and carbon-intensive region (see Figure 22).

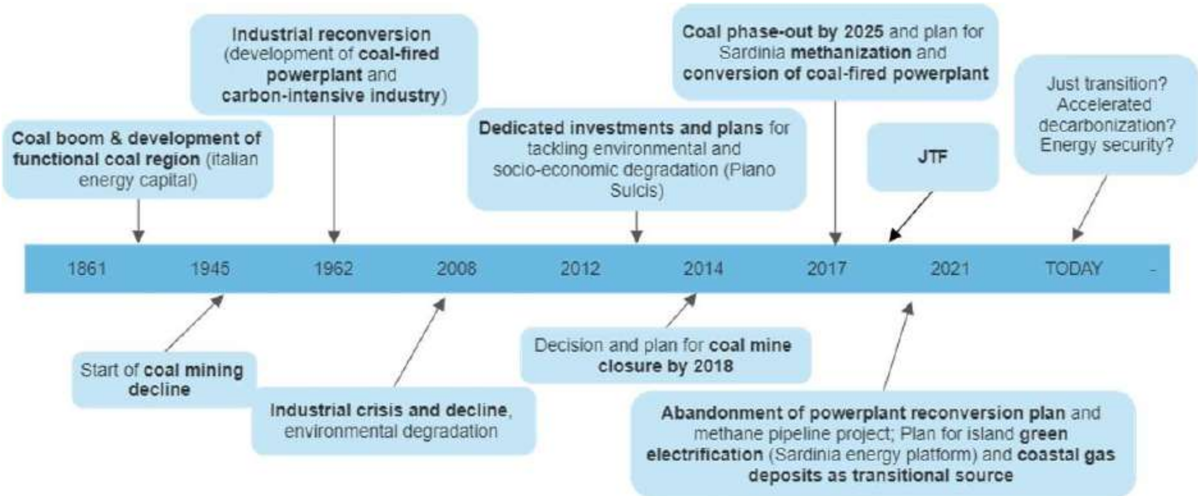

Figure 22 A simplified visualization of the regional trajectory highlighting key tipping events and interventions

We tried to combine macro-level and micro-level analyses connecting individual levels of explanation with the analysis of the cultural and societal dynamics shaping the contextual politics of change.

At a first sight, the region seemed characterized by path-dependent patterns locking in - or at least greatly constraining the corridor of the possible in – the regional transition pathway. Therefore, we attempted to understand the socio-cultural and socio-psychological patterns underlying path dependency and examine why the region failed in (a) creating the conditions for navigating tipping dynamics of destabilization, (b) deliberatively triggering a tipping point for reconfiguration, and (c) how lock-in and path dependency can be disrupted through interventions that acknowledge place-based experiences and imaginaries for a just transition.

Our study on media discourse tried to understand why and how certain pathways of transformation have been (de)legitimated over time.

The findings reveal that media discourse on energy issues in Sulcis region is heavily entrenched in the carbon-intensive industrial crisis and decline. Almost half of the newspaper discourse (47% of the total classified text segments and 2 of 5 total topics identified) reflects this issue, stressing how stable and secure energy supply at an affordable price is a key determinant of industrial survival or decline. Overall, the topics identified in newspaper discourse can be interpreted along the two dimensions of energy transition and deindustrialization, opposing discourses that concern politics and policy (i.e., knowledge and interest struggles; strategies, plans, governance arrangements) with discourses about their local implementation (projects, territories, and actors involved).

In this regard, the emerging representation of energy transition frames decarbonization and phase-out policies as problems or even a potential trauma due to Sardinian dependence on coal and the lack of gas infrastructures, which in turn affect the survival of carbon and energy-intensive industries and the related socio-economic stability.

In this context, coal (and coal-fired power generation) is legitimated over time by discourses that represent it as: a) a potentially "clean source" making reference to clean coal and carbon capture and storage technologies; b) the "most suitable source" and "local asset" for responding to industrial energy needs and the stability of the power system; and c) as part of the "local tradition, culture, heritage, identity, and vocation".

The latter aspect concerns the cultural legitimation of coal, which is accomplished through arguments re-presenting the place stressing its industrial history and vocation (with the coal industry first, and metalworking industry later), as well as the need for transformations that acknowledge the existing skills and traditions based on the mining tradition.

More on instrumental considerations, on energy supply the newspapers stress the high energy costs for industry and families and the macroeconomic trends underpinning the disadvantages for Sulcis and Sardinia, which ultimately legitimated the survival of the coal regime and later support the coal-to-gas transition.

In fact, a large part of newspaper discourses on energy production revolve around the debate over the coal-to-gas transition, while relegating renewable energies almost into the background.

Energy production is almost always discussed in reference to large-scale facilities promoting a picture of energy transition and socio-technical change as a technological substitution, reproducing the centralized model of energy production and distribution typical of fossil fuel- based infrastructure. Indeed, on one hand, these projects are often presented as a feasible alternative to replace coal-fired power generation and thus enable coal phase-out and decarbonization limiting their negative economic impacts. On the other hand, the dominant representation of renewables as large-scale infrastructures embodies a "colonial relationship" between the region and the country, symbolized by the submarine powerline connecting the island and the mainland.

Regional power generation from renewables is often represented as a form of energy colonialism that preserves national energy security but not the regional one. Renewables are represented across time with narratives that emphasize the exploitation of local resources from industry actors and the related political compliance, portraying Sardinia as a colony subject to industrial and national interests and suffering intolerable environmental impacts and energy costs with no visible benefit (e.g., redistribution of economic benefits, creation of economic/job opportunities, termination of polluting activities).

Energy transition as much as de-industrialization are therefore represented as external forces jeopardizing community wellbeing and capability, while the community is represented as dispossessed, lacking the agency and ownership for taking control and responsibility over development pathways and the necessary resources.

All in all, these findings suggest that renewables remain marginal in the media discourse, a niche that finds multiple difficulties in scaling up due to the long-time regime stability (coal legitimacy) and recent transformation (coal-to-gas transition), and in its diffusion due to the proposed business-as-usual and centralized model of large-scale infrastructures, which is locally resisted and considered unacceptable.

The findings from the interview study show that the sense of place (i.e., place meanings, attachment and identity) has been heavily influenced by mining history. In line with territorial functional development, the sense of place is characterized by a functional place attachment and industrial identity. Collective memories about the mining period reflect a nostalgia for a period characterized by increasing well-being, social emancipation, and the creation of capacities that participants recognize as contributing to a mythization of the mining period.

The decline in the mining sector and the following industrial reconversion are understood with ambivalence. While the development of the metalworking industry allowed somehow to maintain continuity in sense of place, especially for what concerns the industrial identity of the place, it is represented as a transitional rupture that undermined place dependence and reverse the condition from emancipation to domination. Most interviewees make sense of this passage as an imposed and decontextualized development pathway with detrimental consequences such as a corruption of consciences and socio-economic destabilization, which resulted in the loss of place-based identities, traditions, capacities, and economic means of subsistence in the agri-food and livestock sectors. Understanding the rise of the metalworking industry through the lens of today, the place is represented as a sacrifice zone, where experiences of socio-political marginality (concerning political decisions) and socio- economic subalternity (concerning investments and jobs created) intersected.

In this sense, Sulcis is re-presented as a territory disrespected, culturally and politically dominated, economically and environmentally degraded and devalued. Job opportunities are presented as dirty in moral (e.g., weapon and military industry) and material terms (waste, coal).

Participants made sense of this experience of injustice as an effect of modernization and development guided by neo-colonialist and capitalist rationales that created the illusion of territorial development. According to interviewees, this produced socio-economic distortions (i.e., lack of economic diversification, dependency on state aid or external resources) that contributed to hindering community agency and sense of responsibility (i.e., welfare and dependency culture, economic marginality, and subordination).

In this context, the industrial decline represented a further transitional rupture followed by inadequate adjustment and recovery. As testified by heterogeneous actors, the difficulty of abandoning the industrialization myth and envisioning alternative pathways is a sign of cultural hegemony – that is, the system of power, identified in a coalition of interests and discourses, manipulates the cultural frames and norms of the community reinforcing path dependency and impeding alternatives to be thinkable. The cultural dominance of the industrial myth contributes to the therapeutic persistence toward industry, characterized by state subsidies, layoffs and - psychosocially - a sense of responsibility toward the community occupational state, represented as an obstacle that constrains the imagination and expectation of the entire regional community, unable to imagine, plan, and invest alternatively.

This historical and socio-cultural underpinning is crucial to understanding how people make sense of current developments such as the energy transition. Indeed, the interview study corroborates many of the findings from newspaper analysis. In continuity with injustices experienced with industrial development, energy transition is conceived as a further development pathway that is instrumental to others but not the locals. The place is represented as a "colony", instrumental to energy companies or the country, and reproducing a human-nature extractivist relationship that permeated the rise of the mining industry.

It is in line with this understanding that participants advocate for imaginaries, mirroring an increasing discourse structuration around guiding concepts and principles for a place-based approach to sustainable transformation. The place is represented as a laboratory and model for innovation and development guided by the circular economy principle and a waste-to- resource approach. This imaginary involves the widespread sustainable restoration and reconversion of contaminated places. From being a source of environmental degradation and territorial stigma, brownfields, polluted sites, and wastes are re-presented as territorial features that can become local assets, even for the energy transition. However, this imaginary can be pursued only if the strategic vision and feasible alternative are developed through co-production, ensuring that the community is fully engaged in the transformative process, and can feel co-responsible, develop agency and ownership, and perceive the socio- economic prospects of transformation. This aspect concerning the appropriation and territorialization of a new transformative narrative is well exemplified in the following excerpt from a regional politician opposing two pathways for tackling energy transition.

It is the concept of Sardinia as a laboratory and not as a guinea pig (ID 26)

Indeed, energy transition imaginaries expressed by stakeholders reveal a predominant preference for energy system change characterized by decentralization of power, competencies and benefits, and distributed generation and renewable energy communities and districts as the main socio-technical configuration for energy transition. This spatial transformation imaginary opposes the instrumental views of nature and place of previous pathways, while not compromising idealised representations of places that are at the core of the imaginary (e.g., sea landscape for tourism, land for agri-food).

To summarize, following a tipping dynamic of destabilization incorporated by the decline of coal and carbon-intensive industry, reconfiguration has been constrained by corridors of the possible (path dependency) and multiple lock-in mechanisms (psychosocial, socio-political, infrastructural, and socioeconomic).

Psychosocially, the sense of place embedding the industrial myth, identity, and tradition undermined the development of new/alternative visions, identities, and pathways for the regional community. Cognitive patterns denoting subalternity, passivity, fatalism, and psychological conservatism in the local population played a key role in this dynamic. Political resistance from powerful discourse coalitions fostered for a long time a therapeutic persistence to protect industry and workers, locally constraining energy visions and strategies, delegitimating and postponing the phase-out of coal, justified by an infrastructural and socio-economic lock-in – i.e., energy security and affordability for industrial survival; lack of appropriate grid for diversifying the energy supply; lost professionalisms and scarce occupational diversification. These lock-in mechanisms interact with each other via self- reinforcing feedback reproducing a path-dependent trajectory. The trap and addiction metaphor (Marschke & Berkes, 2006; Bailey et al., 2010) is an appropriate way to frame the situation that characterized the Sulcis region.

Nowadays, coal phase-out, the recovery plan, the just transition mechanism, or the green electrification narrative and project are windows of opportunity for a sustainable reconfiguration and low-carbon transition.

Nevertheless, political action is urgently needed to avoid that recent tipping events (i.e., the Ukraine war and energy crisis) accelerate decarbonization for national energy security reasons while disregarding the just transition.

Indeed, while opening a window of opportunity for disrupting a locked-in development and promoting energy transition, the increasing legitimacy of the alternative onstream narrative involves several risks in re-configuration dynamics. First, taking a new direction without opening up discursive space – marginalizing or co-opting the off-stream narrative - risks disregarding the emerging and already existing drivers of injustice, which may exacerbate inequalities and cross-scale conflicts, ending up not stimulating the development of capacities to support the transformation, and losing momentum for socio-cultural reconfiguration.

A just transition can still be pursued by navigating transition momentum through the confrontation of competing visions and pathways that considers key uncertainties and creates mutual understanding and actionable meaning. The discourse structuration of concepts such as circular economy, green electrification and 100% renewable transition must be problematized in terms of agency and ownership of development paths, including coordinating collaboration, envisioning new pathways, identifying leverage points, developing strategies for addressing barriers, and linking strategies to the specific opportunity context for gaining momentum. Hopefully, this process could foster learning and inform the pathway selection and adoption (Moore et al., 2014; Olsson et al., 2014).

Without addressing these elements, the regional transition is destined to suffer harsh resistance, increase vulnerability and uncertainty, and make investments that do not bring the expected or effective territorial development.

10.11 Reflection on inter- and transdisciplinary research approach

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11 Case study 10: Carloforte, Italy

Small islands, Carloforte (San Pietro island), South Sardinia

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11.5 Introduction

11.5.1 CCIR description

This study makes sense when compared and contextualised together with the "Sulcis" case study (see Biddau, Sulcis' case study)

Looking for a fieldwork in which to ground the research questions, we chose a site involved in decarbonisation processes, but geographically marginal. This choice allowed us to observe processes of denial, distancing and mirroring between two communities (Sulcis & San Pietro) involved in the industrial crisis linked to the exit from the coal economy.

The island of San Pietro - the municipality of Carloforte - has a mainly maritime economy and has been radically different from that of its mother island since 1700. In fact, until the beginning of the 20th century, the town of Carloforte (the only one on the island of San Pietro) was the second port in Sardinia after Cagliari, from where cargoes of minerals (mainly coal) from Sulcis departed.

The island has long been home to high-ranking sailors (officers) and today houses a Nautical Institute of regional renown, attracting students from the neighbouring province. As historians and anthropologists testify (Vallebona, 1975; Tiragallo, 2015) for these two main reasons, trade and sailors' remittances, historically the island is richer, lives off boating and trade, unlike Sulcis it does not have alarming unemployment rates, and due also to this structural fact it is perceived as radically different from the rest of agro-pastoral and then industrial Sardinia.

From the fieldwork it emerges that all Carlofortini, born or acquired, without distinction, highlight from the outset elements of wealth, competence, cosmopolitanism, and what they construct as the historical diversity of the island, a Genoese colony of Ligurian families who migrated first to the Tunisian island of Tabarka and then to Carloforte. According to this narrative, which is often put at the forefront, the people of Carloforte are not Sardinians. If they take the ferry, they 'go to Sardinia', which is linked in the discourse by verbs of displacement not only to describe the logistical aspects.

To be remarked here the local deny of the formal region, based on the local perceptual dimension. In our study, we have been trying to explore how does this identity marker of 'not-being-sardinian' come into play when facing transitional challenges.

Today, the island of San Pietro, compared to Sulcis and more generally to Sardinia, has become marginal, especially when compared to its its role as a port open to cosmopolitanism on a Mediterranean scale. In fact, until the Fascist era, Carloforte was the second largest port in Sardinia after Cagliari. As historians (Vallebona, 1975) testify in accordance with our primary sources "Coal sailed from Carloforte to the world", in the past. Above all it is reported that at that time it was usual to leave from Carloforte and to sail directly to other Mediterranean ports. Today, from the point of view of collective mobility practices and what they entail in terms of constructing mental geographies, to leave Carloforte one has to take the ferry and cross Portovesme, and then reach Carbonia, which have become new interfaces and points of passage and frontier.

Formal; Functional. To be remarked the local deny of the formal region, based on the local perceptual dimension.

11.5.2 Societal problem description

Several locally observed practices may be expressions of underlying dependency processes. These practices can be observed into the material and symbolic components of the following phenomena:

a. Depopulation (Qualitative data collected; quantitative data to be collected);

b. Change in economic assets: (ongoing) reconversion of former steelworkers and specialized navy officials toward small touristic sector (Industrial payroll subsides. Qualitative sources collected);

c. Pollutions from Portovesme's steel industry and coal fire plant.

11.5.3 Research problem

Two communities (Sulcis, Carloforte) perceive each other as follows:

- Sulcis as carbon locked-in (see Biddau, Sulcis' case study);

- Carloforte as green alternative already engaged in a progressive transition, at the same time a number of contradictions seem to emerge:

The same mechanism of community fragmentation observed in the carbon lock-in region (Sulcis) also emerges in Carloforte by reducing the perimeter of the energy transition to the domestic space only (see key findings).

Some community (Carloforte) assets (strongly asserted community identity; high level of technical education; historical wealth; cosmopolitan vocation) could consolidate and broaden the participatory base of the local energy transition. Instead, they seem to hinder it.

Disciplines: Social anthropology; Social psychology.

11.5.4 Research questions

a. Starting from a comparison with Sulcis region, do the above specified community assets facilitate or hinder socio-environmental tipping points?

b. In particular, is the strong ethnic identity, which pivots many ongoing processes of local differentiation, an asset or an obstacle to triggering radical tipping points?

c. How do identitarian claims (included intragroup dynamics and place identity) influence the processes of distribution of agency at the local level?

d. The Tabarkine colony in Carloforte begins with a gift (Tiragallo, 2015) from King Charles Emmanuel III of Savoy who parceled the island by giving each settler an urban parcel and an agricultural parcel. Carloforte is an island of parcel owners. Do this cognitively and politically structures participatory processes on the island, including those of appropriation of the energy transition?

11.6 Research approach

a. Political anthropology: narrative constructions of ethnic identities as a tool for the community building (Herzfeld, Michael, 1997, Cultural Intimancy. Social Poetics and the real Life of states Nation", Routledge, London);

b. Cultural anthropology: temporalities analysis as a field for individuate cultural and cognitive ressources at the local level (Appadurai, Arjun, 2013, The Future as a Cultural Fact, Verso Books, London);

c. Timescape analysis (Bear, Laura, 2016, "Time as Technique", Annual Review of Anthropology, vol.45, pp. 487-502);

d. Energyscape analysis (Sarah Strauss, Stephanie Rupp,Tomas Love, eds, 2013, Cultures of energy : power, practices, technologies, Left Coast Press, Walnut Creek - CA);

e. Analysis of dispossession mechanism and power across low-carbon pathways (Sovacool, B. K. et al. (2019) 'Processes of elite power and low-carbon pathways:

Experimentation, financialisation, and dispossession', Global Environmental Change. Elsevier Ltd, 59(September), p. 101985. doi: 10.1016/j.gloenvcha.2019.101985).

f. Social representation theory (Castro, P. (2015) 'The approach of social representations to sustainability: Researching time, institution, conflict and communication', in Sammut, G. et al. (eds) Handbook of Social Representations. Cambridge: Cambridge University Press.)

11.6.1 Research methods and tools

Press analysis (Sardegna); ethnographic research, participant observation, remote structured interviews, face-to-face structured interviews; secondary sources analysis (local publications and journals, websites, political plans).

11.7 Narratives

11.7.1 Geography & Migration (Work Package 1)

1. Are there any population/migration movements in the region?

Emigration.

2. What is the key motivation for migration (based on the data already collected)?

As described above, as long as the coal economy was central to the Sulcis region, San Pietro was an important naval hub. This constituted the hub of local employment dynamics. The gradual dismantling of the coal-related economy since the 1970s has led to the loss of countless jobs. Emigration, since then and progressively, has imposed itself as a necessity to find employment outlets. More recently, in the last twenty years, emigration to pursue university studies has also increased.

Età	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	>74
Maschi	116	114	113	101	119	143	169	231	196	199	181	166	195	191	157	329
Femmine	74	111	87	100	136	157	153	203	196	216	174	185	215	206	178	449
Totale	190	225	200	201	255	300	322	434	392	415	355	351	410	397	335	778

Figure 1. Population, showing a prevalence of adults and elderly inhabitants

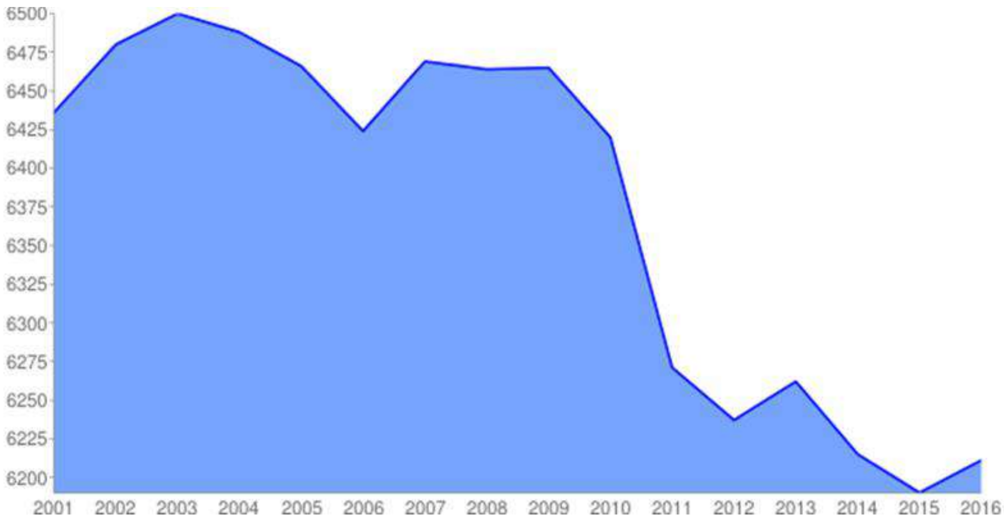

Figure 2. Number of inhabitants

1. Geography & Migration indicators	Examples
1a. population NUTS 1, 2 & 3 here 1b. composition of gender 1c. education levels 1d. age pyramid 1e. migration patterns 1f. life expectancy (only relevant over a longer time frame)	population and demographic data graphs: https://ugeo.urbistat.com/AdminStat/it/it/demografia/popolazione/carloforte/111010/4

Does identity (change) and values (change) reflect on electoral behaviour and electoral platforms?

Specifically in the case of Carloforte, a new mayor was recently elected who was previously the town planning councillor. He is the main bearer of European projects aimed at supporting the ecological transition in San Pietro. His name is expressed and supported by the Democratic Party (moderate left, centre-left) at the local level.

2. Values and identity indicators	**Examples**

2a. political parties' positions **2b. political parties' representations** ***(used as proxies for value orientations)***	PD - Partito Democratico (centre-left social-democrats positions) ; Civic list expressing centre-right or liberal-right positions Both parties support through green-oriented and green-tourism oriented EU-Funded projects alternative pathways.

11.7.2 Policy & Politics (Work Package 3)

3. Policy indicators	**Examples**
3a. public investments **3b. investment support** **3c. subsidies** **3d. taxes** **3e. policy planning documents**	Key relevant policy interventions: 1. In Sulcis region as a whole: a. Just Transition Fund (UE Level); b. Public subsides for unemployment (former coal-related employments) 2. Only in San Pietro Island: c. EU (mainly H2020) funds from transition-oriented projects (public electric cars; green tourism); d. Local policies oriented to "green" food tourism (Tuna Route; GiroTonno) locally produced.

11.7.3 Economic potential (work package 4)

Is there an alternative to the mainstream that is seen as economically viable?

4. Qualitative indicators on economic opportunities	**Examples**

4a. Key stakeholders' opinion on (new) economic opportunities	Two main stakeholders are interested in new economic opportunities: the institutional one is represented by some young municipal administrators who attracted, for example, new projects funded in H2020. The second stakeholders is the rebranded tuna fishery, connected with the wine and food tourism. Both are located in the Comune di Carloforte, their relevance is so clear that the place is internationally known for its famous gourmet tuna, and its symbolic value matches with cosmopolitan entrepreneurship and political elites. - The main emerging ideologies in the island, that we can label as on-stream since it's not at all disruptive but rather a re-organization of the mainstream narrative, can be summarised by the sentence "We are different from the Sulcis, we are green, we are cosmopolitan and sustainable entrepreneurs". Ideally we can identify 2007 as a key year for the emergence of this new vision of the self. Actually, the on-stream narrative is driven by a local institutional policy that -since 2007- promotes Carloforte as "Mediterranean's green island", this policy is mainly funded by EU projects and mainly tourist-oriented. This type of vision is far beyond energy issues and decarbonisation. Indeed, the identity dimension, economic processes and aspirations for green tourism capable of systematically attracting tourists in search of sustainable paradises are elements consistent with this on-stream vision. Both the over mentioned stakeholders are against the national project of a off shore wind

	farm nearby San Pietro. They don't see a new economic opportunity and their narrative might be resumed as follows: "wind farms spoil our main asset, that is the landscape".

11.7.4 Mainstream narrative: technology

In the case study, the technological sectors that have been dominant since the '900 are connected with the harbour, in front of Portovesme's industrial site. The harbour technological has been pivotal for the community since the 1700, with apogee from the late 1800 to around 1920, because of the coal's and other mineral's transportation. Indeed, the harbour was formerly functional for the coal transportation, then became functional for carpenters and blacksmiths for the industries and for steelworkers commuting to Portovesme. Nowadays, the harbour is relevant for tourism, although it is still relevant for linking Carloforte to the functional region of Sulcis, for example through the electric cable that connects Carloforte to Portovesme.

☐ Level. What types of technological sectors have been dominant in the region?

a. Harbour, formerly functional for the coal transportation, than became functional for the Portovesme's commuting steelworkers and now for tourism;

b. The electric cable.

☐ Space. Where have the technological sectors been located?

Harbour (in front of Portovesme's industrial site).

☐ Time. How long have these sectors been dominant?

Harbour because of the coal's and other mineral's transportation: from the 1700, with apogee from the late 1800 to 1920 ca.

Primary sources (interviews; observations);

Historical sources: Vallebona, Giuseppe, 1975, Evoluzione della società carlofortina, Editrice sarda Fossataro, Cagliari.

Atzeni, Francesco, 1993, Intellettuali e politici tra sardismo e fascismo, Cuec, Cagliari;

2000, Riformismo e modernizzazione. Classe dirigente e questione sarda tra Ottocento e Novecento, Franco Angeli, Milano;

2002, Elezioni e classe politica in Sardegna tra età giolittiana e primo dopoguerra, Cagliari, AM&D, 2002)

11.7.5 Mainstream narratives: stakeholders and institutions

The main type of stakeholders that have been dominant in the area are sailors, the tuna-fishery entrepreneurs, and the micro-tourism ones. These stakeholders have been dominant since 1700 for the sailors, starting from 1900 for the tuna fishery and from the 1970 for the micro-tourism.

The institutions that have been dominant in the case study are the municipality and the local high-schools, mainly the nautical institute (which formed generation of sailors) and the teacher's school (that formed -according to our interviewees the teachers for the entire region). Both attractive for the whole Sulcis' region, the importance of these institutions highlight the reciprocity of fluxes into the functional region. All these institutions, actives since the 1950.are located in Carloforte downtown, again close to the harbour side.

11.7.6 Mainstream narrative: ideologies

First, an owner's relationship with the environment that we can resume in a statement "this is our island, this is our sea". Indeed, the Tabarkine colony in Carloforte begins with a gift (Tiragallo, 2015) from King Charles Emmanuel III of Savoy who parcelled the island by giving each settler an urban parcel and an agricultural parcel. Carloforte is an island of parcel owners. This, we suggest, is one of the roots that cognitively and politically structures participatory processes on the island, including those of appropriation of the energy transition.

The second main ideology we detected is the ethnicist myth of the ontologically different and high ranking identity of the colonist settlers (technically, economically, culturally, ecologically) as compared with the Sardinians, and with the inhabitants of sulcis.

The second main ideology we detected is the ethnicist myth of the ontologically different and high ranking identity of the colonist settlers (technically, economically, culturally, ecologically) as compared with the Sardinians, and with the inhabitants of sulcis.

- Two main types of non-written policies have been dominant. First, the informal managing of the controversies that can be resumed in the statement "turn a blind eye" (informal management of conflicts, and beyond). Second, we detected a vertical collectivism that coincides -in other terms - with a familistic management. Indeed, in the eyes of the locals the public administration 'can' only be exercised by certain families of Tabarkino lineage (i.e. descendants of the first settlers) or by co-optation. Direct sources and historical ones (Vallebona, 1975) testify that these policies have always been dominant.

Taken all together, these five facets, can be summarized in the mainstream narrative that stresses a distinctive and positive social identity, and at the same time doesn't acknowledge the necessity or even the opportunity to really deal with Sulcis and with ongoing transformations – included the ones linked with decarbonization. Translating into a single sentence, it almost seems to hear the island saying: "we are different, our backbone is represented by the sailors and the harbor, we are descendants of colons who have been able to re-invent their destiny, just let us do our business, and we'll manage somehow"

11.7.7 Mainstream narrative: policies

☐ Level. What types of policies (policy mix) have been dominant in the region?

a. "turn a blind eye" (informal management of conflicts, and beyond)

b. Vertical collectivism; familistic management (public administration can only be exercised by certain families of Tabarkino lineage - descendants of the first settlers - or by co-optation).

☐ Space. Which areas/regions do the policies cover?

Island.

☐ Time. How long have these policies been dominant?

Direct sources and historical ones (Vallebona, 1975) testify that these policies have always been dominant.

Mainstream narrative specifications

2. Stakeholders: provide a description considering the following

☐ Level. What types of stakeholders have been dominant in the region?

Sailors;

Tuna fishery;

Micro tourism.

☐ Space. Where have the stakeholders been located?

☐ Time. How long have stakeholders been dominant?

Sailors since 1700;

Tuna fishery: starting form 1900;

Tourism: starting from 1970.

3. Institutions: provide a description considering the following

☐ Level. What types of institutions have been dominant in the region?

Municipality;

Schools (Nautical institute; teacher's school. Both attractive for the whole Sulcis region, the importance of these institutions highlight the reciprocity of fluxes into the functional region).

☐ Space. Where have the institutions been located?

Carloforte downtown - Harbour side.

☐ Time. How long have these institutions been dominant?

School: since the 1950.

4. Ideologies: provide a description considering the following

☐ Level. What ideologies have been dominant in the region?

a. Owner's relationship with the environment "this is our island, this is our sea".

The Tabarkine colony in Carloforte begins with a gift (Tiragallo, 2015) from King Charles Emmanuel III of Savoy who parceled the island by giving each settler an urban parcel and an agricultural parcel. Carloforte is an island of parcel owners. (This cognitively and politically structures participatory processes on the island, including those of appropriation of the energy transition).

b. Ethnicist myth of the ontologically different and high ranking identity of the Genoa's colonist settlers (technically, economically, culturally, ecologically).

Space. Which area/where have the ideologies steam from?

Island's perimeter.

☐ Time. How long have these ideologies been dominant?

Since 1700.

Other contextual factors (e.g. external events, the environment, politics): provide a description considering the following

☐ Level. What types of technological sectors have been dominant in the region?

Harbour and naval carpentry (as a logistic hub for the energetic rough materials).

☐ Space. Where have the technological sectors been located?

Downtown

☐ Time. How long have these sectors been dominant?

Since 1700

11.7.8 Alternative (on-stream and/or off-stream) narrative

Alternative narratives, both on-stream and off-stream, can also be described following five main components: technology, stakeholders, institutions, ideologies, policies.

On stream here means a pseudo-transition narrative, which proposes a technological substitution without a deeper structural transition. Instead, off-stream is used here to identify a system transition towards communitarian ownership of sustainable technologies.

- Wondering what kinds of technological sectors are emerging in the region, we have identified two items that support the on-stream narrative, represented by the sentence "We are the vanguard": The island hosted among the first wind-farm prototypes built by Ansaldo (Genova); there is (in the same area) a municipal photovoltaic system (1GW). Wind-farms are located there since 1993, photovoltaic power plants since 2000. Both emerging technological infrastructures are located in the "Nasca" area, which is diametrically opposite to the harbour and historical downtown, in an uninhabited and hard to join by car area. Interestingly, despite a general knowledge about the place, it is very difficult to collect detailed information about the technologies and about their functioning status.

- As regards stakeholders, since 2000, two main stakeholders are emerging in the island that drive the on-stream narratives. The institutional one is represented by some young municipal administrators who attracted, for example, new projects funded in H2020. The second stakeholders is the rebranded tuna fishery, connected with the wine and food tourism. Both are located in the Comune di Carloforte, their relevance is so clear that the place is internationally known for its famous gourmet tuna, and its symbolic value matches with cosmopolitan entrepreneurship and political elites.

- The main emerging ideologies in the island, that we can label asc on-stream since it its not at all disruptive but rather a re-organization of the mainstream narrative, can be summarised by the sentence "We are different from the Sulcis, we are green, we are cosmopolitan and sustainable entrepreneurs". Ideally we can identify 2007 as a key year for the emergence of this new vision of the self. Actually, the on-stream narrative is driven by a local institutional policy that -since 2007- promotes Carloforte as “Mediterranean's green island”, this policy is mainly funded by EU projects and mainly tourist-oriented. As we have seen above, other elements have emerged in the field that confirm the significance of this type of vision, far beyond energy issues and decarbonisation. Indeed, the identity dimension, economic processes and aspirations for green tourism capable of systematically attracting tourists in search of sustainable paradises are elements consistent with this on-stream vision.

Minoritarian yet present in the analysed case study is the off-stream narrative, which can be summarised by the sentence "We are Sardinians and subalterns as the other Sulcitanian are". Such a narrative subverts the assumption of positive distinctiveness, and underlines a movement towards class awareness (we might say coscientization) that could produce a shift towards reclaiming agency and ownership. This off-stream narrative is very minoritarian, circulates in specific meeting points or among very few intellectuals, and emerged in the 1990 with some demonstration against the Portovesme's industries. It was particularly interesting to see some elements of the off-stream perspective emerging in the collective mapping exercise. Women involved in that task, to some extent, did not deny the analogies between San Pietro and the entire Sulcis. Consistently, well aware of risks for the environment and health, women reported a collective action in the past, demanding and obtaining that filters be applied to the chimneys of the Portovesme steelwork industries. Similarly, some actors claiming to be ecological activists (we interviewed their leader) have in the past-organised protests and attempted to draw the attention of local journalists to the risks of the coal-related industry. The pervasiveness of this narrative, thus, requires further investigation.

Both on and off-stream narratives must be read by taking in account another emerging issue that gives sense to the context: there is a strong interest from the Italian State to build offshore wind farms, one of which is planned to be located 35 km away from the San Pietro's coast. At the same time there is a project of a natural protected sea area, in the area in front of Carloforte. Many of the locals seem to oppose both projects. We consider this emerging local opposition to be part of the on-stream narrative: there is no need for change; it is not necessary to propose structural changes. Only the off stream seems to propose an ecologically conscious discourse: "let's build wind farms, let's emancipate from the fossils”.

A. ON STREAM here means that the pseudo-transition narratives propose a technological substitution that is not a structural transition.

B. OFF STREAM here proposes (or should) communitarian ownership of sustainable technologies

When describing the alternative narrative please include the 6 following components:

1. Technology: provide a description considering the following

☐ Level. What types of technological sectors are emerging in the region?

(ON STREAM)

a. "We are the vanguard": The island hosted among the first wind-farm prototypes built by Ansaldo (Genova);

b. Municipal photovoltaic system (1GW).

☐ Space. Where are the emerging technological sectors located?

"Nasca" area (diametrically opposite to the harbour and historical downtown, in an uninhabited and hard to join by car area).

☐ Time. Since when have these sectors been emerging?

a. Wind-farms since 1993;

b. Photovoltaic power plants: since 2000.

2. Stakeholders: provide a description considering the following

☐ Level. What types of stakeholders are emerging in the region?

a. Some municipal administrators (by projects funded in H2020);

b. Rebranded tuna fishery traditional industry/wine and food tourism.

☐ Space. Where are the stakeholders located?

Comune di Carloforte/match with cosmopolitan entrepreneurship and political elite.

☐ Time. How long have stakeholders been present?

Since 2000.

3. Institutions: provide a description considering the following

☐ Level. What types of institutions are emerging in the region?

ON STREAM

Carloforte municipality; LIPU (Italian league for the bird's protection).

☐ Space. Where are the institutions located?

Carloforte town.

☐ Time. How long have these institutions been emerging?

LIPU Oasis since 1996.

4. Ideologies: provide a description considering the following

☐ Level. What types of ideologies are emerging in the region?

ON STREAM "We are different from the Sulcis because we are green".

OFF STREAM " We are Sardinians and subalterns as the other Sulcitanian are" (class awareness that could produce reclaim and ownership).

☐ Space. Where are the ideologies emerging from?

ON STREAM described above

OFF STREAM very low representation, in some pub or among very few intellectuals.

☐ Time. How long have these ideologies been emerging?

ON STREAM around 2007

OFF STREAM in the 1990 with some demonstration against the Portovesme's industries.

5. Policies: provide a description considering the following

☐ Level. What types of policies (policy mix) are emerging in the region?

Carloforte as "Mediterranean's green island, mainly funded by EU projects and mainly tourist-oriented.

☐ Space. Which areas/regions do the policies cover?

San Pietro island.

☐ Time. How long have these policies been emerging?

Since 2007

Other contextual factors (e.g., external events, the environment, politics): provide a description considering the following

The Italian State wants to build offshore wind farms (35 km away from the San Pietro's coast) at the same time there is a project of a natural protected sea area, the Carlofortino on stream narrative refuses both projects. We consider event this local opposition to be part of the on streamon-stream narrative: it does not contradict main narrative, it does not propose structural changes. Only the off stream seems to propose an alternative ("let's build wind farms, let's emancipate from the fossils)

11.8 Trends and indicators for sustainable transformations

Table 1: Indicators and trends derived from the narratives

Observed in:	Name of the narrative or other factors And role of supporting stakeholders	Trends observed in the narrative (qualitative description)	Indicator(s) that helps describe the trend (way to measure)	Indicator discipline(s) e.g. economics, policy, etc.
Mainstream narrative	we don't need to change and to deal with the Sulcis neither Stakeholders supporting the narrative: Tuna fishery industry's administratos. Touristic sector small howners. Teachers.	we have always been different ethnically, we are also ontologically different	Identity; Denial; Memory uses; Perceived agency: a. ability/inability to think of himself as an actor endowed with agency b. ability/inability to position himself through specific rhetoric (ownership/dispossession) Lack of:	social anthropology / social psychology; policy & other interventions

			Bottom-up visionary discussion processes; Information campaigns about environmental awareness and health; Collective action; Acceptance of climate science; Acceptance of renewable energy deployment; Support of government; Trust in government; Civil engagement and own participation in public consultations; Corruption perception	
On-stream narrative	we are different, we are an happy and green island Local intellectuals and administrators that have a strong	we recognize that we are different and as different we can change without changing the	Perceived agency; ability/inability to think of himself as an actor endowed with agency Ability/inability to position himself through specific	social anthropology / social psychology

	backup in political science and social anthropology (epistemological loop).	logical structure / we don't really need to change	rhetoric (ownership/dispossession) Acceptance of climate science; Acceptance of renewable energy deployment; Support of (UE) government; Trust in (local and UE) government;	geography, economics, business, politics & society
Off-stream narrative	we are involved in the Sulcis, we must realize it and do something ourselves if we are different Stakeholders supporting the narrative: Environmentalist activists. Cosmopolitan intellectuals living in the island or second-home owners. Ex stillworkers and trade unionist.	we are not ethnically or economically different at all, we are the same, we have the same problems	ability/inability to think of himself as an actor endowed with agency ability/inability to position himself through specific rhetoric (ownership/dispossession) Acceptance of climate science (search of) Civil engagement and own participation in public consultations Corruption perception	social anthropology / social psychology geography, economics, business, politics & society

11.9 Summary of key findings

The emancipative role of Europe is underlined here as capable of overcoming “cultural and legislative barriers”, also including the Mediterranean area in which different countries are placed.

Italy is presented as marginal, as “the State” that can be even ignored, while the priority is here to construct a bridge of the island with the EU (as a part of the on-stream narrative)..

The tendency is to emancipate from the national context and to be progressively autonomous

The lack of agency on the part of the community can be seen not only in the failure to mention them, but also in the use of impersonal verbs that eliminate any reference to the actors, while still putting the responsibility on someone else undefined. For example:

[…] the alternative to coal, which must be found now if we really want to phase-out quickly

[…] investments are needed for the construction of a new interconnection […]

1. Strong individualism at the local level:

When asked about the reasons for their participation in individual power plants implementation projects, the REACT project, all our interlocutors, without exception, affirm that the reasons are the reduction in energy consumption and the consequent economic savings. By describing themselves as consumers, rather than as citizens or actors of a socio-environmental or cultural change, our interlocutors describe an entirely individualized participation in the conversion project to renewable sources led locally by the Municipality and financed by the European Commission. Some interlocutors, admitted or not admitted to the project, position themselves outside, or if possible above the community as 'more interested', 'more sensitive', in some way forerunners. In this sense, participating in the project serves a clear function of social confrontation and positive distinctiveness of the self.

2. Home as an energyscape and the lack of a communitarian approach:

We wondered what the range of action, and therefore the panorama or energyscape, our interlocutors have in mind when planning the installation of photovoltaic systems. The answers draw a completely domestic perimeter, in which the only reference community, if present, is the family one.

The house, even more than its inhabitants, is the main actor that allows or does not allow access to the project and, more generally, to be sustainable (from water recovery to the possibility of installing panels because the exposure is the right one).

For example, the Municipality of Carloforte presented several times the REACT project in public through assemblies, however, many of the participants declare that they are ignorant of who else has participated in it - this in a context of 6000 inhabitants - and that, in any case, the energy issue does not constitutes a theme of informal exchanges between acquaintances in the country. In other words, a picture emerges in which renewable energy sources and related devices are an instrumental issue for safeguarding the family’s economic asset.

3. Tourism as dependence: resources come from the outside:

As Sardinia as a whole, San Pietro island is a touristic destination. However, due to the fact that it is not well connected with the main airport, Carloforte folks imagine that "his" tourists might be radical-chic and eco-conscious.

Touristic one is the only plan in which a possible interaction emerges outside the family perimeter.

Being the main (more or less imagined) economic resource of the island, the tourism is treated as an element that could bring wealth from outside. In the imagination of some of our interlocutors, specifically owners of small family-run accommodation facilities,” the tourist” would be attracted and gratified by the ecological practices suggested by photovoltaic panels. Therefore, the instrumentality of the energy transition and the lack of transformation of the value sphere returns as in the lexicometric and discoursive analisys.

It remains to be explored how, concretely, are these findings influencing a sustainable transition.

11.10 Reflection on inter- and transdisciplinary research approach

The first steps of the Carloforte's case study's research combined and integrated anthropological and psychological approaches both in the theoretical framework and in the methods.

While clashing with different disciplinary practices, and aware of the many epistemological problems inherent in this operation, we believe that a true dialogic work between the two disciplines can bring out an original contribution to the problem of the production and reproduction of mechanisms of exploitation and dispossession (Sovacool et al, 2019) that they are observed in the socio-cultural dynamics linked to the energy transition.

Therefore we worked in constant comparison on data that are different by nature: ethnography and participant observation, semi-structured interviews, discursive and lexicometric analysis on press sources.

This last point, that is, to consider the press as a homogeneous and non-situated collective actor, is undoubtedly problematic for anthropologists.

However, we think that this analysis can provide two important elements: quantitatively relevant knowledge that allows to acquire relevant information about the context and the plurality of actors who inhabit it; feedback and validation - based on different sources - about the significance of anthropological constructs - such as the lack of agency - which emerge in fact also in the qualitative and situated analysis of the ethnographer.

More in detail, the phases of this work are varied and articulated as follows:

1. It starts from an analysis of secondary documents such as:

a. national and local press analyzed with quali-quantitative approaches. I.e., lexicometric techniques based on the analysis of co-occurences of words and on text mining and discursive methods applied to the emergent results of quantitative analysis;

b. regional and national energy plans which foresees for Italy to achieve a 50% share of renewables and the phase out of coal by 2025, and for Sardinia the construction of new infrastructures for supply and distribution of gas and electricity, (National Energy Strategy – SEN 2017; Piano nazionale integrato per l'Energia ed il Clima (PNIEC), 2019; Piano Sulcis, 2019).

2. This was followed (May 2021) by a first phase of semi-structured episodic interviews (Flick, 1997) focused on renewable energy, remotely conducted with seven interlocutors from San Pietro (Sulcis) island, understood her as main informants.

3. Although not mentioned here, to understand the context we also used twelve structured interviews carried out remotely with local stakeholders from environmental organizations, former trade unionists, local administrators of Sulcis (province of Carbonia and Iglesias). (Biddau et al., 2021).

4. In May 2021 we conducted a series of unstructured interviews with about twenty interlocutors considering the island of San Pietro, in front of Sulcis, as an interested

margin.So far, in order to test our hypotheses we have conducted three immersive ethnographies (June 2021; October 2021; February 2022), contextualizing the above-mentioned data through participatory observation, deepening them, expanding them, in a portion of the Sulcis region, San Pietro island. These interviews help reshape the research questions, in an hermeneutic loop-approach.

1) Framing the research problem (research questions in case studies): which stakeholder groups were consulted and how did they contribute to framing the research problem?

a. Local intellectuals and administrators that have a strong backup in political science and social anthropology (epistemological loop). (on stream narrative)

b. Tuna fishery industry's administratos. (mainstream narrative)

c. Touristic sector small howners. (on stream narrative)

d. Teachers. (mainstream and off stream narrative)

e. Ex stillworkers and trade unionist. (mainstream and off stream narrative)

f. Environmentalist activists. (off stream narrative)

g. Cosmopolitan intellectuals living in the island or second-home owners. (off stream narrative)

2) Analysing the problem and knowledge development: which stakeholder groups were consulted and how did they contribute to analysing the problem or developing knowledge?

Our approach views cultural practices and particularly discursive practices centered on renewable energy as a plane in which communities create or deny the space for change. The change may be understood as social, environmental, or both. In this sense, ethnographic analysis focuses on the rhetorics about individual solar panels, considering these artifacts, among others, as symbolic mediators capable of bringing out conservation ideologies of society as a whole.

Our analysis is multi-sited, and focused Sulcis area and San Pietro island by following the circulation of rethorics on renewables and old energy industries. Within this theoretical framework, we have made an operational choice that, inspired by George Marcus' (1995) multi-site ethnographies, however somehow overturns the procedure. Indeed, our choice is to enter the field following the flow of another European project, focused on the use of renewable energy in small islands, to draw the contours of our "village".

Therefore, the ethnographic research started from the analysis of the local engagement in energy transition at the local level, studying the articulations with the regional dimension and with the wider one whose perimeter extends up to Brussels.

The construction of the case study took place in dialogue with local institutional stakeholders (local administrators). Moreover, we did include the views and requests of minority groups with other political orientations.

3) Exploring impact: which stakeholder groups were consulted and how did they contribute to the research impact/output? (you might not answer this question until later on this year when discussing potential strategies with stakeholders.

• How does your research project (potentially) contribute to solving the societal problem (described by the stakeholders)?

Improving local awareness through three main actions:

a. Stakeholder's workshops and p2p exchanges;

b. Educational activities to be designed and organized together with local schools;

c. We are exploring the possibility to organize the Tipping.plus final meeting in Carloforte, in order to embody, ground and improve the local eco-vanguard imaginary. In parallel, the visibility of the event may contribute in legitimating the local stakeholders already involved in energy transition.

11.11 References

Missing

12 Case study 11: Upper Silesia Region, Poland

Seeking opportunities to enable positive tipping points in the coal mining region: case of Upper Silesia, Poland

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Institute for Structural Research

12.5 Introduction

Both the development of alternative energy sources and technologies, and a substantial reduction in the use of fossil fuels are required for a successful large-scale decarbonisation. Therefore, the energy transition becomes a disruptive process aimed at the phase-out of specific technologies (Rogge & Johnstone, 2017) and a shift in policies, consumer habits, scientific knowledge, cultural categories, and financial flows (Turnheim & Geels, 2013). Theoretical studies of technological transitions identify the destabilisation of incumbent systems equally as crucial as developing new ones to replace them (Roberts, 2017). As a result, decarbonisation affects carbon-intensive industries and imposes multidimensional changes in the entire economic ecosystem.

The path that results in a fundamental change in the economic structure can be analysed following the concept of tipping points. According to Milkoreit et al. (2018), a tipping point can be understood as a critical threshold crossed when a small quantitative change results in fundamental, non-linear qualitative changes in the configuration and dynamics of a given system. When trying to identify potential or actual positive tipping points in the socio- ecological system of reference, Tàbara et al. (2022a), argue that three key moments need to be considered: (1) the building of transformative conditions and capacities for systemic and appropriate, deliberate change, (2) a tipping event, precipitating the system towards a desirable trajectory or basin of attraction, and (3) qualitative, irreversible, and structural effects derived from such transformation.

The system shift may pose opportunities for some stakeholders while proving to be a challenge for others, particularly those highly dependent on the existing regime. Stakeholder attitudes towards the transition are expressed through narratives defined as "explanatory schemes integrating different observations, facts, experiences, and understandings of a socio-technical regime" (Roberts, 2017). Moreover, actors presenting similar storylines can influence the pace and course of the transition as they carry agential power and transformative capacities. A shift in narrative may therefore indicate the emergence of a window of opportunity to introduce a system-wide change.

The case study is structured as follows. Section 2 explains the process of identifying stakeholder groups. Our goal was to recognise attitudes towards regional structural change and indicate potentially converging interests in the transition. In Section 3, we seek to explain the economic and socio-political context of the coal mining transformation in Upper Silesia. We examine population and labour market trends, as well as the political and cultural environment of the coal phase-out since its start in the early 1990s. Thus, we characterise the mega-trends accompanying mainstream narratives that supported the incumbent technology. We also strive to identify potential narrative shifts and interventions that lead to systemic change. Section 4 analyses the mainstream and alternative narratives, presenting their main arguments and indicating which stakeholders represent particular storylines. Section 5 presents our conclusion on potential tipping points in the regional development pathway.

12.5.1 Research questions

In this case study, we seek to explain the context and dominant narrations of the coal mining transformation pathway in Upper Silesia. We examine socio-economic trends since the beginning of the coal transformation in the early 1990s. We strive to address the relationships between structural change in the regional economy and the development of transition narratives. Our aim is to identify the factors that lead to change in the narrative around hard coal in Poland and the social acceptance of the planned coal phase-out date. We answer two research questions:

What narratives are promoted by the main energy transition stakeholders in Upper Silesia?

Are the observed changes a tipping point for the energy transition in Poland?

12.6 Research approach

We followed two stages to identify the relationships between regional structural change and the development of transition narratives. First, we analysed quantitative data to evaluate the economic, political, and cultural trends from publicly available datasets. We also systematically reviewed 54 local development strategies from those municipalities in Upper Silesia where mining activities were carried out (as of October 2020). We focused on the role of coal mining, particularly enterprise, as well as the scale of mining activities in past, present and future regional development trajectory. Additionally, we examined the provisions of national and regional strategic documents, e.g. the “National Energy Policy until 2040” and the “Territorial Just Transition Plan for the Silesian Voivodeship”, enacted during the second quarter of 2021.

Second, we conducted a participant observation study via a series of seven consultation seminars in each subregion devoted to the Territorial Just Transition Plan draft, totalling 449 participants. This helped us identify stakeholders as well as map their positions and power relations within the discussion on the coal phase-out process. At the same time, we conducted a dozen in-depth individual interviews with various stakeholders (labour market institutions, trade unions, economic self-governments, miners, NGOs, and representatives from mining municipalities, regional authorities, and business environment institutions). Our sample was purposive as we wanted to achieve a span that would take into account all types of stakeholders, especially those playing active roles in the debate. Then, we put particular emphasis on labour market offices – technocratic institutions with a broad perspective on the short- and long-term transition effects on regional and local economies (total sample on Silesian mining area). Our research process coincided with the most critical strategic policy decisions regarding the development of the Upper Silesian region and the future of the Polish energy sector (Figure 1).

Figure 1. Research process and public policy background. Source: Own elaboration

This procedure facilitated the reconstruction of stakeholder group narratives and views on future regional development projections beyond coal. Thanks to this, we were able to confront and verify the results of strategic documents with official positions from the institutions engaged in the discussion based on both public and private statements.

In April 2021 (23.04.2021), we conducted a dedicated co-creation project workshop devoted to regional labour market challenges in the context of decarbonisation, with the active engagement of 35 public, private, and NGO sector representatives. The online workshop served to discuss the main challenges for regional development trajectories in the context of the so-called social agreement (signed 28.05.2021), present the first project results in terms of predicted employment pathways, and consider other essential research dilemmas from the perspective of the region (Figure 2).

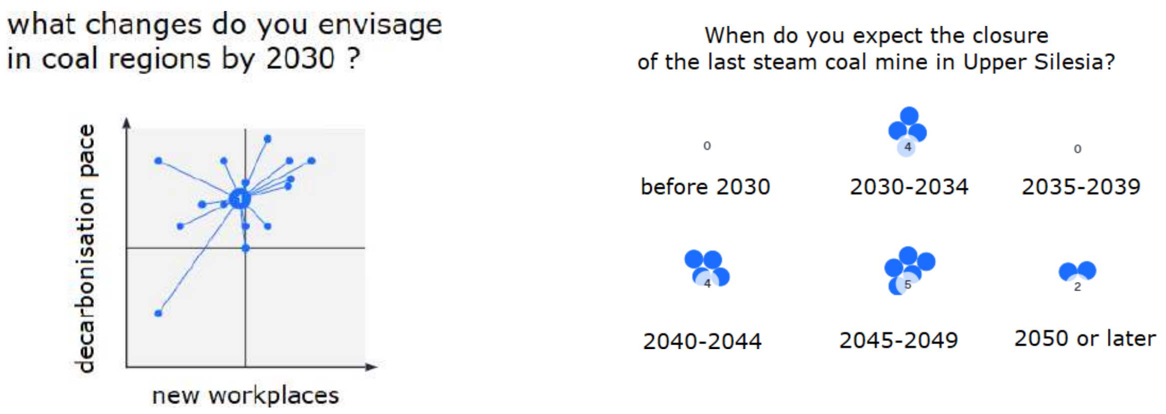


Figure 2. Examples of knowledge co-production during the workshop. Note: First question: (1) What changes do you expect in coal regions until 2030? (2) When do you expect the closure of the last steam coal mine in Upper Silesia? Source: Workshop exercises using menti.com

To sum up, our engagement in the Territorial Just Transition Plan (TJTP) covered three roles: active participant (invited to closed workshops devoted to the JTF plan; as well as reviewers of the TJTP project plan), observer (during workshops dedicated to regional stakeholders) and knowledge contributor (researcher, interviewer, workshop organiser, and discussion moderator).

We supplemented the qualitative feedback collected in 2020 and 2021 with documents and other publications devoted to energy policy narrations (Biedenkopf, 2021; Krzywda et al., 2021; Mrozowska et al., 2021; Nowakowska et al., 2021) published during the data collection period. Our additional qualitative sources included transcripts of meetings of the Just Transition Governmental Subcommittee on the plans and policy programmes regarding the regional consequences of a coal phase-out. Other sources used were podcasts and interviews with impactful regional stakeholders. Our analysis included the mutual reading of transcripts of interviews with a focus on such categories as 'decarbonisation,' 'coal phase- out,' 'social agreement,' and 'tipping point', with particular attention being paid to the norms and values understood behind just transition, as well as specific actions that would have to be performed.

Reflecting on the case, we identified several methodological limitations in our approach.

Firstly, the fact that it was conducted during the COVID-19 pandemic between 2020 – 2021. We did not include further implications regarding the consequences of Russia's invasion of Ukraine, which provided additional arguments for both the transformation's supporters and opponents. Based on our initial observations, the war in Ukraine put energy security at the centre of Polish policy. However, until the case study submission, regional and sectoral development pathways agreed upon by the government and miners' organizations were the same as before. Secondly, we placed a particular emphasis on specific institutions (e.g. labour offices – which we found underrepresented in coal transition studies), so our view shows slight bias towards labour market and economic issues. We tried to balance the case with evidence from existing documents and insights from other stakeholder groups through several iterations.

12.7 Narratives

12.7.1 Mainstream narrative

Mainstream narratives in Silesia outline the views of different stakeholder groups directly affected by the energy transition: coal and mining-related companies and their employees, trade unions, and municipalities heavily dependent on coal. Matters related to energy security also reflect the government's position. The mainstream narrative can be divided into three strands that partially overlap but maintain the importance of coal in energy and the regional socio-economic system.

12.7.2 Mainstream energy security narrative

The first mainstream narrative highlights the importance of coal in national energy security. Its core argument is based on the large share of coal in electricity production in Poland. Domestically extracted coal guaranteed energy security (self-sufficiency) and independence (also geopolitically). Although final consumption of coal in Poland decreased by over 46% between 1991 and 2020 (Eurostat), the country remained highly dependent on domestically produced fuel. Coal-fired power plants constitute a major share of the energy mix, accounting for about 70% of electricity and heat production (Figure 12). Besides coal, no other significant fossil fuels are produced in Poland and used in the energy sector.

The strength of this narrative is reflected in the fact that in almost all coal mining industry restructuring programs in Poland from the 1990s onwards, one of the recurring and overarching goals was to cover the nation's demand for coal with domestic production (see Appendix 5). The role of coal as a guarantee of energy security changed along with the gradual decrease in the share of this carrier in the energy mix. Along with the developmentof new technologies, coal-fired power plants are seen as a buffer for variable production from renewable sources and a guarantee of the stable and uninterrupted operation of the energy system. Coal is perceived as the backbone of energy generation in Poland and a fuelwhich secures national energy supplies (Kuchler & Bridge, 2018). The war in Ukraine only served to strengthen this narrative by justifying the need to postpone the transition. Nevertheless, due to current market instability, the long investment cycle enabling the increase of coal production, and the assumed long-term horizon for the coal phase-out, themain direction of the transformation seems undisturbed so far.

This narrative is represented by coal and mining-related companies, trade unions, and sectoral business environment institutions – incumbent stakeholders in the region. As decarbonization will affect companies concentrated in the region, the transition is also described as a significant threat to the interests of local entrepreneurs. Due to the pressure of energy and climate policy goals, mining-related companies are forced to reduce production, change their business model, or reorient their production towards exports. A focal point of this narrative is that the rationale for the transition is being imposed on the sector by external actors.

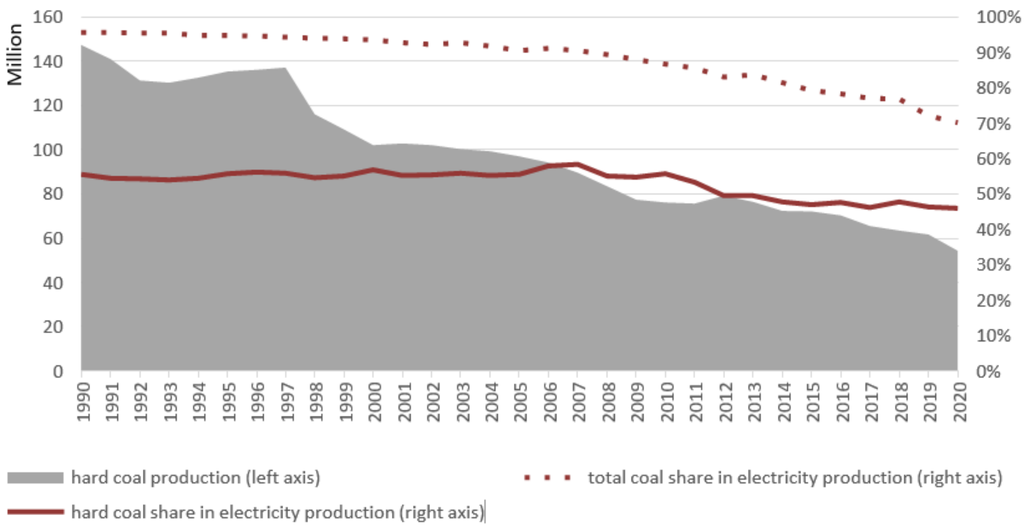


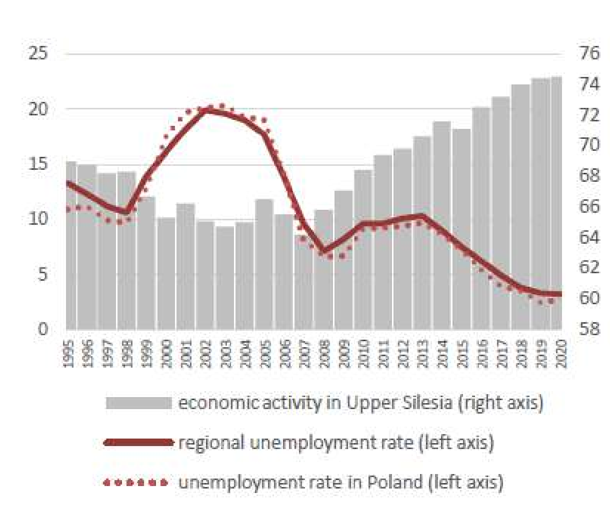
Figure 12. Hard coal output and share of coal in electricity production in Poland. Source: Own calculation based on data from the Industrial Development Agency, Katowice.

12.7.3 On-stream labour market narrative

The second narrative focuses on direct and indirect job losses and potential labour market destabilization due to surges in unemployment, which will result in income declines and welfare losses. In this context, the historical experience of the rapid closure of coal mining and other heavy industries in Poland forms the attitude and expectations toward future phase-out attempts (Sokołowski et al., 2022). Work in the coal mining industry is perceived as rigid but stable by members of mining communities, offering high wages and social benefits such as additional remuneration and the right to an early retirement.

Coal mining jobs tend to pay well – significantly more than local alternatives in agriculture or low-skilled services – and typically more than similar occupations in the construction and manufacturing sectors (Ruppert Bulmer et al., 2021), which makes them an attractive option to have in the labour market. Therefore, when assessing the future transition pathway as a disruption of the region's economic stability, energy system, and socio-cultural basis, stakeholders (mainly trade unions) opt for safety net implementation and industrial investments that secure alternative jobs in the region.

In Silesia, the labour market narrative emerged in the mid-1990s after intensive reduction of employment in the mining industry and the rapid transition implemented in the Wałbrzych region. In the 1990s and 2000s, workers who lost their coal mining jobs had few labour prospects as sectors that offered similar jobs (e.g. manufacturing, construction) were also struggling. Moreover, labour supply and the number of job seekers were increasing constantly, especially among people with relatively low educational attainment (Figure 13). However, since the late 2000s, these conditions have changed as other industrial sectors have rebounded, and the overall growth in labour supply has slowed due to demographic changes (Sokołowski et al., 2022).



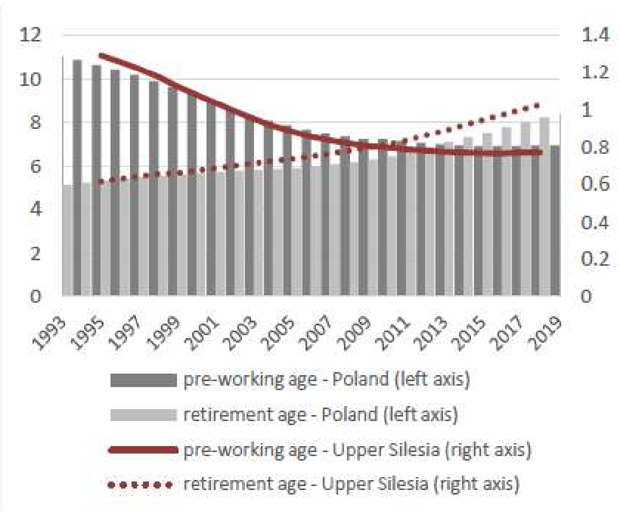


Figure 13 (left). Economic activity and unemployment rates in Upper Silesia (%). Source: Own calculation based on data from Statistics Poland. Figure 14 (right). Labour supply changes in Upper Silesia and Poland (millions of people). Source: Own calculation based on data from Statistics Poland and ERD Eurostat

Labour supply has constantly been decreasing since the 1990s, both in Poland and in Upper Silesia. At the beginning of the coal sector transformation, more young people were entering the industry than older people retiring from it (Figure 14). Mine closures and the reduction of jobs in the mining industry placed additional pressure on the labour market. Since 2013 (2010 in the Silesia region), the number of people of retirement age has surpassed the number of pre-working age inhabitants. Thus, in the coming years, reductions in employment in the mining sector will release the additional number of workers needed to stabilize the regional economy rather than create a structural labour mismatch that cannot be managed efficiently (Sokołowski et al., 2022). Considering these issues and the minor consequences of ‘small coal mine restructuring’ between 2014 – 2016 and the safety net system, we can carefully say that this narrative is becoming less potent than it was.

Labour market issues are raised in particular by stakeholders related to the mining industry: trade unions, coal companies, the mining chamber of industry and commerce, representatives of mining municipalities affected by the transformation, and some local media. Also, labour market institutions are engaged in activities to support employees during mine closures. The positions of regional stakeholders are also influenced by past events, as Upper Silesia has been under a coal transition of varying intensity since the beginning of the 1990s. These experiences still resonate in Upper Silesia and have served as a background for transition narratives and affect public discussion about the pace of the coal phase-out.

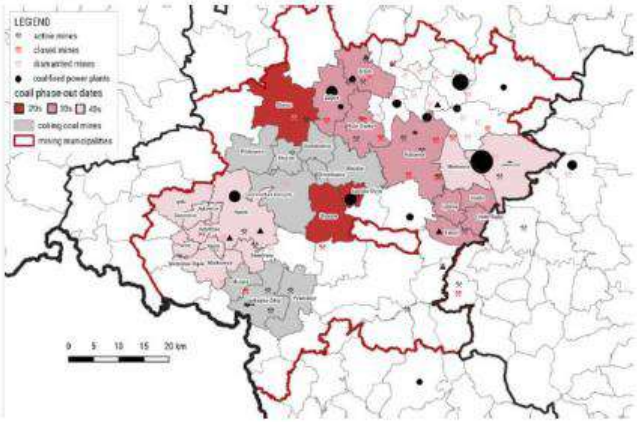
Similar to energy security, the goal to maintain stable jobs in the coal mining industry was reflected in the government's policy towards the sector. Optimizing employment structure, social protection for dismissed employees, and mitigating the adverse socio-economic effects of the transition were the basis for introducing safety nets. As a result, mining workers gained social protection, which distinguished this professional group from other workers affected by the transformation. This inequality was noticed during the preparation of the region's just transition territorial plan in 2022, which called for the implementation of special programs and interventions that would support employees from mining-related companies as well. The benefits and costs of a coal phase-out are discussed within the framework of fairness, focusing mainly on mitigating the negative economic and social consequences of structural changes in the energy system, as well as ensuring those impacted by the energy transition have a say in ensuing decision-making processes (Cha, 2020).

12.7.4 On-stream local economy collapse narrative

The third narrative addresses income loss and the issue of struggling local economies in coal-dependent municipalities. In addition to jobs, coal mine investments bring economic stimulus and tax revenue to coal districts and municipalities. The creation of coal mining jobs spurs labour demand within coal supply chains and other local sectors, as coal workers spend their wages on local goods and services, generating taxable transactions that can contribute to government coffers (Ruppert Bulmer et al., 2021). These arguments are raised mainly by local authorities and sectoral business environment institutions, who warn of the spillover effects of mining job losses, a decline in municipal revenues, and the accumulation of structural mismatches in local markets. This issue is crucial for municipalities where mining has been the backbone of local economies for years, if not decades. This problem becomes even more substantial in peripheral areas with limited access to infrastructure that would facilitate the development of alternative economic activities.

Since the transformation will affect coal-dependent communities, the region's most vulnerable municipalities have been diagnosed. The areas 'undergoing transformation' face economic, social, spatial, and environmental threats due to the coal phase-out. This includes communities where hard coal mining activities are carried out, where many inhabitants still work in the mining industry, or where mining activities have ended (mines closed or in liquidation) but policy intervention is required to rebuild the local socio-economic structures. The above criteria are met in 64 communes (out of 167) located mainly in the central and western parts of the region (Map 4).

In the past, coal mine closures generated persistent economic, social, and environmental challenges in some mining communities in Silesia. Deteriorating conditions and quality of life of the region's inhabitants, degraded post-industrial areas, and the relatively low pace of their reclamation remain pending challenges that require capital-intensive solutions. Mainstream narratives on the transition pathway have translated these issues into calls for special consideration and support for coal-dependent regions in the EU structural and just transition funds. The current attitude can be described as conservative concerning the pace of climate policy implementation, expecting substantial support for mitigating the social consequences of the transition and avoiding rapid transformation.



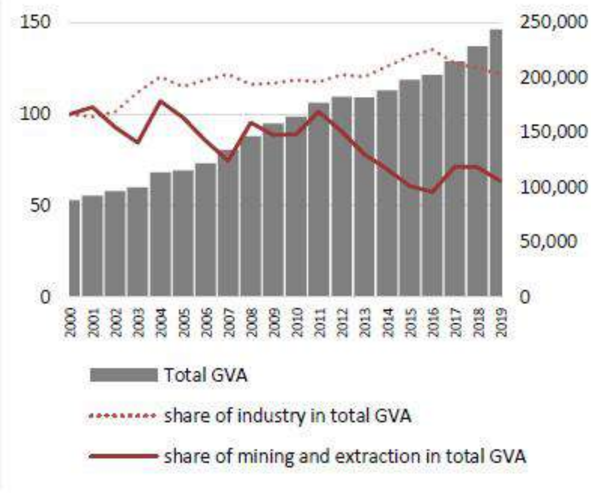


Figure 14 (left). Municipalities undergoing coal transition. Figure 15 (right). Share of industry and coal mining in the regional GVA. Source: Own calculation based on regional. Strategy "Silesia 2030".

Unlike other mainstream narratives, support for local economies did not resonate with the government's sector restructuring programs. The first declarations regarding the restructuring of the region appeared at the turn of the 1990s and 2000s (see Appendix 5). However, macroeconomic trends show that Upper Silesia, which was highly dependent on coal in the 1990s, has been diversifying its economic structure and has become less reliant on coal mining since the mid-2000s (Figure 15). Investments carried out with the support of structural funds were one of the main drivers behind this regional development. Nevertheless, the 'local economy collapse narrative' still carries weight among some small mining communities where many people are indirectly connected with the mining sector, and the mine is a significant taxpayer.

The mainstream narratives in Upper Silesia were formed in the early stages of the transition, during a period with a completely different market, and institutional and technological setting. Moreover, all mainstream narratives have been embedded in the experience of rapid mining closure, not supported by a comprehensive regional development strategy. As our case study shows, labour market conditions for a coal phase-out and demographic megatrends have changed markedly since the late 2000s. Therefore, the current labour market outlook for future transition is much better than it was in the 1990s and early 2000s. As the economic position of Upper Silesia deteriorates, a reduction in coal production should be balanced by growth in other sectors and industries. Obtaining favourable social and stakeholder attitudes that support the transformation are essential for its success. These narratives are analysed in the next section.

12.8 Alternative narratives

Along with the pressure of energy and climate policy, the narrative that coal is Poland's 'black gold' is not the future regional development scenario any longer. And while most stakeholders have accepted a general need for decarbonization (with phase-out scheduling and energy carriers being the main points of contention), there are two alternative narratives about the future of Upper Silesia. Both emphasize the need to maintain the region's industrial economic profile. The first on-stream narrative supports the mainstream statement arguing for a gradual and slow transition, maintaining hard coal exploitation and usage in the gasification process and carbo-chemical installations. In the other, off-stream stakeholders advocate a swifter abandonment of coal mining in favour of creating national supply chains for industries that support the energy transition and a circular economy (Krzywda et al., 2021; Kubin, 2021).

12.9 The clean coal technologies (CCT) on-stream narrative

The clean coal technologies narrative emerged in the mid-2000s. It encourages the public sector to support, research, develop and demonstrate that coal technologies are available for large-scale commercial deployment. It focuses on coal gasification technology (the chemical processing of coal to obtain gas and liquid products) and low-emission energy technologies. The main argument for the development of CCT is the technical, scientific and economic potential that is present in both mining and the region. This narrative aims to shape the image of coal as a modern, innovative, environmentally friendly and socially acceptable fossil fuel. It supports other mainstream narratives and maintains the crucial role of coal in the energy system and the regional economy.

The development of clean coal technologies is mainly supported by different regional stakeholders with a long history of cooperating with coal companies, such as mining-related research institutions, government authorities6 and trade unions. These stakeholders have access to political power (especially the Ministry of State Assets), finance (through state research grants) and information sources (the media). The narrative propagated by heavy industry has a potentially strong impact on innovation and knowledge creation, with a relatively weak economic contribution to the regional economy in terms of job creation (especially in the short run) and the diversification of regional economic structures. The narrative also utilizes arguments about energy security and economic patriotism; that it is imperative that Poland relies on its own national resources and stands against the implementation of foreign technologies (Russian gas, German gas boilers, Danish wind turbines etc.). This goes hand in hand with the mainstream energy security narrative. CCT stakeholders are generally supportive of using nuclear energy as a backup source, but do not believe in its fast implementation.

12.10 'Green' off-stream narrative ("Green Silesia")

Narratives that support the energy transition often point to the multifaceted aspects of the process, highlighting health and living condition improvement as core transition benefits. This view focuses on mitigating the problem of air pollution, mining damage in urban areas, and mining waste deposits. While responding directly to the need for improved quality of life in the region, this narrative derives from the concept of sustainability, joint responsibility for climate change, and intergenerational justice.

This narrative also points out that there would be increased investments and innovations in the public and private sectors due to the deployment of green technology. The main drivers for such growth are the availability of clean technologies and the fact that their implementation will lead to cost reduction and improved effectiveness. New business models and growing demand for environmentally friendly solutions ensure the creation of potential jobs and new supply chains in the transition region. This can then lead to accelerated economic diversification, growth, and regional development.

The green narratives are supported by interdisciplinary research institutions, most green NGOs, the mainstream media, local civil society, business entities, the regional administration and authorities, the European Commission, and international bodies (e.g. the World Bank). These institutions are often located outside the region and may include members of central government or opposition parties who attempt to push this narration further. This narrative has a potentially strong impact on the regional economy in both the short and long term. The construction, manufacturing and energy sectors have the highest potential to replace lost mining jobs. Moreover, according to the regional specialization plans, business services (ICT, BPO/SSC), logistics, medicine, tourism and land remediation have the highest potential to diversify the economic structure of the region.

12.10.1 Example of bottom-up transformative capacity

According to the European Environmental Agency, 14 towns on a list of the most-polluted urban areas in Europe are located in Upper Silesia. And it was this immoderately high number of days with critically elevated air pollution levels during the winter heating season that resulted in a bottom-up reaction. Despite weak citizen engagement in environmental issues, "Smog Alerts" began sproutin g in every major Polish city as formal and non-formal organizations focused on monitoring air quality, educational campaigns, and local advocacy (Frankowski, 2020). Active social movements focused on preserving air quality can be found in Rybnik, Katowice, Ustroń and Bielsko-Biała. Especially Rybnik has become an epicentre of air quality-motivated activities. Local smog alerts launched aggressive campaigns, which prompted the president of the city to promote state-led Clean Air Programmes and vow to penalize households that did not respect antismog laws, which, since 2022, banned the use of old furnaces (that did not meet EU emission standards). Moreover, the city also supports innovations e.g. cohousing for elderly citizens who are living alone (to protect them from energy poverty) and citizenship debates about energy costs.

Thanks to these actions, Rybnik and towns in the surrounding area have become leaders in terms of household solid fuel stove replacements (Map 5). Interestingly enough, strong opposition to coal stove substitution remained in these communities. Older people, especially former miners, still prefer using coal for cultural reasons, often acquiring it straight from a colliery. According to Irma Allens' work, "embodying its dirty work has long been a primary route for attaining domestic masculinity, securing its patriarchal authority and integrity and acceptably expressing its familial love and care" (Allen, 2021). However, the activities of smog alerts and local municipalities led to more radical coal phase-out dates in the residential sector, as the regional government in Upper Silesia declared to terminate coal use in households by 2029. This example shows how a bottom- up transformative force was able to generate a tipping intervention in this particular niche – a domestic energy transition. Nevertheless, the success of the transition was very limited in 2022 as coal sources were replaced by gas in most cases (Figure 16).

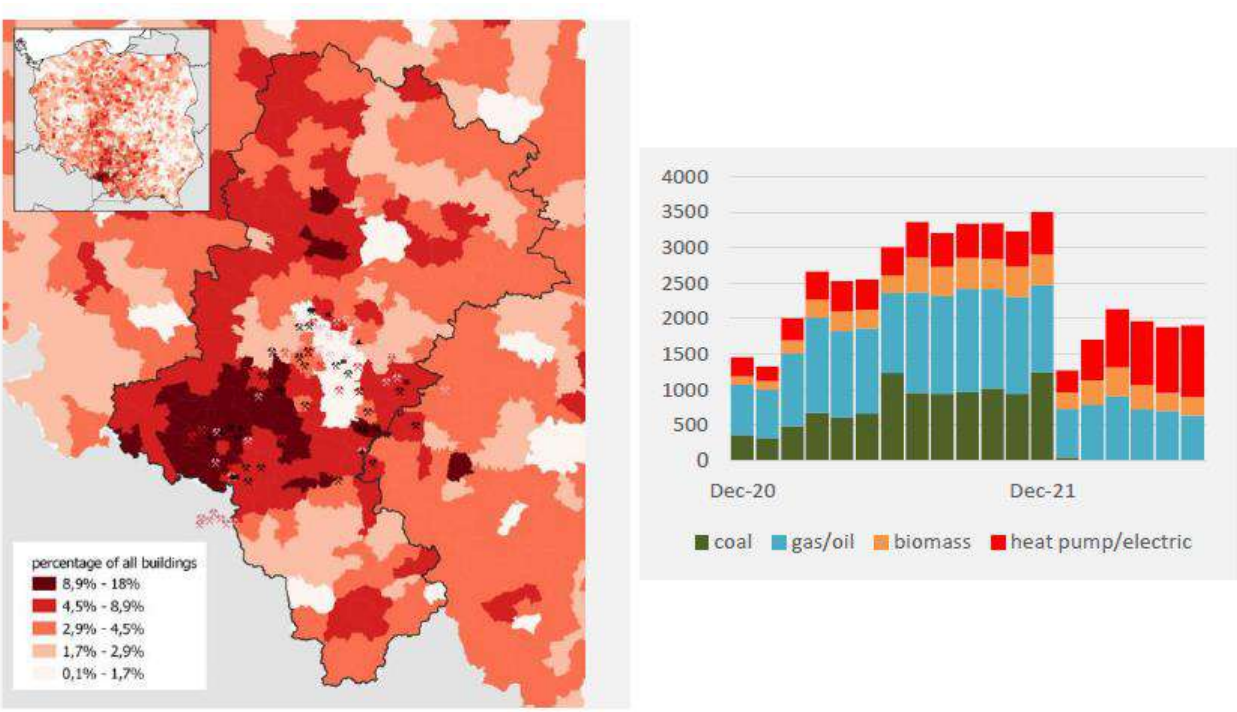


Figure 16. Percentage of households that participated in the Clean Air Programme (lefit). Coal stove replacement in Upper Silesia (right). Source: Own elaboration based on Clean Air Programme statistics (2021 – 2022)

One of the main premises of the industrial narrative relies on the willingness to use the knowledge and competencies that are already accumulated in the region. This potential can be used to strengthen the region's competitive position, justified by its high concentration of production companies operating in heavy industry sectors and enterprises cooperating within market chains. The transformation is therefore seen as the further development of the industry towards modern industrial technologies. Opposingly, the green narrative emphasizes the need to improve living conditions in the region. Stakeholders promoting this approach appreciate the regional industrial competences, but their main focus lies in the need to create favourable conditions for modern services and sustainable industrial development in line with environmental and climate policy obligations. The common point for both approaches is the need for economic diversification and raising regional resilience to economic turbulence.

Table 1. Alternative narratives about Upper Silesia

Narrative	**Industrial Silesia**	**Green Silesia**
postulate	to extend the lifetime of heavy industry, especially coal technologies (IGCC, CCS, coal to SNG)	to diversify the economic base into more modern and service-oriented activities
expected coalexit	2049 or even later	2030s / early 2040s
rationale	accumulated technical know-how, energy security, economic patriotism	improved health and living conditions, deployment of green technologies, intergenerational justice
main actors	unions, mining-related institutions, industry research institutes	regional authorities, business institutions, research institutions, NGOs, European Commission
The vision of the region	The industrial heart of Poland	A European hub of modernservices and industries

Source: Own elaboration

12.11 Key policy interventions supporting regional development in Upper Silesia

Since 1989, many policy interventions have stimulated transformation processes in Upper Silesia. Prior to Poland's accession to the EU, the primary interventions came from limited state funds, pre-accession funds (e.g. PHARE, ISPA), and development assistance (e.g. World Bank grants). After joining the EU, the dominant financial resources to support regional development came from the European Funds – Cohesion Fund (CF), the European Regional Development Fund (ERDF), and European Social Fund (ESF). EU funds provided a substantial investment boost and promoted good governance, long-term strategic thinking, stakeholder partnerships and multi-level cooperation (Dąbrowski, 2013). Since 2007, regional authorities have possessed operational programmes to conduct partly independent regional policy. As many other recent works elaborated on sectoral policies (Śniegocki et al., 2022; Bulmer et al., 2021), we limited our analysis of policy interventions to EU-funded programmes for two reasons – they remained the most essential resources to strategically implement regional and local policies, and were the best reported. For the purposes of the Tipping+ project, we prepared a dedicated EU project database (including three EU perspectives 2004 – 2006; 2007 – 2013; 2014 – 2020), which enabled us to compare financial flows, intervention category (including energy transition support), and type of beneficiary for the selected area to observe trends and choices across this period (Figure 17).

The distribution of public intervention schemes in Upper Silesia was similar to that of other regions in Poland. During the last 18 years, most funds were allocated to transport (26%), environment (16%), and research and innovations (14%). More state-led funds in Upper Silesia were spent on the environment (+7 p.p.), research and innovations (+2 p.p.) and social services (+2 p.p.), with a lesser share on ICT and transport. Regional authorities invested more in social services, transportation and R&D&I, and less in SMEs and the environment. The largest investment in Upper Silesia financed using EU funds was the A1 Motorway, which connects the region with the Polish coastline.

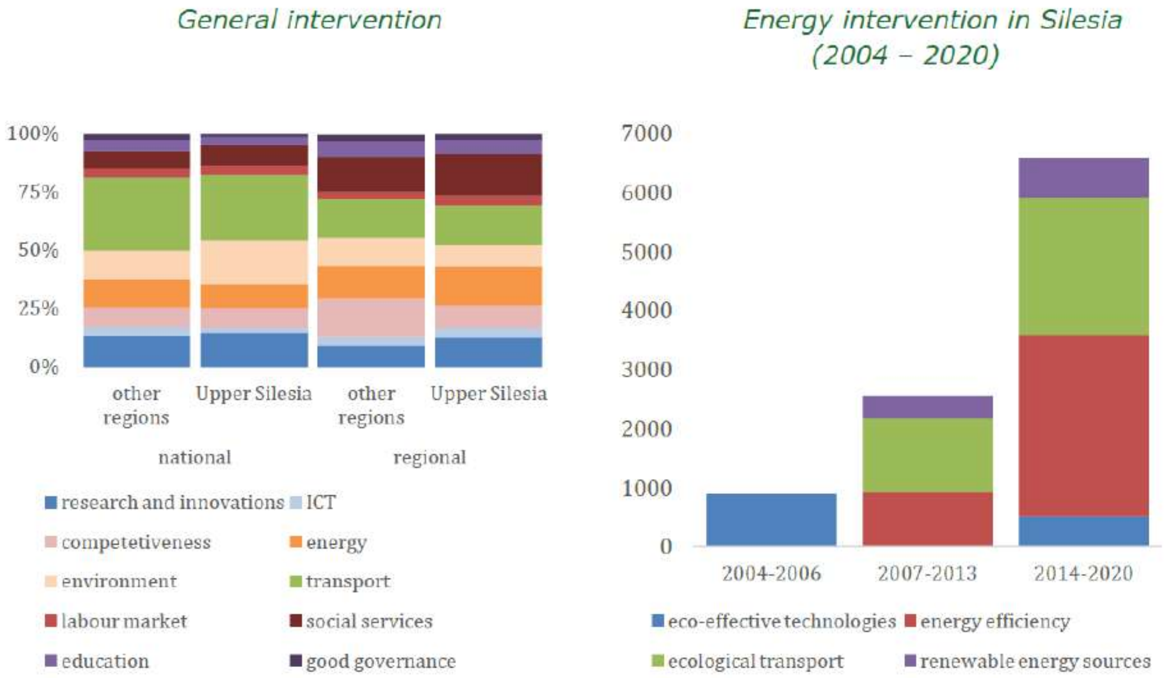


Figure 17. Distribution of financial support from EU Funds in Upper Silesia

We observed various trends in energy interventions over these periods.

2004 – 2006: The main focus of energy interventions was to decrease the harmful environmental impacts of the industry. Upper Silesian entities received almost 13% of funding from all of the EU's programmes. Large state-led companies implemented the most expensive projects, including electrostatic precipitators, desulphurisation, and closed water circuits in coal-based power plants, and the construction of metallurgic plants and foundries. Also, the largest Polish coal mining company (Kompania Węglowa) received money for averting from the desalination of the Vistula River by the Piast coal mine.

2007 – 2013: Upper Silesia received far fewer general funds for energy interventions (approx. 5%), as the most significant projects were located in northern Poland (i.e. the LNG terminal). Nearly 80% of renewable energy installation projects subsidised by EU funds concerned large wind farms (60%) and biogas and biomass plants (Chodkowska-Miszczuk et al., 2016), which could not be implemented in the region because it was highly urbanised. The most extensive EU-funded intervention in Upper Silesia concerned a biomass boiler in the Jaworzno coal-fired power plant and the implementation of more ecological urban transport.

2014 – 2020: In this period, the European Commission earmarked at least 10% of the entire ERDF in Poland's funds for clean energy. Almost 11% of total funds allocated to energy intervention were spent in Upper Silesia. During this period, we observed a number of investments in energy efficiency in buildings and companies, district heating networks, modern ecological public transport, and prosumer PV support. Climate protection and air quality served as rationale for these activities. However, the larges project during this period was a loan for JSW KOKS (a state-led coking coal producer) to develop a coking gas-led station in Zabrze.

Over the years, energy spending has gradually shifted from EU sources. Most recently, the Polish government and Upper Silesia’s regional authorities have invested more money in diverse energy interventions. Also, the motive for these moves changed too. Soon after Poland’s accession, the main goal of funding energy projects was to increase competitiveness. Then, investments were financed due to energy security and sustainability. Finally, due to pressure from enforced EU regulations – especially the Europe 2020 Strategy

– the Polish government and regional authorities adopted energy efficiency interventions under clean energy and climate policy rationale. And despite the fact that large state-led companies, including coal-fired power plants and mining companies, remained the significant beneficiaries of these funds, they will probably benefit from the Just Transition Fund in specific interventions.

The EU’s funding highly contributed to the region's economic transformation, especially after a series of mine closures. And even though there was a lack of safety nets and social or retraining projects for miners and workers from mining-related sectors – as these were instead funded directly from the state budget – local authorities spent EU funds on protecting their cultural heritage (Rybnik, Zabrze, Świętochłowice, Katowice), preparing mining-dependant areas for economic development (Zabrze, Jaworzno), or on adapting mining objects to other functions, e.g. academic (Sosnowiec) or recreational (Figure 18). Funding also came from private resources, such as in the case of a spectacular adaptation of a post-mining region into a shopping mall (Baca-Pogorzelska & Jodłowski, 2016). Some cities also financed the urban renewal of historic mining estates (e.g. Ruda Śląska, Figure 19), improving their aesthetics, energy efficiency, and overall living conditions, and contributing to alleviating energy poverty (Sokołowski et al., 2021).

Figure 18. Bicycle paths in the area of a former mining waste dump in Bieruń. Figure 19. Renovated mining

estate buildings in Ruda Śląska. Source: (Gawor & Marcisz, 2018 and fieldwork materials.

Regional policy interventions are scarcely controversial. To some extent, regional policy is seen as technocratic rather than a source of potential political conflict. Political disputes focus on the funds available, EU-level prohibition, or particular investments connected with regional identity. In 2020, all parties in the regional parliament approved a new Silesian Regional Development Strategy ("Green Silesia 2030"), which set the directions for further interventions (e.g. a regional operational programme). In general, institutions responsible for regional policy choose to adapt a 'transformative' narrative in opposition to state and industry actors who try to compete with this channel, proposing sectoral policy tools, investments, and funding sources.

12.12 Summary of key findings

Nationwide decarbonisation will particularly affect Poland's coal and carbon-intensive regions. In this case study, we explored the narratives that accompany the coal phase-out in the country's largest mining region, Upper Silesia. We identified different stakeholder groups, their concerns with and arguments for the decarbonisation process, and addressed the relationships between structural changes in the regional economy and these transition narratives.

Is Upper Silesia at a tipping point in its transition pathway? The case study reveals the circumstances that may create a window of opportunity for a permanent change in the energy system. It should be noted that mainstream narratives have changed since 2019 – negative arguments warning of a collapsing industry and threats to energy security and regional development are now balanced with vital pro-transformative arguments such as creating opportunities to develop innovative industries and services, or improving air quality and living conditions. Both mainstream and alternative narratives also have other points in common. The narratives find consensus on further development pathways based on the region's existing competitive advantages. The transformation is therefore seen as an opportunity to comprehensively carry out major processes that would inevitably take place sooner or later due to increasingly difficult coal extraction conditions and the mining industry's economic situation . There is also a general agreement to preserve the region's coalmining heritage and respect its history. This narrative shift occurs in the parliamentary discourse and the regional debate and is further supplemented by progressive development activities.

Gaining trade union approval of a concrete mine closure program was a major tipping intervention on the transition pathway. Even if the schedule is still being debated and could either accelerate or delay the transition, this is undoubtedly the first agreement constituting the complete cessation of steam coal mining in Upper Silesia. The gradual phasing-out of coal production has also been incorporated into regional development strategies ("Green Silesia 2030") and has become the focal point of the Territorial Just Transition Plan. These changes are constantly reinforced by the vital role of the European Union as a leading actor mainstreaming energy and climate policies.

A socio-ecological tipping point is defined as a "discontinuity moment in which suddenly a given system of reference qualitatively, fundamentally and irreversibly changes its structure and future dynamics" (Tàbara et al., 2018). However, we cannot determine that at this transition stage, the changes observed in the case study fulfil all these requirements.

First, we must keep in mind that changes in mainstream narratives, and thus in attitudes towards the transition, are not a sudden process but rather a slow and gradual change shaped by the internal dynamics of stakeholder interactions and external events. Our case study precisely indicates how a shift in the mainstream narrative may be observed. The geopolitical turnabout caused by Russia's invasion of Ukraine bolstered the arguments of the energy security narrative. However, energy transition advocates have taken over the narrative for maintaining a high share of coal in the energy mix. The main argument points to severe dependence on fossil fuels, which must be secured due to the declining production of domestic mining or the incompatibility of Polish coal resources with household needs. Thus, most stakeholders perceive increasing the share of renewable sources and nuclear energy uptake as the right way to maintain energy security. However, it seems that the current situation can, on the one hand, slow down the coal exit process in electricity production but accelerate the coal exit in households on the other.

Second, as Maier et al. observed, many economic processes are reversible, and policy interventions may pose tipping events that trigger or accelerate the system towards a desired pathway (Maier et al., 2020). It is hard to define what should be considered as 'irreversible'. Regarding the coal exit, irreversible actions should be attributed to material efforts (such as closing down all coal mines), not only discursive changes (such as policy declarations – even social agreement). Although we recognise many current actions and trends that enable and accelerate the diversification of the regional economy, we agree with the insights from the German study (Mey & Lilliestam, 2022) that the approach to a coal phase-out in Central Europe is the result of incremental, long-term changes. Thus, using the framework of tipping points (applying irreversible criteria) may be problematic and only observable in retrospect (Mey & Lilliestam, 2022). To some extent, a problem of scale seems to be complicated. Finding a coal region wholly dependent on one industry is challenging as regional systems are multifaceted and complex. Such dependency is usually a characteristic of towns and selected communities, which can suffer from sudden and ill prepared coal exit strategies. We also agree with the suggestion that the socio-economic tipping points should be considered as "looser, metaphorical scenarios for regeneration" (Geels, 2022). We discuss two aspects: the irreversibility and radical character of tipping points, which in our opinion, are challenging to translate into positive regional development pathways.

Third, ensuring the irreversibility of changes is also a political challenge. Upper Silesia is a specific region as it concentrates almost all hard coal mining companies in Poland. Because of this, regional changes directly affect the national energy system, and regional decisions take on a national importance. The coal phase-out will cause a decline in the region's political power, and regional actors will lose the ability to influence national energy and industrial policy. Therefore, the coal phase-out and energy transition processes carry with them the capacity to transform the regional political economy (Steckel & Jakob, 2022) and, in the case of Poland, could lead to undermining the widespread doctrine that Silesia is Poland's industrial and energy heartland. Moreover, replacing coal in the energy mix will increase the role of the country's coastal regions, where large-scale nuclear and offshore investments are planned. Considering the above, it is also crucial to recognise and appreciate the historic role of Upper Silesia as a major contributor to current welfare and provide fully inclusive and transparent procedures during the transformation process.

We must remember that narratives which emphasize 'the power of coal' can also be used for political purposes. Such a message is targeted mainly at active miners whose political views seem diverse and pragmatic, as well as at a large group of mining retirees left bitter by closing mines and their sentiment for the industry's strong position. This coal-supporting narrative could be played in political games to win election votes. Meanwhile, this influence will likely weaken over time due to cultural and social changes. Overcoming the cultural dominance of coal, diminishing its role in the labour market and hence the symbolic role of mining, and moving towards a brand-new vision for regional development would also contribute to tipping point achievement.

It should be noted that such a policy highlights the dilemma of justice. The time-consuming nature of a comprehensive reconstruction of social and economic structures must compete with the need for urgent radical changes which are necessary for climate protection. This discrepancy brings about another 'radical' aspect of the socio-ecological tipping points. To what extent can coal exit policy be just in terms of temporal dimension? How much time do we need to prepare the process and deliver a positive tipping point (complete coal mine closures)? Does Upper Silesia have the right to postpone the transition process and expect the phase-out to proceed in a similar fashion to what took place in the Ruhr Valley in the past? These questions reflect the dilemma that is born when climate justice meets just transition discourse, and there are no straightforward answers. In this case, the individual interpretation of justice among decisive stakeholders – and their take on industry and green narratives as well as incrementally taken tipping interventions – will be what decides on the final shape of the transition pathway.

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13 Case study 12: Jiu Valley Regions, Romania

Jiu Valley, Romania

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13.5 Introduction

13.5.1 CCIR description

The Jiu Valley in Romania is a functional region because it is a geographical boundary cutting across several administrative areas and has about 160 years of coal mining. The region is not a separate administrative region/county but is part of the Hunedoara county. Jiu Valley emerged through the initiation of mining activities and the expansion of the mining industry throughout the Jiu Valley since the middle of the 18th century. The functional nature of the region led to the aggregation of the population, both Romanians and momârlani, i.e., local natives who existed in the region before the development of mining, and the population of workers of other nationalities brought from other mining regions to work in the Jiu Valley. The region is surrounded east and west by the Jiu River, springing in the Southern Carpathians and flowing into the Danube. It is located in a deep depression; therefore, the mountains that can be seen are the Retezat mountain to the west and northwest and the Parâng and Vâlcan mountains to the south.

The Jiu Valley faces severe socio-economic problems compared to other country regions. The region has been undergoing a series of sudden, severe, and unplanned long-term layoffs since the mid-1990s. This has led to an increase in unemployment rates to a record high in Romania. Furthermore, more and more mines have been closed in different years, in blocks, without the concrete and long-term plans. There are currently two other mines at modest capacity, and there are about 4,000 miners left, including both underground workers and workers who are engaged in the mining industry (Mustață, Nazare, 2019, p.4).

The mono-industrial development of the Jiu Valley region was mainly due to the distribution of coal reserves. Before 1989, the region's development also took place to ensure energy independence, as there were massive investments in mining sites. If we look more closely at how the Jiu Valley developed, we will see an important role played by the economic and industrial sectors. First of all, the demographic structure of Hunedoara county has been changing continuously since the post-1989 years. There have been adverse economic developments in the county by closing or reducing production capacity, incomes have fallen, and unemployment has risen, reaching record levels over the years. If in 1991, the citizens of Hunedoara county were 545,299. Following the first wave of layoffs in 1995, the population reached 469,853 in 2016. Of course, these declining figures can be explained by the population's migratory flow because, in 2015, more than 8,200 people moved to another country. We also include the negative population growth following the decrease in birth and mortality rates. Only in 1991 and 1992, the population growth was positive (Mustață, Nazare, 2019, p.4).

The 1990s saw a decade of severe mining restructuring. The layoffs led to the region's economic collapse, but they also led to a decrease in the population's living standards. The local authorities have failed to provide a viable alternative to growth and employment opportunities, except in an attempt to boost tourism development due to the two ski resorts, Straja and Parâng. While these appear to be successful, there are no accurate figures on the total accommodation space, tourists per year, and total turnover. The region was also affected by mining, which represented a series of marches of miners in the capital, which led to violent confrontations and political costs for the Romanian Government.

The World Bank has shown that the overall competitiveness of the Jiu Valley is significantly below the Romanian average and is on a downward slope if appropriate long-term strategies are not urgently developed. Moreover, if we refer to the World Bank, it is an entity that has been in the region for a long time. The Romanian Government has resolved the aid several times, supporting the "Strategy for the socio-economic development of the Jiu Valley," which has as its main objective the restructuring of the economy of the Jiu Valley by replacing its dependence on the mining industry as a result of creating a variety of sectors, business, and qualifications" (Guvernul României, p.5).

Moreover, the first World Bank project interventions in the Jiu Valley came in 2004 when the Romanian Government committed itself to reduce subsidies for the mining sector, which had amounted to $ 150 million in the previous year. The World Bank has also supported capacity-building operations to close economically unprofitable mines sustainably and the economic regeneration of mining regions. Therefore, the World Bank played an essential role in the Romanian mining restructuring. The first project involved the closure of 32 mines and the creation of 10,000 new jobs, and the next project targeted mines with more complicated and complex resources, such as sulfur or salt (World Bank, 2004, pp.1 -2). Therefore, the World Bank helped develop mining in the Jiu Valley, but in a sustainable way that did not previously exist from the perspective of the Romanian authorities. On the other hand, it contributed to the industry's decline by supporting and financing mine closure operations.

The Jiu Valley has been regularly confronted with social unrest as riots and strikes by miners due to wage delays, low wages, inadequate working conditions, and excessive workload per person. This fact demonstrates the existence of a high degree of social unrest. The last strike took place in 2021. (Știrileprotv.ro, accessed on 02/15/2022). Most strikes were generated by decisions or rumors about cutting the total employees for the leading miners' employers in the region, Hunedoara Energy Complex.

The Jiu Valley is a region with an aging population. The only University in the region, i.e., the University of Petroșani, is trying to re-profile itself as a university where students' specialization in the renewables industry prevails because the educational offer is no longer valid and available anchored in the Romanian economic and social reality. In addition, the number of students is steadily declining (Initiative for Coal Regions in Transition and European Commission, pp.5-6)

Another issue is that workers have the opportunity to retire at the age of 45. After this age, they receive a miner's pension, which is about twice the value of their salary when they were miners. As a result, they lose the incentive to look for a new job in another field (especially in the renewables industry). Therefore, the retired miner in the Jiu Valley has no incentive to retrain, so the Jiu Valley continues to benefit from the workforce (Boboc, 2014, p.8).

Hunedoara Energy Complex, the company that owns the mining operations in the Jiu Valley, is no longer profitable and a severe and competent entity for the region's economic viability. CEH is supported by the Romanian state through subsidies, especially for paying miners' salaries. However, the CEH has been in insolvency for several years and is seriously threatened with bankruptcy, which would lead to the total collapse of the region. The total debts of the Hunedoara Energy Complex amount to three billion Lei (Mihaela Mihai, accessed on 02/15/2022)

Moreover, coal exploitation is seen as the "black hole" of the Jiu Valley economy. The volume of money invested is unreliable because it is consumed by the economic sector that continues not to perform and brings losses. The economic cost is calculated using the ratio between income and expenditure to obtain a tonne of brown coal or extracted net coal. Cost measurement is done in Giga calories, costing $14.76 per Giga calorie and $11.10 per Giga calorie. The economic cost is derived by comparing these costs with the prices in the world coal market. According to the Ministry of Industry and Trade of 1998, between 1991 and 1998, the coal and ore industry lost $ 4 billion, of which the Petroșani National Coal Company had lost about $2 billion, half of which was government subsidies. At the same time, the Pit National Coal Company had laid off half its employees in 1997 due to the economic black hole (Boboc, 2014, "The Social Costs of Restructuring the Coal Mining Industry in Romania: A Case Study of the Jiu Valley).

As mentioned, since 2019, the Hunedoara Energy Complex has been insolvent. In June, July, and August 2020, CEH amounted to losses of 129 million Lei (26 million euros) at an income of 119 million Lei (24 million euros) and spent about 249 million Lei (50 million euros). These amounts are added to the debts to the state of 91 million Lei (18 million euros) and 41.5 million Lei (83 million euros) to the suppliers (Moșoianu, 2020). These data demonstrate the liability to the economy.

Development strategies and government measures to ensure the economically sustainable development of mines have been mainly temporary and poorly implemented, without any actual expertise. There was no long-term plan for reorganizing mining, including the effects on labor and poverty. The planning was relatively short-term. There are few opportunities to introduce programs to prevent unemployment and increase employment. Employment capacity has worsened over the years as coal production declines. Moreover, external migration has increased, and migration to the Jiu Valley has decreased considerably since 1990. Chronic unemployment has also increased (Boboc, 2014, p.6).

Furthermore, many miners have been unable to receive their unemployment salaries. This happened because the County Agency for Employment and Vocational Training (CAEVT), the Hunedoara county branch, was going to pay the miner's unemployment benefits. This payment meant an unemployment salary for nine months and an unemployment exemption for another 16 months. However, in 1999, CAEVT recorded a considerable unemployment rate of 54%, and a few months later, the unemployment rate increased by two percent. At the end of the year, around 16,000 former miners who lost their jobs in the first three waves of layoffs could no longer receive their unemployment pay and were eligible to receive only unemployment assistance rights from local communities (Boboc, 2014, p.5).

In 1996 the production/employee in the region's mines, labor productivity was 159.61 tons/person per year. If in 1996 there were about 45,000 miners, three years later, in 1999, there were about 20,000 left. Coal production had fallen from 7.17 million tonnes to 3.82 million tonnes. It should be noted that productivity has increased from 159.61 to 191.84 tons/person per year. Coal production was on an upward trend in the early years after 2000, even though its number continued to decline. Therefore, production in 2022 had reached 254.24 tons/person per year. Subsequently, production began to decline due to the intensity of layoffs (Faur, Marchiș, and Nistor, 2017, p.112).

Although the number of miners has been steadily declining since 1999, the reason why productivity increased in 2002 was, in fact, one of the reasons for the miners' riots, when the Government increased the working hours from six to eight hours. Thus, the miners had to work harder, which resulted in increased productivity. To conclude this section, productivity has not increased due to technological improvements and innovations, nor as a result of lower mining costs (ibidem).

Years			
Year 1991	Year 2000	Year 2010	Year 2020
MU: Percentage			
Percentage	Percentage	Percentage	Percentage
3	10.5	7	3.4
4.5	16.4	8.5	3.4

Figure 7 Unemployment rate in Hunedoara County in 1991, 2000, 2010 and 2020. Source: INSSE.ro

The Jiu Valley is relatively safe regarding environmental conditions, as the environment is not a major regional issue. In the early 2000s, the region faced many pollution problems due to mining activities. Some issues came from the pollution of the Jiu River, which turned brown at one point due to impurities spilled into the river, and the collapse of land in some hills near the mining perimeters. The Romanian authorities did not provide more data or collect through complex pollution monitoring systems, but the Jiu River is no longer polluted.

13.5.2 Societal problem description

13.5.3 Research problem

Our primary research focuses on two issues: understanding why public policies adopted to mitigate the transition in the Jiu Valley have not been very successful and what are the main changes, endogenous or exogenous to the region, that would change the socio-economic profile of the area. Thus we aim to extract some public policy lessons that could be extrapolated to the other areas that share similar challenges. The research team is formed by political scientists focusing on institutional and sociological variables but attentive to all relevant input and trying to learn as much as possible from the methodological approaches employed by all other research teams in the Tippin+ project.

13.5.4 Research questions

We follow the three overarching research questions set within the project as presented at https://tipping-plus.eu/about/objectives

Peculiarly to the Jiu Valley case, we also aim to tackle three specific questions:

- What are the most essential endogenous and exogenous factors that explain the evolution of the mining sector in the Jiu Valey?
- What explains the success or failure of policies aiming to generate tipping points in the Jiu Valley's development trajectory towards embracing low carbon, clean-energy transformation sustainable development?
- What could public policy lessons be extrapolated from the experience of the Jiu Valley, in combination with the rest case studies?

13.6 Research approach

We place our research effort within the process tracing approach. As our initial evaluations could not identify a specific point in time that could be labeled as a unique STEP, we have planned to identify how various causal streams generate change across social, economic, political, and institutional changes at local, national, and European levels level.

Our research was primarily based on three field trips to the Jiu Valley, in all cities in the region where participatory observation was conducted, and three-step face-to-face interviews with local and national government officials, with people academics or ordinary citizens, including retirees.

In October 2020: The interviews were based on an interview guide with pre-set, open-ended questions, conducted over 45 minutes, of a unique nature, without repetition.

The interview's main objective was to explore the social, economic, and environmental aspects specific to the region, which were not achieved through qualitative research. Stakeholders involved: Dr. Chief Engineer of the Livezeni mine, Mr. Durbaca, and Mr. Terteci, Head of the Topography Service of the Livezeni mine; The mayor of Petroșani, Tiberiu Iacob-Ridzi; Cristian Roșu, special administrator of the Hunedoara Energy Complex; Cosmin Rădescu, director of the Dramatic Theater from Petroșani;

February 2021: The interviews were based on an interview guide with pre-set, open-ended, and scale questions, conducted over 25-80 minutes, of a unique nature, without repetition. According to the number of interviewees, this was a personal one, taken from an adult, and according to the way of communication, it was a face-to-face interview in Petroșani, Jiu Valley. The interview's main objective was to explore the social, economic, and environmental aspects specific to the region, which were not achieved through qualitative research. Stakeholders involved: Mrs. Belea Onița (52 years old, a caregiver at Petroșani University); Imning Raul (42 years old, from Petroșani, electromechanical engineer/maintenance electrician); Baghiu Ilie (chief mechanic at a mining company); Mircea Baron (Ph.D. professor at Petroșani University, currently retired).

In November 2021, the Romanian team from Tipping+ visited the Ministry of Economy in Bucharest's Romanian capital. For about 90 minutes, discussions took place with multiple people who are part of executive positions within the Ministry.

Also, in December 2021, we traveled again to the Jiu Valley for participatory observation in all the component cities of the region. We had two face-to-face interviews with the mayors of Uricani and Petrila, having a rather free, unstructured discussion like in the first two rounds of interviews.

13.6.1 Research tools

We have collected and analyzed all relevant statistical data related to the Jiu Valley and the broader evolutions of the mining sector in Romania. All statistical data were taken from the National Institute of Statistics, documents, strategies, or discussions with official stakeholders (see https://insse.ro/cms/en).

13.7 Narratives

13.7.1 Mainstream narrative: technology

The dominant sector in Jiu Valley was/is coal mining, i.e., pit coal. The Jiu Valley is a traditional coal-mining region with mining activities dating back over 150 years.

13.7.2 Mainstream narrative: stakeholders and institutions

The Hunedoara Energy Complex (CEH) (established in 2011 by merging Deva Power Planta and Paroșeni Power Plant, which were former subsidiaries of the Trading Society for Electricity and Heat Production "Termoelectrica".)

- The Jiu Valley National Society for Mine Closure, which took over the mining units Petrila, Paroșeni, and Uricani;
- The Romanian Wind Energy Association
- The network operator CEZ Oltenia Distribution
- The University of Petroșani (which continues to teach students about mining and geology, fields of activity that have made tradition here and are certified on national and international levels, although the demand on the labor market is much inferior to the offer)
- Civil society: NGOs, professional associations, trade unions, civic, social and sports clubs, media, community and political organizations, cultural institutions, environmental movements
- Local Public Social Work Service Petroșani (supported in 2006 a significant number of disadvantaged older people. Thus, approximately 400 cases of families in need of Petrosani benefited by minimum income)
- Romanian Orthodox Parish Livezeni I Petrosani (PORL)
- Planeta Petrila Association (Founded in 2016, the association sought to transform Petrila into a creative hub, something they feel could replace the leading role coal has played in the town for generations.) – these attempts have remained in an uncertain state, with no specific purpose. Petrila City Hall is considering transforming the mining perimeters from Petrila into a museum for tourism and culture, but these ideas have not yet materialized.
- Investinjiuvalley Association

Principal legislative drivers of the transition

- The European Commission/ The European Parliament
- The Parliament of Romania
- The Government of Romania
- Hunedoara County Council
- The Local Councils of the 6 Territorial Administrative Units
- Local, county, and central public authorities

The dominant institutions in the Jiu Valley are the town halls of the Jiu Valley's component cities and the Hunedoara County Council (there is no administrative body dedicated only to the Jiu

Valley). The town halls of component cities of the region represent the central administrative body overseeing the Jiu Valley. Unfortunately, the Romanian Government's involvement in the Jiu Valley policies and rescue has been negligible in recent years, except for subsidies to support the Hunedoara Energy Complex and a declining industry.

13.7.3 Mainstream narrative: ideologies

Romania's party allegiances are very loose, and no specific political party exists. However, AUR is a new-entry party with a nationalist, homophobic, anti-system, anti-covid, pro-orthodox, anti-western discourse. AUR is the party that supports miners' wishes and defends miners' interests in the protests of 2021.

13.7.4 Mainstream narrative: policies

- On the grounds of the Law of mines (no. 61/1998), the down shutting process of mining units was initiated and developed for the mines' production units with shrinking deposits, challenging geological conditions, and high production costs.
- Emergency and financial support were also provided in the Jiu Valley. For instance, in 2002, emergency support was provided in accordance with art. 28, alin. (1) in Law no. 416/2001, for families or single persons who were victims of the collective work accident at E.M. Petrila on 16.07.2002 and the victims of fires and natural disasters.
- Support for domestic heating during winter – according to Emergency Ordinance no. 5 of February 20, 2003, modified and completed by Government Emergency Ordinance no. 81/2003, families and single persons with low income who use central heating benefit from monthly support the granted sums varying by the number of family members and the average monthly revenue per family member.
- Law No. 278/2003 on approving Government Emergency Ordinance No. 176/2002 on establishing some measures regarding the Socio-economic development strategy of the Jiu Valley Coalfield, the Jiu Valley Government Authority was established in order to ensure the Strategy included the programs, actions, and projects of the public central and local authorities. This authority was led by a governor, who was part of the Board of Directors of the Jiu Valley Association and was also the president of the Jiu Valley Cross-ministerial Committee. This regional coordination was short-lived, as the Government Emergency Ordinance No. 36/2004 disassembled the Jiu Valley Governmental Authority.
- The Regional Operational Programme, 2007-2013, was meant to improve regional and social infrastructure, strengthen the regional and local business environment, and develop cities and tourism (Mustață, and Nazare, p.8).
- On the other hand, the Strategy for the economic, social, and environmental development of the Jiu Valley (2021-2030) assumes that the foundations are laid for the transformation in the

dynamics of the region by implementing actions that have an impact on the social, economic, and environmental spheres. These effects will determine the revitalization of the area and the capitalization of the Jiu Valley's real potential for sustainable development through the Just Transition Mechanism dedicated to the coal regions in transition. The Strategy includes the production of energy from renewable sources due to studies from the Jiu Valley Hydrogen Hub, i.e., the desire to develop a hydrogen plant based on methane emitted in mining galleries or renewable energy produced in the vicinity of mining galleries. In this sense, the Jiu Valley could become a national center of research, development, and innovation.

- The EU-funded project "Modernization of water and wastewater infrastructure in Hunedoara County (Jiu Valley) - 2014-2020" aims to rehabilitate and expand water distribution pipelines and ensure drinking water supply for residents of the Jiu Valley urban system (European Commission, accessed on 02/18/2022).

- The Western Region Regional Development Strategy 2014-2020 aims at regional development, including the Jiu Valley region. This Strategy is based on several measures, such as a more explicit focus on SMEs and direct investment; improving the level of productivity through interventions grouped in critical factors found in skills, innovation, and enterprises; increasing connectivity and mobility in and out of the region, focusing on the road, rail, air or sea transport; identifying niches in tourism and formulating an aggregate tourist offer; improving participation indicators, especially in upper secondary and tertiary education; combating poverty and social exclusion in the region; reducing development disparities; sustainable development of tourism or strengthening regional administrative capacity (ADRVEST, accessed on 02/18/2022).

- Five essential strategic documents which set priorities at the national level and propose measures to achieve the targets:

- Romania Mining Strategy 2017-2035 (2017)

- Romania National Strategy on Climate Change 2013-2020 (2013)

- Romania National Strategy for Sustainable Development 2030 (2018)

- Integrated National Plan for Energy and Climate Change 2021-2030 (Draft version 2018)

- Romania Energy Strategy 2019-2030, with 2050 forecast (2018).

- The Energy Strategy 2019-2030, with a 2050 forecast, underlines that in extreme weather conditions, coal is the basis for power supply resilience and proper functioning of the Romanian National Energy System (SEN), covering one-third of the electricity demand. In 2030, the energy produced from coal is estimated at 15.8TWh, representing 20.5%.

- Greenline project adopted by HCJ 86/2015 being promoted to be financed from ESIF (development of a public electric transport bus line to serve all settlements in Jiu Valley).

- On the territory of Romania, the National Gas Transport System will be developed on the

Bulgaria-Romania-Hungary-Austria corridor - the BRUA project with an estimated completion date in 2022, which will cross Hunedoara and Jiu Valley.

• The National Strategy for Sustainable Development 2016-2020-2030: The Strategy defines the key objectives and actions to be taken towards 2030 following the strategic guidelines of the European Union. The objective is to ensure the efficient and safe operation of national energy systems and to attain the current average levels of energy intensity and energy efficiency of the EU. It aims to fulfill its obligations by the EU legislative package on climate change and renewable energy and with international targets of the Paris Agreement and Sustainable Development Goals.

• Plan for Regional Development of the Western Region 2014-2020: The plan identifies its priority axis: the promotion of sustainable growth through a transitioning to a green economy; and the adaptation and mitigation of adverse effects and risks associated with climate change. Its objective is to preserve natural resources, improve the quality of the environment in the Western Region and move towards a low-carbon economy by supplementing conventional energy sources through renewable energy.

At the regional level:

• The Plan for Regional Development 2014-2020 – Hunedoara County: The plan defines under its priority axis 5, the aim to combat the negative effects of industrial activities on the environment and promote modern technologies to increase the quality of the environment and combat the effects of climate change; and also the use of alternative energy sources and refurbishment and modernization of the energy system (Rodica, Bogdan, and Viorel, 2019, p.53);

• The Local Development Strategy for the Jiu Valley Micro-Region: The Strategy defines development priorities for the development of the Jiu Valley micro-region, focusing on the modernization of street lighting and civic amenities and environmental protection through the reduction of VOC (Volatile Organic Compounds) emissions from industrial activities, as well as ecological rehabilitation of areas affected by intense economic activities (Initiative for Coal Regions in Transition and European Commission, pp.6-7);

• Plan for Regional Development of the Western Region 2014-2020: The plan identifies in its priority axis: as the promotion of sustainable growth through a transition to a green economy; and the adaptation and mitigation of negative effects and risks associated with climate change;

• The Plan for Regional Development 2014-2020 – Hunedoara County: The plan defines under its priority axis 5, the aim to combat the negative effects of industrial activities on the environment and promote modern technologies to increase the quality of the environment and combat the effects of climate change; and also the use of alternative energy sources and refurbishment and modernization of the energy system;

- The Local Development Strategy for the Jiu Valley Micro-Region: The Strategy defines development priorities for the development of the Jiu Valley micro-region, focusing on the modernization of street lighting and civic amenities and environmental protection through the reduction of VOC (Volatile Organic Compounds) emissions from industrial activities, as well as ecological rehabilitation of areas affected by intense economic activities.

At the local level:

- The Strategic Plan for the Socio-Economic Development of the City of Petrila.
- The Local Development Plan of Petroșani Municipality during 2014-2020. The Development Strategy of Vulcan Municipality 2014-2020 - updated in 2015.
- The Development Strategy of Lupeni Municipality during 2014-2020
- The Development Strategy of Vulcan Municipality 2014-2020 - updated in 2015
- The Strategic Development Plan of the City of Uricani during 2015-2020

Current partnerships and initiatives supporting economic diversification/development and decarbonization:

- The "Platform for Coal Regions in Transition," launched by the European Commission
- The Memorandum, "Approval of the Measures, Plan for the Implementation of the Carboniferous Regions in Transition Initiative for the Jiu Valley", approved by the Government October 4, 2018;
- The Memorandum of Understanding between the six administrative units of the Jiu Valley, for the establishment of "Jiu Valley Partnership for Just Transition", signed by the mayors in the Jiu Valley on July 16, 2019, in Brussels, in the presence of the European Commission representatives;
- The "Jiu Valley Socio-Economic Development Strategy", which will be elaborated by the Ministry of European Funds with the support of the European Commission through the Structural Reform Support Program (SRSP);
- The Report "A Just Transition in Hunedoara – Sustainable, Equitable and Economic Diversification", prepared by the Romanian Center of Economic Policies – CEROPE, was launched by the Greenpeace Romania Foundation and Bankwatch Romania Association, at the Cultural Palace in Lupeni, on September 23, 2019.

The project for retraining in the Jiu Valley coal region in transition, launched by RWEA – Romanian

Association for Renewable Energy, the RESS-MONSSON Academy; CEZ Romania and the Ministry of Energy, the Training Center for Renewable Energy and Electricity Distribution for the inauguration of the Academy for Renewable Energy and Electricity Distribution in Petroșani, on October this year, together with Petroșani University (Nicuț, 2019, accessed on 02/15/2022).

The Emergency Ordinance no. 69/2019 for the application of social protection measures granted to persons made redundant through collective redundancies, based on redundancy plans of the National Mine Closure Company Valea Jiului S.A. and the Complexul Energetic Hunedoara SA in the period 2019-2024. The ordinance provides for granting monthly supplementary income as a social protection measure that benefits persons made redundant.

The project "Modernization of water and wastewater infrastructure in Hunedoara County (Jiu Valley) - 2014-2020" financed by the EU, aims to rehabilitate and extend the water distribution pipes and ensure the supply of clean drinking water for the inhabitants in the Jiu Valley area. The infrastructure serves the urban areas of Aninoasa, Lupeni, Petrila, Petrosani, Uricani, and Vulcan; 69.6 km of water distribution pipelines will be rehabilitated.

Law No. 278/2003 on approving Government Emergency Ordinance No. 176/2002 on establishing some measures regarding the Socio-economic development strategy of the Jiu Valley Coalfield, the Jiu Valley Government Authority was established in order to ensure the Strategy included the programs, actions, and projects of the public central and local authorities.

13.7.5 Mainstream narrative description

At the end of the communist era in 1989, the restructuring of the coal sector and a shift towards natural gas contributed to a decrease in domestic coal production and consumption. Since the early 1990s, the Jiu Valley has registered an aging population parallel to an overall decrease of inhabitants, partly induced by the emigration of young people and those of working age and an accompanying fall in the birth rate. The decline of the mining industry and related significant layoffs in the workforce triggered this negative migration trend.

The distribution of hard coal reserves in Romania is restricted to a limited area in the Jiu Valley coalfield, which led to the mono-industrial development of the area. Before 1989, the policy for securing energy independence impacted the Jiu Valley: the area saw an extensive economic expansion, as all known mining sites started to operate using massive investments. The 1973 Oil crisis caused the approach to obtaining energetic independence and the drive to industrialize Romania's economy quickly.

Another event that guided the energy security agenda was the very Communist regime of Nicolae Ceausescu, who, out of a strong desire to pay Romania's colossal foreign debt at the time, saw in the mining industry in the Jiu Valley an extremely accessible way to earn significant income to cover the amount. Thus, the mining policy aimed at producing as much as possible, with the efforts of special workers, to exploit as much as possible to obtain as much as possible.

At that time, the only entity that invested significantly in the Jiu Valley was the state itself. Long after the fall of the communist regime, after the 2000s, several other essential investors or institutional actors emerged who played an important role in attracting domestic or foreign investors or who invested themselves: World Bank, the Romanian Government, and private companies. Of these three main actors, only the first two can be seen as actors who have influenced the mainstream narrative.

The demographic development of towns, especially the mono-industrial ones in the Jiu Valley, was directly influenced by the shifts in the economic and industrial sectors. The demographic structure of Hunedoara County was significantly changed in the first years after the 1989 Revolution. This was due to the county's adverse economic developments (closed or downsized production capacity, reduced income, and increased unemployment) (Mustață, and Nazare, 2019, p.4).

On the other hand, there was no restructuring in the Jiu Valley region until 1997, when the new progressive Government managed to carry out massive layoffs over two years. The layoffs created a crisis in the regional labor market.

The mineriadas, the miners' marches, in the early 1990s effectively suppressed progressive voices such as intellectuals and students as well as right-wing politicians. Without the miners' action, the structural reform of the economy would have proceeded faster, and, in particular, some mining restructuring would probably have occurred in the early 1990s.

Miners made marches to Bucharest on several occasions to violently quell the progressive movement. In 1997, however, the new Government carried out massive layoffs using a carrot-and-stick approach: it provided severance payments of up to 20 months of wages while keeping the charismatic union leader Miran Cozma in jail (Gotia, 2011, pp.126-130).

The causes of unemployment are multiple. However, the leading cause is economic: one ton of locally produced pit coal costs 400% more than one ton which is produced abroad (1,176,000 compared to 275,000 Lei). The Government's decision to close the Dalja and Barbateni mines caused the first significant conflict between the miners with the Government. When the miners' revolt was stopped at the beginning of 1999 and their trade union leader arrested, the Government decided to close 23 mines or sectors at the beginning of March 1999. Even when the mines were closed, active employment measures were not ready. The Government and parliament made some excellent proposals, but concrete actions did not accompany them.

When the released Cozma mounted another mineriada in 1999, the Government outwitted him and put him back in jail with a 17-year sentence; the miners were finally defeated as a political force.

Almost all the unemployed have been without a job for at least two years since their dismissal in autumn 1997, when EGO No. 9 and GO 22 were proclaimed. They are called "Ciorbea's unemployed," referring to the former Romanian Prime Minister and the trade union confederation (Gotia, idem, pp.127-128).

Therefore, in Jiu Valley, ex-miners (those not yet retired) had great difficulty adjusting to new occupations, and their wage was as low as half of the average wage in the region. On average, the unemployment duration across ex-miners is 30 months in Jiu Valley.

Regarding coal production, after 1989, coal production experienced an upward trend, from approx. 5.27 million tons in 1991 to 7.17 million tons in 1996, even though, due to the depletion of some deposits (especially those from floodplains, exploited at the surface or shallow waters exploited through coastal galleries) but also of natural outflows (retirement), the number of employees has decreased from over 60,000 to 44,920In 1996 the production/employee in Jiu Valley mines (labor productivity) was 159.61 tons/man and year (although labor productivity is typically calculated considering employees in the productive sectors, not total employees). 1996 also marked the beginning of the restructuring of the mining sector in Romania and implicitly in the Jiu Valley. Thus, in only three years (i.e., by 1999), the number of employees decreased from 44,920 to 19,914, and the production of coal from 7.17 to 3.82 million tons. However, in terms of productivity, there is an increase from 159.61 to 191.84 tones/man and year.

After 1999 the decline in the number of employees continued so that in 2001 it reached 17,700 employees. Also, coal production registered an upward trend during this period, so 4.5 million tons were extracted in 2002, and productivity increased to 254.24 tons/man and year. At the same time, the restructuring process (closure of some mining units and layoffs) continued, so coal production also declined from year to year. Moreover, the mining units in the Jiu Valley were not allowed to recruit new staff, so there was a new problem: sub-dimensioning the number of jobs (especially with qualified staff)

In 2008, 2,809,925 tons were extracted, 2,196,681 tons in 2009, 2,283,345 tons in 2010, and 2,121,574 tons in 2011.

Against the backdrop of gradual restraint and cessation of productive activities in non-viable mines, coal production continues to decline, so in 2012 it was 1,876,062 tons, in 2013 - 1,839,667 tons, in 2015 - 1,583,350 tons, and in 2016 a production of only 1,600,000 tons was estimated. This decline is also reflected in the productivity aspect, decreasing to approx. Two hundred tons/person and year (Faur, Marchiș, and Nistor, 2017, pp.110-112).

The mining activities within the Jiu Valley and its resulting largely mono-industrial economy were heavily affected by the restructuring of the mining industry in the past decades. Significant layoffs and, consequently, outward migration of the population were particularly pronounced in smaller towns with a marked focus on coal mining and related activities, despite efforts to retain the affected workforce by providing compensatory payments. Given the lack of investment in economic diversification, the region registered a decrease and aging of its population since the 1990s. This trend seems irreversible because the Romanian authorities are not concerned about taking the necessary long-term measures to mitigate these harmful effects on the entire region.

Prime Minister Victor Ciorbea's report on Government's work during the first year in office also remarked: "I started getting the mining sector restructuring in a few months what it took other countries decades to accomplish. This claim would result in Ciorbea's Government's unmatched efficiency compared with other European governments - ineffective and powerless. In the days when this governmental ordinance applied, the Minister of Labour and Social Protection, Alexander Athanasiu said that by using the received money (between 9 and 16 monthly wages, which was mentioned in the previous pages), the miners would be able to establish small enterprises and by association, medium enterprises. However, shortly after this affirmation, half of the small businesses across the country, about 300,000, have disappeared due to the Government's high taxes, which shows the lack of policy mix coordination- a problem seen in many other countries!. For those who saved money in banks, interest rates were rarely able to offset the depositors' losses due to the galloping growth of inflation. Two years after this extreme measure, which was a premiere in Romania after the revolutionary December 1989, the situation of the population in the area appeared to be one that contradicted the assurances that the authorities had ensured an economic recovery of the region by force of the Government programs, to absorb the redundant labor (Mustață, and Nazare, pp.8-9).

One of the decisive factors leading to the restructuring of the mining industry was the removal of subsidies granted to this sector, to which Romania committed in its accession process to the European Union. Between 1990 and 2007, state expenses for mining aid amounted to 6,156.4 million USD, highlighting the economic unsustainability of the mining sector. After joining the EU, according to a 2010 Council Decision, Romania could no longer grant state aid to unprofitable coal units.

Romania does not yet have a clear and agreed phaseout plan or timeline for coal. Therefore, the industry's future, in terms of extraction and power generation, remains uncertain, as does the speed and nature of transition in the Jiu Valley. Despite this uncertainty, there is a pressing need to address the challenge of economic diversification within the respective communities of the valley while ensuring a joined-up and coordinated approach to development across these communities.

To a much smaller extent, coal, mainly lignite and hard coal, will still play 2040 a vital role in Romania (17.3% contribution in the total primary energy production) for ensuring this energy independence and security of electricity supply. In this respect, the European Commission recommended Romania increase its ambition for 2030 to a share of renewable energy of at least 34%.

13.7.6 Alternative (on-stream and/or off-stream) narrative

Perhaps the most significant alternative narrative that can be noticed in the Jiu Valley at the moment is the creation of the Academy for Renewable Sources and Energy Distribution in the Jiu Valley. It was established as a result of a partnership between the Romanian Association for Wind Energy (RWEA), together with its companies (Monsson - RESS), CEZ Romania, the Ministry of Energy, and the University of Petroșani (Valea Jiului). This Academy is an ambitious professional training project and retraining for people in areas dependent on the coal energy sector, which addresses the issue of education and retraining of the labor force. As a result, the Academy accessed the funds available through the Platform for Carboniferous Regions in Transition. The project's duration is ten years, and the conversion target is about 5,000 specialists in wind energy and 3,000 specialists in electricity distribution.

Thus, they will learn additional technical and professional skills compared to the mining sector, which will be transferred to the renewable energy and energy distribution sector. The certifications obtained from the training and reconversion courses will allow them to work in the installation, operation, and maintenance of renewable projects and electricity networks in the Jiu Valley and worldwide (Nicuț, 2019, accessed on 02/15/2022).

Also, another alternative narrative that can be mentioned is the very geographical feature of the Jiu Valley, a mountainous area, hence the peculiarity of a tourist area, being, practically, a "natural paradise," as tourists call it. An example is the mountain resorts Straja and Parâng. At the beginning of 2021, thousands of tourists came to the two resorts, occupying 100% of all accommodation units.

The Parâng resort stretches in a fairytale place, the Parâng Mountains, at the foot of which are the towns of Petroşani and Petrila. The nine slopes in the ski area total over eight kilometers, the longest being Slope B, 3.2 kilometers. The most recent investment in Parâng was a chairlift built-in 2015.

The Parâng Massif is the main tourist attraction for excursion enthusiasts arriving in the Jiu Valley. The highest road crosses the Parâng Mountains in Romania, Transalpina, which reaches over 2,000 meters. In the massif, there are a large number of glacial lakes, the best known being Mija, Călcescu, Roşiile, and Iezerul Îngheţat. The highest peak of the massif, Parângul Mare, has 2,519 meters. The Muierilor Cave, from the Galbena River valley, and the Polovragi Cave, from the Olteţ river valley, complete the number of tourist attractions in the area, next to the Parâng resort.

The Straja resort in the Vâlcan Massif was established at an altitude of 1,445 meters, eight kilometers from the municipality of Lupeni. Straja has 12 ski slopes, each equipped with a cable car (ski lift). Five of them also benefit from night installation. The slopes total about 26 kilometers. One of them, which descends to the foot of the mountain, is eight kilometers long. In December, a new chairlift was inaugurated in the resort, which adds to the chairlift and gondola built in the past years.

If we are talking about stakeholders or institutions that have not been involved in the way they should have done in the spirit of sustainable development of the region in recent years, we should, of course, talk especially about the Romanian Government (which has not yet set a deadline for cessation of mining activities as the other EU Member States have done), but also for local and county authorities that do not have a proper involvement, especially in terms of financing, developing and implementing policies specific to the decarbonization of the region. The literature on varieties of capitalism stresses the limited coordinating capacities among industrial actors and politics.

The main problem is that the Romanian political stability is precarious, crushed by frequent disputes between political parties between their leaders. Most of the time, the ruling majority party tries to boycott the public policy initiatives of the other minority/opposition parties. Therefore, the mining industry has been neglected by Romanian officials for years. In recent decades, the Social Democratic Party has been the party that has been primarily concerned with the needs of miners. With the emergence of the AUR party, a far-right party, it played the fervent supporter of miners' rights in 2020 (especially with the protests of miners in the Jiu Valley).

Public policies are not current in terms of energy change and transition in the Jiu Valley. Regarding the values used to assess things as good or bad according to perceptivity and logic/rationale, we can include the preoccupation of decision-makers with predominantly economic issues. In contrast, social issues can be seen as one step down, and environmental issues are often overlooked. Many strategies in Romania and the Jiu Valley have been written "on paper" in the last two decades, and too few have been put into practice to help develop the Jiu Valley region.

13.8 Key policy interventions leading to an energy transition

The Jiu Valley is one of the essential coal regions in Romania. April 2018 marks the start of the just transition in the Jiu Valley, when, fortunately, the Romanian Government cooperated with the Platform for Coal Regions in Transition. Shortly afterward, the national NGOs Bankwatch and Greenpeace began to act as facilitators between the local community and the European structure.

Bankwatch participated in all the meetings of the Coal Platform that took place in Brussels in 2018. In May of the same year, Bankwatch held meetings with Hunedoara County Council, the prefect, mayors, and civil society in the region, which began to give birth. New ways of cooperation between local actors.

'Some stakeholders like the trade unions were suspicious of our intentions, as one would expect, given our objective for a European coal phaseout before 2030. However, we chose to focus instead on what we have in common – a desire to prevent the catastrophic effects of yet another unplanned transition', Mustață said.

With the support of the local community, Bankwatch held two meetings in mid-2018 in Bucharest with representatives of the Ministry of European Funds. This Ministry is responsible for implementing the Platform for Coal Regions in Transition in Romania, and Bankwatch has supported the transition to a low carbon economy through a national participatory process. The second meeting was attended by Greenpeace and local actors from the Jiu Valley.

In April 2019, Bankwatch and Greenpeace met with a European Commission team in the Jiu Valley. They created space for discussions between Commission representatives and local authorities, NGOs, trade unions, local businesses, and representatives of the Ministries of European Funds and Energy. The objectives of the meeting were to understand the opportunities created by the Platform for Transitional Coal Regions and to start a direct dialogue between Brussels and the Jiu Valley.

'The Planeta Petrila project represents the concrete form of a vision for a new center of Petrila and – why not – of the entire Jiu Valley. Through the complexity of its functions, the project allows for the replacement of unsustainable means of subsistence [mining] with new types of activities: environmentally-friendly cultural, economic, and research projects', says Mihai Danciu, an architect with the Planeta Petrila organization.

'What in 2012 was an industrial site on the verge of demolition is now a site in the process of bottom-up urban regeneration. Although we encountered administrative difficulties, we are now carrying out the first procedures for the restoration of the mining complex itself: application[s] for financing the restoration, integration of the regeneration area within the General Urbanism Plan, and daily activities to inform visitors', Danciu says.

The six mayors of the region were already familiar with the concept of a just transition from Bankwatch and Greenpeace, and thanks to the Coal Platform's visit to the region, they became interested in how this vision could help them in the process of change and economic diversification.

In October, the six mayors favorably requested technical assistance from the Platform for Transitional Coal Regions through the START program, designed to help them identify projects that benefit the entire region.

'We are now starting to get some results [on issues] that we have been working on for years. I have confidence in what will happen. I have great confidence in European funds. […] We want projects for the entire Jiu Valley, we want projects for all citizens … We want to attract as much money as possible for Jiu Valley because, with our resources alone, we are not able to do much, said Lucian Resmeriță, mayor of Lupeni, at a press conference.

Bankwatch and Greenpeace have asked the Romanian Center for Economic Policy to conduct macroeconomic research for the Jiu Valley. It identified five economic scenarios, two inactions, and three redevelopments. The last three focus on the primary sectors of the economy (agriculture, industry, and services) and are built as viable, equitable, and sustainable alternatives.

In September 2019, the study was launched entitled "Fair transition in Hunedoara - Economic diversification, fair and sustainable." As the research results attracted regional authorities and the central government, NGOs organized two events to promote it.

The first event occurred in Lupeni (Jiu Valley) in the presence of mayors, county representatives, NGOs, local business representatives, and the press. The second took place in Bucharest, with the participation of Romanian government officials, civil society, trade unions, and speakers from the coal regions of CEE.

In December 2019, the civil society in the Jiu Valley formed an official coalition called "Jiu Valley involved," aiming to support the sustainable development of the Valley, in addition to the just transition process, adding other local issues facing the community.

Although the COVID-19 Pandemic blocked many activities, including the meetings of the Jiu Valley Platform, PwC continued to work on the transition strategy and, in March 2020, published the first draft for public consultation.

Finally, the Ministry of European Funds announced the first draft of the first financial program dedicated to the just transition in March. The Fair Transition Operational Program, 2021-2027, addresses the carboniferous regions in transition - Hunedoara (Jiu Valley) and Gorj - and other carbon-intensive regions. The program aims to contribute to the creation of new SMEs and investments in existing ones in the fields of research, green energy, and reduction of greenhouse gas emissions, but also to retrain the workforce and create new employment opportunities. The final version is expected to be approved in June 2021.[5]

[5] Bankwatch, Romania's Jiu Valley, ready for just transition, created on 07/26/2020, accessed on 06/11/2022, https://www.just-transition.info/romanias-jiu-valley-ready-for-just-transition/

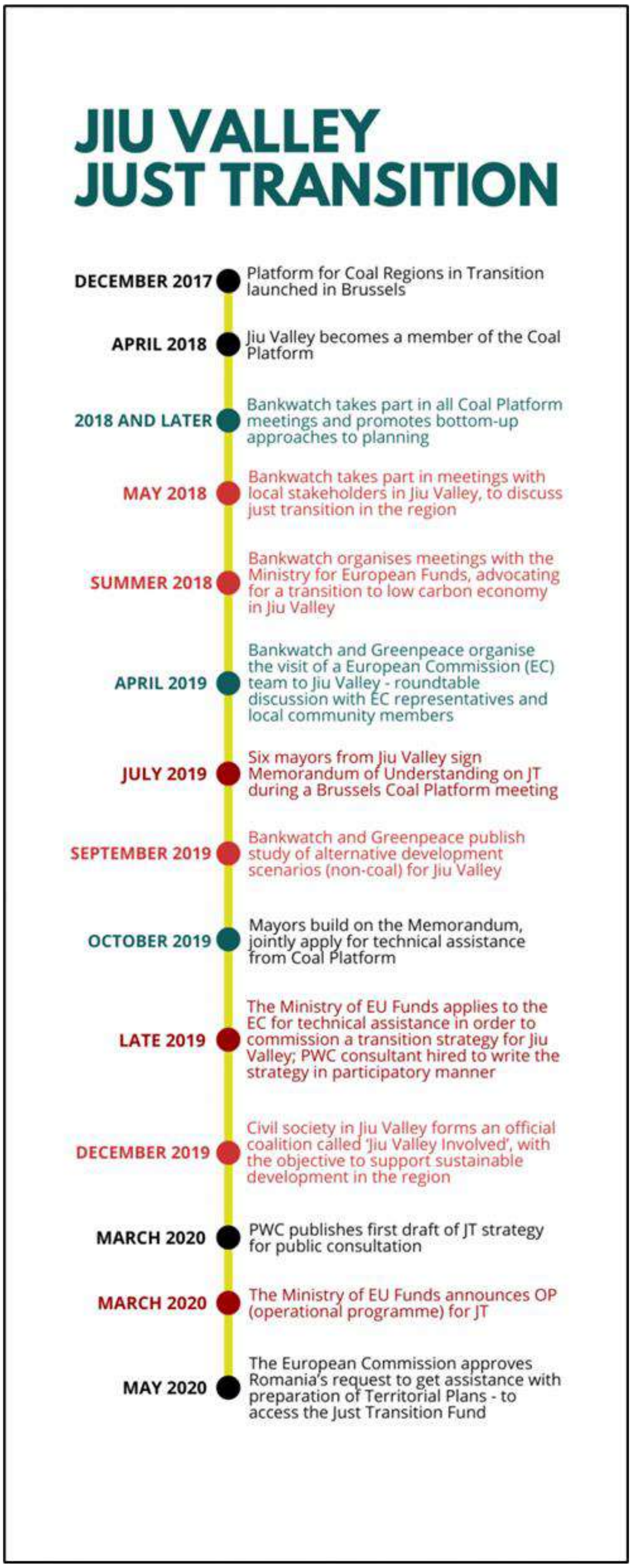


Figure 1. A timeline of just transition in Jiu Valley (source: https://www.just-transition.info/romanias-jiu-valley-ready-for-just-transition/)

Ongoing investments

ll the six cities in the Jiu Valley are in full investment process.
Investment priorities in Aninoasa
- Major projects

Electric bus public transport – 9 km
Mining museum at the former Aninoasa Mine
- Infrastructure

Asphalt works
Sidewalks
Utilities (gas)
LED public lighting
- Social

Medical center
Social housing
Kindergarten
Playground
- Heritage

Restauration of a genuine mining collective housing ensemble
Investment priorities in Lupeni
- Major projects

Straja ski-bike Resort development plan
Electric bus public transport - 6,5 km
- Social

A community center for Rroma ethnics
- Environment

Energetic rehabilitation for schools
Investment priorities in Petrila
- Major projects

Șureanu Resort development plan
Electric bus public transport - 12,3 km
Petrila Mine economic, administration and cultural center
- Infrastructure

Asphalt works on every street
Bike lanes along the main river and on the main street
Public spaces rehabilitation
- Tourism

Airdrome on former Maleia sterile heap
Rehabilitation pf Petrila – Lonea narrow gauge line
- Environment

Energetic rehabilitation for schools and blocks
- Cultural

Etnographic park
- Social

Social housing
Investment priorities in Petrosani
- Major projects

Parang Resort development plan
Electric bus public transport – 8,0 km
Victoriei passengers hub
- Infrastructure

Asphalt works on DN
- Cultural

Rehabilitation for the Mining Museum
- Environment

Energetic rehabilitation for schools and blocks
Investment priorities in Uricani
- Major projects

Cheile Butii - Retezat National Park development plan
Electric bus public transport - 4,9 km
- Infrastructure

DN66A road connection to Baile Herculane - Orsova Danube port
Complex regeneration program for the central area public space: pedestrian sidewalks, green areas, sport fields
- Environment

Energetic rehabilitation for schools and collective housing
- Economy

Business incubator, containing: bakery enterprise, factory for the gathering, storage and processing of forest fruits and medicinal plants, slaughterhouse, factory for milk producing, storage and processing.
Investment priorities in Vulcan
- Major projects

The Carpathian Castle – Pasul Vâlcan development plan
Electric bus public transport - 7,4 km
- Education

Modernisation of every school
- Social

A strategy for marginalized urban areas
- environment

Energetic rehabilitation for schools
Energetic rehabilitation for public buildings.

Latest investments

All the six cities in the Jiu Valley are in full

investment process.
Latest investments in Aninoasa
- Infrastructure
Asphalt works
Utilities
- Social
Playground
Latest investments in Lupeni
- Infrastructure
Asphalt works
Sidewalks
Utilities
- Social
Parks
Playgrounds
A strategy for marginalized urban areas
Latest investments in Petrila
- Administration
Capacity building for local administration
- Social
Park
Public space safety
- Infrastructure
Asphalt works
Utilities
River overflow risk reduction
- social
A strategy for marginalized urban areas
Latest investments in Petrosani
- Social
Parks
Public space safety
- Infrastructure
Asphalt works
Utilities
River overflow risk reduction
Pedestrian avenue in Petrosani North
Latest investments in Uricani
- Social
Social housing rehabilitation
- Infrastructure
Asphalt works, utilities, river overflow risk reduction
Latest investments in Vulcan
- Environment
Energetic rehabilitation of schools
- Infrastructure
Asphalt works
Utilities
River overflow risk reduction

Modernization of the central boulevard.

13.8.1 Geography and migration (WP1)

Due to the urbanization and industrial policy before 1990, the migration in the Jiu Valley also increased. But migration is declining with the industrial reorganization and the impact of mining in the mid-1990s. However, in 1995 there was a peak in migration, which will increase until 1997. Between 1997-1998 there was the largest layoff in the Jiu Valley when the migration rate became negative for the first time. Therefore, in 1998 the lowest value of migration was registered, and only in 2002 the number of people who came to the Jiu Valley was higher than the number of those who left the region.

If we look at the net migration rate, which is calculated as the difference between the number of immigrants and the number of emigrants divided by population and multiplied by 1000, we will see that more people are leaving the region than those arriving in the Jiu Valley. The highest negative migration rate, i.e., -18.3, was recorded in 1998. Not surprisingly, given the total decline of the population. In 2018, for example, nine people left the area for every 1,000 people.

Population fluctuations also impact the labor force, as age and sex structures also fluctuate due to migration. If, in 1992, the Jiu Valley population was divided into 51% men and 49% women, in 2019, this ratio was reversed. According to the graph, in 1992, there were more people aged 0-40 years than in 2019. This meant 56% fewer people aged 0-20 in 2019 than in 1992, which also determines an aging population because this percentage of people over 45 years increased by 45% in 2019 compared to 1992.

Although migration can be perceived as a negative phenomenon, it has brought some improvements in the Jiu Valley, reflected by temporary work abroad. Cimpa din Petrila had a population growth of up to 25% between 1992 and 2002. However, resources for migration have been reduced, especially for the poor. One type of action to promote migration is the adoption of support schemes for the poor's territorial mobility.

In the Jiu Valley, there is also the phenomenon of immigration – 43% of the region's inhabitants are born in localities outside the region. The emigration rate in the area had reached 42% after 1996, the size decreasing to the level of 2000. Another exciting aspect is that about 1% of people aged 15-65 in the Jiu Valley had gone abroad, and only 300 out of 1360 were gone to work.

The Sociological Institute of the Romanian Academy estimated that a third of the unemployed miners interviewed at that time worked abroad, i.e., about 14%, 5.5% moved to other cities, and about 10% worked on the farm in their hometown. Due to these external migrations, the local population suffers because it ages increasingly, and thus more families will face family economic problems. Returning to the wave of layoffs in the second half of the 1990s, between 1997 and 1999, 9,663 unemployed miners in the Jiu Valley left for other cities in the country.

:hart 21 – Jiu Valley population by age and gender (1992 vs 2019)

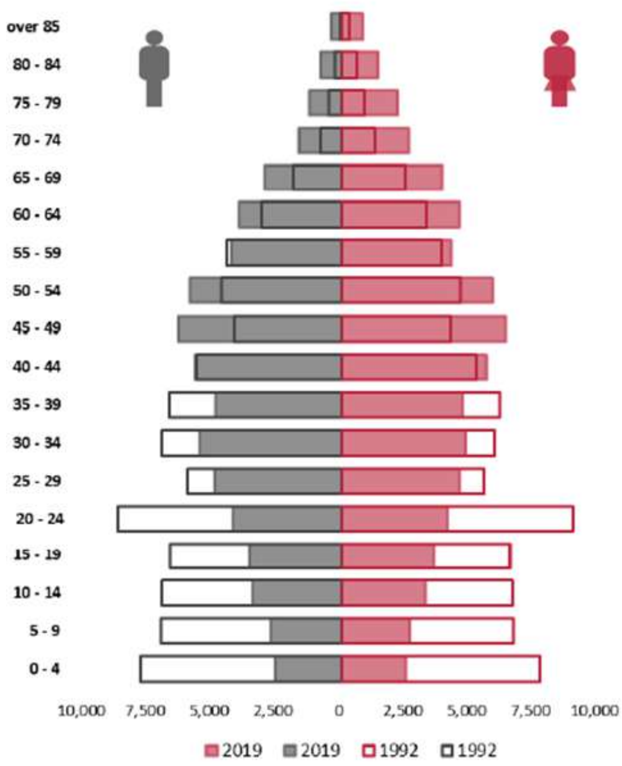


Figure 1 Source: PwC, idem, 72

2. What is the key motivation for migration (based on the data already collected)?

One reason that can be understood is that those who left the area in the first waves of migration returned, especially from the rural environment. This can be understood in that they could not achieve the idealized life far from the urban environment. Therefore, between 2005-2011, migration continued to increase, fluctuating subtly and remaining at negative values.

We can ask what the main reason why locals leave the region is. The main reason is to look for other employment opportunities because the Jiu Valley employment offer is limited due to mono-industrialization conditions and the bleak prospect of mining in the area. Of course, educated young people will look to go to Bucharest or the western part of the country, where there are many more employment opportunities. It should also be borne in mind that those who return to the Jiu Valley at the end of their studies are very low due to the limited number of jobs available and high demand in other country regions. Precisely as a result of the technological impasse and the delayed innovations, jobs also suffer from the lack of diversification in the region.

The Jiu Valley has three technical colleges, two technical high schools, and a post-secondary school. The problems encountered in technical and vocational education assume teachers do not use modern tools, and practical training is inadequate and often too repetitive. Moreover, teachers are not creative enough, being focused on the school curriculum. Most teachers have a conservative attitude, and they are not very attentive to the needs of students, to the digitization of teaching-learning methods. Technical schools are poorly funded, and laboratories that should be centers of modern learning often lack modern equipment dating back to communism. We are talking among students about the lack of long-term perspectives regarding professional development and access to a career in study.

According to Sandu (2004), the Jiu Valley is not a poor area compared to other similar urban areas in Romania. The difference is that the Jiu Valley is much more vulnerable to poverty, unemployment, and dependency, which are higher. Entrepreneurial guidance and success are also not significant. For example, in 2004, only 13% of the population intended to open a business in the coming years, and in 2016 this percentage increased to only 19%. These facts lead to migration, especially the migration of young people who choose to graduate from high school and study in major cities such as Bucharest, Cluj-Napoca, Iasi, Brasov, or Timisoara, which have notable universities in the country. The University of Petroșani has lost a significant number of students and is still failing to fully adapt to new sustainability trends and global needs and contexts on climate change.

Chart 20 - Evolution of net migration rate in Jiu Valley between 1992-2018

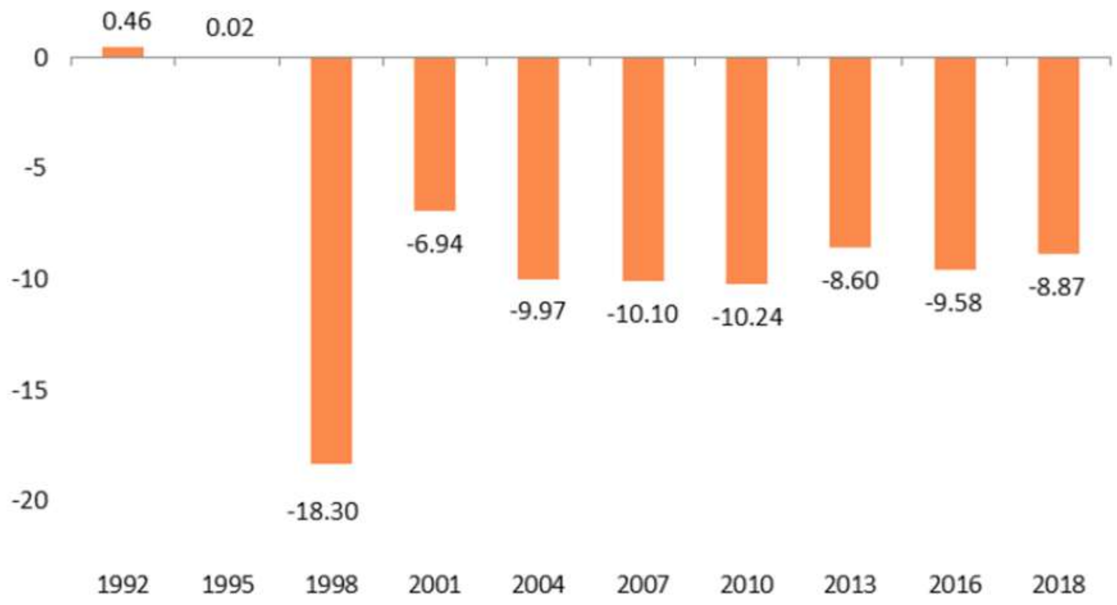
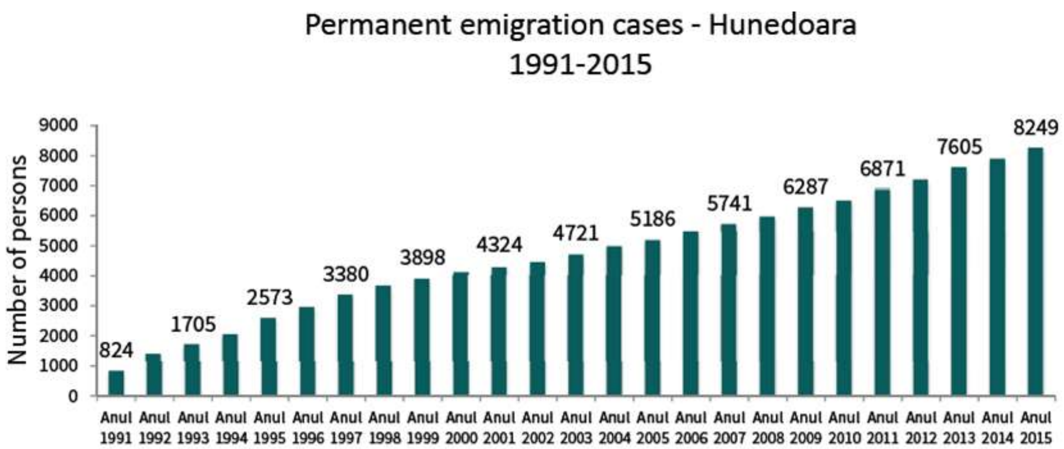


Figure 2 Source: PwC, idem, 71



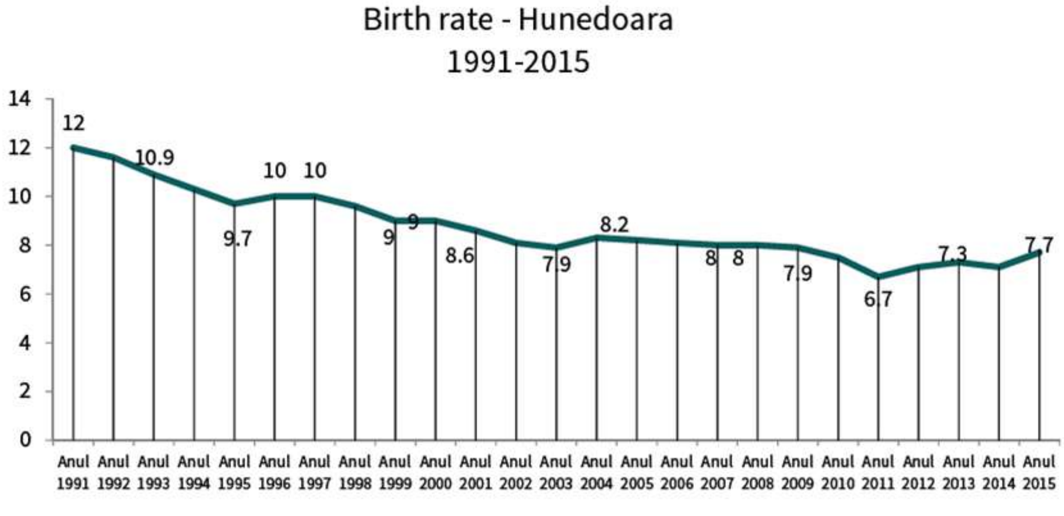


Figure 3 Source: Bankwatch, Alexandru Mustață, Laura Nazare, ”Retrained and Forgotten”, 2019, 5

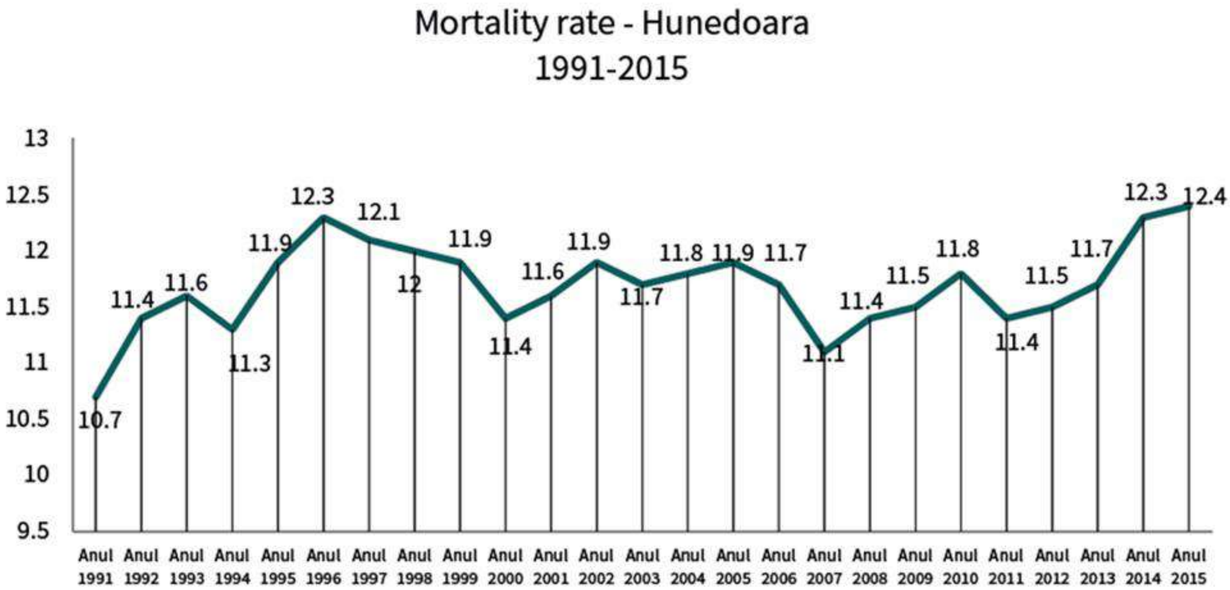


Figure 4 Source: Bankwatch, Mustață, and Nazare, ibid.

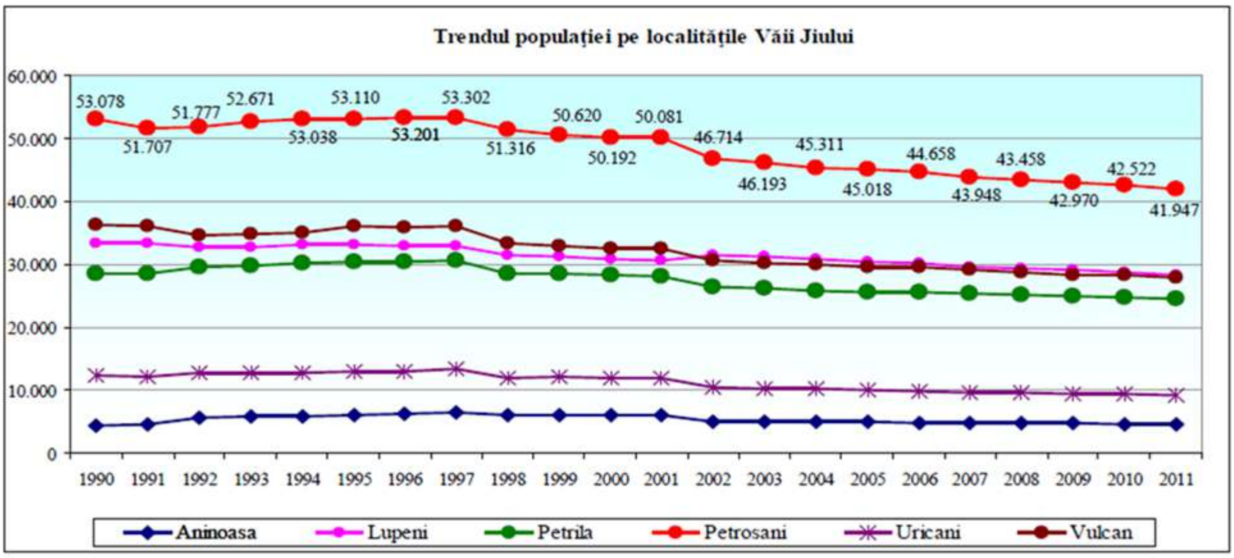


Fig. 1. Fig. 1 Population Dynamics in the Jiu Valley localities during 1990-2011 (No. Persons)
** Source: County Department of Statistics Hunedoara; Anghel, 2014*

Figure 5 Source: Felicia Andrioni, Mariana Anghel, and Lavinia Elisabeta Popp, ”Jiu Valley's Demographic Dimensions at the intersection of Socio-Economic Transformations”, n.d., 661

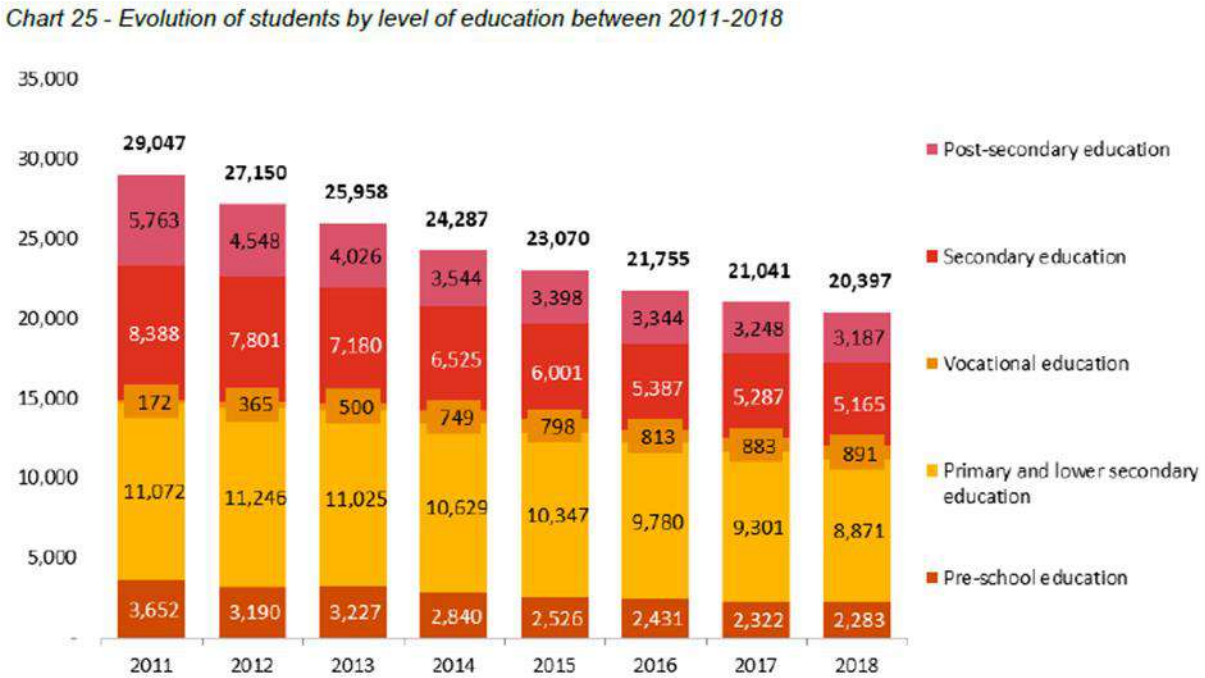


Figure 6 Source: PwC, idem, 76

If we refer to religion, the population is predominantly Orthodox, i.e., 83.50%, followed by the Roman Catholic population with a percentage of 5.54%, and the population-specific to the Pentecostal cult, i.e., 2.95%. By referring to the share of young people under 14 in the total population, we will see that they represent around 18%. The working-age population (15-64 years) is 72.70%, a higher percentage than in the county, i.e., 14.86% for young people and about 71% for working-age people. People over the age of 65 in the county amount to 14% of the county and 9.35% in the Jiu Valley.

For the field of education, it is known that in the Jiu Valley, there are 45 educational institutions divided as follows: 12 kindergartens, 22 primary and lower secondary education institutions, ten high schools, and a post-secondary educational institution in Petroșani. Annually, the number of students decreases by 5.5% compared to the previous year. Uricani registered a minor reduction, where the total number of students dropped from 1,184 in 2011 to 1,011 in 2018. 8% annually – the number of students enrolled in post-secondary education has decreased, which may indicate a high dropout rate or may be a consequence of student migration to better universities in the country. Given the downward slope of population growth, this decrease in the number of students enrolled can also be thought of as a concordance of the decline in the young population in the region's total population. The University of Petroșani offers the opportunity to obtain a bachelor's, master's, and doctoral degree. According to the data provided by the university, in 2019, there were 2,353 students enrolled in undergraduate studies, 778 in master and 153 in doctoral studies.

13.8.2 Values and identity (WP2)

Sociological surveys have shown that residents' spending is mainly on raw food. Moreover, a new destructive social phenomenon seems to be on the rise. We refer to the comparisons that young people from the Jiu Valley make, including families and financial opportunities, and those living in other big cities. In the process of searching for personal and social identity, as mentioned in the document, it is crucial in the lives of young people that the family and the community provide a positive social identity translated into social support and well-being for young adolescents and young adults.

Compared to other mountain resorts in Romania, such as Poiana Brașov, Bușteni, Sinaia, or Predeal, the cities in the Jiu Valley have a lower degree of urbanization, hence this rural character. This aspect can determine urban regeneration, which would need uniformity of the rules on building permits, strategic urban development planning, and promotion of local identity through sustainable marketing.

Mining and the state coexisted for a long time, being the primary sources of well-being and identity in the Jiu Valley. The mines also provided a place for the miners to live. The miners' unions regularly organized outings in the city, holidays, or May Day holidays, Labor Day. There were also mine clinics that cared for both the miners and their families. Mining has also managed to organize vocational schools. The Communist Party, however, had managed to create a very well-developed surveillance apparatus, which eventually destroyed most of the voluntary associations; the mining industry became strongly dominated by men, women being redirected to more domestic areas.

Highiduș and Fulger (2016) states that:

”The redundancies in mining have lead to an increase in social mobility. The social mobility of each individual is judged by two extreme marks: social origin and the status reached at the end of career. Far from being at the end of their careers, many of the people who make up the new social category of the Jiu Valley currently have an uncertain status, trying, if not forcefully, a sentiment of losing the identity, alienating.”

No change in regional values and identity was observed. The central identity remains that of the mining region, firmly anchored in the mining industry. The most widespread values are also related to mining and the tradition of inheriting the miner's profession from father to son.

Does identity (change) and values (change) reflect on electoral behaviour and electoral platforms?

Romania's party allegiances are very loose, and Jiu Valley has no specific political party. However, AUR is a new-entry party with a nationalist, homophobic, anti-system, anti-covid, pro-orthodox, anti-western discourse. AUR is the party that supports miners' wishes and defends miners' interests in the protests of 2021. Before the AUR party, the Social Democratic Party, which was between the first two political parties in Romania (the other party being the National Liberal Party), was the leading supporter of the miners in previous years.

Another relatively new party, the United Romania Party, has sent members to the Jiu Valley for the Romanian parliamentary election campaign. Party members even attended a religious service at a church in Petrosani, where they met with supporters of the party, a center-left nationalist party that wants "a strong state and a strong citizen." Meetings were also held with regional agricultural producers to look for solutions to the development of local producers. The party's honorary president in Hunedoara county declared, "I will always be for the people, Romania and Hunedoara county." However, there are currently no data to suggest that the population of the Jiu Valley would favor the AUR party.

It can be said that the Social Democratic Party, the Alliance for the Union of Romanians, and the United Romania Party favor the Jiu Valley's needs and in defending miners' rights and interests. At the same time, the National Liberal Party can be seen as antagonistic in this populist story.

În prezent nu se poate argumenta că există un partid politic care să sprijine efectiv tranziția energetică. Factorii care au inițiative sunt mai degrabă autoritățile locale și regionale sau ONG-urile. Totuși, Ministerul Energiei a publicat o ordonanță de urgență în data de 31 mai 2022 privind decarbonizarea sectorului energetic. Această măsură prevede ca minerii disponibilizați din județele Gorj și Hunedoara să primească o finanțare nerambursabilă pentru achiziția de sisteme fotovoltaice cu o putere instalată de 3-5 kW, având astfel posibilitatea de a deveni prosumatori.

13.8.3 Policy and politics (WP3)

In recent years, political parties' support for the energy transition has been minimal, with the 2022 energy crisis taking far too long for the authorities to decide on measures. For example, on the official website, the Green Party in Romania has no mention of the Fair Transition or the energy transition starting with 2019.

3. Policy indicators	**Examples**
3a. public investments **3b. investment support** **3c. subsidies** **3d. taxes** **3e. policy planning documents**	A list and short description of key relevant policy interventions and if relevant, indicate if/how the policies are supported/not supported by political parties.

13.8.4 Economic potential (WP4)

4. Qualitative indicators on economic opportunities	**Examples**
4a. Key stakeholders' opinion on (new) economic opportunities	Presentation of the narratives of the interviewed stakeholders.

0	1	2	3	4	5
5	Rehabilitation neighboring roads, alleys and city streets (Uricani)	6.000.000	Regional Operational Programme	Priority 2 : Improvement of regional and local transport	2.1 . Rehabilitation and modernization of county roads and urban streets , construction / rehabilitation of ring roads
6	Realization and development of rural tourism infrastructure in the Campusel - Sârba	16.000.000	Regional Operational Programme	Priority 5 : Sustainable development and promotion of tourism	5.2. Creation, development, modernization of tourism infrastructure for the exploitation of natural resources and increasing tourism services
7	Infrastructure for sustainable tourism in the tourist area Parang (Petrosani	10.556.000	Program Operaţional Sectorial de Mediu	Priority 1 Expansion and modernization of water and wastewater	Expansion and modernization of water and wastewater
8	Rehabilitation tourist resort Straja, landscaping recreation area and access routes Braita	3.000.000	Regional Operational Programme	Priority 5 : Sustainable development and promotion of tourism	5.2. Creation, development, modernization of tourism infrastructure for the exploitation of natural resources and increasing tourism services

Portofolio projects and identifyingfunding sources

Nr. crt.	Project title	Value (euro)	Source of funding		
			Operational Program	Priority Axis	Area of intervention
0	1	2	3	4	5
1	Realization of road infrastructure Babii.- Merişor	10.000.000	Regional Operational Programme	Priority 2 : Improvement of regional and local transport	2.1 . Rehabilitation and modernization of county roads and urban streets , construction / rehabilitation of ring roads
2	Modernization DJ 664Vulcan- county limit GJ	2.000.000	Regional Operational Programme	Priority 2 : Improvement of regional and local transport	2.1 . Rehabilitation and modernization of county roads and urban streets , construction / rehabilitation of ring roads
3	Modernization area Pasul Vulcan	20.000.000	Regional Operational Programme	Priority 5 : Sustainable development and promotion of tourism	5.2. Creation, development, modernization of tourism infrastructure for the exploitation of natural resources and increasing tourism services
4	Rehabilitation of DJ 709 F and area road infrastructure Parâng	4.484.000	Regional Operational Programme	Priority 2 : Improvement of regional and local transport	2.1 . Rehabilitation and modernization of county roads and urban streets , construction / rehabilitation of ring roads

Figure 8 Source: Sergiu, Luca and Marchiș, Diana, Ecoturism trigger of sustainable development in the Jiu Valley, Analele Universității din Oradea, Fascicula Protecția Mediului, vol. XXIV, 2015198-199

Sergiu and Marchiș (2015) conclude that an alternative to development based on coal mining and processing can be ecotourism, for which the authors identify ten principles for the development of sustainable tourism:

”Sustainable use of tourism resources (optimal exploitation, conservation, protection); reducing the consumption and wastage of interest; preserving the diversity of natural, cultural and social development of rural areas; integrating tourism in national development planning and strategy, regional and local especially (general infrastructure development and technical - municipal) involvement of local communities in the tourism sector by supporting the initiative groups for developing and supporting local supply, protecting the environment and cultural assets; specialists and public consultation in the development of tourism and the local economy to avoid conflicts of interest between government policy and the local tourism entrepreneurs and population; sustainable development of tourism should be maintained through training, skills development, training civic appropriate sociological and ecological; promoting ecotourism marketing in the tourism market study of local and regional area or nationally and internationally; research and monitoring of ecotourism and actions to protect and conserve the environment and tourism resources.”[6]

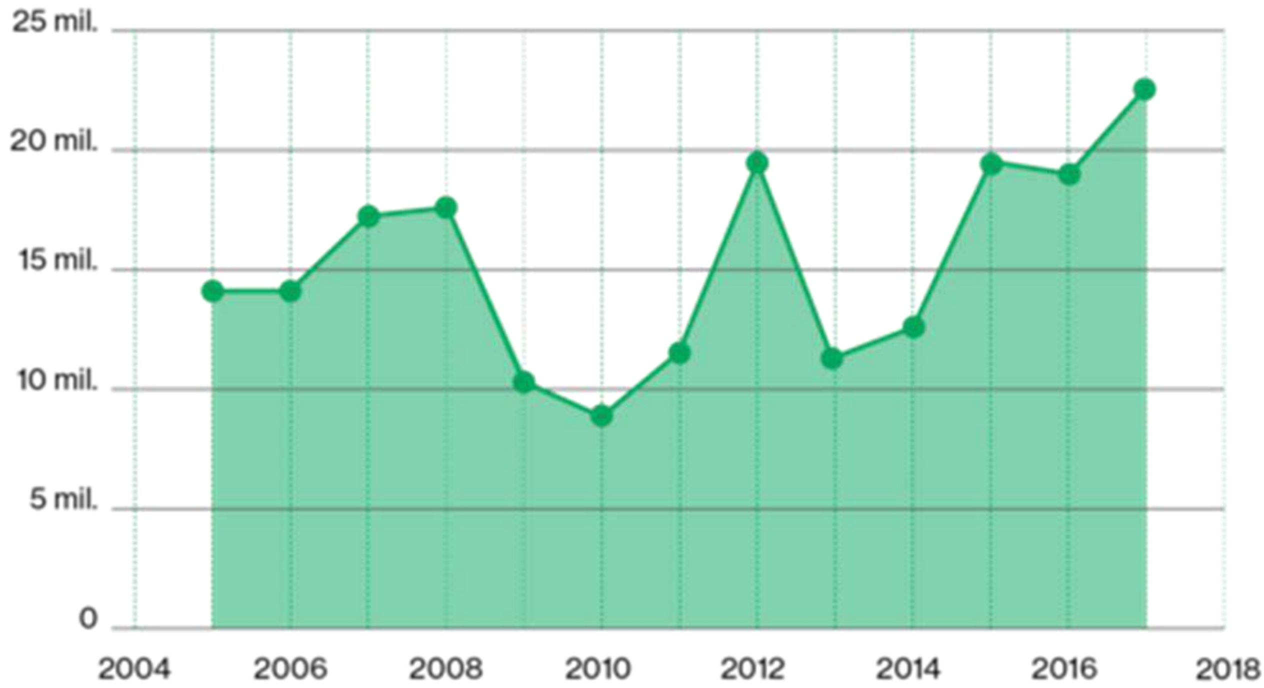


Figure 9 Total profit in the JIu Valley, between 2005 and 2017 (EUR) Source: investinjiuvalley.com, accesed on 10/06/2022, https://investinjiuvalley.com/investment-opportunities/economic-ecosystem

Also, at the end of 2021, the Ministry of Energy announced that CET Paroșeni would start the tests to replace the coal with pellets "Arbacore" produced by the Norwegian company Arbaflame, in 2022. This measure aims at good cooperation on replacing coal in the Paroșeni plant with wood pellets, and the long-term vision is to build a pellet production plant, most likely in the Jiu Valley. The Arbacore pellet resource consists of green biomass that will help reduce carbon dioxide emissions by more than 90%.[7]

[6] Sergiu, Luca & Marchiș, Diana, Ecoturism Trigger of Sustainable Development in the Jiu Valley, Analele Universității din Oradea, Fascicula Protecția Mediului, vol. XXIV, 2015, p.201

[7] Tracer, Jiu Valley made another step towards a Just Transition away from coal, accesed on 06/10/2022, https://tracer-h2020.eu/2021/12/15/jiu-valley-made-another-step-towards-a-just-transition-away-from-coal/

Figure 10 Source: Press-Media, Specificul local, nișa pe care Valea Jiului s-ar putea relansa (The local specifics, the niche that the Jiu Valley could relaunch), accesed on 06/10/2022

PriceWaterhouseCoopers experts have drafted the Jiu Valley development strategy, and local specifics are seen as the leading solution for further development. The Jiu Valley is part of the European Initiative on Carboniferous Regions in Transition, and the Ministry of European Funds is the institution that, in 2018, was designated nationally as coordinator of the Jiu Valley Initiative within the Coal Regions in Transition platform. Given the mono-industrial specificity of the region, development opportunities are limited. Experts have identified several alternatives, including "local craft." According to experts, the Jiu Valley can become an energetically reconfigured and socially revitalized region, sustainable and interconnected with a competitive economic environment, supported by investment and innovation. Thus, the Strategy for economic, social, and environmental development of the Jiu Valley (2021-2030) aims to reconfigure the region on several levels in the conditions of coal decline.

First and foremost, the aim is to mitigate the socio-economic impact of the mining sector and create an environment conducive to economic growth and diversification and attracting young employment. It is also desired to develop the competitiveness of small and medium enterprises and local entrepreneurship, changing the Jiu Valley from a mono-industrial area to an economically diversified region. In this context, the Jiu Valley should be economically diversified and coherent in tourism. The development of local specificity aims at the sustainable development of tourism, creative industries, the stimulation of local producers, the enhancement of the natural and cultural heritage of the region.

13.8.5 Key stakeholders' opinion on (new) economic opportunities

1. In November 2021, the Romanian team from Tipping+ visited the Ministry of Economy in the Romanian capital, Bucharest. For about 90 minutes, discussions took place with multiple people who are part of executive positions within the Ministry. The conclusions of the discussions are as follows:

- Until 1997, much money entered the Jiu Valley, but that money did not remain in the region.
- At the beginning of the 2000s, specific analyses were made to declare unfavorable areas (the mining and adjacent areas, where the labor force came from, and the headquarters of the mines were located). Thus, it was decided to grant facilities to local investors who moved locally to the mining areas. This statement worked for several years, and the Jiu Valley benefited from loans from the World Bank - active financial incentives for investors who employed unemployed miners, doing well.
- The World Bank's monitoring studies at that time were successful. The main collaborators were the local authorities through social dialogue and focus groups. Thus, groups in the region and community leaders were identified. The most significant achievement was the local initiative focus groups around a cultural center, a school, and public authorities that facilitated several successful projects and initiatives. However, they were small-scale because the grants were not immense but tremendous success. The World Bank's procedures were followed and followed.
- The World Bank had suspicions due to the implementation at the agency level because usually, in Romania, employment was made doubtful and non-transparent.
- The World Bank had the principle of community consultation; from 1998 to 2009, when the significant investments of extensive infrastructure began, people no longer believed in saving the region, but after implementing World Bank projects, the local community was satisfied. The works amounted to $ 500,000. The projects involved 80% financial involvement from the World Bank, 10% from the local community, and 2% from the direct beneficiaries through co-financing. People were delighted to give money and watched how the activity was carried out. The projects lasted 2-3 months and could not be stolen; nothing was in vain, and community involvement paid off.
- Business centers in the area - incentives were offered for unfavorable areas; it meant a social program that helped the community through community programs, repairing schools, roofs. It was a poorly funded local infrastructure program. The innovation was that the community was involved in the decision-making process, having the power to decide which street to repair; the community gave its opinion so that a street could be built, following the model of the World Bank.

- Romania has programs that address the existing unemployed, attracting them by retraining, but these programs do not provide the expected result. There is a low degree of voluntarism in adjacent urban areas.

- The best model was the one in which the entrepreneur managed in 2-3 years to think about expanding the business and removing the remaining vacancies on the labor market, which would then be absorbed by the unemployed.

- The problem was represented by the solid social temptation in the Jiu Valley and the mono-industrial characteristic.

- 50% of the staff in the Jiu Valley are displaced people, and they have no skills other than mining; when they finish the job, they have nothing else to do - a fact accentuated in Aninoasa and Vulcan.

- In the Ministry's view, an exchange of experience would be helpful in the implementation of good practices for the extension of the transition for another ten years.

SOLUTION: From the discussion with the representatives of the Ministry of Economy, a solution is the community approach in the Jiu Valley; the transition must be made as soon as possible.

- Today, apart from the Just Transition, the priority agreed upon between the Jiu Valley and the Government was tourism, but the covid-19 pandemic intervened, and the transition philosophy changed - they want to invest in research and education more than in tourism.

- When it is a desire to transform a mining area into a tourist area, the authorities must first invest in greening. The problem was that tourism could not be done in a river valley where the water flowed red due to pollution. In the Jiu Valley, a 24/7 treatment plant is needed, which involves maintenance costs and funds that neither the local authorities nor the state has through the state budget.

- There is no modern technology in the Jiu Valley, and no investment has been made in mining technology. New technology means investment, and the Romanian state no longer wants to make such investments. However, private actors could make such investments, but they have no interest because there is no national policy or share capital. It needs a circular economy and investments of millions of euros.

- It takes 4-5 years of investment in the mining industry, and the profit comes later. Medium and long-term planning is needed. No political party will create a policy that takes four years and thus accepts that another party that will come after the expiration of its mandate will enjoy the profit they should have made.

- The legal framework for exploitation was not apparent until December 2020. It was wanted to reopen the closed mining operation; Law 175/2020 claims that the mining activity can be reopened in the already closed perimeters under certain conditions.

- A graphite mine in Gorj, at Baia de Fier, near the Jiu Valley. It was not exploited; the graphite reserve was discovered as collateral with the salt reserve in that area and belonged to the Romanian state-licensed to the National Salt Society. Graphite mining can start at any time!

• The representatives of the Ministry complained that Romania never negotiated anything in Brussels, and the Romanians were always "yesmen." Romania did not have specialists in the mining industry to say that compared to other states, there have resources and should not close more than 500 mining targets at once, but this had to be done in stages and by refurbishment for energy security, not necessarily in terms of resources.

A medium-term SOLUTION would be to identify the industrial heritage that should be cleaned and to identify and bring in Israeli and German hydrophone farming technologies to provide food, as there is no agricultural land in the Jiu Valley due to the mountainous area. In digitization, the investment must be made in research and education on renewable resources.

• Another problem identified is that the mayors of the Jiu Valley have created some fiefs so that the idea of community is vitiated by the centers of power created by the mayors. The mayors do not think at the highest level in the interest of the Jiu Valley. Their influence is powerful, and they believe they should be involved in all aspects of life in the region, which is wrong.

• There is a need to have local development plans and local development strategies. A team of consultants is needed to mobilize forces and bring in volunteers.

• The Jiu Valley, a mono-industrial area, depends on the taxes and duties of the Hunedoara Energy Complex, only that the mining taxes and duties have decreased from 80% to 20%.

• Also, the industrial patrimony can be ceded to some investors. Alternative energy services for photovoltaic panels can be developed, and a photovoltaic park can be created from the mining heritage.

• There is a need for a national policy (the measures taken in the 1990s were neoliberal because companies had to make a profit); At that time, it was the CAER market, and the Romanian managers did not know the management of the free market. In Romania, there have been no medium and long-term public policies on making timely strategies and solving problems.

• An attempt was made to copy the Portuguese model for accessing funds for mine closure projects. At the time of accession to the European Union, there were 550 mining targets, but today there are only half because there was no funding. The Ministry of Economics wanted to submit project applications through third parties to access European funds, but problems arose because there were problems at the level of land tabulations. It is desired that the Ministry of Finance receive funding for closure, greening, and reconstitution of the property right. All the areas were expropriated, and the mining companies did not exploit those areas in the financial book. The expropriation decrees were not well executed; it is unknown who the expropriated landowner is. Thus, there is no eligibility for European funds without property, so there must be a discussion in Brussels.

• When ravines are created with contaminated material after rain, the mining perimeters must be monitored and repaired, but no money is left. In Romania, a catastrophe is expected to be repaired from the reserve fund instead of measures to prevent disasters (natural and financial).

2. Between December 12-18, 2021, the Romanian team traveled for the third time to the Jiu Valley to interview other mayors in the region and make a participatory observation in all the component cities of the Jiu Valley. Each interview involved a discussion of about an hour.

Interview with the mayor of Vulcan, Cristian Merișanu. Following discussions with him, it was found:

• In Vulcan, a new ski area was opened in December at the Vulcan Pass, with two slopes and a chairlift.

• The mayor acknowledged that industrial areas had been severely affected in recent years but is pleased that there are START programs, ITI Jiu Valley, and the Just Transition Fund.

• Out of a total of 45,000 miners, 800 remained.

• The County Council and the Agency for Regional Development West are involved in saving the region, and the funds are obtained in an organized form.

• There is a need to create opportunities for people through tourism. The local community must receive bonuses and tax exemptions, staff must be relocated, and those who relocate for 50 kilometers must receive a sum of money.

• There is the LAG project for marginal areas, through which people's needs were met through questionnaires.

• Miners have pensions of 6-7000 lei (somewhere at 1,500 euros), which is a lot in Romania. Therefore, they have no serious reason to look for another job.

• There is no relationship between Vulcan City Hall and the Ministry of Economy.

• It is the desire to create a technology park on different topics in each city in the region.

• ITI Jiu Valley laid the foundations of its association.

• There is a green line program in the Jiu Valley, public transport with electric buses. It is currently in the project delivery phase, followed by tenders. 2% co-financing support is needed on European funds. There are many ineligible works, and thus 20 million euros are needed, which is difficult to obtain.

• The mayor said the mine would close on its own. Scrap metal thieves have been allowed to do their job - they steal cables that feed underground fans and feed the shaft well. Miners can get stuck underground!

• The mayor agrees to continue mining until 2032, but with significant investments.

• Thermal power plants no longer work; they want to run on pellets, which is wrong and not anchored to reality. The central heating system no longer exists; The Hunedoara Energy Complex no longer offers hot water, except in the National Energy System. There is no more heat due to financial losses, the costs have been very high, and people have disconnected.

Mayor Vasile Jurca from Petrila:

• He pointed out that in the 1990s, there were 30,000 miners and two mining operations with 9,000 employees. The Petrila mine had 4,500 miners and was closed in 2015. Currently, the Lonea mine has another 300 employees. There is also a 1000-employee coal preparation near the Petrila mine, plus small craft cooperatives and satellite companies around the mines.

• Since 1997, the layoffs of miners and mines have begun.

• There is a local company of a resident of Petrila who exports wood to Austria, which is exploited in Petrila because Petrila has wood managed by the forestry directorates at the county level, the Forest District has been abolished, and only the one Petroșani remains. Petrila has 80% of the forest fund managed. Five thousand hectares are in composesorate; private forests are also on small areas.

• Timber is being created in Petrila, but there are few jobs; there is no factory proper.

• 80% of those who left Petrila went abroad.

• "Start-up nations" have managed to attract people who have opened businesses in the area.

• Companies in the Jiu Valley were exempt from tax when the region was declared a disadvantaged area. Large companies opened headquarters in the region, but the headquarters were still in the big cities to benefit only from exemptions, a measure that did not have the desired effect.

• A few years ago, Prime Minister Cioloș had come with great promises to the Jiu Valley for a discussion with all mayors. He wanted to create a particular territorial unit to solve the problems by directly linking the government and the local central administrations. At the end of the discussion, the prime minister told the mayors that the Lonea and Lupeni mines would be closed. They closed everything down but did not put anything in place to generate stability.

• The mayor paid a visit to the closed mines in Poland and the representatives of Bankwatch Romania and Greenpeace Romania. Very different things were observed there. On the one hand, people were happy that the mine was closed and the state wanted to close another mine, and in another community, people were complaining that the mine was closed and they had to go to another area to work.

• In Poland, the mayor saw a mining museum with an entrance ticket and a visit circuit, but in the Jiu Valley, this is impossible due to officials.

• In 2012, a project was made to expand the ski area; a chairlift that had not been operating for six years was purchased. Serious efforts have been made to remove the lands from the ROMSILVA forest fund under their "patronage."

• There is a ski area at Ciureanu Alba. A ski area cannot sustain the economy.

• The economy of the Jiu Valley is collapsed, and there are no more jobs.

• All mayors in the region have signed a memorandum in Brussels, fruitless for two years. Nobody says or does anything about it anymore.

• The mayor's solution is to have more small companies than one large company in the Jiu Valley. A large company's bankruptcy has a significant social and job impact.

• There is an outstanding collaboration between Petrila City Hall and NGOs from the Jiu Valley (the most notable being Planeta Petrila, investinjiuvalley).

• They wanted to create a village museum with 23 wooden buildings, a church, sheepfolds, and places where momârlanii (i.e., natives) lived, an idea implemented by Mihai Danciu.

13.9 Trends and indicators for sustainable transformations

We have noticed a trend regarding sustainable development through tourism that has helped develop sustainable development so far. Also, the creation of the Academy of Renewables in Petroșani can be mentioned here, but we cannot conclude the extent to which this is a trend because no data have been issued to highlight the relevance and success of this Academy of professional conversion of miners in renewables.

Paradoxically according to this statement, about half of the Romanian small enterprises, i.e., 300,000, have disappeared due to the high taxes imposed by the Government. This is how the region's economic recovery through government programs risked burying the Jiu Valley, bringing it into a situation of economic collapse. In the 2000s, the Jiu Valley population was concerned about poverty and the unemployment rate, which was higher than in the last years of the 20th century. Economic development policies and programs for the Jiu Valley were ignored mainly during that period, as political programs were more in social development. However, in December 1999, 67% of respondents said that they used to live well and very well before 1990, but if we refer to the population of 2007, we will see that 63% considered that by 1989 their earthly life was perfect. It is a tiny difference, and that's caused by depopulation. Also, in 1999, the interviewed subjects answered 40% that their material condition was acceptable (Fulger, Hirghidus, and Bocsa, 2011, pp.121-130).

Between 1998 and 2002, economic operators operating and operating in less-favored mining areas as listed in the Jiu Valley also received several tax incentives, such as exemption from customs duties and value-added tax on cars, the uses, installations, equipment, and means of transport that are imported to make investments in the area, the exemption from the payment of taxes levied for the change of destination or the removal from the agricultural circuit of some lands intended for the realization of the investment (Costache, 2020, p.71)

It must be said that much of the state aid to the mining industry goes back to the state and also contributes to the support and development of local communities in the form of mining royalties, mining concession fees, social security contributions, local taxes, and duties paid by the employee and the employer (Sindicatul Huila-Valea Jiului, p. 9, accessed on 02/18/2022)

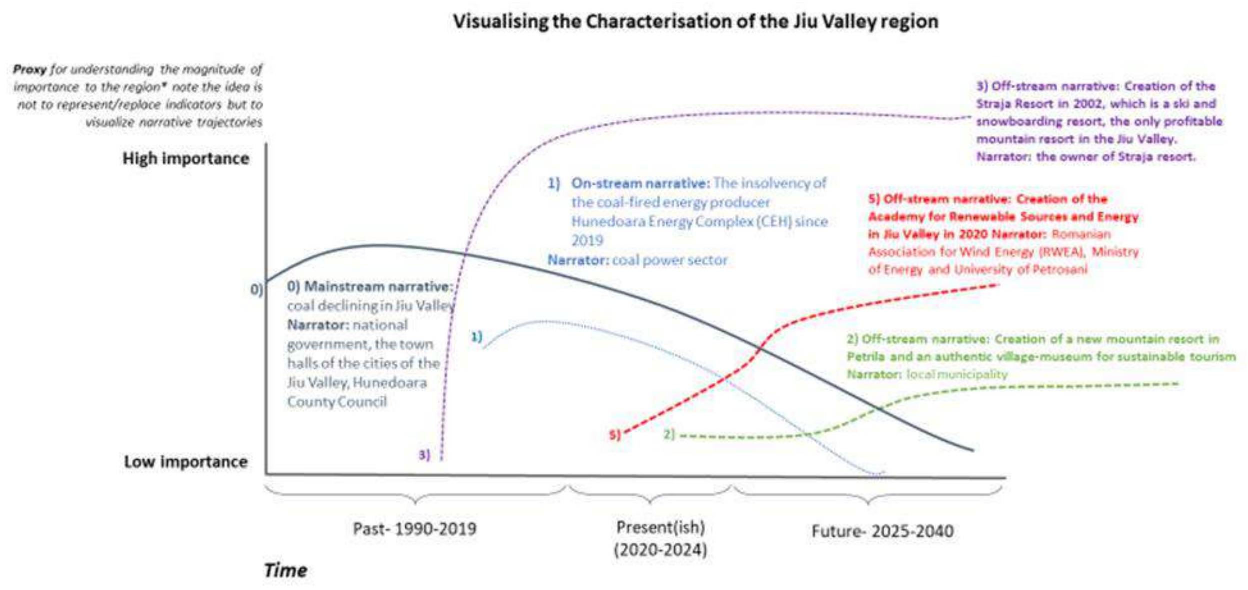
Moreover, in winter, mountain bikers visit the three ski areas, Straja, Parâng, and Pasul Vulcan, using downhill or enduro chairlifts. Moreover, Petrila and Uricani have underdeveloped potential in cross-country cycling, benefiting from longer routes. The area between Jiul de Est and Jiul de Vest is used for mountain biking with cross-country trails; on the routes, there are several chalets points of tourist attraction; someone can practice mountaineering, caving, and hiking for at least one day (Strategia pentru tranziție de la cărbune în Valea Jiului, 2020, p.53).

The region has an impressive number of caves, namely 662, of which 630 are at least 10 meters long, which can always represent local and international tourist attractions. For mountain biking support, we mention that the Jiu Valley has 700 kilometers of mountain trails, being one of the leaders in Europe in this regard. Considering all these aspects, we understand that there is a vast and real employment potential in the listed sports and activities that are not yet exploited (PwC, 2020, 11).

Also, according to the mayor of Uricani, in the coming years, the construction of a tourist village about 20 kilometers from the city, at an altitude of 1115 meters, the village is positioned at the foot of the Retezat and Vâlcan mountains. Unfortunately, there is no additional data. In the interview with the mayor of Uricani in December 2021, these plans were not fully realized. Therefore, the data and information available were not comprehensive.

Too this village, through its positioning, will connect the western part of the Jiu Valley with the Herculane Baths, a spa town. The village will have a specific momârlănesc (the natives of the Jiu Valley who lived in the region for the first time). The ethno-socio-ecological principles will be promoted within the village (Luca, Dezvoltarea durabilă a mediului montan al depresiunii Petroşani ca alternativă la mineritul din zonă, 2017, p.4).

A series of economic and cultural traditions have been preserved, and the agri-food sector is praised as ecological. In fact, the Jiu Valley is recognized as an area with good ecotourism practices (Luca and Marchiș, 2015, p.197).



"Trajectories are self-fulfilling prophecies based on the actors' decisions and expectations of the future"
Freeman, 1993, The Economics of Hope, pg. 198

13.9.1 Trends and indicators

Some of the indicators that could help this analysis would be population (the exact number, because in Romania, the last census of the population took place in 2011, but in 2022 it will be done a new); age pyramid, migration patterns (because many young people are graduating from the University of Petroșani leave the region in other important regions of the country or outside Romania), GDP (currently no exact data on the GDP of the Jiu Valley), poverty rate, employment and unemployment levels, productivity level; contribution to local GDP; subsidies level; production output; the number of companies active in the region; start-ups and technology and business innovation; support of Government (in terms of policies, subsidies); trust in Government; civil engagement in public consultations; corruption perception; funding for different levels/ministries; climate protection; labor (retraining and upskilling); research and education; innovation; public spending.

Moreover, the key indicators that can be actively used and for which there is sufficient data are grouped in "Socio-economic trends and changes," "Importance of incumbent dominant industry" (i.e., coal), "Presence and importance of other sectors," and "Presence and importance of low carbon sectors." These are described below:

(i) GDP – it can help identify changes and economic shifts that have occurred since the late 1990s and to the present date; the level of GDP can demonstrate how the coal region is positioning itself in the country's economy and whether the economic situation has led the region to an economic profit, economic stability or economic decline. However, for the Jiu Valley, information is scarce, especially on the region's GDP level since 2010. However, information is available on the GDP of Hunedoara County. Other notable indicators are (ii) the unemployment rate and (iii) the number of miners – which are intended to illustrate the progress or regression of the mining industry within the region; It is expected that the unemployment rate will not currently exceed the national average only to a negligible extent, but the situation will worsen in the coming years as a result of establishing 2040 as the reference year for the closure of all mines in the Jiu Valley (unofficial information).

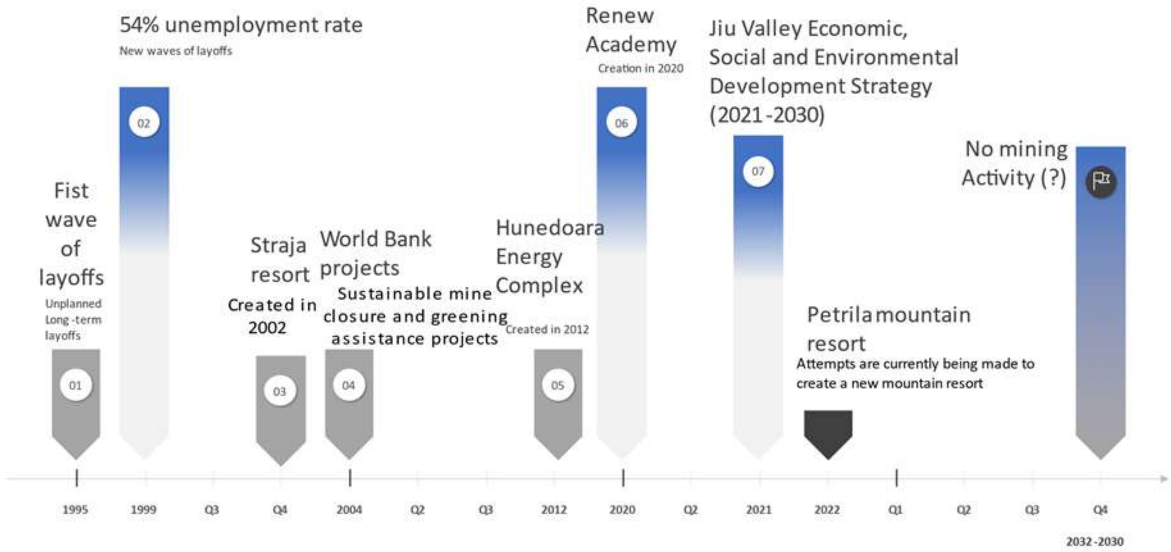
Another essential variable is (iv) the level of subsidies – it is important to see how the Government grants subsidies, to which components of the industry these sums of money go, and for how long they are granted. The (v) Innovation and Research engagement also refer to any key institution, company, or actor that currently plays a crucial role in the Just Transition and stands out as a critical element in the field of renewables as an alternative to the mining industry (in The Jiu Valley can currently be considered the Academy of Renewables, established in Petroșani in 2021).

Observed in:	**Trends observed in the narrative** (qualitative description)	**Indicator(s) that helps describe the trend** (way to measure)	**Indicator discipline(s)** e.g. economics, policy, etc.	**Key stakeholders representing the narratives**
Mainstream narrative	Minimal concern of the municipalities of the Jiu Valley for the development of renewable industries as an alternative.	- public and / or private financing in the field of renewables	Economics	The Hunedoara Energy Complex (CEH); The Jiu Valley National Society for Mine Closure; The Government of Romania; The Town Halls of Jiu Valley; Hunedoara County Council
	Out-migration, adding students migration after the graduation, most of them prefer to migrate in other important cities in Romania or abroad	- population; age pyramid; migration patterns;	Social	
		Regional GDP Poverty rate	Economics	

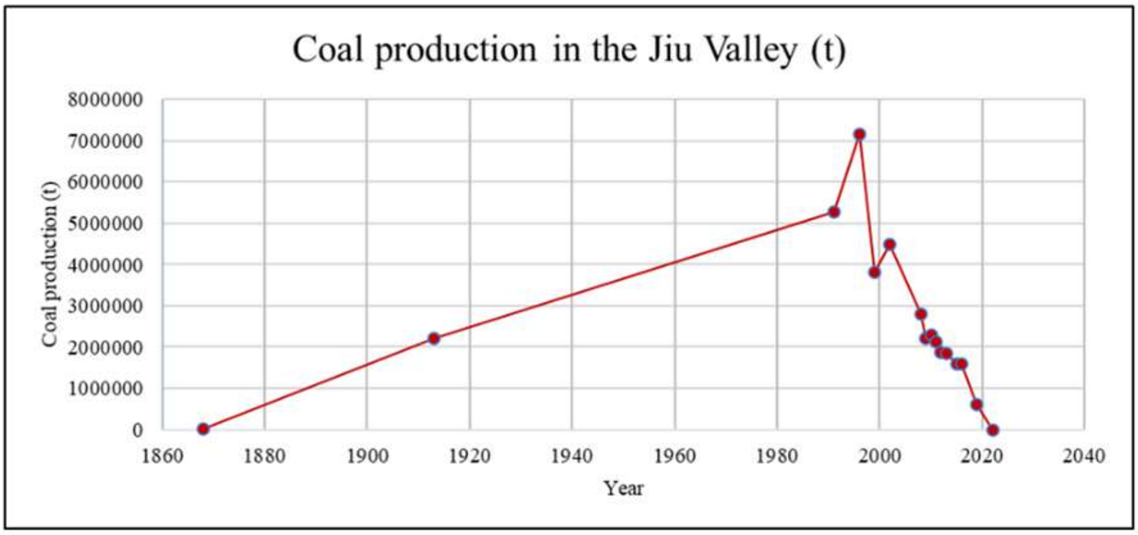
		Funding for different levels / ministries; public spending		
On-stream narrative		(current) Employment and unemployment levels; Productivity level; Subsidies level;	Socio-economic	All of the above
Off-stream narrative		Number of companies active in the region; start-ups and technology and business innovation; Labor (retraining and upskilling); research and education; innovation; Climate protection;		The Romanian Wind Energy Association; The network operator CEZ Oltenia Distribution; The University of Petroșani; Planeta Petrila Associations; investinjiuvalley Association;

			Environment	
Factors not derived from narratives	Straja Resort is one of the two mountain resorts in the Jiu Valley (the other is Parâng Resort). A new mountain resort in Petrila is to be established. Trust in Government; support of Government; civil engagement in public participations; corruption perceptions;	- number of tourists; - seasonal earnings / profit generated	Tourism Political	NGOs; media; political parties

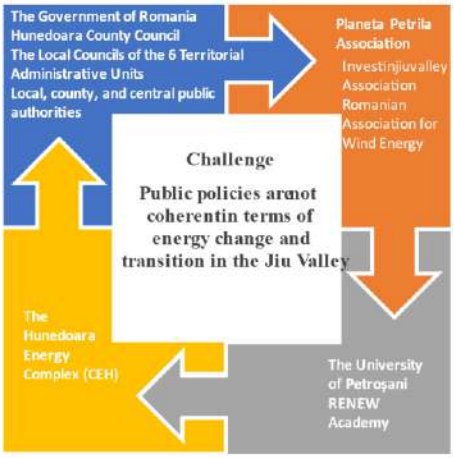
What happened in the Jiu Valley



The evolution of coal production in Jiu Valley



Main Stakeholders in Jiu Valley



Ministry of Energy

According to the National Recovery and Resilience Plan and the statements of the Minister of Energy, all coal mines will be closed and greened by 2032 or more likely by 2040

Planeta Petrila Association

Founded in 2016, the association sought to transform Petrila into a creative hub, something they feel could replace the leading role coal has played in the town for generations (still uncertain).

Renew Academy = The University ofPetroşani + Ministry of Economy + the Romanian Association for Wind Energy

Renew Academy is targeting the conversion of approximately 5,000 specialists in wind energy and 3,000 in electricity distribution per year, for a total of up to 8,000.

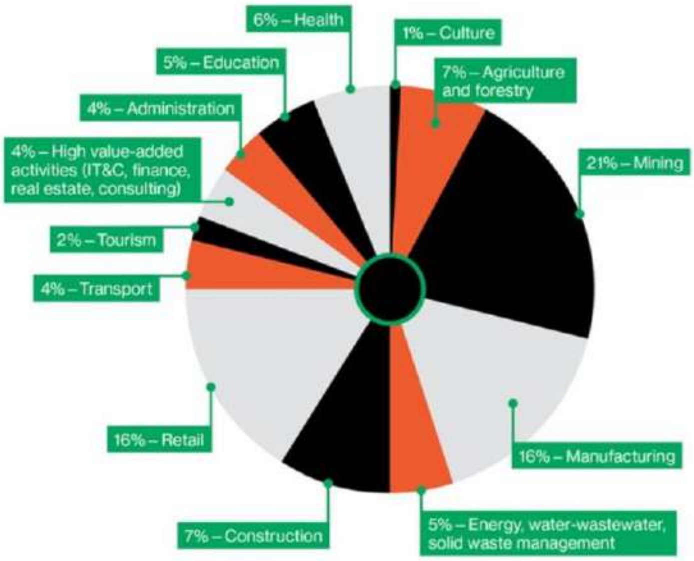
The Hunedoara Energy Complex, in insolvency since 2019

The Hunedoara Energy Complex (CEH) (established in 2011 by merging Deva Power Planta and Paroşeni Power Plant, which were former subsidiaries of the Trading Society for Electricity and Heat Production "Termoelectrica").

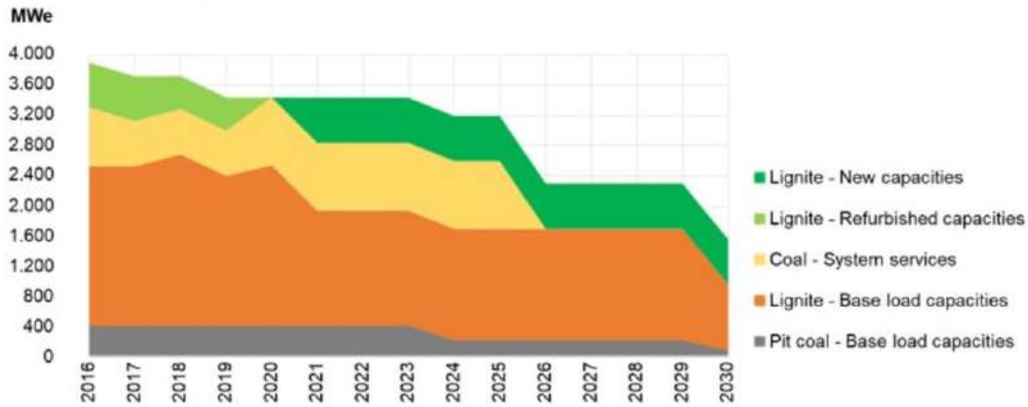
The evolution of coal production in Jiu Valley

Year	Coal production (t)
1868	853
1913	2200000
1991	5270000
1996	7170000
1999	3820000
2002	4500000
2008	2809925
2009	2196681
2010	2283345
2011	2121574
2012	1876062
2013	1839667
2015	1583350
2016	1600000
2019	600000
2022	401 500

Labor force in Jiu Valley



Evolutiond and prognosis of the available coal-based ned capacities (MWe)



Source: Romania's energy strategy 2019-2030, with the prospect of the year 2050, draft version

Coal installed power

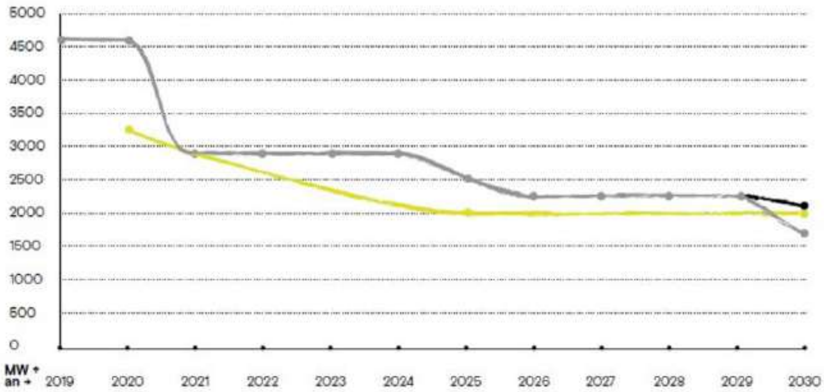
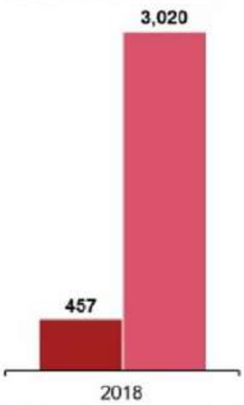


Chart 3 – 2018 GDPs, Jiu Valley and Hunedoara County, [EUR M]



Jiu Valley's GDP, 2018, EUR M
Hunedoara County's GDP, 2018, EUR M

Source: PwC analysis

The 2018 GDP of the Jiu Valley was EUR 457 M, representing 15% of Hunedoara's GDP.[21 22]

The contribution of the region to the GDP of the county is relatively low, a fact mainly determined by the lack of economic activity in the area and by the negative cumulative profitability of local companies.

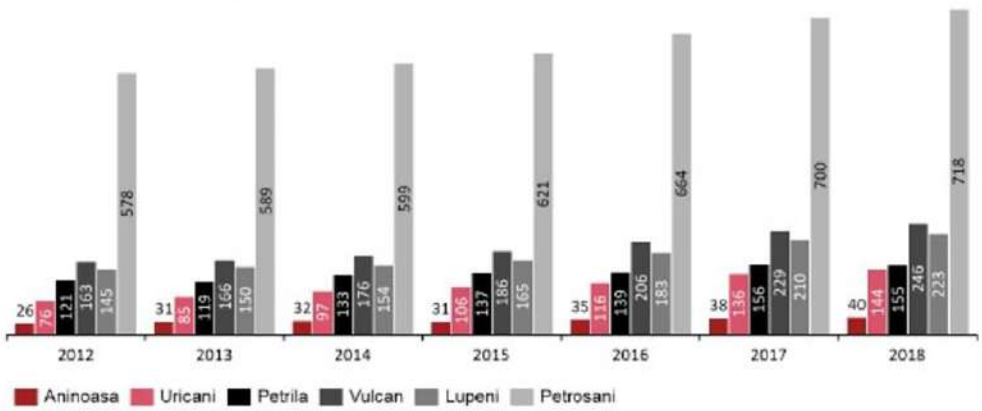
This situation is reflected in the top 5 companies with largest operational revenue in Hunedoara in 2018, where Societatea Complexul Energetic Hunedoara – the largest company and employer in Jiu Valley – stands the fifth:

1st place – SEWS ROMANIA S.R.L. (EUR 184.5 M);
2nd place – PHILIPS ORASTIE S.R.L. (EUR 148.4 M);
3rd place – ARCELORMITTAL HUNEDOARA S.A. (EUR 145.7 M);
4th place – FARMACEUTICA REMEDIA DISTRIBUTION & LOGISTICS S.R.L. (EUR 93.3 M);
5th place – SOCIETATEA COMPLEXUL ENERGETIC HUNEDOARA S.A. (EUR 87.2 M).

Business environment

The business environment analysis was performed by PwC based on the available TP Catalyst[31] centralized information, for companies with at least one employee. For the 2012 – 2019 timeframe, we analysed the following data categories per company: operating revenue (turnover), number of employees, operating profit or loss (EBIT), taxation, cost of employees, profit or loss before taxes and profit or loss after taxes.

Chart 3 - No. of companies per municipality



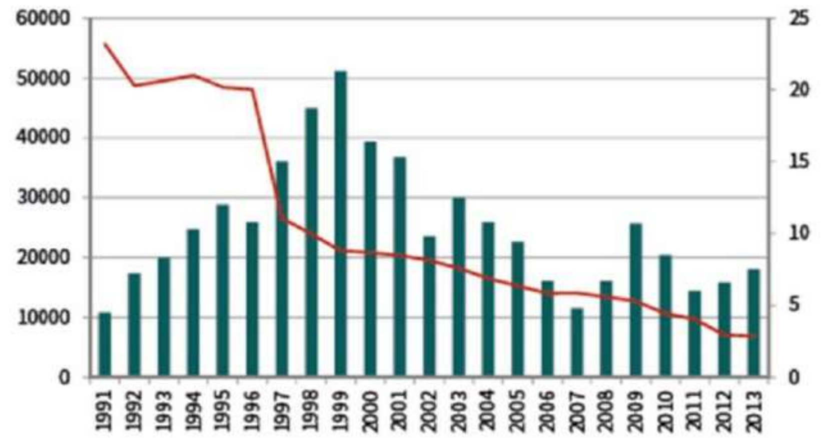
Source: PwC analysis

Petrosani has, by far, the largest number of companies, followed by Vulcan and Lupeni. All cities recorded a growing number of enterprises, Uricani having the largest percentage growth between 2012 and 2018 (89%). In absolute terms, Petrosani is leading, with 140 more firms at the end of the period.

Initially, the Lonea mine should have been closed in 2018, with a state aid of 27.7 million euros for the period 2011-2024 granted for Lonea and Lupeni. The mine is closing, but it was not closed either in 2018 or 2020, as was later announced.

The Lupeni mine was to be closed in July 2021, according to the deadline set by the Government in the substantiation note of GD 420/2021. Mina Livezeni (about 800 workers) and Mina Vulcan (about 650 workers).

In the period 2000-2019, there were 25 accidents in the underground, of which 18 at the mines in the Jiu Valley. 54 miners died and 42 were injured.



Unemployment rate (%, bars) and Hunedoara Energy Complex employees (line)

Table 2

Synthesis of main indicators of the Jiu Valley mining

No.	Indicator	U.M.	Period	
			1990	2018
1.	The population of Jiu Valley	loc.	167.456	120.734
2.	Workers in the mining sector	no.	43.791	4659
3.	Mining perimeters in operation	no.	17	4
4.	Active preparation plants	no.	5	1
5.	Exploited strata	no.	12	3
6.	The mining production achieved	mil.t	10,5	1,3
7.	State investment in the mining sector	mil.lei	128,59	-
8.	Population below the poverty line	%	-	10,25
9.	Unemployment rate	%	-	1,26
10.	Contribution to the local budget	%	76	1,71

13.10 Summary of key findings

The Jiu Valley is a regional pole of socio-economic disintegration, in which the focus of local, regional, and national authorities falls on economic factors, less on social factors, and almost not on environmental factors. Sustainable development in the region is almost non-existent, as it is considered that there are other pressing issues, such as the economy (mining industry), on which the authorities have to intervene. Attempts are currently being made to create a new mountain resort in Petrila that will rival the two existing resorts in Straja (which are profitable) and the one in Parâng.

One of the most remarkable projects in the Jiu Valley is establishing the School that will convert 8,000 miners into technicians for the renewables industry, Renew Academy. It was inaugurated in 2021 due to a partnership between the Romanian Association for Wind Energy, ONSSON, the University of Petroșani, and CEZ. The plan aims to access European funds from various sources, such as the Fair Transition Fund, for the training of 800 miners per year for ten years (Nicuț, 2021, accessed on 02/18/2022).

13.11 Reflection on inter- and transdisciplinary research approach

Among the stakeholders involved in our research were the mayors of Petroșani, Petrila, and Vulcani, representatives of the Romanian Ministry of Economy, the administrative director of the Hunedoara Energy Complex, the administrator of the Livezeni mine, the miners of Livezeni and Petrila, the retired professor at Petroșani University, Prof. Baron, Mihai Danciu, one of the most involved in civil society, founder of several associations and NGOs of importance in the region (Planeta Petrila Association, investinjiuvalley).

In 2021, during a visit to the Ministry of Economy, participating in discussion with ministry officials, the following were found. From the conversation with the representatives of the Ministry of Economy, a solution for the Jiu Valley is the community approach. The transition must be made as soon as possible. Today, apart from the Just Transition, the priority agreed upon between the Jiu Valley and the Government was tourism, but the covid-19 pandemic intervened, and the transition philosophy changed – the Government wanted to invest in research and education more than in tourism.

When it is a desire to transform a mining area into a tourist area, the authorities must first invest in greening. The problem was that tourism could not be done in a river valley where the water flowed red due to pollution. In the Jiu Valley, a 24/7 treatment plant is needed, which involves maintenance costs and funds that neither the local authorities nor the state has through the state budget.

There is no modern technology in the Jiu Valley, and no investment has been made in mining technology. New technology means investment, and the Romanian state no longer wants to make such investments. However, private actors could make such investments, but they have no interest because there is no national policy or share capital. It needs a circular economy and investments of millions of euros.

It takes 4-5 years of investment in the mining industry, and the profit comes later. Medium and long-term planning is needed. No political party will create a policy that takes four years and thus accepts that another party that will come after the expiration of its mandate will enjoy the profit they should have made.

The representatives of the Ministry complained that Romania never negotiated anything in Brussels, and the Romanians were always "yesmen." Romania did not have specialists in the mining industry to say that compared to other states, there have resources and should not close more than 500 mining targets at once, but this had to be done in stages and by refurbishment for energy security, not necessarily in terms of resources.

A medium-term SOLUTION would be to identify the industrial heritage that should be cleaned and to identify and bring in Israeli and German hydrophone farming technologies to provide food, as there is no agricultural land in the Jiu Valley due to the mountainous area. In digitization, the investment must be made in research and education on renewable resources.

Another problem identified is that the mayors of the Jiu Valley have created fiefs so that the idea of community is vitiated by the centers of power produced by the mayors. The mayors do not think at the highest level in the interest of the Jiu Valley. Their influence is powerful, and they believe they should be involved in all aspects of life in the region, which is wrong.

There is a need to have local development plans and local development strategies. A team of consultants is needed to mobilize forces and bring in volunteers. The Jiu Valley, a mono-industrial area, depends on the taxes and duties of the Hunedoara Energy Complex, only that the mining taxes and duties have decreased from 80% to 20%.

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14 Case study 13: Essen and Duisburg, Germany

Empirical observations of tipping dynamics in a coal phase-out region in Germany: the cases of Essen and Duisburg

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Institute for Advanced Sustainability Studies

14.5 Executive summary

The imperative of fully decarbonising our energy system and industries, as inscribed in the Paris Agreement, brings coal- and carbon-intensive regions under particular pressure. The impacts of closing industries may be especially strong here due to the strong socio-economic, political and cultural path dependencies and lock-in effects that have made them reliant on fossil fuel industries in the first place.

The conurbation of the Ruhrgebiet (Ruhr Region in the following) in North-Rhine Westphalia/ Germany is an example of such an industrial region in which structural change away from coal has been ongoing for about sixty years. There, the two cities of Essen and Duisburg share a long tradition of coal mining and coal-dependent industry – experiencing a similar transition process and trajectory in the mining industry's decline. At the same time, they appear to de- velop differently as they are perceived as very differently good or attractive. This indicates that Essen's transition away from coal is potentially going somewhat better than it has so far in Duisburg.

In this paper, we investigate the socio-economic transition processes of Essen and Duisburg as part of the wider structural change in the Ruhr Region. In the two case studies, we explore causes and effects of the cities' development trajectories in the last 30+ years, seeking to identify differences in outcome as a function of the interventions and/or contextual differences. We analyse events, interventions and their impacts on the social and economic systems of the two cities across time. Apart from identifying the key development drivers, we investigate whether either city crossed a tipping point in their transition process (yet), away from coal to- wards a low-carbon but still prosperous future. Therefore, we specifically evaluate the cities' development trajectories by seeking evidence for "no", "incremental" or "radical" changes in a set of indicators. Here, we have taken a long temporal perspective, because trajectories of and trajectory changes in social systems are specifically visible in demographic dynamics, economic structures and political arrangements across time.

Our analysis shows that both cities experienced incremental changes in their demographic, economic and political trajectories but we found no evidence for either city to have crossed a tipping point in their transition process yet. However, distinct developments in the cities' policy narratives indicate qualitative changes while putting them on different development trajectories potentially leading to tipping points in the future. Consequently, the cities appear at a cross- road. While their socio-economic trajectories still show similar trends, the narratives and policy visions of the cities suggest that their future trajectories will diverge. While Duisburg builds on the old narrative of continued and new heavy industry structures, Essen has formulated an al- ternative vision for the city, departing from the old mining image towards a greener future. Alt- hough success and prosperity are still uncertain, the developmental bifurcation is likely already happening. As they embark in different directions, the cities will likely grow increasingly different over time.

Our study shows that the sequence of interventions and timing are important factors for the trajectory of a region determining the quality of societal change. But radical change and tipping are the exception rather than the rule, especially in the highly complex social systems of cities.

Nevertheless, our research suggests that the distinct local narrative developments may herald a tipping dynamic in the future – and we cannot rule out that, seen from a few decades into the future, the period around 2020 can be identified as a tipping period in one or both cities. The strategies to influencing the local narrative building as well as focus on local strength and capacities appear as key mechanisms also relevant for other coal communities in their transition process. These interventions, whether they trigger tipping or not, are still necessary and useful steps towards a prosperous future beyond coal.

14.5.1 Introduction

There is growing consensus that a rapid and profound near-term decarbonisation of the energy system is essential, as an initial step towards the zero-carbon energy future necessary for meeting the temperature targets of the Paris Agreement (IPCC 2022). This brings coal- and carbon-intensive regions under particular pressure, because the impacts of closing industries may be especially strong here due to the strong socio-economic, political and cultural path dependencies and lock-in effects that have made them dependent on fossil fuel industries in the first place [1], [2].

Yet, some previously coal-dependent regions have already advanced in their transition away from coal and provide insights in the system dynamics and change processes. The conurbation of the Ruhrgebiet (Ruhr Region in the following) in North-Rhine Westphalia/ Germany is an ex- ample of an old industrial region in which structural change away from coal has been ongoing for about sixty years [3]. There, the two cities of Essen and Duisburg share a long tradition of coal mining and coal-dependent industry – all of which has come under transformation pressure as coal mining decreased and ultimately stopped. In the process, both cities have seen similar prob- lems of population decline, increased unemployment and growing low-income segments, both in comparison to the coal era and compared to other regions in Germany. At the same time, the two cities appear to develop differently and they are perceived as very differently good or attractive:

in national city ranking reports, Essen consistently performs in the middle of such rankings, well ahead of Duisburg, which sits at the lowest tier of all assessed cities [4]–[6]. Hence, we hypothesise that something is different in the two cities: something appears to go better in Essen's transition away from coal than it has so far in Duisburg.

In this paper, we investigate the socio-economic transition processes of Essen and Duisburg as part of the wider structural change in the Ruhr Region. In the two case studies, we explore causes and effects of the cities' development trajectories in the last 30+ years, seeking to identify differences in outcome as a function of the interventions and/or contextual differences. Apart from identifying the key development drivers, we investigate whether either city crossed a tipping point in their transition process (yet), away from coal towards a low carbon but still prosperous future. To this purpose, we examine policy interventions and their impacts on socio-economic indicators to identify non-linearities and significant shifts. In addition, we draw on 20 interviews with local stakeholders to better understand the local narrative developments.

We find marginal social, economic and demographic differences, in which Essen consistently performs somewhat better than Duisburg, but not dramatically so. Importantly, their development trends are practically parallel, indicating that they are not on different social and economic trajec- tories, yet. However, we also identify a bifurcation in the cities' visions and their narrative devel- opment: whereas Essen envisions a green, sustainable future, Duisburg remains devoted to its industrial storyline. Neither of the cities have crossed a tipping point in the hard quantitative indi- cators, yet the narrative change may indicate a significant and qualitative shift in the long term: if the cities embark on different trajectories now, this will likely result in stronger social and eco- nomic differences in the future.

14.5.2 Societal change: path dependency and policy narratives

Regional systems dominated by carbon-intensive industries are (often) locked into specific development pathways, both because they depend on the economic activity continuing in the short term (e.g. to keep employment up) but also because social, economic and technical institutions and infrastructures have co-developed with the dominant industry, supporting and entrenching it. Once an industry has become dominant, reducing or eliminating regional dependence faces strong short- and long-term problems. Such path dependency results from different positive feedbacks among technological infrastructures and political or economic institutions which increase the returns to scale and make change difficult and costly [1], [2]. In other words, the costs of reversal are getting higher and higher over time and create a considerable obstacle to move off an established path [7]. Changes in such established and path dependent systems thus tend to be incremental and materialise in slow processes over long periods of time.

However, social systems can also change in more radical ways when significant qualitative shifts in the trajectory occur. Examples are revolutions, wars and collective mass mobilisation overthrowing existing and no longer desirable systems at a certain point in time [8] or the closing of a previously dominant industry. Such radical change is often associated with high costs, including economic, social or political costs. Yet, systems do undergo radical change – not often, but sometimes they shift into fundamentally different trajectories.

Such social tipping points are limited periods of time in which interventions – both large and small

– can trigger self-reinforcing feedbacks that accelerate systemic change in social or economic context [9]. These interventions may be directed towards the triggered effect, which is the type of interventions we are interested in here, but tipping can, at least in principle, also be unintended effects of actions with an entirely different intent. Similarly to the natural world [10]–[12], social tipping points can become visible in abrupt non-linearities of peaks or dips in selected system indicators [13]. These impacts and disruptions are sought in hard indicators such as demographic, economic and political developments [9], [14]–[16]. For example, the closure of a dominant industry is often followed by significant local unemployment and migration leading to an overall socio-economic decline and drop of GDP in the region, which has happened in many old coal regions, for example Wales or Appalachia [17]–[19]. If this declining trend is reversed, for example through new jobs creation triggered by dedicated policy action to attract new companies, the region may have passed a tipping point – from the decline associated with the disappearance of a dominant industry to a new but still prosperous future.

In addition to such 'hard' indicators, there are softer indicators such as public and policy narratives carrying transformative capacities and agential forces [20], [21]. Narratives are ways of structuring human comprehension of complex environments, in other words help people to interpret their world [22]. They constitute a crucial element in transformation processes as means for eroding lock-ins and reorienting practices and visions towards desirable alternatives [23], [24], and so potentially inducing tipping points [16], [25]. Narrative changes may not constitute tipping points in themselves – the mere change of vision of perception does not equal new jobs or income – but they may be indicative of an upcoming tipping point, because they signify the emergence of a new vision for the region with associated measures to achieve it.

The closure of an industry is an example that follows the (more widely used) negatively connoted or undesired tipping point perception, yet there is a growing literature about 'positive tipping points', which describe a normative perception of a desired trajectory in terms of sustainability transformations [16], [26]–[29]. A distinctive feature of (positive) social tipping processes is the element of agency: the intention to bring about desired socio-economic trajectories [9], [14]. Interventions are purposeful actions from individual or collective public (e.g. government, civil society) or private (e.g. industry, businesses) actors to accelerate, avoid or facilitate (manage/ coor- dinate) a change process in a social system [9], [14], [15], [30]. This idea of desirable, radical so- cial change triggered by deliberate actions emphasises the importance of human agency as a central idea in the social tipping point literature. Interventions are essential in this concept since they create the enabling conditions for a system to tip [9].

There is still much discussion about when tipping points become observable in the complexity of social systems across times and scales, and whether they can be predicted or not [31], [32].

Winkelmann et al (2020) state that "social tipping processes do not have a spatial extent or effective dimensionality that is known ex-ante" (p. 8). Hence, the dominant view is that tipping points may only be identified retrospectively in reference to the specific historical legacy or systemic change [33], [34]. While still rare, newer studies suggest that social tipping processes can be pre- dicted, particularly in smaller, sectoral systems. [35] provide evidence from a behavior threshold model finding that the benefit–cost ratio of norm change is a key determinant of the probability of social tipping [35]. Other studies suggest that past stock market bubbles [36] or electricity grid blackouts show signs of early warning [37]. [21] find that changes of narratives carry radical transformative forces and can trigger systemic disruptions. Thus, in specific cases, behavior change, the rise of new discourses or narratives may anticipate or precede tipping dynamics. In this report, we examine evidence for past changes, including tipping points, but we also assess ongoing, not yet concluded processes to discuss whether they may constitute tipping points.

However, because the idea of social tipping points is new and empirical study of complex social systems is difficult, there is no clear view in the literature for how to distinguish tipping processes from other forms of structural or social change, resulting in calls for further empirical investigation particularly for systems currently in transformation [14]. Despite the rapidly growing body of conceptual literature on the topic [13], there is a lack of empirical examples. Our study does precisely this by empirically investigating the societal and economic development trajectories of Essen and Duisburg during and after the phase-out of coal mining.

14.6 Research approach

To answer our research question, we examine interventions and outcome of regional developments in a case study comparison of Essen and Duisburg. The cities were chosen as two examples of intensive socio-economic transformation processes in close geographical proximity with very similar starting conditions yet diverging perceptions and possible future pathways. As illustrated in Figure 1, for each case study we explore events, interventions and their impacts on the social and economic systems of the two cities across time. Specifically, we evaluate the cities' development trajectories by seeking evidence for "no", "incremental" or "radical" changes in a set of indicators. We investigate three types of variables:

• Events: The trigger for the change process away from a previously dominant industry. This trigger can be exogenous (e.g. competition from other countries, a natural disaster) or endogenous events (e.g. coal runs out, politically decided phase-out) that lead to an industry disappearing, abruptly or gradually. In our cases, the event is the closure of the local coal mines.

• Interventions: deliberate and targeted policy and industry measures influencing socio-economic trajectory of the regional/ local system, seeking to address the effects of the event(s) and keep the system or put the system (back) on track for an alternative prosperous development. In our cases, the interventions are mainly policies for the post-coal economic development of the two cities – specifically to counteract the negative effects of the coal mine cloures.

• Impacts: long-term changes in socio-economic variables, including both hard social and economic indicators (e.g. unemployment) and softer ones (e.g. political visions, local identity narratives). These variables are where we can observe the outcome of interventions, including a possible tipping point.

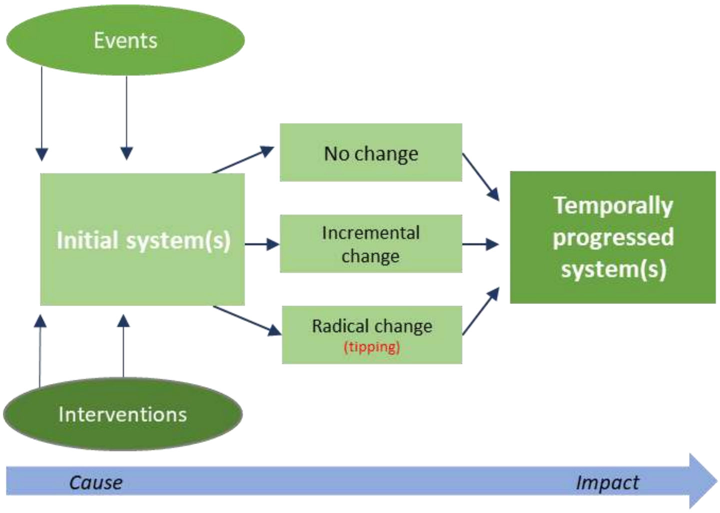


Figure 1: Analytical framework for regional case study analysis

We approach this in three steps. First, we conduct a qualitative analysis by systematically examining socio-economic policy measures that sought to counteract the impacts of the industry phase-down and -out in the case studies since the 1960s. These measures are direct interven- tions from different government level that seek to address and influence demographic, economic and social developments as well as the public discourse and narrative in the two cities. To this purpose, we review relevant literature including national and state parliament protocols, legisla- tive documents as well as policy and strategy documents from local level concerned with relevant interventions in the post coal-crisis era. In addition, we conduct semi-structured interviews with state and local stakeholders (Table 2) to receive in-depth insights into the local and regional transformation process and the qualitative importance of specific policy measures. Hereby we relate to Winkelmann et al. (2020, p.13) suggestion that that the observation of tipping dynamics requires a retrospective tracing of specific process, "identifying the key moments, actors, networks, mechanisms affecting criticality, the triggering event (threshold), and the positive feedback dynamics propelling the system towards qualitative changes".

In the second step we analyse quantitative data for a set of demographic and economic indicators over timeframes of 20 to 50 years (depending on data availability) (Table 1). We take this long temporal perspective, because trajectories of and trajectory changes in social systems are specifically visible in demographic dynamics, economic structures and political arrangements across time [14].

In addition to the quantitative data, we further examine the "soft" indicator of local narrative and discourse development. The initial literature review served as a basis to help build the analytical narratives and discourses. Adapted from Lieu et al. (2020), Tabara et al. (2018) and Hinkel et al. (2020), we structured the narratives into dominant and alternative perceptions, describing mainstream and emerging views at local and regional level. The mainstream narrative represents the (previously) dominant regional pathway and respective interventions that promoted the coal and steel industry as central factor for a prosperous local development. Alternative perceptions comprise measures and strategies that depart from this mainstream perspective and (potentially) challenge the mainstream pathway. For example, a critical view on the ecological impacts of mining operations existed (for a long time) outside of the mainstream perspective, though became increasingly relevant with the closure of mines and the need for brownfield redevelopment.

Table 1: Selected indicators and measurement

Indicators	
Demographics	
Population size	Local population development and migration patterns 1962-2020.
Age	Distribution of different age cohorts 1995-2020.
Education	Share of residents with tertiary education 2005-2020
Election patterns	Local voter turnout and party preferences at local, state and nationalelections between 1975 and 2020.
Economics	
Unemployment	Unemployment rates as percentage of all unemployed in relation to all persons in the labour force 2000-2020
Employment	Employment rates in total number of the local population 1976-2020
GDP	Trends in the regional and local economic output measuring GDP atmarket price and per employed person 1991-2019.
Narratives	
Public discourse	Policy discourses and narrative development in policy documents andmedia articles, as well as municipality websites, local strategies, and information from local companies, and interviews.

In the third step we examine the relation between interventions, the quantitative social and economic data and narratives developments to determine the impacts of the interventions and particularly if they are related to any strong trend shifts. To this purpose, we evaluated the trajectories of the indicators in the data time series towards dynamics of no, incremental or radical change. In this, 'no change' is indicated by an indicator remaining roughly constant over time, be- fore and after an intervention. We consider a trend as 'incremental change' when an indicator does change, but only slowly, without any particular discontinuities, such as rapid surges or drops, over time. 'Radical change', in contrast, is recognised by a sharp and rapid shift in a varia- ble, regardless of the direction. Here, we see radical change as a proxy for a tipping point (see Figure 1): because radical change signals the departure from an old to a new trend, this is indica- tive of system tipping.

For the narratives, we examine the policy discourse and narratives to identify similar changes – no, incremental or radical changes – indicated by a continuation of the old dominant narrative, a slow but discernible narrative change within the same paradigm, or the emergence of a new dominant narrative for the development of the city.

Our analysis is based on both qualitative and quantitative data. We generate the qualitative data through an extensive document and literature analysis, including news media articles, national and state parliament protocols, and websites of local governments, regional governance organisations and NGOs. Additionally, we conducted 20 semi-structured interviews to identify the key interventions and local perceptions of their importance and effects, especially on the narratives. The interviews were held between March and November 2021 with representatives from government and non-governmental organisations, including regional and local governance authorities, labour unions, local companies, university, media and local NGOs, focused on a set of central questions:

- In your opinion, what were major events in the city and/or Ruhr Region regarding the coal-phase out process in the last decades?
- What were significant political decisions that influenced the local/ regional trajectory, and why was this/ these measures particularly important for the city?
- How did the public (and your) perspective on the dominant industry change over time, and why?
- What is the current and future vision of the city/ region?
- In your opinion, what constituted a tipping point for the locality, and why?
- What was the role of your organisation in the local/ regional transformation process?

Table 2: Interviewed stakeholders in at local and region/ state level.

	Essen	Duisburg	Regional/ State Level
Government	2	-	3
Public governance bodies/ Unions	1	1	3
Industry	2	1	1
NGOs	2	2	1
Academia and Media	1	-	1

For the quantitative variables, we obtained data from local and state government websites, and regional statistics sources such as regionalstatistik.de or arbeitsamt.de, as well as through direct contact with local government representatives.

14.7 Results

14.7.1 Tipping events: the demise of the coal mining

The Ruhr Region is a regional archetype of lock-in and path dependency [3], [38]. There, the coal and steel industries have been dominant for several decades dating back to the industrialisation in the 19th century. The very first mining activities in the Ruhr were noticed already in 14th century on the southern edge of the Region where the coal was close to the surface. With significant pro- duction and output growth the workforce rose to about half a million miners and steel workers af- ter World War II and contributed to the rebuilding efforts fuelling the nation’s increasing energy demand. At the end of the 1950s, the annual production of hard coal reached its peak with around 150 million tons.

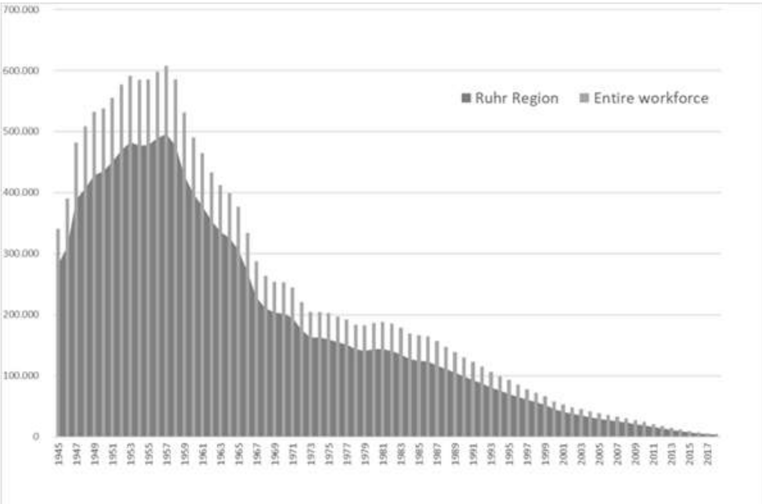


Figure 2: Development of the workforce in hard coal mining in the Ruhr and Germany (entire workforce) between 1945 and 2018. Source: [39].

In 1958 the coal crisis represents the early tipping event for the region. The lack of competitiveness of German mines and the influx of cheap coal and oil imports forced the closure of more than 90 mines in the first ten years [38], [39]. In the same timeframe employment also declined substantially dropping by half (see Table 3). A key production site was the Ruhr Region in the state of North Rhine Westphalia. With industrial change and technical progress, mining operations continuously moved north to reach still profitable depth of coal.

Table 3: Selected key figures of German hard coal mining (both Ruhr Region and Saarland) in selected years since 1957

Year	Hard coal mining	Employees	Trainees	Capacity per person and shift	Number ofmines	Hard coal imports	Hard coal exports
	in 1 000 tons [x]	*end of year*		*in kg*		*t=t*	
1957	149,446	607,349	48,181	1,585	173	18,936	27,529
1967	112,043	287,270	12,505	3,264	81	7,356	25,631
1977	84,513	192,015	15,551	3,850	43	7,275	20,837
1987	75,818	156,483	13,776	4,559	32	8,974	8,570
1997	45,796	78,101	2,690	5,762	17	23,290	789
2007	21,307	32,803	2,398	7,071	8	45,891	463
2017	3,669	5,711	86	8,809	2	42,980	1,065
2018	2,584	4,125	0	10,041	2	41,107	1,045

Source: Statistik der Kohlewirtschaft e.V.

[x] Usable extraction (water and ash content are also considered)

Although the ramifications of the coal and steel industry decline were felt across the region, the two cities experienced their tipping events much later: The local mine in Essen closed in 1986 [40], in Duisburg another 20 years later in 2008 [41].

Essen's coal mine Zeche Zollverein employed up to 8,000 workers mining a total of 240 million tons of coal across its lifetime. In the 1970s when the mine reached its final depth at 1000 metres, the mine produced 23,000 tonnes of coal per day. The industry's decision to close the mine was part of the ongoing consolidation measures and hence did not come to a surprise since it no longer operated economically through depleting resources at greater and greater excavation depths. The transition process for local workforce was managed through early retirements, "golden handshakes"[8] (, and the relocations of younger workers to remaining coal mines (Interview). The architectural status and the importance of the mine considered as a the "cathedral of industrial culture" however was to preserve. Against the "normal" procedure of demolition of

[8] This included a significant financial compensation package when the employees lost their job.

closed plants, the city and state government intervened put a preservation order on the entire site conserving it as a technological monument by the time of closure [40].

The closure of the mine in Duisburg was a compromise after extensive public protest in 2008. The Zeche Walsum was located further north and in direct vicinity to a coal fired power station to convert the hard coal into electricity. Walsum reached its maximum annual production in 1982 with 3.4 million tonnes of coal and a workforce of 4,600 [41]. A local conflict emerged around the 2000s, when residents were no longer willing to accept the prospect of mining damages anticipated from an expansion of mining operations. In fact, for decades it has been taken for granted that mining damages occurs (Interview). The ground above the mines sunk (and is still sinking) in parts by more than 20 meters (in Essen up to 25 meters) resulting in cracks in the walls, doors and windows no longer to close, sometimes the ground even collapse taking a garage with it [42]. For the first time, a local initiative was successful in mobilising support and forcing govern- ment and industry to a compromise, the Walsumer Agreement (Walsumer Verständigung) determining the mine to close 11 years earlier than originally intended. The State Government and Mining Company (DSK) stated in the agreement: "The acceptance of hard coal mining is a great asset for DSK (Deutsche Steinkohle AG). The public interest in environmental protection and concern about possible environmental risks can be imposed on in individual cases, enabling early voluntary closures" [43]. It was the first time, ecological criteria and the economic risks for residents were considered when a mine was closed (Interview).

14.8 Policy interventions

The German coal industry has always been subject to interventions due to its great importance for national energy security, economic growth as well as the labour market [44]. With the demise of the coal sector actions by different government levels intensified firstly to halt the decline and later counteract its negative impacts.

Indeed, purposeful policy actions can prevent, avoid, or buffer undesired transition outcomes and hence may constitute tipping interventions. [15] highlight the importance of governance and pol- icy interventions to induce tipping processes by changing the regulatory, normative and institu- tional setting. For example, redirecting national subsidy programs to renewables and low-carbon energy sources or removing the subsidies for fossil-fuel technologies are considered as tipping interventions for a take-off and diffusion of fossil-fuel-free energy systems (ibid, p. 4).

In the 60 years, after the coal crisis, there have been numerous interventions in the Ruhr to facili- tate and manage the regional and local transformation processes. Due to the limitations of this study, we selected several key interventions taken by national to local government level listed in Table 4. The selection is based on literature review and interview feedback comprising measures dedicated to supporting coal, regional development programs and local transformation strategies while effecting the cities trajectories. Each of these will be discussed in turn.

Table 4: Key events and interventions

National	NRW (state level)	Essen	Duisburg
Coal laws and regula-tions incl. law to end coal subsidies (2007)	IBA (1989-1999)	Cultural Capital 2010	Duisport extension at Krupp-Stahl-werk Rheinhausen 1998
	Government change (2005)	Green Capital 2017	New Silk Road - Chinese partner-ship

14.8.1 National level measures: support coal mining and protect workers

Coal mining in the Ruhr Region has historically been a matter of national energy security and economic growth. When the coal crisis brought large unemployment and questioned the domestic production of hard coal, the national government interventions were immanent [42, p. 17], [43].

The early measures focussed on avoiding a further coal sector decline to lessening social hardship and facilitate a domestic coal production and use with subsidies and fiscal measures (Table 5). The first coal law was introduced in 1963 determining the establishment of an Association to rationalise the coal industry issuing closure premiums (Bundesgesetzblatt 1963). These government interventions also triggered industry measures and ultimately the establishment of the Ruhrkohle AG (later RAG Aktiengesellschaft) in 1968. The new company amalgamated 94% of the coal production in the Ruhr at that time and later integrated all remaining coal mining companies in the region [47].

Table 5: Major laws and regulation of coal interventions since 1960s

Year	Title of Law	Purpose
1963	Law to support the rationalisation of mining *(Gesetz zur Förderung der Rationalisierung des Bergbaus)*	The mining companies had to join the Rationalisierungsverband (association for consolidation), which aimed at to reduce the number of mines. In the case of closures, the fed- eral government awarded premiums and financial aid.

1965	1st law *to support* the use of hard coal in power sta- tions *(Gesetz zur Förderung der Verwendung von Stein- kohle in Kraftwerken)*	The law included tax benefits for the establishment of new coal fired power stations requiring the use of domestic hard coal for electricity production. Increase competitiveness against oil fuel in heating.
1966	2nd law *to secure* the use of hard coal production in the electricity industry *(Gesetz zur Sicherung des Steinkohleneinsatzes in der Elektrizitätswirtschaft)*	Subsidies for the use of domestic coal to ensure competitive- ness in the world market – to ensure a reasonable share of do- mestic coal in the electricity production. It offered the steel in- dustry subsidies and funds in case of redundancies to cushion social hardship, when using domestic coal.
1974	3rd law to *further secure* the use of "community coal" (Gemeinschaftskohle) in the electricity system *Gesetzes zur weiteren Sicherung des Einsatzes von Gemeinschaftskohle in der Elektrizitätswirtschaft (Drittes Verstromungsgesetz)*	Under the Act, the amount of hard coal to be purchased by the electricity industry was determined so that domestic demand for hard coal was stabilised and electricity supply was secured. In return, the electricity industry was granted subsidies to com- pensate for possible additional costs. These costs were to be covered by households with a levy on the electricity bill (also known as the Kohlepfennig).
1980	Amendment of the 3rd law to *further secure* the use of community coal *Neufassung des Gesetzes zur weiteren Sicherung des Einsatzes von Gemeinschaftskohle in der Elekt- rizitätswirtschaft (Drittes Verstromungsgesetz)*	For the purpose of energy security, the use of domestic coal for electricity and heat production receives subsidies for 191 million tonnes 1981 to 1985, 215 million tones 1986 to 1990 and 232,4 million tones 1991 to 1995.
	Law to *secure* the use of hard coal in the electricity production and amendment to the nuclear law and feed-in law	For the purpose of energy security, a reasonable share of the German hard coal should be secured for electricity production 1996 to 2005.

1994 (July)	*(Gesetz zur Sicherung des Einsatzes von Steinkohle in der Verstromung und zur Änderung des Atomge- setzes und des Stromeinspeisungsgesetzes)*	The coal mining industry receives a special fond for subsidis- ing its operations.
1995	Law to *reorient* the hard coal use for electricity from 1996	To secure the support for coal industry after the end of the special coal levy, the subsidies will be provided by federal gov- ernment budget.
1997	Law to *restructure* the coal subsidies 1997 *(Gesetz zur Neuordnung der Steinkohlesubventio- nen*)	Subsidies for mining companies will be drawn from the federal budget and provided in a decreasing stagger between 1998 and 2005.
2007	Law *to finance the end* of the subsidised hard coal mining by 2018	The law specifies to end the subsidised extraction of hard coal in Germany at the end of 2018 in a socially acceptable way.
2020	Act to reduce and end coal-fired power generation and to amend other laws (Coal Phase-out Act)	This included the reduction and ultimate end of coal and lig- nite-fired power generation by 2038 in Germany.

Yet, as shown in Figure 4, the workforce decline was not halted but slowed down (see also Table 3 – "Employees"). Hence, "no one is left behind" became the moto of the sectors' transformation and further government interventions. The policy interventions between the 1960s and late 1980s were foremost conserving and follow-up measures to halt structural change by preventing the shrinkage of threatened sectors or at least to delay it to avoid social unrest [48], [49]. In addition, the social welfare system in Germany also contributed significantly to securing the social stability and buffering hardship for the local workforce through e.g. unemployment and pension funds as well as health insurance offered by public and private providers.

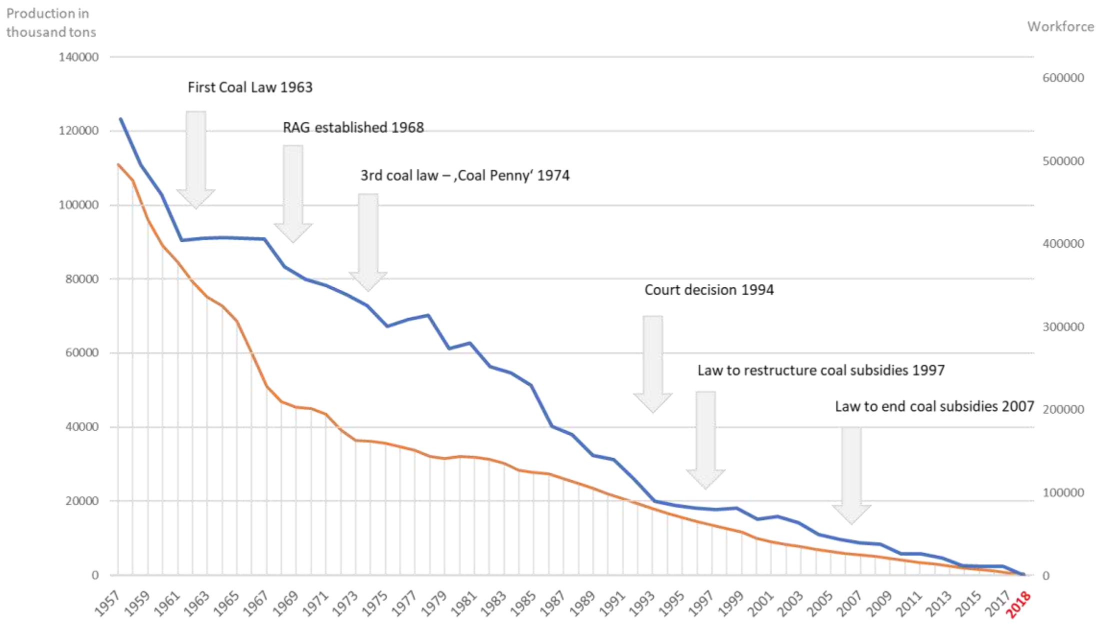


Figure 3: Hard coal production and workforce in the Ruhr Region 1957 to 2018. Source: Statistik der Kohlewirtschaft e.V.

At the same time, national subsidies for the hard coal sector steadily increased through various financial aids and fiscal measures reaching a peak in the mid-1990s [50]. But since the 1980s the coal subsidies became under increasing pressure from the public, the electricity industry as well as EU level. In 1982, an electricity customer declined to pay the "coal penny" to its power provider RWE, a levy that was introduced in 1974 and constituted a significant part of the subsidies (1/4) (Table 5). This dispute issued a significant milestone as it was eventually brought to the Federal Constitutional Court in 1994 who decided that the levy is unconstitutional and must end by 1995. In fact, the court decision was the precursor for a general change of mood and a loss of importance of pro-coal policy at the federal level [48]. In addition, the introduction of EU Single Market and its competition law in 1993 required measures from the national government to avoid unfair competition advantages. These developments ultimately triggered a change of the policy narrative focussed on the reduction of subsidies materialising in the subsequent coal agreement of 1997, which required a restructuring of the coal subsidies.

However, an end of coal policy support was not in sight yet, since the state government had not reached the threshold at which winning or losing elections was dependent on their coal policy.

14.8.2 State level interventions: structural change support and preparation for the post-coal era

The (still) large workforce and the economic added value of the sectors determined the subsequent policy measures. "Conserving the status quo" was the leading motif for many decades, yet since the 2000s measures to prepare for a post coal era were finally introduced.

There have been four different periods of structural interventions in the Ruhr Region (Table 6) [49]. These interventions were driven by state level government and funded through national, state, and later EU programs. As early as 1968 the state government intervened to complement and integrate the national with specific regional measures targeting the modernisation of mining operations and investment in local transport and recreational infrastructure. An important milestone was the foundation of the Ruhr Universities to increase human capital during that time [51]. However, these and the measures in the following three decades did not provide a significant change in the political course, rather the economic decline of the industry was accompanied by political measures moderating and facilitating societal transformation process. Dahlbeck et al (2022, p. 52) analysed the interventions having a conserving impact since they were only introduced after a significant workforce decline. Instead of a rapid shift, the approach followed the notion of a "gliding flight" over a long period with the prime intention to avoid social hardship (Interview). The policy narrative was focused on recreating jobs, stop migration and reverse the negative image of the Ruhr Region as a "crisis-hit trouble spot" (krisengeschüttelter Unruheherd) [52], [53].

In the late 1980s, a greater focus on supporting the regional potential and measures to address local ecological impacts emerged in particularly from an increasing number of abandoning mine fields and brownfield land. A significant milestone was the Emscher Park International Building Exhibition (IBA), put forward by the Head of the Department of Urban Development in the NRW State Ministry of Regional and Urban Development. The IBA was a decade long program (1989 to 1999) which is still very present in the collective conscious and indeed considered as a threshold with great symbolic power for the identity development for the region (Interviews). The main aims of this regional development measure were an ecological and cultural renewal understood as the imperative for the economic prosperity of the region's future [54][55]. More than about

€2,3 billion were spent to realise 120 projects in 17 municipalities of the Emscher region (ibid 1999).

The IBA documentation shows the program's critical look at the past calling for a new vision after the end of the industrial age. In fact, the IBA was conceived and implemented at a time when the environmental discourse intensified and principles of sustainable development and resource protection postulated and later at the Rio Conference internationally confirmed [56], [57]. The aims and measures of the IBA emphasised the environmental theme though it was mainly associated with renaturation of the river Emscher, providing access to green spaces for the residents and rejuvenate the Garden City idea[9] in the region. In addition, the local material remains were repur-

[9] Urban planning model by Ebenezer Howard 1898 based on the concept to break up the density of a city by integrating settlement structure interspersed with green spaces, loosened up and divided into neighbourhoods according to plan by radial streets, with spatial separation of important functions, a surrounding green belt, and sufficient provision of jobs and utilities for the population.

posed and re-valuated as "technical monuments worthy of preservation" and set them up as lighthouse projects of the program including the "Duisburg-Nord Landscape Park" and the "Zollverein Mine Shaft XII".

Ultimately the IBA and regionalised focus triggered the emergence of a new course of interventions from the 2000s. These were focused on competence fields and economic clusters in line with the regional and local capacities and resources. This approach was further strengthened by the EU regional development programs and funding indicating a clear break from the old indus- tries. For example, the Cultural Capital Ruhr.2010 event was held across the Ruhr Region under the moto "change through culture, culture through change" supported by state and EU funding.

Table 6: Periods of structural intervention in the Ruhr Region since 1960s.

Time	Intervention measures	Measures	Purpose
1966-1974	Integrated structural policy	Development Program Ruhr targeting the modernisation of mining operations, investment in infrastructure particularly local transport and recreational areas as well as attracting new industries; the foundation of the Ruhr Universities and investments schools were to increase human capital	Conserving and patching up regional and lo- cal impacts since the measures were only in- troduced after a significant workforce decline.
1975-1986	Centralised structural policy	Improving the technological base of the existing of the existing large enterprises to strengthen the productivity of companies and thus increase their competitiveness, minimising environmental pollution and improving the transfer of technology into practice.	Interventions were driven by a "follow-up ap-proach" (Nachsorge) with conserving measures oriented towards re-industrialisa- tion focussed on classical sectors to cushion social hardship. Though, first regional, and local dialogues be-tween key stakeholders initiated.
1987-1999	Regionalised structural policy	Regional potential moves into the centre of action, with regional conferences and regional development plans. A new bottom-up approach and governance structures emerged, though still driven by similar/ same targets and measures as in the first two periods. This materialised in the International Building Exhibition Emscher Park (IBA).	Like the periods before, policy interventions had a conserving impact with a focus on eco- nomic and social dimension. Yet, ecological measures and regional identity were ad- dressed explicitly for the first time providing a new vision and impetus for new identity build-ing.
Since 2000	Competence field-oriented	Driven by the EU policy approach, interventions became competence field or cluster oriented (spatial concentrations of interdependent companies connected along the value chain) which led to the definition of eight lead markets and industrial zones (e.g. sustainable consumption and health) in the Ruhr Region to emphasise the endogenous potential and capacity of the region. The Cultural Capital Ruhr.2010 event joined the cities in the Ruhr Region under the moto "change through culture, culture through change" financed by state and EU funding.	First clear break with past interventions to conserve "old" industry sectors. But the highquantitative number of clusters made it diffi- cult to really profile core competencies EU Operational Programs between 2000 and 2020 were considered as having an overall positive impact however, they did not achieve a significant socio-economic turn regarding employment and investments. Regional events and projects contributed to new identity building and improved imagewithin and far beyond the region.

Source: adapted from [48], [49].

14.8.3 Interventions at the local level

For many decades, the local level did not take a leading role to intervene in the transformation, instead local socio-economic trajectories remained subject to national and state measures. Moreover, the localised decline - closure of coal mines and steel plants – occurred time delayed following the geological conditions of coal and established industry structures[10]. Yet, since 2000s the efforts of the local governments in Essen and Duisburg become more visible seeking to influence the internal and external perception of their localities.

IBA and Cultural Capital Award

In Essen, the IBA Program coincided with the closure of their local mine and provided an impetus for seeking new opportunities and visions. Instead of demolishing the industrial area (as usual done), the mining plant and buildings were renovated and repurposed for new users predominantly from the cultural scene establishing its status as a model example of industrial transformation [40]. The recognition of Zeche Zollverein as UNSECO World Heritage in 2001, the only one in the Ruhr Region, marked another milestone for it becoming a nationally and an internationally acknowledged symbol of the industrial culture as well as the transformation process. "Preservation through repurposing" is the moto which invites creatives, start-ups, restaurants and artists to move to the 100ha large areal and has created more than 1,300 jobs already [58]. The lighthouse project also serves as a tourist magnet and is after the Cologne Cathedral the second most visited site in NRW.

The industrial culture narrative led the city's efforts to gain the EU's Cultural Capital Award. The application process was started in the early 2000s and was led by Essen as a proxy for the region. Unlike the IBA which was driven by state government and stakeholders from beyond the region, this event was driven by a coalition of Ruhr municipalities and the Ruhr association [59], [60]. The focus of Essen's application is the transformation of a landscape consumed by industry into a new location of culture and knowledge. The successful applicants were announced in 2006 with the Ruhr Region to become Cultural Capital in 2010. Essen hosted every third of the almost 300 event projects and benefitted from a positive reception beyond its local borders. Hence in addition to the policy narrative for creating a new image within and making the region attractive for beyond its borders, the event aimed at strengthening regional governance structures and collaboration between the Ruhr municipalities as well as bringing new innovative impetuses (e.g. in tourism) to tackle the challenges of the structural change.

Although the city of Duisburg was also part of the IBA and Ruhr2010, it was not able to capitalise on the events as much as Essen. In particular, the Ruhr2010, did not remain in good memory.

The Love Parade, an electronic dance music festival and part of the Ruhr2010 program, ended in disaster with lives lost because of significant safety issues and failure by the authorities [61],

[10] The industries of the Ruhr have developed from the south to the north following the geological conditions of coal reserves from the Ruhr zone via the Hellweg zone into the Emscher and Lippe zones.

[62]. This stifled the efforts in associated with the Cultural Capital Award and led to great risk aversion by the local authorities so that cultural activities have a hard time to receive official event approvals [63].

Box 1: Renaturation of the Emscher River

More than 100 years ago, the Emscher river was transformed in an artificial system of open sewers to meet the needs of the growing industrial conurbation and underground mining. While all commercial and domestic wastewater was discharged into the Emscher River and its tributaries previously. This was no longer possible with extensive mining and the associated sinking of the ground. Under- ground pipelines would not have been able to withstand the pressure. It was therefore decided to straighten the course of the river and transform the Emscher (51 km) into a canal of reinforced concrete sewer pipers to discharge all wastewater from the region. The decline and anticipated end of mining in the region resulted in a decision by the Emscher Genossenschaft in 1991 to re-convert the Emscher as a natural flow - a generation project (Interview). The end of mine subsidence enables to drain wastewater in closed underground channels and to gradually convert the river with its tributaries into near-natural water bodies. Emschergenossenschaft invested a total of €4.5 billion (funding from state government) to relocate the 285 of a total of 400 kilometres of canals, and just under 125 of 350 kilometres of watercourses have already been ecologically improved. No mine water will be dis- charged into the Emscher River after 2021. The transformation of the Emscher goes beyond the river system. The Emscher Genossenschaft and local and regional stakeholders have developed a new vision of the Emscher Valley. The residential areas along the river and its tributaries will be socio-economically upgraded and greatly benefit from the Emscher conversion. The current planning basis is the Emscher Future Master Plan published in 2006. The key aims centre on improvements of the ecolog- ical potential, as well as flood protection and integrating the water system into the cities to increase the quality of life through leisure facilities (e.g. biking along the river) and idyllic green spaces. Future tasks include climate adaptation and resilience. Both Essen and Duisburg are part of the future initiative Klima.Werk, which was founded in 2014 as the future initiative "Water in the City of Tomorrow". The common goal of the network of 16 Emscher municipalities and the Emschergenossenschaft: to convert urban infrastructures to be climate-robust, to provide more green space and to give water more room. This is a response to the consequences of climate change, which make themselves felt in the form of periods of heat and drought or heavy rainfall and which affect the quality of life of citizens in the densely populated Ruhr region.

Source: [64], [65] and Interview.

Green Capital Award

After the Ruhr2010 and in reference to the IBA, Essen started to actively promote its "green" pathway [66]. This included the adoption of a local climate protection strategy, Essen's participation in the „Covenant of Mayors" in 2010 and receiving the European Energy Award 2013 (ibid). The management staff at Essen's local government also progressed the opportunity to receive the EU Green Capital Award. The Award is an initiative of European cities to recognise municipalities with more than 200,000 inhabitants that are leading the way with environmentally friendly urban living. The aim is to trigger further efforts by cities and boost the awareness within and beyond the city [67]. Essen's application was successful wining the Green Capital Award for 2017. The City's progress was strongly attributed to the efforts of previous programs particularly the IBA and its renaturation and restoration of the river Emscher (Interview). Indeed, the process of transforming the previously open sewage canal of the Emscher into a liveable river was a major task since the early 1990s and will end in 2022/23 (see Box 1). An interview partner emphasised that the decision by the Emscher Cooperative to plan and invest in the transformation of the river system was a socio-ecological tipping point (Interview).

The Green Capital Award created momentum for other bottom-up initiatives: in 2020 the parliament of the city decided to implement measures to increase safety and attractiveness of cycling and walking in Essen. After a local initiative (Essener Radentscheid) collected more than 23,000 signatures, the City pledged to support the initiative by developing an implementation strategy and funding of €232 million as well as 19 new staff within the municipality within the next nine years [68]–[70]. Another example is the Climate Decision (Klimaentscheid). This community initiative follows the example of other cities across Germany to request their respective City to become carbon neutral until 2030. Although they haven't been fully successful (yet), the initiative achieved that the City Essen committed to greater efforts: the previous target to reach climate neutrality by 2050 was abandoned while carbon emissions have to be reduced in line with 1.5 - 1.7 degree global warming (new target period is 2030 and 2040) [71]–[74].

In addition, the 2021 evaluation of the Green Capital Award emphasises the event's success in terms of an increase of employees in the "green sectors". Between 2017 and 2020 the total "green workforce" increased by 21% to 14,300 making Essen the leader in the Metropole Ruhr [75]. The target is to increase this figure to 20,000 by 2025.

Chinese city partnership and logistic hub

In contrast, the City of Duisburg's interventions focused on the development of existing and new industrial activities since the late 1990s. Duisburg still hosts a local steel production and has a port with international connection. However, state interventions initiated the brownfields to become repurposed for the establishment of an international logistic centre linked to the local port and railway. A first milestone was the purchase of land by the state government after the closure of the oldest Krupp steel mill in Rheinhausen in 1998 (Interviews). This was followed by further local land acquisition and the expansion of the duisport logistic hub, which is partly owned by the city (1/3) and state government (2/3) (Interviews and Duisport Presentation 2021). A second milestone was the intensification of a partnership between Duisburg and the Chinese city of Wuhan fostering the development of an international trade route [76]. Duisburg is the end of an 11,000-kilometre-long railway line that runs from China via Kazakhstan, Russia and Poland to the port basin in Rheinhausen. About every third train that travels between China and Europe stops here. 2020 arrived 60 trains a week an increase by 40% compared to 2019. The "new silk road" initiative was celebrated by the Chinese Head of State Xi Jinping, the NRW Prime Minister Hannelore Kraft and the German National Minister of Economy Sigmar Gabriel with a train arriving from China in the port of Duisburg in 2014 [77]. With the establishment of a network of business experts, a China Affairs Coordination Unit and the appointed China-representative by the city further institutionalise this pathway.

In addition, new opportunities for the local steel industry are seen in green hydrogen [78]. A joint collaboration between the energy company STEAG, thyssenkrupp Steel and the electrolysis supplier thyssenkrupp Uhde Chlorine Engineers work on a feasibility study for the construction of a water electrolysis plant with a capacity of up to 500 MW located at site of the former Zeche Walsum [79]. The industry initiatives are accompanied by national and state government funding of €100 million for a Hydrogen Technology and Innovation Centre (Innovations- und Technologiezentrums Wasserstoff) in Duisburg [80]–[82].

14.8.4 Impacts in time series of selected structural data

How did these interventions influence the transformation process in both cities, and did they contribute to a significant change or tipping in their trajectories? Studies emphasise the rather heterogenous socio-economic development across the Ruhr Region [83], [84]. However, Essen and Duisburg share a similar picture in several socio-economic indicators at present (as shown in Table 7) while both performing lower or significantly lower than the state and national average. Essen appears as the slightly more prosperous city while having a much lower industrial density than Duisburg. Essen is home to six listed companies - including three DAX members E.ON, RWE und Brenntag (EWG 2022). Duisburg's main industrial sectors are logistics with Duisport and ThyssenKrupp steel production.

Table 7: Key socio-economic statistics from Essen, Duisburg, and comparison to the Ruhr Region, NRW and Germany.

	Essen	Duisburg	Ruhrgebiet	NRW	Germany
Population March 2020	590,908	50,694	5.1 million	17.9 million	83.1 million
GDP 2019 (per employee)	€77,357	€75,789	€67,728	€74,316	€74,032
Income per Person 2017	€20,316	€17,049	n/a	€22,263	€22,623
Immigration Rate 2019	+1669	+1 606	+10.122	n/a	n/a
Unemployment Rate (Jan2020)	10.2	10.9	8.9	6.8	5.3
Poverty Rate 2018	21.6	27.4	21.1	18.1	15.5
Political Participation (NationalElection 2017 in %)	73.9	68.7	n/a	75.4	76.2

Source: [85], [86].

In the following section we explore the effects of national, state, and local interventions on a set of selected indicators. We differentiate between no, incremental and rapid changes. The latter indicates tipping dynamics which become visible in nonlinear shifts in the trajectories of the quantitative and qualitative indicators.

14.8.5 Population trends: rapid decline halted and stabilized

The demographic change in both cities mirror the transformation process and both show very similar though slightly time-delayed population trends. Since the 1960s a population decline occurred in several waves yet showing no rapid shifts in trajectory. Although the interventions were not able to reverse the trend, they stopped the early accelerated population decline and stabilised the local trajectories.

In 1962, more than 750,000 people lived in Essen and more than 660,000 in Duisburg (RVR, 2020). Since then, both cities lost almost one quarter of their population. In the transformation process of the reunification population grew again for a short time, followed by another period of incremental population decline. Despite forecast seeing the Region further shrink in the coming decades, the migration of refugees in 2015 and 2016 brought this negative trend to a halt. Since 2019/20, population stagnates in both cities and a slightly negative trend appears to emerge again.

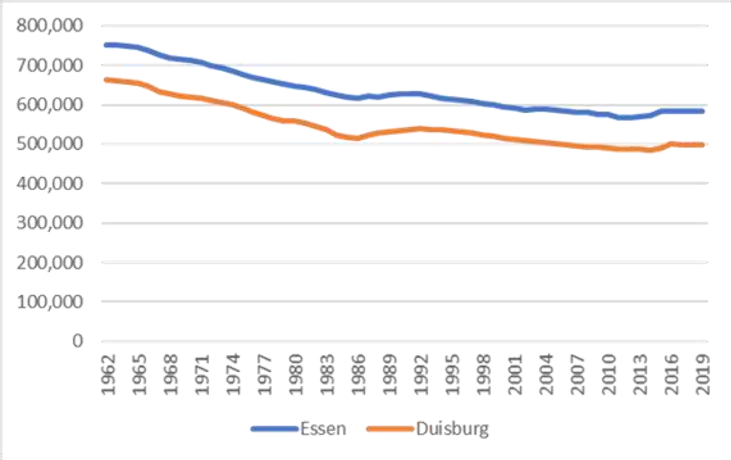


Figure 4: Population development in Essen and Duisburg since 1962. Source: [87]

These developments are also reflected in the migration patterns of both cities. In Duisburg the migration of residents peaked in the 1980s, this pattern is visible in Essen already in the late 1960s.

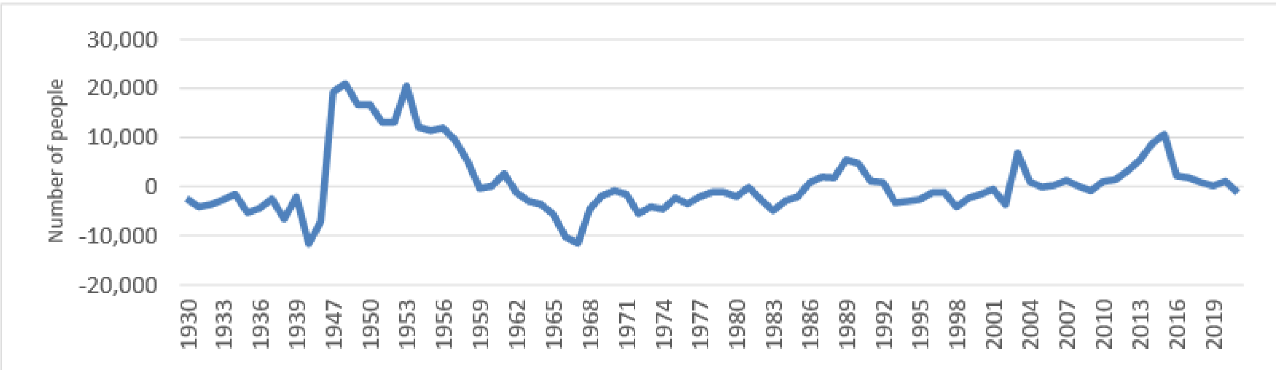


Figure 5: Migration in the city of Essen – in- and outflow between 1930 and 2019. Source: [87]

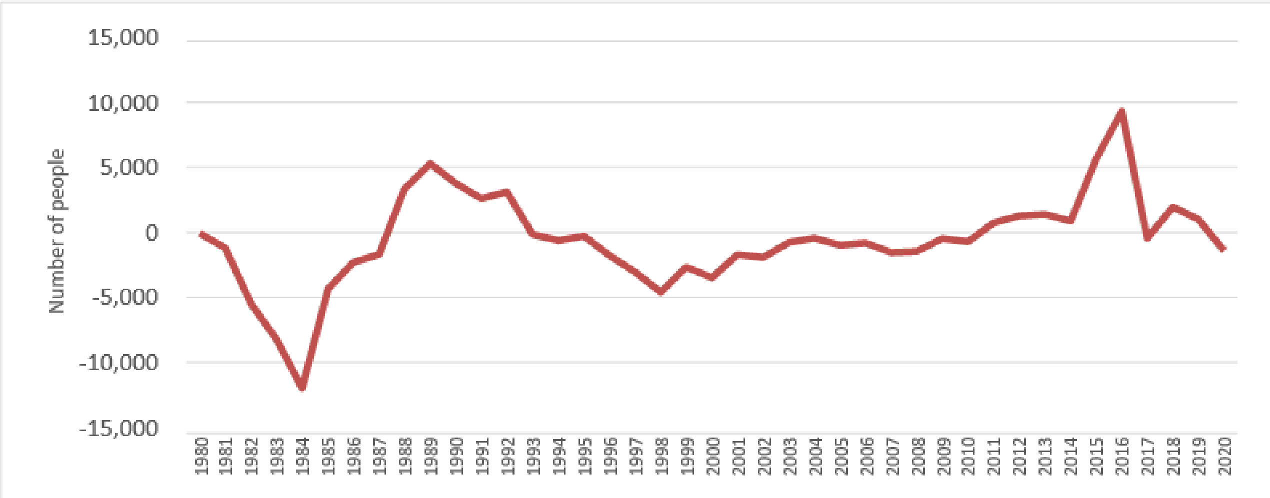


Figure 6: Migration in the city of Duisburg – in- and outflow between 1980 and 2020. Source: [87] and personal correspondence with city of Duisburg.

Overall, the municipalities are losing residents to the rest of NRW and to the other German states and gaining residents from abroad. In the period from 2017 to 2019, the Ruhr region lost a total of slightly more than 18,000 inhabitants due to migration within Germany, of which almost 10,200 went to the other parts of NRW – most people moved to Lower Saxony (-2,900), Hesse (-1,700) and Berlin (-1,400) [88].

In addition, demographic change in both cities moves faster than the state's average (Table 8). The proportion of the population under 20 years of age in Essen fell from 25% in 1975 to 18% in 2020, in Duisburg it fell from 28% to 19% at the same time. In comparison, the corresponding fig- ure for NRW fell from 29% to 19%. In the same timeframe the population over 60 in Essen rose from 23% to 28%, and in Duisburg 20% to 27% [89].

Table 8: Development of population in Essen, Duisburg and NRW per age groups 1975 and 2020.

		1975	2020	TOTAL CHANGE	% CHANGE
ESSEN	Below 20 years	171,453	106,556	-64,897	-37.85
	20-60 years	352,778	310,264	-42,514	-12.05
	Above 60 years	153,339	165,595	12,256	7.99
	Total	**677,570**	**582,415**	**-95,155**	**-14.04**
DUISBURG	Below 20 years	162,772	96,360	-66,412	-40.80
	20-60 years	313,029	264,538	-48,491	-15.49
	above 60 years	115,838	134,987	19,149	16.53
	Total	**591,639**	**495,885**	**-95,754**	**-16.18**
NRW	Below 20 years	4,926,269	3,377,100	-1,549,169	-31.45
	20-60 years	8,912,203	9,460,466	548,263	16.66
	Above 60 years	3,290,728	5,088,004	1,797,276	54.62
	Total	**17,129,200**	**17,925,570**	**796,370**	**4.65**

Source: [89].

14.8.6 Unemployment and employment rates: positive developments at incremental pace

Unemployment and employment rates constituting strong indicators for regional and local structural change processes [90], [91]. As a heritage from the industry decline, the Ruhr Region and so the two cities still experience higher than state average unemployment rates but also show recent positive trend in the labour market.

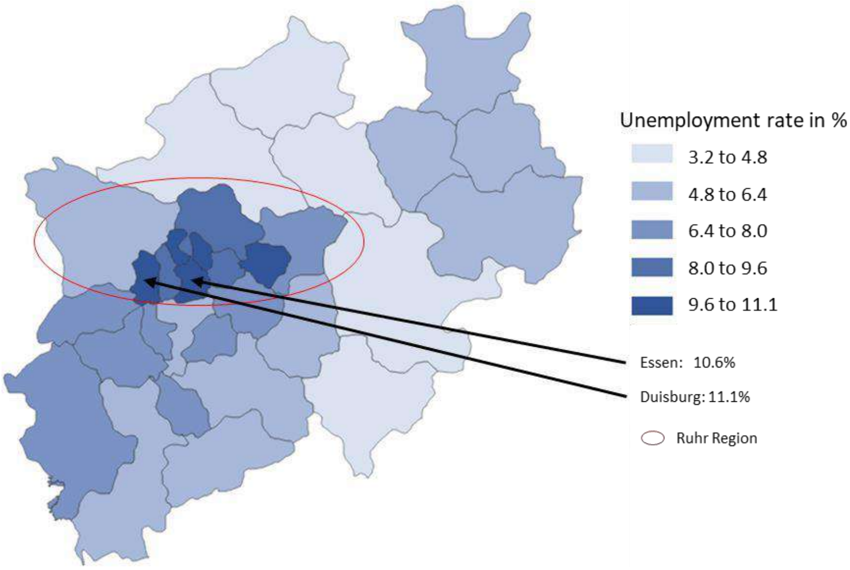


Figure 7: Unemployment rate in North-Rhine Westphalia and respective cities and regional districts 2019. Source: [92].

In late 1980s the unemployment rate in the Ruhr reached a first peak with 15% and was thus sig-nificantly higher than in NRW with about 11% and 8% in other (western) German states [48].

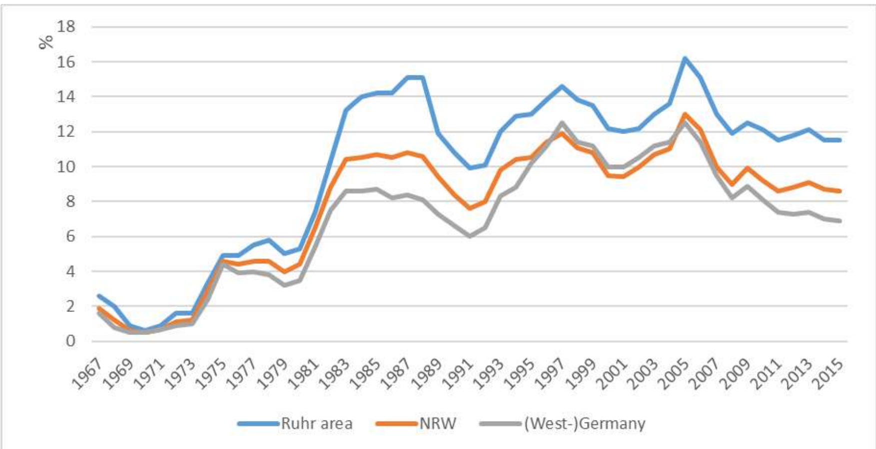


Figure 8: Unemployment in Ruhr Region, NRW and West-Germany 1960 to 2014[11] Source: [85], [92]

This development was also reflected in the two cities (Table 9), though Duisburg experienced continuously higher unemployment rates than Essen. In particular, the share of long-term unemployment is greater in Duisburg: almost 40% in 2002 increasing to almost 50% in 2016 of unemployed in the city were without work for more than one year [93], [94].

Table 9: Unemployment rates in Duisburg and Essen in selected years since 2001.

	2001	**2004**	**2008**	**2013**	**2019**
Essen	10.8%	12.2%	12.3%	12.4%	10.2%
Duisburg	12.9%	14.3%	12.7%	12.9%	10.8%

Source: [94]

Since 2005 the unemployment rate has fallen considerably, mirroring state and national developments, though the decline slowed in the last decade in both cities. In 2019, the unemployment rates in Essen and Duisburg were still over 10%, far higher than in the comparison to other regions and Germany as a whole.

The decline in unemployment was accompanied by a rise of employment since 2000s and particularly after the national labour market reform in 2005. But the Ruhr Region and the two cities did not benefit from the nationwide labour market upswing as other urban regions.

Nonetheless, the specific interventions in the Ruhr and the two cities had a positive effect. The entire Ruhr Region recorded employment gains of around of 22 % percent between 2006 and 2020 [95]. Since the late 2000s the positive trends have been driven by an economic diversification in the fields of healthcare (with over 330,000 employees), digital communication, logistics or the chemical industry. However, while Essen shows a steady dynamic, Duisburg’s labour market appears more volatile with their local economy (logistic and steel) stronger dependent on international market developments.

[11] Note on 2005: The introduction of unemployment benefit II ("Hartz IV legislation" Second Social Code, SGB II) in 2005 created a new legal basis for the receipt of unemployment benefits for the long-term unemployed. Unemployed social welfare recipients, who were not previously listed in the unemployment statistics, were listed here from 2005 onwards. The increase in 2005 is due to this change. A comparison of the figures before and after 2005 has to be considered with caution.

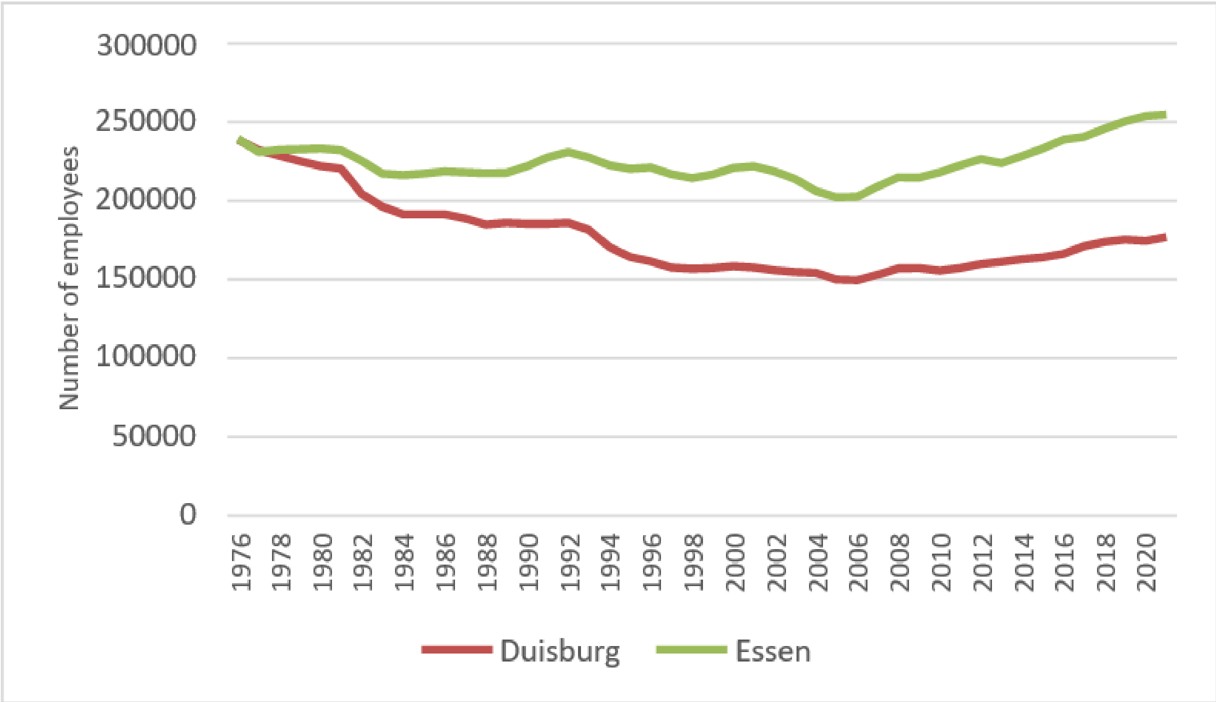


Figure 9: Employment trends in Duisburg and Essen since 1976 (in total number of local workforce). Source: [85], [89]

The economic diversification process in Essen increased the importance of the tertiary sector significantly (Stadt Essen 2019). More than 80% of all employees work in trade, technical and economic service, and innovation as well as the health sector. In addition, Essen fosters specifically the local environmental economy. Between 2017 and 2020 the total "green workforce" increased by 21% making Essen the leader in the Metropole Ruhr [75]. The target is to increase this figure to 20,000 by 2025.

In Duisburg, the number of employees has risen by more than 10,000 to 175,300 employees since 2015. This results in a growth in employment of + 6.8% (Stadt Duisburg 2021). The duisport logistic hub has contributed to significant employment gains in the city. 15% of all jobs in Duisburg are attributable to duisport. This comprises a total of 51,600 direct and indirect workers increasing from 19,000 in 1998 and 46,500 in 2018. This generates an annual value added of al- most €1.9 billion for the city [96].

Another important role in the local economy remains the steel and metallurgical industry. Although thyssenkrupp is in a process of continuous restructuring [97], the city greatly identifies with the sector "being the number one location for European Steel" [98], [99]. In 2019 a total of 33,600 workers were employed in the sector [100]. According to the company there are 13,000 people directly employed in Duisburg at the moment (Interview and Website).

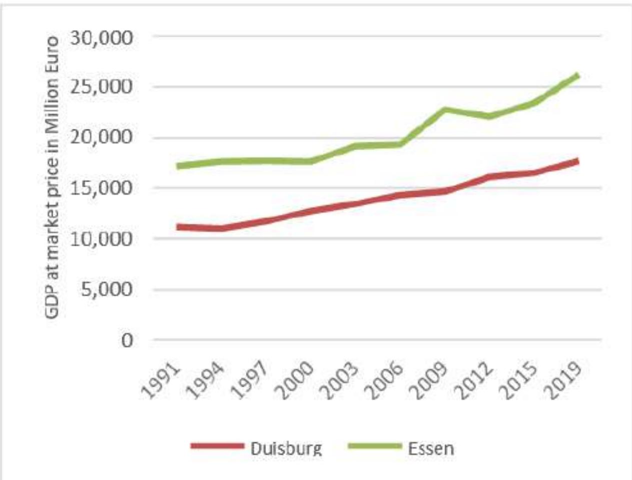
In summary, both cities experienced very similar developments of unemployment and employment variables yet lacking any rapid or non-linear trajectories. Instead, the rise in unemployment was relatively sharp in the 1980s, though this trend did not last since improvements are visible after 2005. Similarly, the employment rate demonstrates no significant shift but incremental change between the late 1970s and today.

14.8.7 Gross Domestic Products: slow but steady increase

The interventions appear to have a positive impact on the GDP development in both cities. The GDP is an important measurement of the economic performance of a country or region. In coal-phase out regions, it can also serve as an indicator for the success or failure of policy interventions to facilitate the structural change process.

The structural change process and loss of importance of the industrial sector resulted in a weaker growth of GDP in the Ruhr Region overall. From 1991 to 2015, GDP in the region in- creased from €104.2 billion to €157.3 billion in nominal terms: an increase of about 51%. The de- velopment in the Ruhr Area thus nevertheless lagged at state and national level. GDP rose by 62% in NRW and by 79% in Germany [94].

This development is reflected on local level. Both cities show a slow but steady increase of their respective GDPs. Although starting from a higher level, Essen increased its GDP (at market prices) by about 52% while Duisburg performed slightly better gaining about 58% (Figure 12).



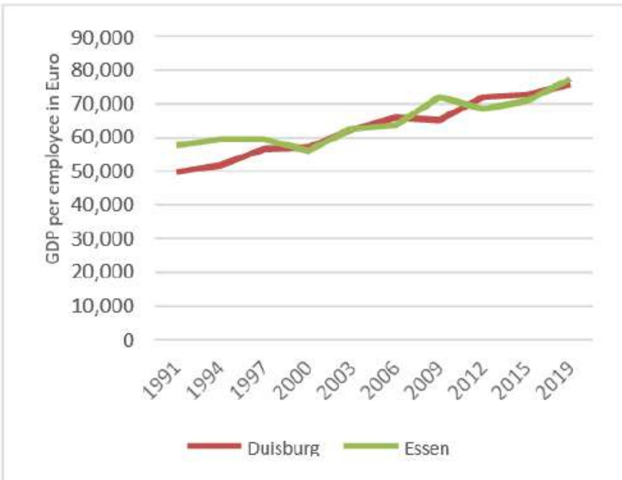


Figure 10 (left): GDP at market prices 1991 to 2019 in Million Euro of Essen and Duisburg. Figure 11 (right): GDP per person employed 1991 to 2019 in Euro of Essen and Duisburg. Source: [89], [101].

The indicator GDP per person employed measures the average labour productivity generated by each person employed. Both cities should very similar patterns again. Though, Duisburg’s performance appears greater with an increase in labour productivity by 52% in comparison to Essen with an increase of 34% between 1991 and 2019. This difference results from the still slightly larger share of producing industry in the Duisburg.

Disposable income per household: lower than average

The industry decline and loss of well-paid jobs in the coal and steel production is visible in the relatively lower disposable income per resident in the two cities (see Table 11). Dahlbeck et al (2022) found that there was a significant "break" after 1987, when disposable income in the Ruhr Region started to fall behind state and national levels. There is no data for the cities before 1995, though similar patterns can be anticipated. Since 1995, both cities show an increase of private household income (Table 10), though at a slower pace and scale than state level. Essen appears to outperform Duisburg slightly.

Table 10: Disposable income per resident (in €) in Essen, Duisburg and NRW in selected years between 1995 and 2019

	1995	2000	2005	2010	2015	2019
Essen	15,875	16,357	17,271	18,178	18,939	21,168
Duisburg	12,639	13,287	14,227	15,038	16,162	17,741
NRW	15,119	16,038	17,505	18,745	20,526	23,093

Source: [89].

14.8.8 Education: success story with steady increase of tertiary-level students

An important intervention in the transformation process was the establishment of universities in the Ruhr Region to increase local capacity. Both cities show a similar positive trajectory, which still appears incremental rather than rapid. However, in 20 years, the change in the data considered in a more compressed timeline might appear more significant.

The first university (Ruhr University Bochum) in the Ruhr Region was founded in 1965, the Universities in Essen and Duisburg were established in 1972. The number of enrolments has increased in the last decades continuously with engineering sciences representing a focus in comparison to other universities in NRW. However, there are stark differences between the localities. The number of people entitled to study in Essen is with 64.4% considerably higher than in Duisburg with only 52.7% [85].

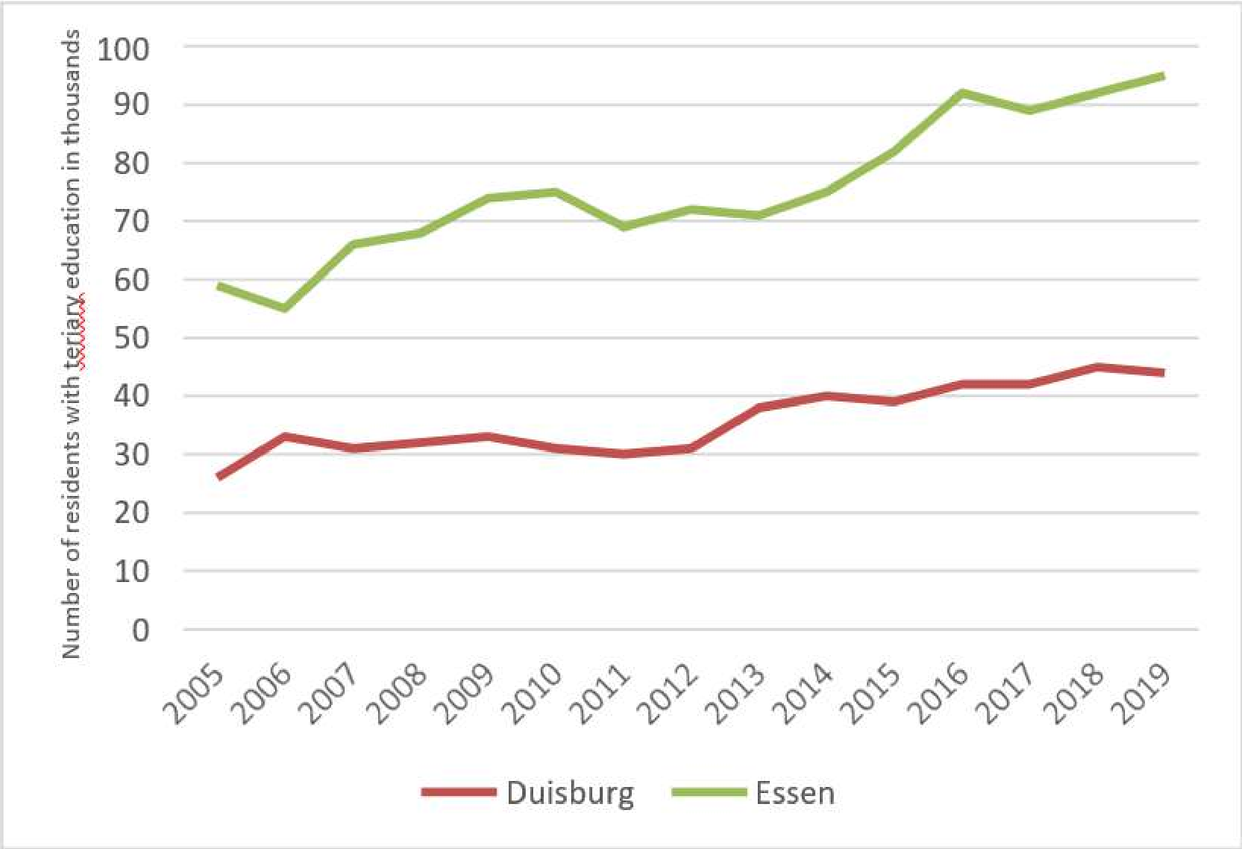


Figure 12: Share of residents in Duisburg and Essen with tertiary education (Bachelor, Master, PhD),2005-2019. Source: [89].

This is also reflected in the number of residents with university degree. Essen has a significant larger share of people with a Bachelor, Master or PhD graduation and shows a strong positive trend since 2005 with an increase of about 61% (no earlier data was available). Duisburg has a substantially lower number of residents with a tertiary education, still being considered predominantly as a "workers town" (Interview). However, their share increased noticeably by about 69% since 2005.

14.8.9 Electoral behavior: mood change and break-up of path dependency

In contrast to the socio-economic indicators, the electorate behaviour in NRW showed a significant shift after more than 40 years of political stability. It appears that the interventions have (un- intentionally, Interview) contributed to a public mood change towards the established power structures. The decreasing workforce and new regional visions (IBA) eroded the unconditional acceptance of mining and its subsidisation driven primarily by the SPD government.

For decades, the Ruhr Region and so the two cities have been heart land of the Social Democratic Party (SPD). The SPD led both state and local governments since height of the coal and steel crisis in the mid-1960s while establishing a hegemonial position in close collaboration with unions and industry. Perceived as the party caring for the "needs of small people", the SPD permeated all social structures shaping the local political culture and a regional model of "social partnership" (Oei et al 2020, Interviews). The SPD strongly identified with the workforce in heavy industry sectors as its electorate backbone. Still today, the miners' hymn "Glückauf, der Steiger kommt" is regularly played at SPD party assemblies (Interview). In addition, prioritising coal in the national electricity supply was a leading policy aim and hence mining considered a state task ("NRW is coal country") (Maedge 1981). However, with the progressing decline of the industries and its fading importance, as well as the growing burdens of subsidising the sectors, the dominance of the SPD waned since the 1990s (forsa in Spiegel 2005) (see Figures for Essen and Duisburg). The SPD was no longer able to rally their constituency while also suffering from demographics shifts and a new voter generation with no direct ties to the "old" industries.

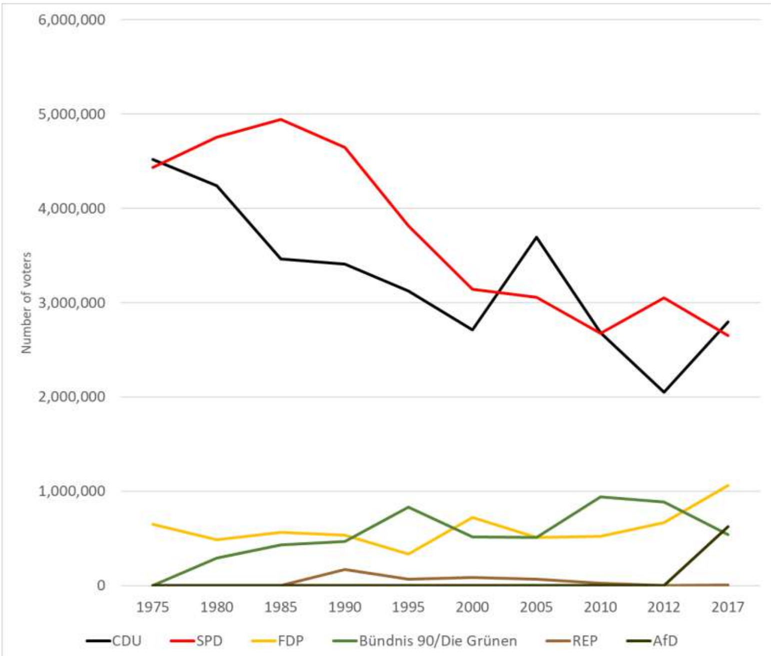


Figure 13: NRW state election since 1975 in total numbers of voters. Source: [89].

Considered a political earthquake was the election loss of the SPD at NRW state election in 2005 (Figure 15). After almost four decades, NRW received a CDU and FDP led government. Alt- hough, the next election saw a return of the SPD for two election periods, the CDU won in 2017 again, proving new power dynamics at state level. In fact, the SPD governments balancing act of conserving measures for the coal and steel industries and the course to modernisation did not convince anymore. In addition, national labour market and welfare reforms by the SPD led national government also contributed to loss in public legitimacy and the election loss on state level in 2005.

Year	1947	1950	1954	1956	1958	1962	1966	1970	1975	1980	1985	1990	1995	2000	2005	2010	2012	2017
Leading Party	CDU	CDU	CDU	SPD	CDU	CDU	SPD	SPD	SPD	SPD	SPD	SPD	SPD	SPD	CDU	SPD	SPD	CDU
Coalition partner	SPD	Zent-rum	FDP	FDP			FDP	FDP	FDP				Greens	Greens	FDP	Greens	Greens	FDP

Figure 14: State governments composition in NRW since 1947. Source: [102]

This new state government by CDU and FDP brought consequences for the mining regions and their self-perception. Breaking up institutional ties and coalitions, the new government ended the paradigm of the indefinitely subsidised hard coal mining in the Ruhr Region and signalling an end of the sector. For the first time (state and national level), a coalition agreement included the commitment to work towards an actually "phase-out" of hard coal subsidies. ("We want to negotiate and decide with all stakeholders, including the shareholders, on the framework conditions for the socially acceptable phase-out of subsidised mining" CDU and FDP 2005). Indeed, the previous coalition agreements by the SPD led governments (despite the green coalition partner) repeatedly committed to continuous subsidise the operation of the consolidated mines emphasis- ing "coal is part of North Rhine Westphalia" (SPD and Greens 2000, 1995).

The new government's position specifically shaped the next negotiation round for the renewal of coal subsidies in late 2006 and early 2007. CDU called for the coal mining exit until 2014 to finally abandon the increasing financial burden for the state budget. Further, it was feared that state government had to carry the eternity costs (water management and landscape damage). This was circumvented with the RAG selling parts of the company (power plants, chemicals, real estate) at the stock market to ultimately secure what the state would otherwise have to pay.

In contrast, the SPD supported the concept of maintaining a "base mining industry" (Sockelbergbau)[12] and promoted their position to extent coal mining beyond 2018. Hannelore Kraft (designated party leader of the SPD in NRW) confirmed this position in January 2007, stating: "We must keep the access to coal deposits open - our only domestic energy source. It is a matter of energy security and providing a perspective for German mining technology, which is in high demand internationally. The SPD stands united behind this concept."

A compromise was found with the coal phase-out at the end of 2018 to prevent compulsory redundancies and the state government relieved from the subsidies after 2014. However, as an admission to the SPD, a revision clause was included in the agreement to review the decision again in 2012. Although deemed relatively unrealistic (Interview), this review clause would allow coal mining to continue in Germany if increased world market prices made it profitable.

Local level

[12] Comprising two or three mines with around 10,000 workers are to produce coal on a permanent basis

Neither a majority in the Ruhr Region nor Essen or Duisburg voted for change in 2005 (see Appendix 1 and 2). The local electorates demonstrated their continuous support for the social democrats; still, a mood change is also visible since the 1990s.

While the SPD remains the dominant party in Duisburg, smaller parties gained increasing support since 2010s. In contrast, Essen electorate appears more volatile with government changing three times since 1999.

Year	1946	1948	1952	1956	1961	1964	1969	1975	1979	1984	1989	1994	1999	2004	2009	2014	2020
Duisburg	CDU	SPD	SPD	SPD	SPD	SPD	SPD	SPD	SPD	SPD	SPD	SPD	SPD	SPD	SPD	SPD	SPD
Essen	CDU	SPD	SPD	SPD	SPD	SPD	SPD	SPD	SPD	SPD	SPD	SPD	CDU	CDU	SPD	SPD	CDU

Figure 15: SPD (red) or CDU (black) government and majors on local level across the timeline. Source: email correspondence with city of Duisburg and city of Essen.

Hard right-wing parties (NPD, Republikaner) did not gain a stronghold in the city for many decades, yet local support slightly increased since the early 1990s. The Republikaner received their highest vote with 2,3% (7600 voters) in Essen in 1990s at state level, which coincides with the closure of the local mine four years earlier. In Duisburg this voter trend was delayed. The peak for the Republikaner was in 2000 with 2,5% (4600 voters). However, the Alternative für Deutschland, a right-wing populist party emerging in 2013, remobilised this electorate and rallied support from disappointed conservative voters and largely from previous non-voters at all government elections in both cities.

In the wake of the national environmental movement, a local chapter of the Green Party (Bündnis90/ Grüne, in the following the Greens) founded 1979 in Duisburg and 1980 in Essen. Their ecological agenda stood in opposition to the established parties and offered an alternative narrative for the transition process of the region. In particular, the Greens in Essen appealed to the local electorate. Though, in both cities the electorate demonstrates increasing support for the party gaining 18,3% in the local election in Essen in 2020, and 17,7% in Duisburg. It appears that the green and sustainability discourse in Essen also contributed to a respectable result at national level elections in 2021.

Voter turnout

The industry decay was followed by a strong voter decline. Although local elections usually have a weaker voter participation (around 45%), the drop since the 1970s is substantial. In Duisburg, , voter turnout has almost halved in the last 50 years, with 39.1% at the last election, much less than the 48% turnout in Essen. A similar trend appears in the elections at state and national level.

14.8.10 Local narrative developments

The public mood change noticeable in the electorate behaviour becomes also visible in the local narrative developments. The mainstream narrative waned with the decline of the industry when new distinct future visions in the region as well as for both cities appeared.

Mainstream narrative

The early mainstream narrative and the perception of the Ruhr Region and its cities was associated with the "economic miracle" metaphor regarding coal and steel as the fuel for the nation's increasing energy demanding and supporting higher living standards for millions of people (Interview [45], [103]. In addition, the founding story of the European Coal and Steel Community (ECSC) was also associated with the regional industry and carried the strong symbolism of collaboration and freedom after the two World Wars. This mainstream narrative experienced first slight scratches with the increasing economic difficulties of the sectors. Policy interventions followed a narrative of contributing to the industry's recovery applying measures to increase efficiency and help to modernise the mining operations in order to maintain German energy security. Though this framing slowly shifted towards a supporting the restructuring process of the domestic coal production whilst avoiding social hardship.

Further cracks appeared in the mainstream narrative when increasing pressure emerged from the wider public, the electricity industry as well as EU level towards the spiralling subsidies for the sector. In 1982, an electricity customer declined to pay the "coal penny" to its power provider RWE, a levy that was introduced in 1974 and constituted a significant part of the subsidies (1/4) (Table x). This dispute was eventually brought to the Federal Constitutional Court in 1994, which decided that the levy is unconstitutional and must end by 1995 requiring immediate action by the government to avoid a collapse of the industry. In addition, the introduction of EU Single Market and its competition law in 1993 required measures from the national government to avoid unfair competition advantages. This ultimately triggered a change of the policy narrative focussed on the reduction of subsidies materialising in the subsequent coal laws from 1994 and 1997.

Though it took another 10 years, before the end of subsidies was considered. In fact, the national coalition treaty from SPD and CDU in 2005 confirmed again (only) the existing policy narrative for a socially acceptable restructuring of the industry. Only, the change in state government in 2005 and the parties polarising position on subsidies (in particular from the FDP) enabled the policy narrative for ending coal subsidies to reinvest in innovation and future technologies manifest in the 2007 agreement which eventually led the phase-out of coal mining. Surprisingly, the dis- course of environmental impact and (later) concerns over coal related carbon emissions, were merely a secondary argument (Interviews) and only entered the mainstream policy narrative about coal quite late, when the phase-out was already agreed.

New and alternative narrative building

State level interventions fostered the positive connoted mainstream narrative for a long time. Measures to support the industries and to buffer the structural transition in the region through a range of development programs remained priority until the late 1980s (see 4.2.3. state interventions).

A first distancing from the mainstream narrative and appearance of a state-led new yet still substream narrative was initiated through the IBA (Interviews). The main aims of this program were an ecological and cultural renewal understood as the imperative for the economic prosperity of the region in the future [54]. The analysis of the IBA documentation shows the program's critical look at the past calling for a new vision after the end of the industrial age. In fact, the IBA was conceived and implemented at a time when the environmental discourse intensified and principles of sustainable development and resource protection postulated and later at the Rio Conference internationally confirmed [56], [57]. The aims and measures of the IBA emphasised the environmental theme though it was mainly associated with renaturation of the river Emscher, providing access to green spaces for the residents and rejuvenate the Garden City idea[13] in the region.

The other potentially better received set of measures were the re-valuation and repurpose of the material remains of the mining operations such as shaft towers, coal washing plant or coking facilities. The IBA identified "technical monuments worthy of preservation" and set them up as lighthouse projects of the program including the "Duisburg-Nord Landscape Park" and Essen's "Zollverein Mine Shaft XII". Hereby the IBA followed a policy narrative which aimed at enhancing the internal and external perception of the Ruhr Region through strengthening the positive connotation of the industrial culture. This was already promoted by the SPD government of Johannes Rau at the end of the 1970s and associated with the culture for "the little man," the "upright worker" and the "common people [44].

Although structural and socio-economic challenges remain, assessments highlight the intangible impact of the event: The region gained new self-confidence and self-esteem and re-evaluation of their localities. Instead of tearing down all the former sites of industrial activity considered as ugly, these are now appreciated and valued within a new framing of industrial culture and industrial nature. Former "forbidden" areas (only workers were allowed on the sites) are now places of exchange and creativity [55].

Essen strongly capitalised on these new narratives leading the Cultural Capital Ruhr2010 under

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[13] Urban planning model by Ebenezer Howard 1898 based on the concept to break up the density of a city by integrating settlement structure interspersed with green spaces, loosened up and divided into neighbourhoods according to plan by radial streets, with spatial separation of important functions, a surrounding green belt, and sufficient provision of jobs and utilities for the population.

the motto "Change through culture - culture through change" as "Europe's new Metropolis" [104].

The successful application was attributed to the narrative of reinventing an industrial region exemplary for other regions. Unlike the IBA which was driven by state government and stakeholders from beyond the region, this event was driven by a coalition of Ruhr municipalities and the Ruhr association [59], [60]. Though, the documentation of the event indicates a rather positive connoted view of the coal era, and hence does not represent or provide a complete new and alternative story line. In fact, while the IBA critically reflected on the landscape implications of coal mining, Ruhr2010 strongly centred on a self-reassurance of the past and its remnants. Part of the program were several symbolic activities such as the project "Shaft Marks" (Schachtzeichen), where yellow balloons hovering 80m above 311 former mining sites across the entire region providing an indication of the former importance of the industry. Further the evaluation of Ruhr2010 found: "where once the steel and coal industries shaped the region (now) former coal washes, machine halls and colliery facilities have become locations of art and creativity. For people from outside the region, the landscape is not only surprisingly green, but also extraordinarily cultural." [105, p. 10]. Indeed, with the end of mining in 2018 the region lost what it defined as a community, though [44] finds that the industrial culture has advanced to an identity forming narra- tive for the people.

Bifurcation in local narratives

Since the decision to end coal mining the Ruhr Region, both cities foster individual narratives more progressively. In fact, it appears that after 2010, a bifurcation in the local story lines and self-perception manifests.

Duisburg was not able to capitalise on the IBA and the Ruhr2010 for creating a local narrative, although it also promotes its industrial sites as tourist attractions [106]. Instead, the city fosters an existing policy narrative associated with the growing local logistic industry and green steel though in particular the expansion and development of largest inland-port located in the city contributes to the revitalisation of the industrial narrative in the Duisburg. Policy and industry interventions are promoting the image that the "new silk road" ends at the port in Duisburg. The city's website presentation as well as its economic and digital strategies support the international connection as impetus for international trade and growth [107], [108].

In addition, the city's current policy narrative emphasises the opportunities associated with green steel and the necessity of national funding for a local industry restructuring as well as research and development. A study by the Wuppertal Institute fuels this narrative further by emphasising that the region and in particular Duisburg have great potential for a pioneering role in greening the steel industry [78]. The adoption and commercialising of green hydrogen could enable a carbon neutral steel production. And as the researchers note: "This will make the seemingly impossible come true: steel production itself will move into the position of a sector of the environmental economy." (ibid p.99).

Essen used the Ruhr2010 as a steppingstone to foster new opportunities and progress a sustainable policy narrative. Essen submitted its application in 2014 by using the narrative "from a city of coal and steel to the greenest city in North Rhine-Westphalia ". The city's vision for the future is that "of a prosperous, sustainable metropolitan city that is resilient to climate change and that of- fers its population opportunities for development in a healthy environment" [63 p. 230]. The appli- cation followed the efforts of the IBA and Ruhr2010 to support the regional transformation [66].

Additional milestones on the City's sustainability pathway included the adoption of a local climate protection strategy, Essen's participation in the „Covenant of Mayors" in 2010 and receiving the European Energy Award 2013 (ibid).

While the Green Capital Award application focusses on the successes, it also reflects on the impacts of the industrial era e.g. in regards to air pollution, transport infrastructure and water management. Apart from the Emscher renaturation program (Box 1). The public importance and great symbolic power of the local river systems is perceivable in another project of the Green Capital Award. After more than 40 years, the "Seaside beach" at the Lake Baldeney (river Ruhr) was reopened as a bathing area in May 2017 [75]. This project was repeatably mentioned by in- terview partners as a major highlights of the event (Interviews).

The perception of the Green Capital Award the interview partners agreed that the events and activities around the Green Capital City Award were insofar successful that it further contributed to an improvement of the community's self-image and greater awareness that Essen is already quite "green" (Essen is the third greenest city in Germany with a share of 53% green and open space). The local initiatives and activities during the event year were well received (Interview), and more than 7000 media reports promoted the city's efforts within and beyond its borders.

However, some interview partners critically reflected that the efforts were too little, and the Award did not move beyond an image campaign. They bemoan that the city is still shareholder of RWE and dependent on their dividends for the municipality budget (Interview).

Although it is too soon to determine a lasting impact of the narrative change, different interview partners acknowledged that after the Award, demands regarding environmental issue have greater political power. The city has pledged different future environmental and climate targets acknowledging that the title lasts - "Once Green Capital always Green Capital" [75]. Indeed, the city promised to continue its efforts announcing a "Green Decade" across 12 themes including climate protection, water management and mobility which are to be executed through the Green Capital Agency until 2027 [69]. The City's "Green Decade Program" will conclude with the International Garden Exhibition hosted in the Region in 2027.

The respectable achievement of the Green party at the local and national elections in 2020 and 2021 may also indicate increasing awareness and support for the environmental vision of the local government.

In summary, the mainstream narrative was closely connected to the economic development and decline of the coal and steel industries and mirrored the public discourse in the region. National and state interventions had a conversing influence on this narrative while only in the 1990s new and alternative narratives began to surface more strongly (See figure 16: 2 and 3). After the final decision by national and state government in 2007 to end coal in 2018, local governments in Essen and Duisburg have progressively worked on local narrative building. The industrial culture image emerging in the 2000s was still a reminiscence of the mainstream narrative yet presented a steppingstone for Essen towards a sustainable narrative, while Duisburg continued to foster its industry image. The presentation of Essen as a "Green City" and the portrayal of Duisburg at the "end of the new silk road" indicate a clear division of the cities perception once similarly dominated by the coal and steel narrative. Hence the "Green Capital Award" in Essen and the various measures to support Duisburg's logistic hub and green steel industry present tipping interventions for their local narrative development.

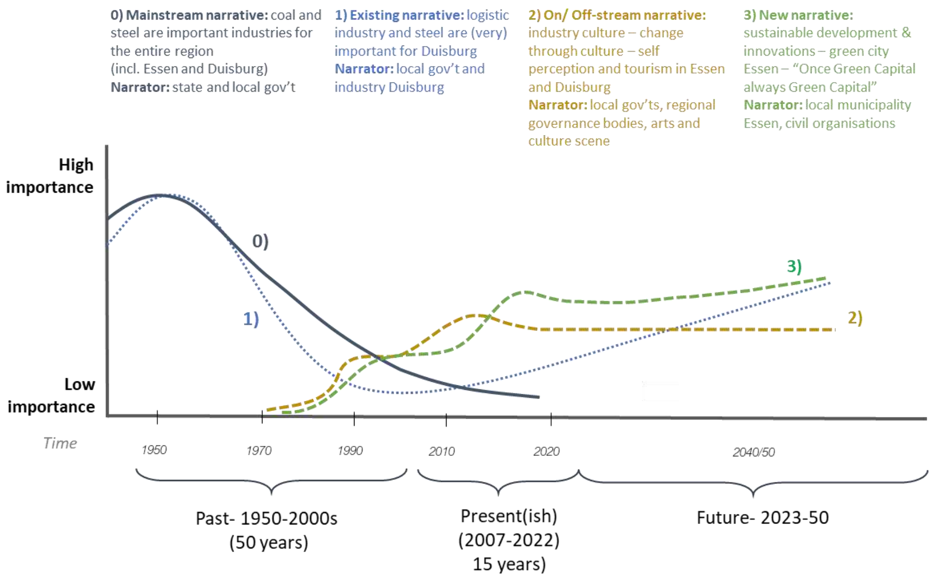

Figure 16: Stylised development of different narratives in the region and both cities.

14.9 Discussion

In this report, we investigated the socio-economic transition process by using the examples of the cities of Essen and Duisburg, which shared very similar pathways. By examining interventions and outcomes, we observed incremental changes in their demographic, economic and political trajectories but we found no evidence for either city to have crossed a tipping point in their transition process yet. However, distinct developments in the cities' policy narratives indicate qualitative changes while putting them on quite different trajectories potentially leading to tipping points in the future.

Both cities are embedded in a wider structural transformation of the Ruhr Region and hence were subject to state and national interventions as part of the coal phase-down and -out process over decades. Yet, these interventions reinforced path dependencies for a long time and only sought and allowed for incremental changes across the region. In fact, the structural interven- tions were meant to avoid rapid and significant shifts, instead intended a long "gliding flight" for the coal phase-out to avoid social hardship.

In Essen, the economic and social trends show the city has coped better than Duisburg in the transition process, and certainly was more pro-active in seeking and shaping a new vision and local narrative. Essen experienced the local industry closure earlier than Duisburg and has thus had more time to adapt to a post coal-mining era, but even so the socio-economic data shows Essen to perform better also in earlier years. The local government successfully leveraged on the major interventions (e.g. IBA and Ruhr2010), ultimately putting forward and promoting the motto "from grey to green" following the contemporary national and European zeitgeist. While new compelling narratives and positive frames have the power to erode lock-ins, reorient practices towards desirable alternatives and ultimately attract new interest [23], the new narrative in Essen has not yet triggered large-scale changes measurable in the socio-economic data. Nevertheless, the new, green agenda may potentially mark the start of a new era of sustainable businesses and practices in the city, and positively influencing the internal and external perception of the former mining town

Duisburg has struggled in the transformation process but appears steadfast in their (heavy) industry pathway. Although the local mine is closed, the steel industry remains an important local economic factor, furthered by recent plans to foster local green hydrogen production. In addition, state-level interventions were successful to turn the local port and the large, decommissioned steel and mining sites into a thriving global logistic sector in the city. Hence the industry activities continue to form the local narrative, which is further enhanced by local government through a city partnership with Wuhan/ China putting forward the narrative of "Duisburg at the end of the new silk road".

Consequently, the cities appear at a crossroad. While their socio-economic trajectories still show similar trends, the narratives and policy visions of the cities suggest that their future trajectories will diverge. While Duisburg builds on the old narrative of continued and new heavy industry structures, Essen has formulated an alternative vision for the city, departing from the old mining image towards a greener future. Since the transition process is still ongoing, it remains to be seen which of the two pathways is more successful for the continued economic and social development of the cities. Whereas it seems unlikely that Duisburg will develop in a "greener" way than Essen, the economic success can go both ways. It may be a risky strategy, hinging on the successful development or access to hydrogen resources, but it is certainly conceivable that Duisburg may prosper with its industry pathway utilising and further developing existing

capacities and resources from the local port and green steel production opportunities. In Essen, policy interventions may have altered the local narrative and hence positively influenced internal and external perception as well as attracting new businesses and innovation. These efforts will likely improve the greenness of the city and may or may not lead to improving social conditions and prosperity in Essen. Success and prosperity are thus uncertain, but the developmental bifurcation is likely already happening: as they embark in different directions, the cities will likely grow increasingly different over time.

Our empirical findings suggest that it is difficult to determine tipping dynamics in an ongoing transformation process. The industry lock-in and associated institutional path dependencies have prolonged the phase-out process of coal mining for six decades. We can see some recent initiatives to reshaping the cities futures, but not yet observe the lasting effects of these interventions. Hence, longer timeframes are required to determine if the transformation process exhibits a radical change. Consequently, this suggests that tipping points in social systems are more likely observable in retrospect.

This study also shows that the tipping lens for investigating societal change may be problematic in itself. Societal transition processes tend to be slow and gradual, and hence dominated by incremental changes that may accumulate to substantial shifts over several decades [33], [109]–[111]. Indeed, social systems exhibiting self-reinforcing dynamics can be quite resilient to change over long periods of time [34], while radical shifts and non-linear trajectories appear undesirable, among other things because they oppose existing power and interest structures and because their success is uncertain. Hence, radical change and tipping should be expected to be the ex- ception rather than the rule, especially in the highly complex social systems of cities. For future research, thus we suggest studying processes of social transformation in carbon-intensive re- gions not through the tipping lens" but by studying gradual change and its interventions, thereby possibly finding a tipping point without looking out only for this specific, uncommon process.

Social systems are characterised by great complexity making it challenging to map processes of cause and effects, especially across (governance) scales. Although our study focused on the cities' developments, the historical dependence of the coal and steel industry on state and national interventions had a significant impact on the local trajectories. Consequently, identifying cause and effect along specific variables can indeed be more precise in smaller, sectoral systems than in larger, more society-wide ones. For example, investigating social-technical systems can yield more definite and potentially satisfying answers about the occurrence of a tipping point dynamic. For example, Sharpe and Lenton (2021) find that Norway has activated a tipping point in consumer preference for electric vehicles based on the number of new car sales, and Strauch (2020) suggests that wind power and solar photovoltaics have passed a socio-technical tipping point based on the rapidly increasing deployment and cost reductions. Undoubtedly, more empirical studies on tipping point dynamics are required, and we see the investigation of smaller-scale social-technical systems as the best suited field for this.

The findings of this study must be seen in light of some limitations. Empirical investigations of large, complex social systems are still rare [14] and hence methods and tools have yet to be further tested for yielding answers to social tipping point processes. For our analysis, we relied on publicly available data but, apart from the interviews, we did not generate further primary data. We would have been particularly interested in (longitudinal) data on local perceptions of the coal phase-out and the appropriateness of the municipal and regional interventions after the mines closed. The selection of the socio-economic variables could have been extended and included additional material e.g. public surveys on perceptions. For example, a deeper, data-driven investigation of the social, ethnic, and demographic segregation within the cities, on the district level, could have yielded insights not observable on the aggregated city level, for example about development of particularly low-status neighbourhoods. The pandemic also hindered the direct and onsite contact with stakeholders (which was done online exclusively).

Our study shows the sequence of interventions and timing are important factors for the trajectory of a region determining the quality of societal change. We have shown empirically that incremental change is, at least in our two cases, the dominant process of change, although tipping dynamics may still materialise in the future – and we cannot rule out that, seen from a few decades into the future, the period around 2020 can be identified as a tipping period in one or both cities. This also means that incremental changes when observed ex post, will have led to a substantial transformation – supporting the notion of transformative incrementalism – achieving transformative change through a long processes and the sum of small interventions [113]. The strategies to influencing the local narrative building as well as focus on local strength and capacities appear as key mechanisms also relevant for other coal communities in their transition process. These interventions, whether they trigger tipping or not, are still necessary and useful steps towards a prosperous future beyond coal.

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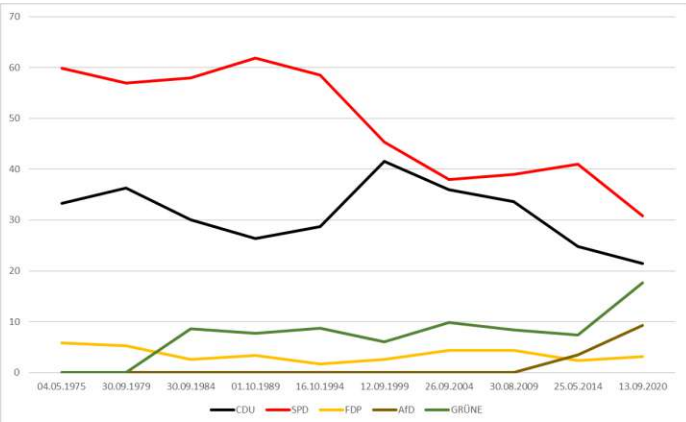
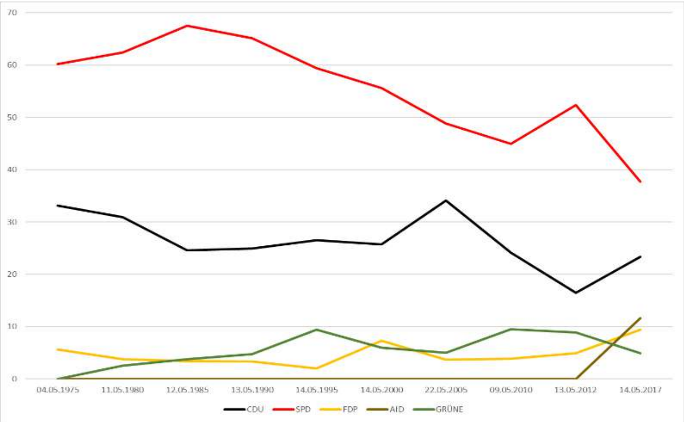
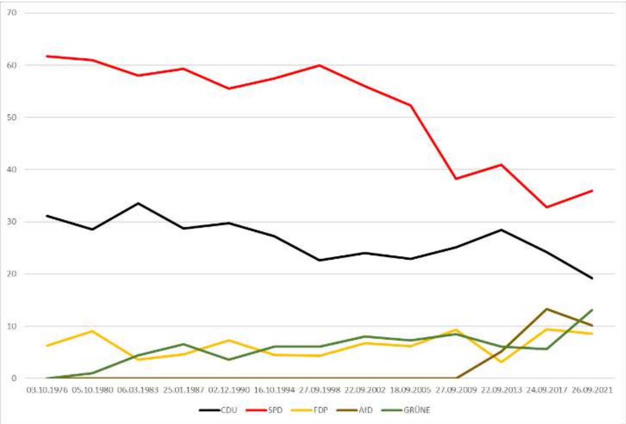
14.11 Appendix of Germany case study

Election results in Duisburg since 1975 at all government levels

Local government	Voters turn out in %
	
State level	Voters turn out in %

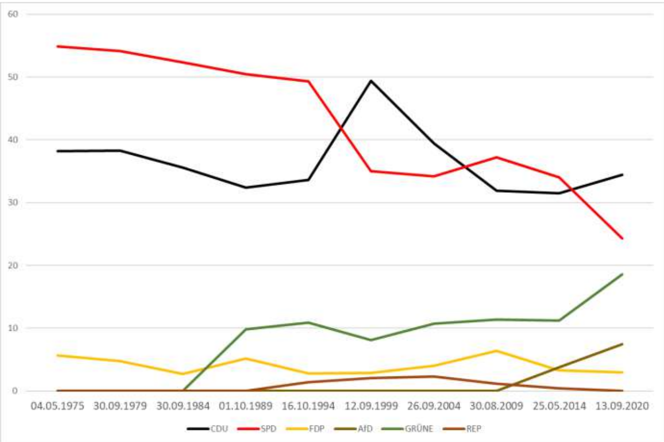


National level | Voters turn out in %

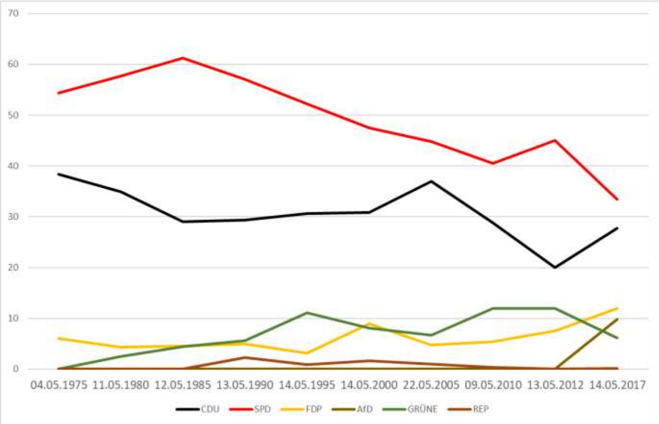


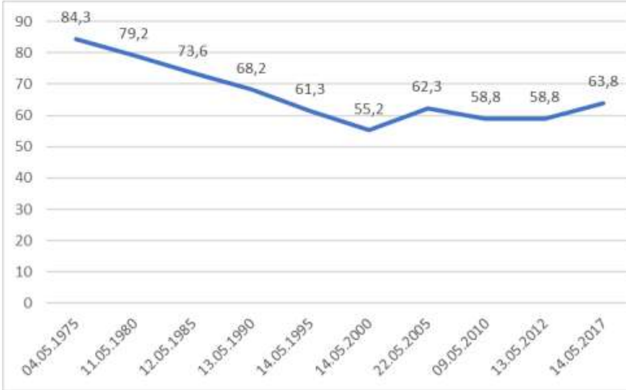
Election results in Essen since 1975 at all government levels

Local government | Voters turn out in %

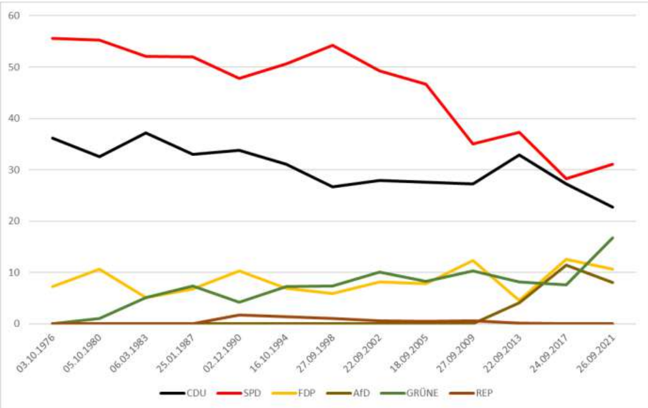


State level | Voters turn out in %





National level	Voters turn out in %



15 Case study 14: Greenland

Case studies in Greenland
Regine-Ellen Møller & Anne Merrild Hansen
Aalborg University

15.5 Introduction

15.5.1 CCIR description: case study 1 "chasing waterfalls"

Greenland is a self-governing territory within the Kingdom of Denmark through the Self-Rule Act of 2009. Greenland is geographically part of the north American continent, but politically part of Europe. The size of Greenland is 2.17 million square kilometers, with 81% of land surface covered in ice. The population of Greenland lives in the coastal regions, and the population size is approximately 56,000. There are 18 towns where 87% of the population lives, and there are approximately 60 settlements defined by a population size of 50-500 where the rest of the population lives (Statistics Greenland, 2018). The capital city is Nuuk with a population size of approximately 19,000 in 2022 which is one third of Greenland's population. For context, the next biggest town is Ilulissat with a population size of approximately 5,000 counted in the same period (Statistics Greenland, 2022). There are no roads between towns and settlements, and thus, Greenlanders travel by air (e.g. airplane and helicopter) or sea (e.g. ship, boats, snowmobile, and dogsled).

Figure 1.1: A geographic map of Greenland.

The map of Greenland includes the name and location of towns. It does not include settlements. The different colors show which one of the five municipalities that the towns belong to. The names of the municipalities are listed on the sides of the picture: Avannaata Kommunia, Kommune Qeqertalik, Qeqqata Kommunia, Kommuneqarfik Sermersooq, Kommune Kujalleq.

The population in Greenland is migrating from settlements or smaller towns to bigger towns. Between 1950 and 2016, the population size of Greenland has more than doubled from 24,000 to 56,000 whereas the habitation places (i.e. towns and settlements) have decreased by half. These demographic changes stemmed from the so-called 'concentration policy' from the 1950's where the rise of the fishing industry required more densely populated areas because of the need for greater human labor (Heinrich, 2013). In recent decades, Greenland has faced brain drain by which 66% of the people emigrating from Greenland have a higher education than those who stay (Greenland Perspective, 2015).

Regional energy distribution characteristics (cf. 'Formal region characteristics'): Through 1993 and 2012, the Government of Greenland has implemented five hydropower plants which in total provide renewable energy to six towns located in all regions of Greenland. Two out of five hydropower plants have the capacity to provide energy for electricity and heating. The other three hydropower plants have the capacity to provide energy for electricity whereas fossil fuels are applied for heating. Other towns and settlements are primarily supplied with fossil fuels for energy. The following photo shows where the hydropower plants are located. Next, a table is presented which illustrates the following: the name of the six towns with a hydropower plant, the establishment year of hydropower plants, and what type of energy the hydropower plant has the capacity to supply.

Figure 1.2: The location of hydropower plants.

The location of the five hydropower plants in Greenland are shown in red circles. The towns with a hydropower plant from north to east are: Ilulissat, Sisimiut, Nuuk, Qaqortoq, Narsaq, and Tasiilaq.

Table 1.1: Location and establishment year of hydropower plants in Greenland

Town	Year established	Capacity
Nuuk	1993	Electricity and heat
Tasiilaq	2005	Electricity
Qaqortoq/Narsaq (share one plant)	2007 / 2008	Electricity
Sisimiut	2009	Electricity and heat
Ilulissat	2012	Electricity

The government is planning to establish more hydropower plants in other towns for civic use and possibly large-scale industrial projects such as aluminum smelters or big tech companies as an alternative to economic development rather than pursuing oil and mining. In early 2022, Greenland and Denmark made a declaration of intent to enable international loan to finance the establishment of two hydropower plants in the northern region of Greenland. The Government of Greenland is also planning to increase the capacity of the hydropower plant in Nuuk (Statsministeriet, 2021).

Functional region characteristics: The towns with a hydropower plant have a projected increase in population size due to the size of the investment and the projected lifespan of a hydropower plant (from an interview). These towns as compared to other towns have relatively better infrastructure, access to healthcare, and educated teachers in primary and secondary education. The average income is also relatively higher compared to settlements. The following table represents the population size from 2010-2020 in places where a hydropower plant provides energy:

Table 1.2: Greenland populations trends in towns with hydropower plants since 2010

Town	2010	2015	2020	Percentage of Greenland's population size (~56,000)
Nuuk	15,469	16,992	18,326	33%
Tasiilaq	1,930	2,093	1,985	4%
Ilulissat	4,546	4,491	4,670	8%
Sisimiut	5,460	5,572	5,582	10%
Qaqortoq	3,306	3,172	3,059	5%
Narsaq	1,613	1,535	1,351	2%

Note: Population size from 2010-2020 in places with a hydropower plant. Specific demographic data will be included when a region of focus has been decided.

Perceptual region characteristics: The perceptual characteristics can be exemplified with a quote by the current Minister of Energy, Kalistat Lund: "The investments in hydropower are a direct extension of the Naalakkersuisut's (in English: Ministers') visions of increasing green energy production and increasing our level of self-sufficiency." (Own translation), (Lindstrøm, 2021). The policy decisions regarding the development of the hydropower plants have been voted for unanimously. The first hydropower plant that was installed in 1993 in Nuuk proved successful and thus serves as a positive example of building the energy infrastructure with hydropower plants in places that are financially and technically feasible. The hydropower plant in Nuuk is perceived as a success because the investment has paid back, for instance between 1993 and 2021, the investment paid back 2,5 times (Toft, 2021).

15.5.2 CCIR description: case study 2 "in the Shadow of the Mountain"

Local geography and demographic characteristics (cf. 'Formal region characteristics'): Narsaq is in the south region of Greenland and is located 7 km from Kuannersuit which is the place where an open pit mine might be developed to extract rare earth minerals with uranium as a byproduct. The population size has been gradually declining within the last decade where the population size in 2010 was 1,613 and 1,351 in 2020. Since 1995, the working population has decreased by 25% whereas the number of elders has increased by 60%. The population is ageing and challenged by emigration (Naalakkersuisut, 2016). The unemployment rate in 2019 was 12,3% whereas the unemployment rate in all Greenland towns was at 4,7% during the same period. The town Narsaq has a history of sheep farming, fishing, and recreational and commercial hunting.

Local energy and demographic characteristics (cf. Functional region characteristics: The region of Narsaq receives electricity from a hydropower plant but uses fossil fuels for heating. It is a region where sheep farmers and fishermen and hunters live and work, but where resource rich families move to other towns due to a general low economic activity.

Perceptual region characteristics: The possibility of mining rare earth minerals with uranium as a by-product in the region of Narsaq can so far be decided for or against by the Government of Greenland. In 2013, the then-biggest political party Siumut (S) lifted the ban on mining for uranium after 25 years (Mølgaard, 2013). From 2020-2021, S was in a coalition with Demokraatit (D), a party that is a strong advocate for the so-called 'uranium-mining'. The chair of D Jens-Frederik Nielsen who was Naalakkersuisoq (Minister) for Raw Minerals told the media in January 2021 why he advocates for the uranium-mining: "The time to start [the mining-project] is just right. There are good prices for rare earth minerals. They must be used in the green transition. They are in demand because the rare earth minerals found in Kuannersuit can be used for magnets in wind turbines and batteries in electric cars" (Jens-Frederik Nielsen quoted in Sermitsiaq, 2021). The government's pursuit of the uranium-mining was strongly opposed by Inuit Ataqatigiit (IA) which is the biggest party in the south region of Greenland. IA opposes uranium-mining because of the environmental risks. A movement called 'Uran Naamik' (No to Uranium) also mobilized themselves in various regions of Greenland to oppose the interests of the government. The opposition towards uranium-mining became so strong that it became one of the main reasons for triggering an election in 2021 (Turnowsky, 2021). IA won the election and is now the biggest party in Greenland.

The locals in Narsaq and others who live near the region of Narsaq participate in the discussions of uranium-mining. They also represent opposing views. The first narrative can be represented by the following quote from a citizen in Narsaq: "[The mine] can totally ruin our lives. Our sheep and the connection we have to nature are destroyed if dust blows in from the mine and if the water in the fjord becomes polluted. But one cannot replace nature. Once you have eaten the last fish and the last sheep, there is no more to live on." (From an interview). The second narrative opposing the first narrative can be represented by a citizen also from Narsaq: "There are no opportunities here. No jobs. The mine is our best bet for a future for the young." (From an interview).

15.5.3 Societal problem

The overall societal and economic challenge related to the two case studies in Greenland concerns with the national overarching goal of attaining economic sovereignty. Most of the population wants to achieve full self-governance by forming an independent state, but the question remains whether and how Greenland can become independent without foreign economic dependency (Kuokkanen, 2021). Thus, the political discourse about sustainable development can become a matter of prioritizing economic sustainability. Within the same timeframe, the government has invested in hydropower plants that decreases the usage of fossil fuels while also issuing licenses for oil and gas explorations (see for example the visual on p. 2).

The gross domestic product (GDP) of Greenland measured in 2018 is 19.270 million Danish kroner (DKK). The GDP per capita in the same year is 345,000 DKK (Statistics Greenland, 2020). The economy has grown in the past few years due to favourable prices of fish and shellfish. 95% of exports come from the fishing industry. Greenland receives an annual economic grant from Denmark worth 3.9 million DKK (Wammen, 2020). The economic grants from Denmark and Europe constitute approximately 60% of Greenland's GDP (Naalakkersuisut, 2020). Therefore, the discourse about mining is usually positively linked to Greenland's state formation because it can promote economic self-sufficiency in the future (Gad, 2009 in Bjørst, 2017).

In 2021, however, the population voted for a new government with a more socially and environmentally conscious political party named Inuit Ataqatigiit as a protest to the so-called 'uranium-project' which has been pursued by the former government to develop the national economy. The new government prioritizes environmental and social sustainability on the coalition agreement. So far, the new government has banned the uranium project and the issuance of licenses for oil and gas explorations. The new government also has interest to join the Paris-agreement which requires the formulation of a climate strategy.

15.5.4 Research problem

The first case study, 'Chasing Waterfalls', investigates and analyzes the positive tipping processes that has led to a political initiative to develop hydropower plants in all regions of Greenland. The concept of tipping processes refers to those critical moments derived from human action critical moments derived from human action in which seemingly small to larger activities, not necessarily related to each other, can amount to a pressure that ultimately results in a tipping point (Tábara et al., 2021). The aim is to understand how political narratives of sustainable development have provided the legitimacy to implement hydropower plants, and how the hydropower plants help to promote a green energy transition. Our study is based on interviews with central stakeholders and documentary studies to explore the narratives of the leading actors for the adoption of an alternative low-carbon, clean-energy development trajectory.

The second case study, 'In the Shadow of the Mountain', investigates the transformative capacity of civilians to stop a mining project in Kuannersuit in the South region of Greenland. The mining project that would extract rare earth minerals and uranium as a by-product promoted the message of financial boost to Greenland's economy and jobs. However, the nearby communities came with an opposing view of how the mining project could destroy the ecosystem in the region if radioactive minerals were to be mishandled.

15.5.5 Research questions

How do the bureaucratic institutions and actors influence decision making for advancement, or lack thereof, of sustainable production and consumption?

15.6 Research approach

Case study 1, 'Chasing Waterfalls':

The theories of 'legitimacy' and 'sustainable development' will be applied to analyse political narratives about the establishments of hydropower plants. The concept of sustainable development in this case-study is understood as a political concept by which the vagueness of the concept provokes competing visions for the future (Gad, Jacobsen & Strandsbjerg: 2018). This case-study thus applies three types of legitimacies to enable the analysis of the political narratives about the projects of hydropower plants have been justified. The three types of legitimacies in the analysis are instrumental, procedural, and cognitive or cultural legitimacies (Dale, Bay-Larsen & Skorstad: 2018).

Case study 2, 'In the Shadow of the Mountain':

Theories for case study 2 will be based on value rationality concepts developed by Flyvbjerg (2004) as a part of a methodology referred to as Phronetic research method. The method is centered around four so-called value rational questions which investigates power and values for specific instances of planning: (1) Where are we going with planning? (2) Who gains and who loses, and by which mechanisms of power? (3) Is this development desirable? (4) What, if anything, should we do about it? These questions has been applied to explore the narratives and related values of locals in the region of Southgreenland.

15.6.1 Research methods and tools

Case study 1, 'Chasing Waterfalls':

In this study, political narratives are analyzed within decision-making processes in the transition from fossil fuels to renewable energies. First, relevant official documents and media content have been investigated to gain an overview of the tipping processes in the transition from fossil fuels to renewable energy, and to identify central stakeholders involved in decision making. The main sources of data for official documents were public materials gathered from the government, e.g. meeting transcriptions, feasibility studies, and policy documents. Second, qualitative interviews have been conducted with central political actors and former policymakers to gain detailed descriptions of their roles and motivations to pursue the transition to renewable energy.

Case study 2, 'In the Shadow of the Mountain':

The case study is based on quantitative studies of register data, literature review, and qualitative studies of archival and historical data. The desktop studies are combined with qualitative fieldwork focusing on conducting semi-structured interviews of relevant stakeholders.

15.7 Narratives

This case study report provides a visualisation of the characteristics of narratives to provide a visual overview of the perceived behaviors of various narratives related to energy.

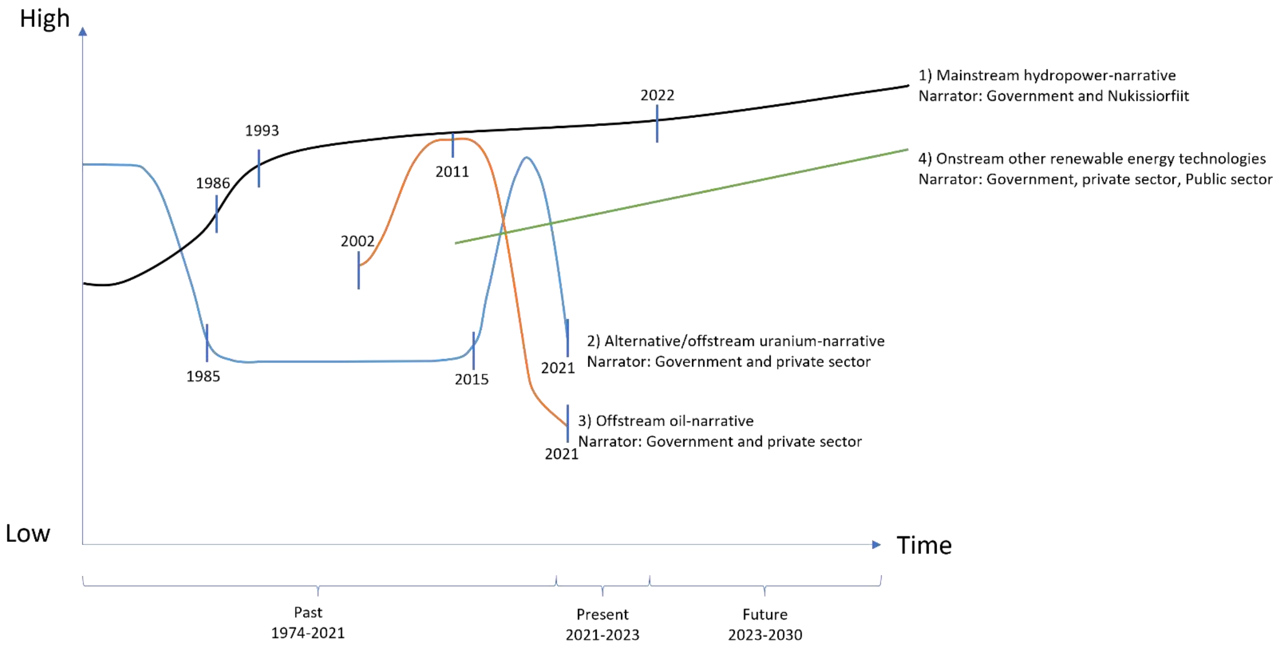


Figure 2: a visual representation of the characteristics of narratives related to energy

15.7.1 Mainstream narrative: technology

In Greenland, hydropower plants provide 60-70% of the country's public energy needs. Currently, five hydropower plants provide energy (in the form of electricity and heat) to six towns in all regions of Greenland. However, approximately 75% of total energy consumption for electricity and heat, both in public and private sector, is still depended on imported fossil fuels. The first hydropower plant was established in 1993 and the last plant was established in 2012. The government is currently negotiating the plans for implementing more hydropower plants in other towns in Greenland to decrease the usage of fossil fuels.

15.7.2 Mainstream narrative: stakeholders and institutions

The planning and decision-making of hydropower plants began at the government-level and continues to be discussed and negotiated by political actors in Greenland, and previously in Denmark. In 1975, which was the time the Parliament of Denmark governed Greenland, the Danish political administration established a workforce to conduct research on hydropower resources in Greenland. The aim was to look for alternatives to oil mainly due to the crisis in the middle east which had increased the price for oil. The primary focus was large-scale hydropower production that could provide energy to Europe. The research project was financed by the then-European Commission (EC) because Greenland was a member through its ties to Denmark (Naalakkersuisut, 2010). In 1979, the Home-Rule Act was effectuated in Greenland by which it was the first time that the Greenlandic people gained democratic rights over their homeland. The Government of Greenland, with elected Greenlandic politicians, took over the planning of the energy infrastructure in Greenland and formulated an energy plan. The Greenlandic politicians were interested in small-scale productions of hydropower to generate energy to citizens (Nukissiorfiit, 2005).

After Greenland left the EC, the Government of Greenland became responsible for the financial costs of researching for hydropower potentials. And thus, the search for hydropower potentials declined during that period. However, previous research could already point to hydropower potentials located in nearby towns. At the time, nearly 100% of energy in Greenland was supplied from imported oil (Grønlands Tekniske Organisation, 1986). In 1986, the Parliament of Greenland voted to implement an energy plan by which hydropower plants would be established in towns where it was financially and technically feasible (Naalakkersuisut, 2018a). In 1990, the Parliament of Greenland voted unanimously to implement the first hydropower plant at Utoqqarmiut Kangerluarsunnguani near the capital city Nuuk (Atuagagdliutit, 1990). The Greenlandic politicians were confident that hydropower plants could provide stable and cheaper energy to citizens and decrease the dependency on imported oil. For example, the then-Prime Minister of Greenland Jonathan Motzfeldt was quoted on the newspaper from 1990 where he expressed his joy about the unanimous vote to establish a hydropower plant near Nuuk, "Due to its long-term economic benefits, a hydropower-based energy supply will in turn secure the economy with the negative effects, among other things, on the trade balance of future energy crises with large fluctuations in oil prices." (ibid.).

The government owns the national energy company, Nukissiorfiit A/S, that is tasked with developing the energy infrastructure in Greenland. The government is thus a central player in developing the energy infrastructure in Greenland. Other stakeholders are municipalities with local politicians and organizations related to the government that work with energy and housing.

Institutions

The governmental bodies are responsible for the development of the energy infrastructure in Greenland. As mentioned in previous paragraph, the government owns the energy company which is tasked with developing the energy infrastructure. Besides governmental bodies, other institutions and private companies have implemented small-scale technology that provide renewable energy to decrease operational costs.

15.7.3 Mainstream narrative: ideologies

The ideology that has been dominant in Greenland is economic autonomy because the majority of the Greenlandic population wants to achieve independence (Kuokkanen, 2021). However, the younger generation is showing an interest in environmental sustainability. For instance, there is a green movement called 'Plastic not so fantastic' which is a community-led online movement that campaigns for a greener environment. The members of the movement also initiate small-scale projects to clean up towns and hold workshops on how to live life with less plastic.

We also learned through the stakeholder workshop that primary and secondary schools are quite active in teaching school children about environmental sustainability because the schools are following the guidelines from the municipalities. And the municipalities are following the policies from the government.

15.7.4 Mainstream narrative: policies

The energy plan from 1985 formulated by the (then) Home-Rule government guided the development of the energy infrastructure until 2012, which was used to implement five hydropower plants. In 2017, the Self-Rule government formulated an energy plan with a vague goal of increasing the utilization of renewable energy-systems "as much as possible" by 2030 (Naalakkersuisut, 2017). The energy plan supports renewable energy-projects when they are technically and economically feasible. The political strategies since 1986 guiding the pursuit of hydropower plants have aimed to becoming less dependent on imported fossil fuels, building capacity for cheaper and more secure supply of energy, strengthening trade balance, and attracting large industrial businesses to strengthen the national economy.

The current government announced in 2021 that it will examine the possibilities of joining the Paris-agreement. As stated elsewhere, the government has also approved the development of two more hydropower plants and a capacity expansion of a hydropower plant near Nuuk.

Other factors

Fossil fuels are still dominant Greenland when you account for the private sector.

15.7.5 Alternative (on-stream and/or off-stream) narrative: technology

The alternative pathway follows an on-stream narrative, where both the public and private sector are working on seeking other technical solutions for renewable energy-systems for remote places such as solar and wind power in small-scale. The implementations of alternative renewable energy-systems are expected to occur at small-scale, complementing the existing electricity supply from oil. The national grocery chain called Brugseni is one example where a company implemented solar energy on its shops in three towns as an alternative to oil to save operating expenses. This alternative pathway covers a period from approximately 2010 and onward.

15.7.6 Alternative (on-stream and/or off-stream) narrative: stakeholders and institutions

The stakeholders for the alternative pathway include actors from the public and private sector. Politicians are interested in implementing cheaper energy-solutions for smaller towns and settlements and to implement more hydropower plants where it is financially feasible, which was evident form the outcome of the workshop in Sisimiut conducted as a part of the case study. The government owns an energy company called Nukissiorfiit that is interested in implementing renewable energy as much as possible and is running experiments such as wind power in remote places. Other stakeholders include private households, municipal institutions such as homes for elders, and companies interested in investing in cheaper and greener energy to replace oil.

Institutions

The interest in implementing renewable energy-systems run on national and regional levels, because the established hydropower plants have proven to be more cost-efficient than oil. The Greenlandic political parties in Government, agree on implementing renewable energy-systems as much as possible especially if it will give socioeconomic benefits. These commitments, policies, and strategies shows the citizens and political leaders' motivation for renewable energy, however it as been demonstrated that the technical and financial aspects of the development process drive the final decisions.

15.7.7 Alternative (on-stream and/or off-stream) narrative: ideologies

The guiding ideology behind the development of renewable energy-systems in Greenland is economic development. However, there are emerging narratives from the younger population with an ideology guided by environmental and social sustainability. This may stem from increasing awareness and education in schools on climate change and implications of environmental degradation.

15.7.8 Alternative (on-stream and/or off-stream) narrative: policies

The policy instruments for implementing renewable energy-systems in Greenland have focused on hydropower solutions. The government owned energy company, Nukissiorfiit, finances its own research on developing other small-scale solutions such as home wind turbines, solar cells micro hydro solutions and other technologies relevant for smaller and more remote places. According to Nukissiorfiit, the budget for researching is limited and there is interest in expanding its research if the government could provide financial support.

Other factors

The popularization of sustainability and Sustainable Development Goals (SDG) are shaping politics in Greenland. Institutions and different types and sizes of organizations are implementing sustainable practices and SDGs in their Corporate Social Responsibility (CSR) policies in different regions in Greenland. Similarly, sustainability discourses also affect the narratives with regards to the planning of hydropower plants.

15.8 Stakeholder engagement

Identification of stakeholders:

(As stated in Deliverable 6.1 "Plan of Dissemination and Outreach (PDOR)", stakeholders in TIPPING+ are defined as entities that are affected by, or can influence, the emergence of Social-Ecological Tipping Points (SETPs), both positive and negative, in Coal and Carbon Intensive Regions (CCIRs) (Michas et al., 2020). The first stage is then to identify those stakeholders in the Case Study scope.)

The identification of stakeholders for Case Study 1 (CS1), 'Chasing Waterfalls', was performed as part of the planning process of a stakeholder workshop. The first task was to define the purpose of the stakeholder workshop, and this part of the process was guided by the findings from our initial desktop studies. We learned that even though the hydropower plants provide renewable energy, primarily in the form of electricity to 60-70% of the population in Greenland, most of the energy used for heating comes from imported fossil fuels Naalakkersuisut. (2018a). In three out of five towns with a hydropower plant, the energy usage for heating comes from fossil fuels due to limited capacity of the hydropower plant. As a result, the purpose of the workshop was to discuss with stakeholders how to transition from fossil fuels to renewable energy in the heating area for all towns and settlements in Greenland.

A total of nine people participated in the workshop. There were three people registered for the workshop who could not participate due to flight cancellations from the coast. The participants represented national politicians, municipal politicians and planners of heat supply in Greenland. The following took part in the workshop (names are provided with the consent of the participants):

- Project manager in the construction section at the Department of Housing
- District Manager at Nukissiorfiit A/S

- Team Leader at Nukissiorfiit A/S
- Technician at INI A/S
- Committee Chairman for the Area of Technology and Environment in Qeqqata Municipality and schoolteacher in Nalunnguarfiup Atuarfia
- Construction Manager for the Area of Technology and Environment in Qeqqata Municipality
- Minngortorsuup Atuarfia
- Enterprise manager at Permagreen A/S
- Self-employed entrepreneur with a focus on energy

Cancellations from: Kalistat Lund, Naalakkersuisoq for Agriculture, Self-sufficiency, Energy and Environment; Naaja Nathanielsen, Naalakkersuisoq for Housing, Infrastructure, Raw Materials, Justice, and Equality. There were thus no representatives of the national decision-makers at the workshop, which could potentially have contributed with specification of their visions for a fossil free future in Greenland.

15.8.1 Active stakeholder engagement

A total number of five interviews have been conducted with selected stakeholders, and some were engaged in the workshop described in the following. Four of the interviewees were politicians from Government and one was a project manager with Nukissiorfiit.

The workshop was held by the Greenland case study team in Sisimiut, Greenland on November 4, 2021. The title of the workshop was: towards a fossil free future in Greenland. The workshop focused on identifying challenges and opportunities for further supporting a green transition in Greenland.

The institutions represented at the workshop were asked to prepare and give a presentation during the workshop. The presentations were collected and will serve as further empirical material for the Greenland case study, together with the notes and observations made during the workshop. The workshop was held in conjunction with the Greenland Science Week and was a part of the official programme. The workshop was held with a total number of 12 invited participants. As a part of the Greenland Science Week programme, we further gave a public lecture on the topic of the workshop including a general introduction to the Tipping+ project. Nineteen people attended the public lecture.

Table 3: Stakeholder engagement checklist

Month	Action	Status
By month 10	Have you identified your stakeholders?	**X**
	Have you analysed and mapped your stakeholders?	**X**
	Have you started the consultation process with your stakeholders?	**X**
	Have you invited the stakeholders to your first stakeholder’s workshop?	**X**
By month 12	Have you held the first stakeholder workshop?	**X**
	Have you integrated their feedback?	☐
	Have you contacted stakeholders to thank them for their inputs and share first results?	☐
By month 24	Have you integrated stakeholders’ inputs to your case study analysis?	☐
	Have you communicated the preliminary results of the research to your stakeholders?	☐
	Have you evaluated the interaction process?	☐
	Have you considered the lessons learned from the first workshop to design the second one?	☐
	Have you invited stakeholders to participate in the second workshop?	☐
	Have you contacted stakeholders to thank them for their inputs and share first results?	☐
By month 36	Have you communicated the project results to your stakeholders?	☐
	Have you invited your stakeholders to the final conference?	☐

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16 Case study 15: Lofoten, Norway

Realizing alternative energy futures in the Arctic: From the promise of a petroleum future to the Green Isles

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16.5 Introduction

Norway's petroleum era began in the 1960s, when exploration in the North Sea led to significant oil discoveries. Since then, numerous offshore oil and gas fields have been developed along the Norwegian Continental Shelf (NCS), with the first fields being developed in the North Sea, and then in the Norwegian Sea and the Barents Sea as activities have gradually expanded northwards and into the Arctic (See Figure 1).

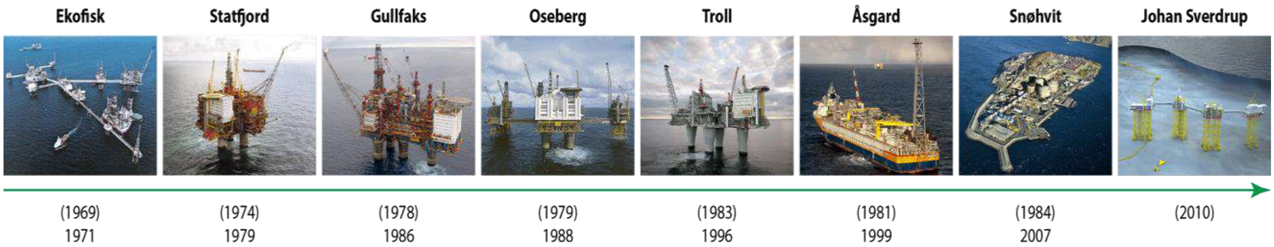

Figure 1. Historical timeline of some important fields (Source: The Norwegian Petroleum Directorate).

Over the course of the past 50 years Norway's economy, politics, and society have become inextricably intertwined with the production and exportation of oil and gas. Indeed, oil and gas revenues now play a central role in Norway's economic prosperity, accounting for almost half of the country's export revenues in 2021,1 up from one third in 1980 (Gjerde 1982: 96). Oil and gas revenues are thus a cornerstone of the robust Norwegian welfare state. As of 2021, Norway's oil and gas industry generated 60 percent of national exports and 15 percent of the country's GDP2. To this day, the Norwegian government maintains a significant direct stake in oil and gas production through two-thirds ownership of the state-owned Equinor (formerly Statoil). Norway also maintains a significant indirect stake in oil production through marginal tax rates of up to 78 percent on oil and gas profits. These revenues fund an enormous sovereign wealth fund, valued at over 11.5 trillion NOK (1.15 trillion USD) per date3, and a specified surplus (no more than 4 per cent) from investments in this fund covers budget deficits (Mildenberger 2020:67-68).

From a global perspective, Norway's oil and gas industry was the world's fifteenth largest oil producer in 2021, extracting a little under two million barrels per day. It was also the world's seventh-largest natural gas producer in the world and third-largest exporter, only behind Russia and Qatar, supplying 3% of global gas consumption. As much as 98% of Norway's natural gas production is exported to Europe, accounting for around 25% of EU gas demand, second after Russia (30% in 2021). Norway is also a significant oil producer, accounting for 2.3% of global oil production in 2020 (IEA 2022).

The importance of the petroleum sector for Norway can therefore not be understated. However, despite being a major oil and gas producing economy, Norway also has an international reputation for being a leader in progressive climate policymaking. Norway was the second country in the world to introduce a carbon tax, in 1991, and the country has also committed to national carbon neutrality by 2030. However, while the domestic policymaking trajectory in Norway has achieved significant incremental reforms, it has never imposed threatening costs to entrenched Norwegian carbon polluters (Mildenberger 2020: 66).

16.5.1 CCIR description

Formal region: The Lofoten archipelago is characterized by rugged coastlines and high mountains and is located just above the Arctic circle in Northern Norway. The archipelago is in the county of Nordland, covers 1,227 km2 and has a population of 23,500 inhabitants. The climate is rough – with long winters and short summers. In the wintertime, northern lights flair the skies, whilst the midnight sun provides a welcoming extension of sunny periods during the summer season, provided the weather is good enough for the sun to appear at all (Dale 2011).

The geographic area Lofoten has been designated as a region historically for at least a millennium and is today a formalized region with six municipalities (Flakstad, Moskenes, Røst, Vestvågøy, Værøy and Vågan) and a regional council based (Lofotrådet) on representation from the six municipalities. Most of the population lives mostly in and around the two towns of Svolvær and Leknes, in addition to around thirty small fishing villages spread throughout the archipelago.

Functional region: The Lofoten region is rich in hydrocarbon deposits but is also a world class tourism destination and the hub of some of the richest and most valuable fisheries in the North Atlantic Ocean (Kaltenborn 2019, Kristoffersen & Midtgard 2016, Steen Jacobsen & Dann 2003).

Today, a network of roads ties most communities together, but just a few decades ago, many were dependent on ferries or the coastal steamer that for over a century has been considered the lifeline of the Norwegian coast, bringing both people and goods to and from fishing communities, trading centers and industrial towns alike. Most settlements, be they large or small, were originally based on fisheries, and many still rely on income from the sea – as costal fishers and trawler crew, or as seafarers in cargo shipping or the petroleum industry (which in Norway is an offshore activity). In Svolvær, public administration, a strong shipyard industry and a booming tourism sector are now the main economic activity whilst in Leknes, trade and administration are the main sectors, in a municipality where both fisheries and farming still hold strong (Dale 2011).

Cod was and is the raison d'etre of the Lofoten region. Every winter, the northeast Arctic cod (Gadus morhua) migrate from the Barents Sea and the waters around Svalbard to the coastal areas of Lofoten and Vesterålen to spawn. The fish gather on the spawning grounds in February – March, with peak spawning around 1 April. The fisheries have traditionally done from small coastal vessels and the fish are caught with jigs, handlines, gillnets, and Danish seine. The Lofoten winter fishing season (Lofotfiske) can be documented back about 1000 years to the time of the Vikings and has been a foundation for settlements in most of the coastal communities of northern and northwestern Norway. For centuries, trading of stockfish (dried cod) from this fishing season was the main activity of the Hanseatic merchants in Bergen, at the time the largest city in Norway. Up to 33,000 fishermen participated in the Lofoten winter fishing season, landing about 81,000 TON of cod. Today, most of the Norwegian quota of the northeast Arctic cod is caught by larger vessels in the southern Barents Sea and off the coast of northern Norway. However, the Lofoten winter fishing season remains vital for the smaller vessels and artisanal coastal fishermen (Misund & Olsen 2013).

The challenges typical for peripheral and rural regions are also found in Lofoten; a declining and aging population (although in recent years a small increase has actually been observed) due to low birth rates and young adult outmigration, a lack of infrastructure investment enabling business to compete with more centrally positioned competitors, a chronic scarcity of risk capital and relatively scarce municipal finances meant to ensure that basic needs and services are provided for inhabitants.

Perceptual region: Due to an historical heritage and a culture spawned from a common adaptation to an ecology specific to the region (see above), actors across the region self-identify as Lofotinger, tied to a joint understanding of the dependency of the bounties offered by the sea, but also a faith influenced by the roughness of the surroundings (see Dale, 2011 for details).

A main line in the popular discourse on alternative development paths for Lofoten assumes that hydrocarbon exploitation runs a high risk of spills and pollution that would be detrimental to tourism and coastal fisheries (e.g., Aftenposten, 2010; Lofotposten, 2017).

The Lofoten dispute involved local, regional, national, and international policy levels and concerns (Buck & Kristoffersen 2011, Kristoffersen & Dale 2014, Misund & Olsen 2013). The Lofoten dispute mirrors larger scale challenges in the Arctic and the Sub-arctic and involve dimensions of national and international energy security and revenues, the livelihoods and future prospects of a thriving, year-round tourism industry and protecting cultural heritage, traditional coastal fisheries and sustainable local livelihoods (Arbo, Iversen, Knol, Ringhold & Sander 2013; Grydehøj & Grydehøj, 2012). As Kaltenborn (2019:3) points out, these are all elements in the larger picture of dramatic on-going changes in northern coastal regions, where political, societal, and natural drivers of change on different scales act in tandem to produce a complex socio-political landscape that is difficult to navigate in terms of understanding the positions of divergent stakeholders.

It is in this setting the question of petroleum development and the potential benefits it could bring to coastal communities was introduced, and although the matter had been debated on and off for at least two decades before, the issue became a political hot topic only after the release of the first marine management plan4 for the Barents and Lofoten seas in 2006–and reached a heated peak during the revision process of this plan from 2008 to 2011. Based on the political developments up to 2015, however, one can with almost complete certainty claim that the debate will continue also up until the elections of 2017, and that Norwegian high north politics seems almost destined, every once in a while, to "look to Lofoten". (Dale 2016:10-11).

16.5.2 Societal problem description

How to bring about a new transition towards a more sustainable, decarbonized energy future is one of the main challenges of the twenty first century (Bridge at al. 2018). While many countries have set ambitious targets aimed at reducing greenhouse gas (GHG) emissions, facilitating transitions to low-carbon energy systems remains complex, challenging, and costly. Within this context, Norway has positioned itself as a pioneer in progressive climate policy action and aims at net carbon neutrality by 2050. Norway is an energy-rich country that is in a unique position with respect to the energy transition. The country's abundance of affordable hydropower has enabled the development of energy-intensive industries and a high level of electrification of homes and businesses with limited GHG emissions. However, at the same time, Norway is – and aims to remain – a major global oil and gas producer, a stance which is currently fortified by an increasingly volatile energy security situation in Europe (IEA 2022). As a result, Norway finds itself at a potentially tenuous crossroads, where the future of fossil fuels is both contested and promoted. Examining the Janus-face of Norway's ambitious climate action aspirations and the "the seemingly hard- coded embeddedness of Norwegian petroleum in the very fabric of Norwegian identity and society" (Dale and Farquharson 2021:146), offers useful insights into the conditions, opportunities, and strategies that may unsettle the status quo of fossil fuel energy systems.

16.5.3 Research problem

This study examines – through the lenses of energy geography and environmental politics – the debate about whether to allow oil and gas development in the seas outside of Lofoten, Vesterålen and Senja ("LoVeSe") in the Norwegian Arctic, the last remaining acreage of the NCS5 closed to petroleum activities. Over the years, pressure has mounted to open the remaining areas of the Norwegian Continental Shelf and expand petroleum activities further into the Arctic. The discussion about whether to allow drilling in the LoVeSe area gained increasing attention in the mid-1990s, both locally and nationally, a discussion which became increasingly divisive and polarizing. While those in favour of oil argued that oil and gas would bring vitally needed economic prosperity to a region experiencing rapid out-migration, rural decline and economic challenges, opponents voiced concerns about the potential environmental risks associated with drilling activities. Opponents were particularly concerned about the harmful impacts an oil spill could have on the North Atlantic cod stock – or the skrei – which has its main spawning area outside of the Lofoten archipelago and has been the be-all and end-all of the region's livelihood and culture for centuries.

Eventually, a grassroots-drive coalition of fishermen, environmental activists, and residents emerged that later evolved into a strong, broad-based social movement – The People's Action for an Oil Free Lofoten, Vesterålen and Senja ("People's Action") – and fought against petroleum activities in the region for over a decade.

In 2001, the Norwegian parliament postponed the decision to open the areas and has since then continued– albeit begrudgingly – to extend a de facto ban on drilling in the region one election cycle at a time. A watershed moment then took place in 2019, when the Norwegian Labour Party announced that it was withdrawing support for drilling off the coast of the LoVeSe region. The move marked the end of political support for further exploration in the Arctic waters and was seen as a major blow to Norway's oil and gas industry, which has for a long time viewed access to the region as a holy grail. For now, the ban introduced in 2001 still holds, and no licenses have been issued in the region (Kristoffersen, Bridge & Steinberg 2021).

In fact, in June 2022, the People's Action declared victory in its campaign for a permanently oil-free Lofoten Vesterålen and Senja and unanimously voted to disband the organization.

The fact that a broad-based coalition of mostly grassroots actors was able to stop oil and gas development in its tracks in the LoVeSe region is highly unusual given the significance of petroleum production to the Norwegian economy, and the dominant order of the Norwegian resource regime, which is characterized by deeply entrenched pro-carbon interests. Despite these conditions, the LoVeSe conflict disrupted a highly change resistant, pro-carbon pattern in Norwegian energy politics. We argue that a closer examination of the dispute may elucidate valuable insights into the conditions, opportunities, and strategies that unsettle the status quo of fossil fuel energy systems and foster transitions towards less-carbon intensive emissions trajectories. As such, the LoVeSe case "…shows that despite the seemingly hard-coded embeddedness of Norwegian petroleum in the very fabric of Norwegian identity and society, there are developments that point in the direction of disruptions to that system: towards opposition to oil and alternative future narratives (Dale and Farquharson 2021:146-147)."

16.5.4 Research questions

Our overarching research question is: how – over the course of a 20-year period – a seemingly locked-in development pathway towards a petroleum future "tipped over" to an alternative, low-carbon development trajectory?

To answer our research question, we set fourth three primary objectives:

1) Identify and assess potential "tipping events" that occurred during the period of 2000-2020.

2) Understand how alternative visions of an "oil free" future materialized in the Lofoten region.

3) Analyze the potential of specific outcomes from the Lofoten dispute, such as the "Lofoten Green Isles" initiative, to successfully transition from carbon-intensive pathways and foster lasting lock-in of decarbonizing trajectories.

16.6 Research approach

The research analysis presented in this article draws on a qualitative framework and is based on semi- structured interviews (using purposive and snowball sampling strategies), ethnographic methods, qualitative process tracing, discourse analysis, and textual and document analysis gathered through ongoing research undertaken from 2008 to 2022, but which extends further back in time through media and document analysis. We also employ qualitative media analysis of local, regional, and national media coverage of oil and gas development in the Lofoten region from 2000-2022. We use Nvivo, a qualitative data analysis software to carry out a media analysis. The research is based in a grounded theory approach and a dialectical dialogue between theory and empirical material (Bryant & Charmaz, 2011). By this we mean that the research process was unfolding in nature and that we let our empirical findings guide the development of our study's design (Maxwell, 2013). We also emphasize the importance of ethnographic engagement and contextual analysis to explore "… how multiple forces come together in practice to produce particular dynamics or trajectories" (Hart 2004, p. 97). Our approach to data analysis brings together information gathered from a wide range of political actors, including public officials, environmental organizations, grassroots activists, and industry actors. For the purpose of this study, we delimit our analysis to the Lofoten region. While all three regions of Lofoten, Vesterålen and Senja are included when political decisions are made concerning potential petroleum development in the area, the Lofoten region is by far the most profiled, researched, and symbolically important of the three. For this reason (and the fact that both authors live in Lofoten – the second author has lived and worked there for over 12 years), we focus mainly on how its development has been influenced by the debate – and how Lofoten has also become an important political issue in and of itself (Dale and Farquharson 2021:152).

16.7 Narratives

In our material, we observe a shift in strategic planning and policymaking for the region from a dominant mainstream narrative in the early 2000s which centered on opening the LoVeSe area to offshore drilling, to a new alternative future narrative centered on decarbonization and circularity that emerged in the late 2010s.

Figure 2. offers a visual representation of the tentative narrative trajectories which we have thus far identified.

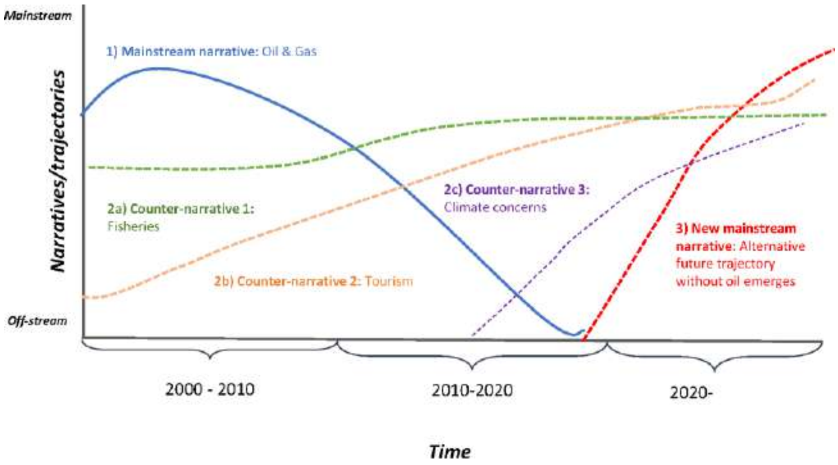

Figure 2. Lofoten case narratives and trajectories (2000-2020)

The mainstream and hegemonic narrative at the beginning of the early 2000s was one in which the Nordland VII area would be opened to offshore oil and gas activities, and which advanced a future development pathway with petroleum production as the main driver in the region.

However, several counter-narrative existed, some of which predated the petroleum era. We identify three distinct counter-narratives, which all center on future development trajectories without petroleum. The first counter-narrative is that of fisheries as a vital cultural heritage and longstanding economic activity in the region. Although discussions ran hot over whether fisheries could peacefully coexist with the petroleum industry in the region, this specific narrative had as its basic premise that it could not, and that therefore, the oil alternative would potentially mean the end to traditional fishing in the area. The second counter- narrative sees tourism – particularly nature-based tourism – as important to the future of the region and argues that oil and gas activities conflict with the goals of regional tourism development. A third counter- narrative then starts to emerge in which climate concerns are increasingly seen as urgent, and the 2015 Pari Agreement also institutionalizes these concerns. Finally – and to a large extent a result of a combination of the described counter-narratives - a new alternative narrative focusing on a future without oil and gas emerges as the new mainstream narrative. In particular, the idea of "The Green Isles"6 sets into motion a new regional development trajectory that centers on decarbonization, electrification and circularity.

16.8 Trends and indicators for sustainable transformations

16.8.1 Geography and migration

Formal region: The Lofoten archipelago is characterized by rugged coastlines and high mountains and is located just above the Arctic circle in Northern Norway. The archipelago is in the county of Nordland, covers 1,227 km2 and has a population of 23,500 inhabitants. The climate is rough – with long winters and short summers. In the wintertime, northern lights flair the skies, whilst the midnight sun provides a welcoming extension of sunny periods during the summer season, provided the weather is good enough for the sun to appear at all (Dale 2011).

The geographic area Lofoten has been designated as a region historically for at least a millennium and is today a formalized region with six municipalities (Flakstad, Moskenes, Røst, Vestvågøy, Værøy and Vågan) and a regional council based (Lofotrådet) on representation from the six municipalities. Most of the population lives mostly in and around the two towns of Svolvær and Leknes, in addition to around thirty small fishing villages spread throughout the archipelago.

Functional region: The Lofoten region is rich in hydrocarbon deposits but is also a world class tourism destination and the hub of some of the richest and most valuable fisheries in the North Atlantic Ocean (Kaltenborn 2019, Kristoffersen & Midtgard 2016, Steen Jacobsen & Dann 2003).

Today, a network of roads ties most communities together, but just a few decades ago, many were dependent on ferries or the coastal steamer that for over a century has been considered the lifeline of the Norwegian coast, bringing both people and goods to and from fishing communities, trading centers and industrial towns alike. Most settlements, be they large or small, were originally based on fisheries, and many still rely on income from the sea – as costal fishers and trawler crew, or as seafarers in cargo shipping or the petroleum industry (which in Norway is an offshore activity). In Svolvær, public administration, a strong shipyard industry and a booming tourism sector are now the main economic activity whilst in Leknes, trade and administration are the main sectors, in a municipality where both fisheries and farming still hold strong (Dale 2011).

Cod was and is the raison d'etre of the Lofoten region. Every winter, the northeast Arctic cod (Gadus morhua) migrate from the Barents Sea and the waters around Svalbard to the coastal areas of Lofoten and Vesterålen to spawn. The fish gather on the spawning grounds in February – March, with peak spawning around 1 April. The fisheries have traditionally done from small coastal vessels and the fish are caught with jigs, handlines, gillnets, and Danish seine. The Lofoten winter fishing season (Lofotfiske) can be documented back about 1000 years to the time of the Vikings and has been a foundation for settlements in most of the coastal communities of northern and northwestern Norway. For centuries, trading of stockfish (dried cod) from this fishing season was the main activity of the Hanseatic merchants in Bergen, at the time the largest city in Norway. Up to 33,000 fishermen participated in the Lofoten winter fishing season, landing about 81,000 TON of cod. Today, most of the Norwegian quota of the northeast Arctic cod is caught by larger vessels in the southern Barents Sea and off the coast of northern Norway. However, the Lofoten winter fishing season remains vital for the smaller vessels and artisanal coastal fishermen. (Misund & Olsen 2013).

The challenges typical for peripheral and rural regions are also found in Lofoten; a declining and aging population (although in recent years a small increase has actually been observed) due to low birth rates and young adult outmigration, a lack of infrastructure investment enabling business to compete with more centrally positioned competitors, a chronic scarcity of risk capital and relatively scarce municipal finances meant to ensure that basic needs and services are provided for inhabitants.

Perceptual region: Due to an historical heritage and a culture spawned from a common adaptation to an ecology specific to the region (see above), actors across the region self-identify as Lofotinger, tied to a joint understanding of the dependency of the bounties offered by the sea, but also a faith influenced by the roughness of the surroundings (see Dale, 2011 for details).

A main line in the popular discourse on alternative development paths for Lofoten assumes that hydrocarbon exploitation runs a high risk of spills and pollution that would be detrimental to tourism and coastal fisheries (e.g., Aftenposten, 2010; Lofotposten, 2017).

The Lofoten dispute involved local, regional, national, and international policy levels and concerns (Buck & Kristoffersen 2011, Kristoffersen & Dale 2014, Misund & Olsen 2013). The Lofoten dispute mirrors larger scale challenges in the Arctic and the Sub-arctic and involve dimensions of national and international energy security and revenues, the livelihoods and future prospects of a thriving, year-round tourism industry and protecting cultural heritage, traditional coastal fisheries and sustainable local livelihoods (Arbo, Iversen, Knol, Ringhold & Sander 2013; Grydehøj & Grydehøj, 2012). As Kaltenborn (2019:3) points out, these are all elements in the larger picture of dramatic on-going changes in northern coastal regions, where political, societal and natural drivers of change on different scales act in tandem to produce a complex socio-political landscape that is difficult to navigate in terms of understanding the positions of divergent stakeholders.

It is in this setting the question of petroleum development and the potential benefits it could bring to coastal communities was introduced, and although the matter had been debated on and off for at least two decades before, the issue became a political hot topic only after the release of the first marine management plan7 for the Barents and Lofoten seas in 2006–and reached a heated peak during the revision process of this plan from 2008 to 2011. Based on the political developments up to 2015, however, one can with almost complete certainty claim that the debate will continue also up until the elections of 2017, and that Norwegian high north politics seems almost destined, every once in a while, to "look to Lofoten". (Dale 2016:10-11).

16.9 Summary of key findings

Our preliminary results indicate that several soft tipping points have occurred, and that these originated at different scales both within and beyond the region itself. Figure 3. Identifies several important events that influenced the trajectory of the Lofoten "oil question" and which we will analyze using a "Socio-Ecological Tipping Point" framework.

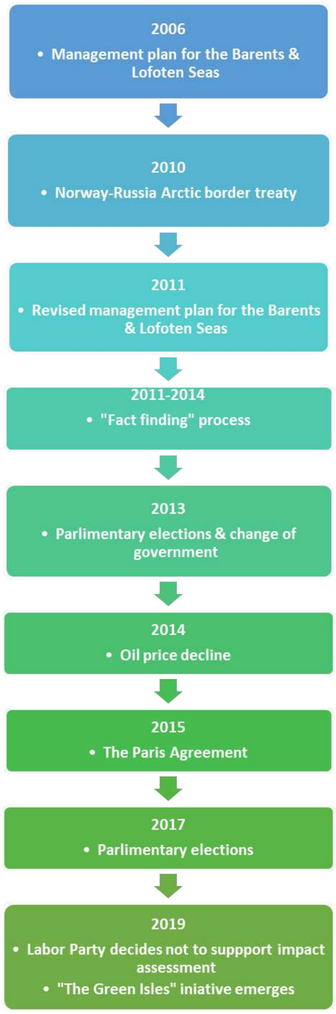

Figure 3. Lofoten case timeline and tentative tipping events

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17 Case study 16: Svalbard, Norway

Tipping points in the transition away from coal energy and economy on Svalbard, Norway

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17.5 Introduction

17.5.1 CCIR description

	Formal region characteristics	Functional region characteristics	Perceptual region characteristics
Case study name	Svalbard is an Arctic archipelago governed by Norway under the Svalbard Treaty of 1920. The Lokalstyre is the local government body, while the Sysselmester is the state government representative. Many local residents do not have voting rights as these are only granted to Norwegian citizens and those residing more than 2 years.	The region is above the Arctic Circle and dominated by tourism and research that link the archipelago first to Tromsø and Norway. The city of Longyearbyen is a hub for cruises and expeditions to natural areas across the islands and coast. Its Arctic location, permafrost, and lack of connection to external power grids places limits on renewable energy alternatives.	Svalbard is a region that has been dominated by explorers, adventurers, and miners. Mining has been phased over previous decades, excepting one mine in Longyerabyen and another in the Russian town of Barentsburg, the allure of exploration and adventure continues to draw tourists and researchers to the Archipelago.

17.5.2 Societal problem description

In Svalbard the mainstream narrative has become superseded in the present by an off-stream narrative, though not yet arrived within the transformative-stream narrative where the future vision of a new economic basis has become reality. Since 1920, coal mining has maintained the Norwegian sovereignty of the Svalbard Archipelago. Coal prices have fluctuated and debates surrounding green transitioning have persisted. Starting in the 1990s, the Norwegian government increased the budget allocations for research and higher education, while supporting the growth of the tourism industry. The intention is for these three areas to take over from coal as the supporting economic basis for Svalbard. With the closing of the coal mines and the coal fired power plant, the population of Svalbard has changed (Figure 1), more dominated by seasonal workers and short-term residents (Figure 2). The ability to grow these new economic activities, as well as ability to find viable energy alternatives remain substantive challenges.

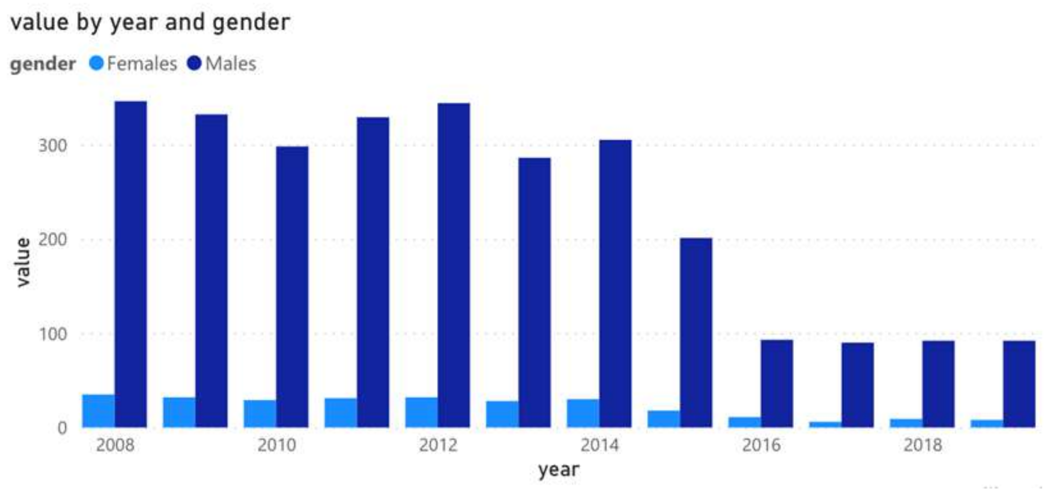

Figure 1 Men and women's employment in Longyearbyen mining and quarrying 2005-2020.

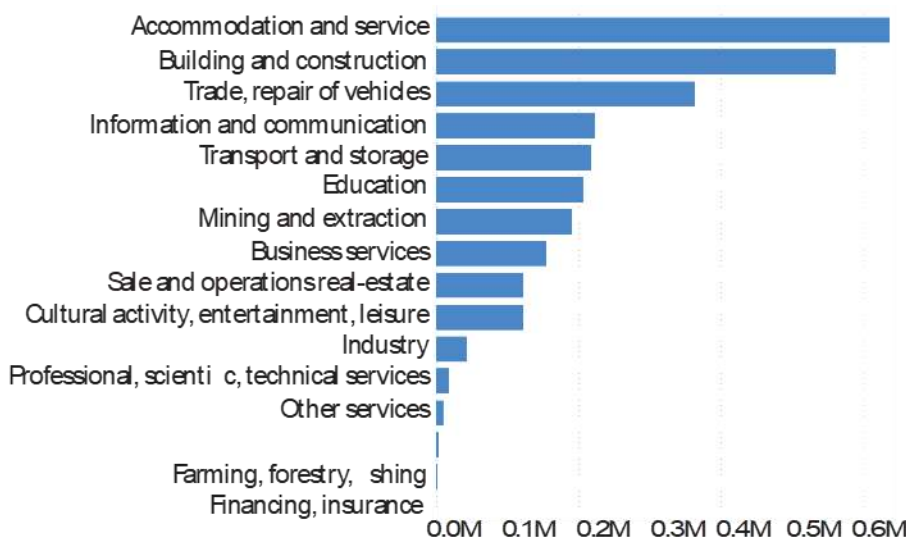

Figure 2: Employment in Svalbard industries (Data: SSB 2021)

17.5.3 Research problem

The research seeks to understand the decision process that led to the decision to close down the coal mining and coal energy generation, ii) to understand how these changes are affecting the Svalbard economy and society, and iii) to uncover how present residents and past coal mining residents perceive the future of the Svalbard region after coal.

17.5.4 Research questions

i) What precipitated the decision to end reliance on coal in the Svalbard energy and economic bases? Ii) How has the decision to end reliance on coal affected the Svalbard society? Iii) what are likely trajectories of change from the 2018 decision to phase out coal?

17.6 Research approach

Literature on tipping points, on Svalbard mining, and on Lofoten oil exploration and development includes peer reviewed literature, grey literature including reports and legal documents, conventional media articles, websites, and social media content. For Svalbard, the literature search on coal mining included a majority conventional media articles from 1999 to 2020. For Lofoten, this literature review is ongoing.

Interviews were carried out with key informants from business, government, volunteer organizations, and residents in Longyearbyen in fall 2021, and in Lofoten in spring 2022. Ethics clearance has been sought and approved for these interviews with NSD (Norsk Senter for Forskningsdata, Norwegian Centre for Research Data). Some interviews were recorded and transcribed where consented by interviewees, and other interviews were noted in fieldnotes where recording was not approved.

17.7 Narratives

17.7.1 Mainstream narrative: technology

The dominant technological sectors in the region have been coal power electricity generation and coal mining. These technological sectors have been located on Svalbard near Longyearbyen. Mining has occurred in eight locations through Norwegian companies, with only one remaining open at Gruve 7 in 2022. In addition, A Russian mine is also operated in Barentsburg, but also this mine is planned for closure.

Coal mining was dominant for the past century or so. Store Norske, the Norwegian mining company started coal mining in 1916, when taking over the “America mine” from the US-based Arctic Coal Company who started mining in 1906. Coal prices have fluctuated over the years, and investment in alternative economic bases started in the 1980s and 1990s to support teaching and education, as well as tourism. Employment in coal started decreasing in the late 1980s, and the decision to close the mines has surfaced intermittently. The final decision to phase out coal came in 2018 with the closure of Svea and Lunchefjell mines, and in 2020 to start an energy-shift project to enable closing the coal power station by 2023.

17.7.2 Mainstream narrative: stakeholders and institutions

Mining company workers and owners, government representatives, but also explorers, researchers, and adventurers have been dominant stakeholders in the region. Fishers and seal and whale hunters have been a much longer standing stakeholder group who have ventured here for centuries. Today small tourism and education businesses, as well as the university are dominant stakeholders.

These stakeholders have mostly been located in Longyearbyen, but not permanently. Since Svalbard is not a lifecycle community, people only live here to work. They will have a place in Norway or another country where they come from and will move to. The government is located in Norway, in addition to the local government representatives in Longyearbyen. The mining company has had its main offices in mainland Norway. The tourism companies are mostly located on Svalbard, with the exception of large cruise ships, some owned by businesses located on the mainland. The University Center on Svalbard hosts researchers and is connected with the University of Tromsø in Norway.

Fishing was dominant for centuries before adventure and exploration became important in the later 1800s. Coal mining and government stakeholders became dominant from the early 1900s. Tourism and education grew from the 1990s onward.

The Norwegian state has been a dominant stakeholder providing support for the Svalbard settlement. Maintaining sovereignty of the archipelago via residence and economic activity is reliant on subsidies from the State.

The dominant institutions in the region have been national mining corporations, small businesses, and government offices. These institutions have been located in Longyearbyen, Tromsø, Oslo, and other locations in Norway and internationally. Mining institutions have been dominant since 1900, tourism, then education and research have been dominant since around 2010.

17.7.3 Mainstream narrative: ideologies

The ideologies that have been dominant in the region have shifted with the dominance of fishing, coal, and tourism and research. Common to each has been frontier adventurous ideologies that has driven explorers, fishers, researchers, and other visitors to this remote and extreme environment. Alongside these ideologies have also been nation-building, where Norway has sought to retain sovereignty over the archipelago and surrounding seas. One might also consider as an ideology the present push to cease coal mining despite lack of viable alternatives. That is, the move to cease coal is a symbolic gesture motivated by ideology more than practicality.

The ideology of frontier adventures stem from, amongst others, Western ideals of the self-made man, conquering nature and wilderness and rendering nature and places knowable to science, mapping, and state-making. The ideology of nation-building is ancient, but was very strong in Norway in the 1800s, and has remained strong since the Svalbard Treaty of 1920. The ideology of ending coal mining comes from knowledge that coal mining contributes large amounts of CO2, and has high emissions.

The frontier adventure ideology and nation-building ideology have been dominant since the 1800s, while the ideology of ending coal is more recent, since around 2010.

17.7.4 Mainstream narrative: policies

Svalbard has been a Norwegian territory under the Svalbard treaty (1920) where all signatories are allowed to enter into economic activity. Norway and Russia are both engaged in coal mining, and China and numerous other nations are also involved in research. The policy has been for this archipelago to be a non-lifecycle community, meaning that people cannot be born or die there. The archipelago is governed by the Svalbard Sysselmann, who is appointed by the Norwegian State. There is a local election for the Lokalstyre, in which only Norwegian citizens and those who have lived on Svalbard for 3 years can participate. In 2019 1827 persons were eligible to vote, and the dominant parties are the same as those on mainland Norway. The Labor Party has been leading, while the new party The Greens have joined in recent years.The relevant institutions and administrative levels are the Lokalstyre who are responsible for the local government, Sysselmannen who administers the archipelago, the national government to which the Sysselmann is answerable, as well as to the Troms judiciary branch, located on Northern mainland Norway.

17.7.5 Other contextual factors

The weather and environmental conditions on Svalbard as a high Arctic region are severely limiting of alternative energy sources. The temperature gradient is too low to permit geothermal energy with today's technologies, the thawing permafrost makes it impossible to mount windmills of sufficient size to provide a viable alternative, and seasonal darkness limits solar energy generation in the winter. Battery technologies combined with solar power may become a future solution.

17.7.6 Alternative (on-stream and/or off-stream) narrative: technology

No technological sectors are emerging in the region as yet. There is an ongoing search for alternative energy sources. Solar panels and geothermal energy are two potential technologies that may one day be important for Svalbard. They can be located close to Longyearbyen. One alternative fuel source that has been considered is wood pellets imported from the continent, from forest resources in Europe and elsewhere. These alternative technologies have been emerging for many decades, but for the Svalbard region in earnest since 2020 when the LCC decided to start an energy-shift project that could result in the closure of the coal power station by 2023

17.7.7 Alternative (on-stream and/or off-stream) narrative: stakeholders and institutions

While coal mining stakeholders have all but left Svalbard, there are other stakeholders emerging, including stakeholders from tourism, research, teaching, trade service providers, and logistics providers. These stakeholders are primarily located in Longyearbyen, Tromsø, and other Norwegian cities, as well as on cruise ships, and across the world. These stakeholders have been present since at least the 1990s, but some longer. Their presence has increased markedly after 2014, when there was a sharp drop in the number of coal miners.

17.7.8 Alternative (on-stream and/or off-stream) narrative: ideologies

There is a stronger sense of political involvement in recent years. The Green Party established a local organization just prior to the 2015 elections to support cessation of coal. There is a stronger sense of wanting to support non-Norwegian residents. With the lower economic turnover during the pandemic there have been cases where persons have been forced to leave Svalbard and Norway due to lack of ability to support themselves financially.

The political ideologies are emerging both from Longyearbyen itself and the long-term residents there who have shaped their political views locally over many years, and from other parts of Norway and the world. The rapid loss of coal miners and their community values and political orientations has been matched by a rapid increase in new and short-term residents who bring with them ideologies from other places.

The political mobilisation in Longyearbyen has increased somewhat in recent years, perhaps linked to the cessation of coal and the influx of new residents.

17.7.9 Alternative (on-stream and/or off-stream) narrative: policies

While there has been a strong local support for the continuation of coal in Longyearbyen, the move to cease coal production has not come from local government. Coal mining policy has been directed by State policies to support (or not) Store Norske's mining activity. In 2018, the decision to phase out the coal mines was made, with Gruve 7 set to close in 2023. The new policy that has emerged in 2022 following the Russian invasion in Ukraine is to delay this date until 2025. The policy has importance both for Svalbard and Longyearbyen, and for actors who buy coal from Svalbard. This new policy has come within the past 6 months since the invasion in February 2022 (Figure 3).

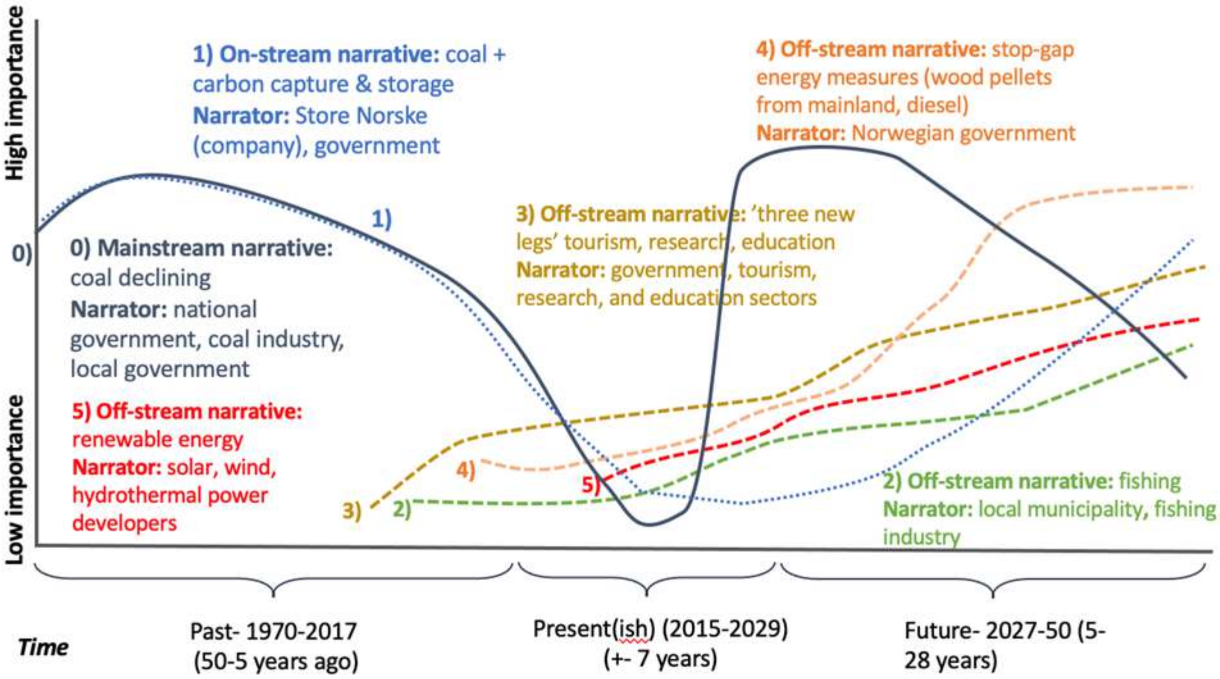

Figure 3: Mainstream, on-stream, and off-stream narratives for Svalbard.

17.8 Trends and indicators for sustainable transformations

The trend away from coal mining and coal energy production in Longyearbyen starts in the 1990s (Justis- og beredskapsdepartementet, 1999; Bjørnsen, 2014; Palm, 2016; Olsen, 2017). This is when the parliament started to aim for and facilitate a more diversified economy on Svalbard (Justis- og beredskapsdepartementet, 1999). The government increased the budget allocation for research and higher education in the late 80s and early 90s respectively, and in 1994, the University Centre in Svalbard (UNIS) was established.

Between 1989 and 1998, employment in coal mining decreased, while employment in private business, especially within the tourism industry, increased. In 1999, coal mining was no longer perceived, by the government, as critical for maintaining a Norwegian society and sovereignty on the island (Justis- og beredskapsdepartementet, 1999). The government's goal was then that the local society should develop in a sustainable manner. It stated that mine no 7 would soon shut down or significantly reduce its production. The Committee on Foreign Affairs called for an assessment on the possibility of a renewable energy system in Longyearbyen both in 2001 and 2009 (Utenrikskomiteen, 2001; Utenrikskomiteen, 2009).

From 2009, the government communicated an interest in facilitating more research, education, and tourism due to the vulnerability of the coal industry to price fluctuations

(Justis- og politidepartementet, 2009). The politicians' comments on the white paper were perceived as a signal for a phase-out of the Svea mine (Amundsen, 2009). The coal prices were plummeting after a record year in 2008 (Figure 5), and SNSK was struggling to adapt and restructure (Aarskog, 2009). In 2012 and 2013 the company ran a great deficit and had production problems, resulting in the need to downsize and dismiss 70 employees (Amundsen, 2012; Amundsen, 2013) (Figure 6). During and following this period, several articles and op-eds in the local newspaper, as well as posts on the Facebook group "Ros & info Longyearbyen", discussed the future of Svalbard and alternative energy sources.

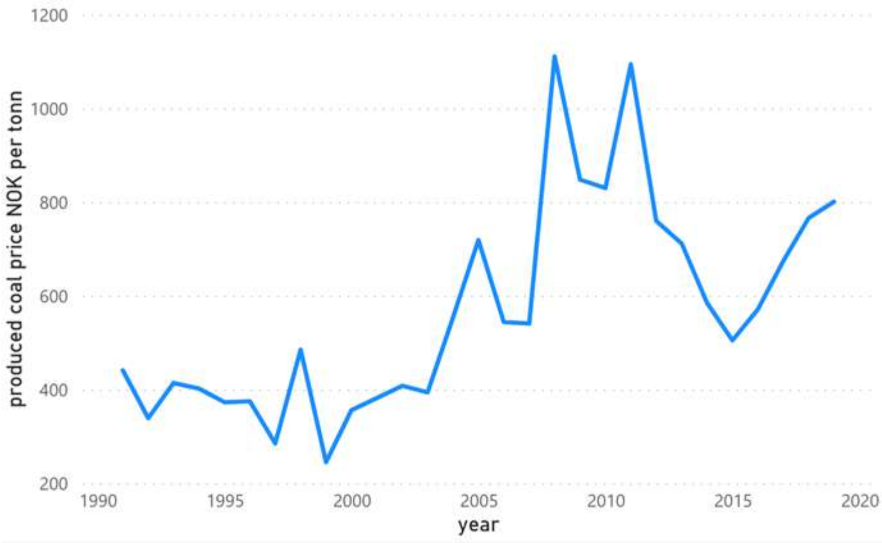

Figure 4 Produced coal prices NOK per tonn 1990-2020

The local community engaged in public debates surrounding the sustainability of keeping the mining activity alive through subsidies after years of large restructurings and economic problems in SNSK (Andreassen, 2016; Olsen, 2017). In 2016, the coal prices plummeted again and SNSK had to resort to temporary downtime, financed by government support (Holdal, 2015; Palm, 2015). The government in 2016 stated that coal mining was of reduced importance, both due to a great share of the workers commuting from the mainland, and due to economic problems (Justis- og beredskapsdepartementet, 2016). However, it did state that continued activity could be possible if coal prices were to indicate profitability in the future. The importance of tourism was highlighted, and the government wished to facilitate a transition through increased employment in this sector, and in research and education.

In 2020, the LCC decided to start an energy-shift project that could result in the closure of the coal power station by 2023 (Bårdseth, 2020b; Olsen, 2020). SNSK argued that the LCC should have waited for the assessment on future energy by the Ministry of Petroleum and Energy (Bårdseth, 2020c). The government and SNSK finally made the decision to phase out mine no 7 in 2020 (Bårdseth, 2021d). The closing date will be in 2028 after a clean-up process (Bårdseth, 2021d).

In 2022, the Russian invasion of the Ukraine and cessation of gas to Europe revived coal mining on Svalbard. The closure of the remaining mine has now been delayed for three years. The board of Store Norske cites the altered world situation has increased demand and prices on coal (Andreassen 2022).

In sum, the transition away from coal on Svalbard has since the 1990s been motivated more by coal prices and demand than it has by emissions reductions.

17.8.1 Indicators

Here, it is important to distinguish between indicators that measure physical changes in the Earth systems (emissions, kwh, volumes of coal, etc) or in human behavior (consumption patterns, mobility, habitation), and those that measure changes in discourse (policies, white papers, media, etc.). In this project, we are concerned with the societal part of these interlinked natural-human systems. Here, prices of coal, employment statistics, and income per sector would be helpful indicators. For the discursive indicators, the frequency with which alternative economic and energy bases are mentioned in media can be one useful indicator.

Indicators of a transition to low emissions societies need to also consider the environmental footprint of energy generation, and would include emissions levels per sector and kwh of renewable versus fossil fuel generation on Svalbard. In particular, determining whether the cessation of coal as a cornerstone of Svalbard, and toward tourism, education, and research is truly a transition to a low-emission society would be to examine emissions from airfare, shipping, and other forms of fossil fuel-based mobility on and to Svalbard. We have been unable to access such emissions figures.

Table 1: Indicators and trends derived from the narratives

Observed in:	**Name of the narrative or other factors**	**Trends observed in the narrative** (qualitative description)	**Indicator(s) that helps describe the trend** (way to measure)	**Indicator discipline(s)** e.g. economics, policy, etc.
Mainstream narrative	Coal mining and other carbon intensive fuels	No viable alternatives to coal and petroleum in	Presence of alternative energy sources in the Arctic and on Svalbard	Economics, technology, human

	are a necessity in the Arctic Coal mining is a cornerstone of Svalbard	the Arctic Coal no longer supports the economy as a cornerstone Coal mining supports Norwegian sovereignty	Prices of coal, presence of mines, income in alternative sectors Norwegian use of Svalbard coal resources, rendering them unclaimable by other states	geography, law
On-stream narrative	The Russian invasion of Ukraine increased demand and price of coal Alternative energy sources and economic bases are not yet viable	Coal has again become a valuable commodity, a means of exercising sovereignty of Svalbard resources	Coal prices Presence of Norwegian mining operations claiming the resource	Economics, technology, human geography, law
Off-stream narrative	Coal must be replaced as energy source to meet Paris agreement Education, research, and tourism are the new economic cornerstone of Svalbard Wood pellets are a stop-gap measure for	Tourism revenue is increasing, demography is shifting to balance gender, smaller proportion in mining jobs compared with other sectors Wood pellets will be delayed while coal is extended for additional two years (2025)	Employment, revenue, gender, kwh from different energy sources	Economics, technology, human geography

	energy production while energy alternatives are developed			
Factors not derived from narratives	Arctic and remote climate and environmental conditions	Seasonal darkness, severe storms, thawing permafrost, low underground temperature gradient rendering renewable alternatives very challenging	Energy per meter squared of sunlight over the year, wind speed, rate of permafrost thaw	Natural sciences, technology and engineering

17.9 Summary of key findings

Two key concepts that can help to clarify the Svalbard context are that of energy regions, and that of natural-human systems. Both shed light on some of the dynamics that enable and hinder energy transitions in Svalbard, and can help to contextualize the transformation in the Svalbard society over the past decade.

Svalbard is part of an Arctic energy region that spans lands that lie north of the Arctic circle, characterized by severe weather, seasonal darkness, and ice/permafrost. As an energy region, the Arctic is carbon and coal intensive region that is heavily reliant on diesel, coal, and wood for heating, cooking, and electricity generation. The region also has rich coal and petroleum deposits that are both exported and used locally. The region is also characterised by small settlements, with the exception of Northern Norway, that are spread apart enough that continuous electricity grids are not feasible. Each community is reliant on locally generated electricity. Already, this places limitations on the available alternative energy sources. Additionally, the harsh climate renders alternative economic bases to coal and petroleum limited beyond tourism and research.

Energy regions are areas that share key characteristics on energy production or consumption. Worldwide, there are numerous such regions, and multiple ways of defining them. For instance, Steckel and Jacob (2022) focus on coal and differentiate between four kinds of regions. Phase-out, established, phase-in, and exporter. For the purpose of this study, the focus is rather on different regionalized energy mixes and availabilities. The Arctic, for instance, is a region with few alternative energy sources due to seasonal darkness, harsh weather, and permafrost. Scandinavia is a region rich on hydropower and windpower, while many Pacific rim regions have access to geothermal energy. Eastern Europe and the United States have regions rich on coal. An energy region can be shaped by the combination of political, cultural, environmental, and technological characteristics. For instance, while Eastern Europe has coal as a shared economic resource and source of electricity, the transition away from coal has the coal region breaking into new energy regions defined by state policies (decisions to invest in nuclear or renewable, etc) and by access to alternative economic activities (if any).

In terms of human-natural systems, the Svalbard case is illustrative of the need to consider the combined societal and earth system components of energy transitions and transformations toward sustainability. The decision to cease coal on Svalbard has vicariously concerned the need to lower emissions and symbolically concerned coal as principal culprit in global climate change. Meanwhile, the economic driver of coal phase-out has been low demand and prices, and the emission levels of the economic alternatives found in tourism, research, and teaching are comparable to coal-generated electricity. In sum, in order to consider whether Svalbard is transitioning away from coal, the discourse surrounding the cessation of the coal economy on Svalbard needs to be understood in context of the tourism and research economy that will replace it. The human-natural system of anthropogenic greenhouse gas emissions is unchanged in the coal and tourism/research-based economies. Meanwhile, there has been a societal transformation in Svalbard. While emissions remain, the coal worker population has been exchanged for a population working in the hospitality-related industry. New and shorter term residents have replaced the longer term former residents, altering the social fabric. There are reports, for instance, that people did not use to lock their doors, but do so now. There is an increase in political activity, and there is a change in laws to prevent temporary residents from voting. This change in demography is recent, and the transformation of the Svalbard community will continue to unfold.

Key enablers of transformation are viable economic alternatives, viable alternative forms of energy generation, and a societal composition capable of maintaining these alternatives. Potential barriers are the emissions levels of tourists, researchers, students, and fuel transport to and from Svalbard.

17.10 Reflection on inter- and transdisciplinary research approach

The case study draws on human geography and economics. It is not really an interdisciplinary study, and focuses mostly on policy, economics, population dynamics, and their environmental footprint. Geography and economics form the explanatory context for the ending of the coal economy on Svalbard, as well as the critical indicators of tipping points. Some discussion on social psychology and politics may be drawn upon to critically reflect on the decision to end coal both as an economic basis and as an energy generator on Svalbard. This will depend on interactions with those trained in those disciplines to ensure insights are accurately referenced and contextualized.

Framing the research problem (research questions in case studies): Stakeholder groups were consulted prior to this project reflected on the role of the coal power plant, and coal mining, and formed the inspiration for contributing a Svalbard case study for the Tipping+ project. They did not participate in framing the research problem, this was framed by the Tipping+ consortium.

Analysing the problem and knowledge development: stakeholder groups from mining, hospitality, university, and logistics were consulted and contribute to understanding how the cessation of coal had affected the community. Business owners, visitors, and government representatives were interviewed on their perspectives on the coal economy and coal energy generation.

Exploring impact: which stakeholder groups were consulted and how did they contribute to the research impact/output? Our research does not so much contribute to solving the problem, since the decision is already made at a level beyond the ability of Svalbard residents to influence. The field work is therefore only documenting and discussing the ramifications. The stakeholders did not really describe a societal problem and were by and large unreflected on the decision to end coal. This is in itself an interesting finding and might reflect the fact that the population of Svalbard has shifted after the closure of the mines, such that many current residents have no attachment to the prior economy. Another explanation might be that many residents are seasonal workers Svalbard long and as such have little awareness of the archipelago's economic basis.

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18 Appendix: structure of case study reports

Project Number: [GA no. 884565]

Project Acronym: TIPPING^{+}

Project title:

Enabling Positive Tipping Points towards clean-energy transitions

in Coal and Carbon Intensive Regions (Updated Guidance)

Guidance for 5.2 “Case Study Key Findings”

Case Study XXXXXX:

Authors:

First submission for review: February 18th, 2022

Comments to your submission: March 18th, 2022

Next submission: June 17th, 2022

Final due date: September 15th, 2022

Guidance for 5.2 “Case Study Key Findings”

Case study title:

Update:

Based on an in-person meeting in Potsdam on April 27& 28th 2022, WP leads drafted key questions and key indicators to consider an interdisciplinary perspective to your case studies. These questions and indicators are to be mainly considered in the narratives (values and identity, policy and politics and economic potential) and in the context discussion (geography and migration).

These questions and indicators (see below) are intended to help with framing your research to cover geography, social psychology, policy and economic disciplines. Most of these aspects you already touch on but may need further elaboration.

Please update your case studies considering the following questions and indicators and submit them in the TIPPING+ cloud folder here by June 20th, 2022.

We have inserted these questions in the context and narrative part of the guidance document (in blue text) so you can see where you can consider these questions and indicators.

Geography & Migration (Work Package 1)

Are there any population/migration movements in the region?

If so, what are the demographics of migration by age, education, gender, rural/urban etc. (based on easily available secondary data)?

What is the key motivation for migration (based on the data already collected)?

1. Geography & Migration indicators	Examples
1a. population NUTS 1, 2 & 3 here 1b. composition of gender 1c. education levels 1d. age pyramid 1e. migration patterns 1f. life expectancy *(only relevant over a longer time frame)*	Presentation of population and demographic data graph.

Values and Identity (Work Package 2)

What are the key identity and values dominant in the region (based on the data already collected)?

Has there been value and/or identity change over the course of the transition in the region?

Does identity (change) and values (change) reflect on electoral behaviour and electoral platforms?

2. Values and identity indicators	Examples
2a. political parties' positions 2b. political parties' representations *(used as proxies for value orientations)*	A list of key governing and opposition parties. Description of political parties' stances on energy transition. Share of seats of political parties (i) supporting pro-coal and carbon intensive energy and (ii) supporting any alternative pathways (national government, regional government).

Policy & Politics (Work Package 3)

What have been the key policy interventions over the course of the case study leading to energy transition? (Note: intervention can be policies, strategies, programmes and projects.)

Has there been specific support/lack of support of policies by political parties?

3. Policy indicators	Examples
3a. public investments 3b. investment support 3c. subsidies 3d. taxes 3e. policy planning documents	A list and short description of key relevant policy interventions and if relevant, indicate if/how the policies are supported/not supported by political parties.

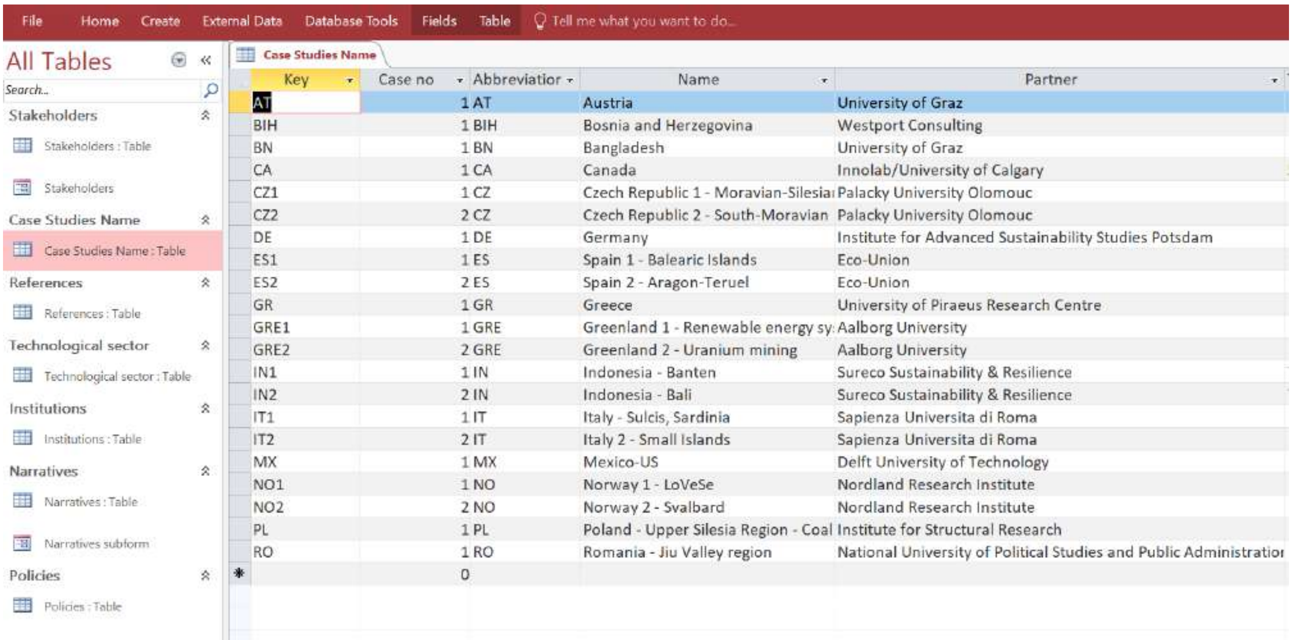
Economic Potential (Work Package 4)

- Is there an alternative to the mainstream that is seen as economically viable?

4. Qualitative indicators on economic opportunities	Examples
4a. Key stakeholders' opinion on (new) economic opportunities	Presentation of the narratives of the interviewed stakeholders.

Preamble

This guidance is a follow-up to the initial guidance you used for defining the context of your case study, identifying the mainstream, and alternative narratives. and characterising the region. The information you have provided or emerged during the two first Integration Workshops is systematised in the Case Study Database (see Figure 1).



Key	Case no	Abbreviatior	Name	Partner
AT	1	AT	Austria	University of Graz
BIH	1	BIH	Bosnia and Herzegovina	Westport Consulting
BN	1	BN	Bangladesh	University of Graz
CA	1	CA	Canada	Innolab/University of Calgary
CZ1	1	CZ	Czech Republic 1 - Moravian-Silesiai	Palacky University Olomouc
CZ2	2	CZ	Czech Republic 2 - South-Moravian	Palacky University Olomouc
DE	1	DE	Germany	Institute for Advanced Sustainability Studies Potsdam
ES1	1	ES	Spain 1 - Balearic Islands	Eco-Union
ES2	2	ES	Spain 2 - Aragon-Teruel	Eco-Union
GR	1	GR	Greece	University of Piraeus Research Centre
GRE1	1	GRE	Greenland 1 - Renewable energy sy:	Aalborg University
GRE2	2	GRE	Greenland 2 - Uranium mining	Aalborg University
IN1	1	IN	Indonesia - Banten	Sureco Sustainability & Resilience
IN2	2	IN	Indonesia - Bali	Sureco Sustainability & Resilience
IT1	1	IT	Italy - Sulcis, Sardinia	Sapienza Universita di Roma
IT2	2	IT	Italy 2 - Small Islands	Sapienza Universita di Roma
MX	1	MX	Mexico-US	Delft University of Technology
NO1	1	NO	Norway 1 - LoVeSe	Nordland Research Institute
NO2	2	NO	Norway 2 - Svalbard	Nordland Research Institute
PL	1	PL	Poland - Upper Silesia Region - Coal	Institute for Structural Research
RO	1	RO	Romania - Jiu Valley region	National University of Political Studies and Public Administratior
*	0			

Figure 1. Access database of the tipping plus case studies. Information on stakeholders, technology, institutions, narratives, and case study industry has been collected.

While our main focus now is on Trends, Indicators and Hints for Tipping Points, please first revisit your initial analysis, complete or update it as needed. For some case studies, the initial analysis carried was quite complete, for others less so.

Important: This deliverable is intended to support you in the publication of a book chapter or an article for the special issue. Please indicate your order of preference for the TIPPING+ book (June 10th, 2022, full book submission) or special issue (Nov-December 2022).

My first preference is:............

My second preference is:............

I'd rather not participate in TIPPING+ book and special issue - I prefer to use this material for another journal/publication:............

Please submit this document (labelling the file with your country case study name) in the folder: https://tipping-cloud.globalclimateforum.org/index.php/f/2262

Defining the problem:

Context (~0.5 page)

This section is based on your empirical case study findings and already include references throughout the text using the Harvard referencing style

Define the high carbon/coal intensive region (see case study guidance)

Briefly describe the 'societal problem'- social, economic, environmental etc.

Briefly describe the research problem, and from which discipline(s) you are addressing it

Formulate your case study research question(s)

In the context description please highlight the following regarding geography and migration.

Geography & Migration (Work Package 1)

Are there any population/migration movements in the region?

If so, what are the demographics of migration by age, education, gender, rural/urban etc. (based on easily available secondary data)?

What is the key motivation for migration (based on the data already collected)?

1. Geography & Migration indicators	Examples
1a. population NUTS 1, 2 & 3 1b. composition of gender 1c. education levels 1d. age pyramid 1e. migration patterns 1f. life expectancy *(only relevant over a longer time frame)*	Presentation of population and demographic data graph.

Analysing the problem:

Research Methods and Tools applied (~0.5 page)

Describe the research frameworks, models and/or theories you used or developed to analyse your case study narratives and findings (please include citations using *Harvard referencing style*).

Describe the qualitative and/or quantitative methods and tools you are applying to analyse your research question(s).

Narratives (~2-3 page summary):

Complete or update the three tables of narratives based on the Narratives framework we introduced in the Integration Workshops (see Lieu, et. al) of your case study. There is one section per narrative type (mainstream, on-stream, off-stream). Feel free to copy-paste the content from your earlier description following the initial case study guidance if they have not changed or update them when necessary. If there is a narrative type that you have not found, please explain in a paragraph why this is the case. Please include the following for:

The Mainstream narrative description & The alternative (on-stream and/or off-stream) narrative description

In the narrative description please highlight values and identity, policy and politics, and economic potential questions and support these by answering the questions and support evidence with indicators, where possible.

Update:

Based on an in-person meeting in Potsdam on April 27& 28th 2022, WP leads drafted key questions and key indicators to consider an interdisciplinary perspective to your case studies. These questions and indicators are to be mainly considered in the narratives (values and identity, policy and politics and economic potential) and in the context discussion (geography and migration).

These questions and indicators (see below) are intended to help with framing your research to cover geography, social psychology, policy and economic disciplines. Most of these aspects you already touch on but may need further elaboration.

Please update your case studies considering the following questions and indicators and submit them in the TIPPING+ cloud folder here by June 20th, 2022.

We have inserted these questions in the context and narrative part of the guidance document (in blue text) so you can see where you can consider these questions and indicators.

Geography & Migration (Work Package 1)

Are there any population/migration movements in the region?

If so, what are the demographics of migration by age, education, gender, rural/urban etc. (based on easily available secondary data)?

What is the key motivation for migration (based on the data already collected)?

1. Geography & Migration indicators	Examples
1a. population NUTS 1, 2 & 3 here 1b. composition of gender 1c. education levels 1d. age pyramid 1e. migration patterns 1f. life expectancy *(only relevant over a longer time frame)*	Presentation of population and demographic data graph.

Values and Identity (Work Package 2)

What are the key identity and values dominant in the region (based on the data already collected)?

Has there been value and/or identity change over the course of the transition in the region?

Does identity (change) and values (change) reflect on electoral behaviour and electoral platforms?

2. Values and identity indicators	Examples
2a. political parties' positions 2b. political parties' representations *(used as proxies for value orientations)*	A list of key governing and opposition parties. Description of political parties' stances on energy transition. Share of seats of political parties (i) supporting pro-coal and carbon intensive energy and (ii) supporting any alternative pathways (national government, regional government).

Policy & Politics (Work Package 3)

What have been the key policy interventions over the course of the case study leading to energy transition? (Note: intervention can be policies, strategies, programmes and projects.)

Has there been specific support/lack of support of policies by political parties?

3. Policy indicators	Examples
3a. public investments 3b. investment support 3c. subsidies 3d. taxes 3e. policy planning documents	A list and short description of key relevant policy interventions and if relevant, indicate if/how the policies are supported/not supported by political parties.

Economic Potential (Work Package 4)

- Is there an alternative to the mainstream that is seen as economically viable?

4. Qualitative indicators on economic opportunities	Examples
4a. Key stakeholders' opinion on (new) economic opportunities	Presentation of the narratives of the interviewed stakeholders.

Trends and indicators for sustainable transformations (1page)

In this section we focus on the trends and indicators that help explain the emergence of tipping points or other types of transformation in your case study.

Example to illustrate the meaning of trends and indicators derived from the narratives:

The Figure 2 below shows a trend of how a combination of policies and events have impacted coal production and employment in the UK coal power sector over a period of 55 years. This could be for example, the perspective from the coal power producers and those employed by coal power plants: i.e. the mainstream narrative. The indicators that we can use to measure these trends are change in coal production and change of number of employed people in the coal sector. These indicators and trends provide some evidence and insights that can help to describe the declining trends of the coal sector, which may be linked to a sustainable transformation, or conversely demonstrate the barriers to preventing a transformation.

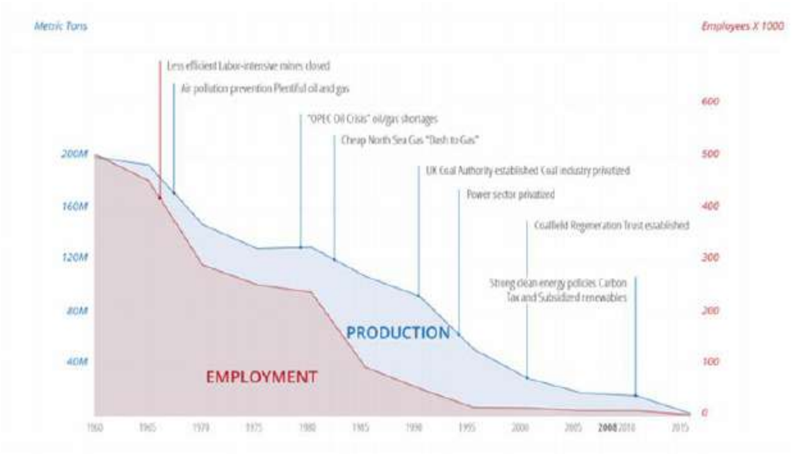


Figure 2. United Kingdom: coal production and employment 1960-2015. Source: World Bank, 2018

Across all narratives (mainstream and alternative narratives), do you observe any trends that help describe sustainable transformations in your case study? Please elaborate.

4.2 What indicators would help you describe such transformation trends? (<u>you may use the indicators as provided in the case study guideline</u>).

4.3 What other trends or indicators from other factors (not included in the narratives) could help describe possible sustainable transformations in your case study?

Table 1: Indicators and trends derived from the narratives

Observed in:	Name of the narrative or other factors	Trends observed in the narrative (qualitative description)	Indicator(s) that helps describe the trend (way to measure)	Indicator discipline(s) e.g. economics, policy, etc.
Mainstream narrative				
On-stream narrative				
Off-stream narrative				

Factors not derived from narratives				

Summary of key findings (1 page summary)

5.1 Feel free to apply a framing of your choice to discuss the key findings

5.2 Discuss Key enablers and barriers to a potential tipping point (positive and/or negative)

5.3 Other key findings

Reflection on inter- and transdisciplinary research approach (0.5 page summary)

What disciplines does your case study and analytical approach draw from? Is it an interdisciplinary or multidisciplinary approach?

What aspect of the research is transdisciplinary, that is the co-designing and/or co-development with stakeholders of:

1) Framing the research problem (research questions in case studies): which stakeholder groups were consulted and how did they contribute to framing the research problem?

2) Analysing the problem and knowledge development: which stakeholder groups were consulted and how did they contribute to analysing the problem or developing knowledge?

3) Exploring impact: which stakeholder groups were consulted and how did they contribute to the research impact/output? (you might not answer this question until later on this year when discussing potential strategies with stakeholders.

How does your research project (potentially) contribute to solving the societal problem (described by the stakeholders)?

D5.2 is followed up by the last deliverable D5.3 "Regional Strategies Booklet" where we work on 'exploring impact' through co-developing regional strategies with stakeholders. Recall (text from case study guidance you already used):

Region:

Formal region: "has definite borders and shares cultural homogeneity (sameness); it is uniform in nature. For example, an area that follows the same laws or speak the same language or follows the same physical features would be a formal region" [14]{examples not limited to

[14] Washoe County School District, 2017

political/administrative/governance}

e.g., Alberta (province), Canada (country) (historical colonial group and present day settler group), Jiu Valley, Romania (geographical boundary cutting across several administrative areas; valley with a history of 160 years of coal mining) or the Schengen region (free flow of goods and services, no visa needed)

Functional region: is based on horizontal spatial *social* and *ecological* flows across a geographic area, i.e., functional links or interactions constituted around common interests, needs, goals or strategies, which are represented by flows of persons (commuting to work, for shopping, healthcare, etc.), or of capital, information, goods, resources or other related to stocks and flows of pollution (e.g., GHG) which also ultimate affect the dynamics of the region

e.g., the region receiving electricity from a coal fire plant; the region in which workers at a coal mine live and work (across nations); oil sands open pit mining supplying jobs to surrounding area; a region developing green hydrogen technology and infrastructure. Note: a coal-and-carbon-intensive region is one of the functional definitions of a region.

Perceptual region: based on shared perceptions and attitudes of people who live in a given area, linked to a shared cultural *identity* (e.g. character shaping) defined by people's feelings, sense of belonging and attitudes about that area. The following questions (provided by WP2) help describe the characteristics of a perceptual region:

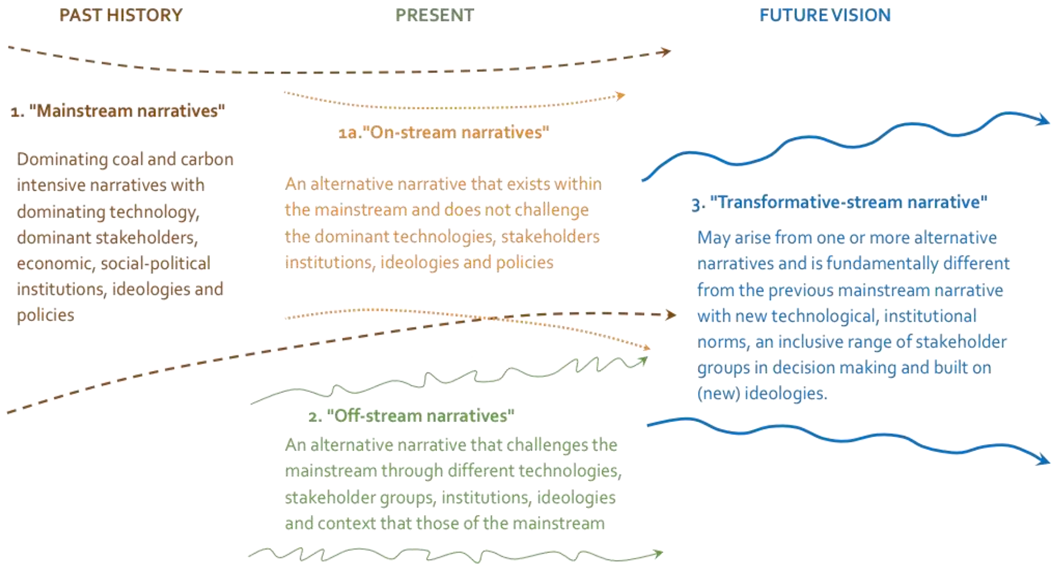
Who is attached (individual/group), what they are attached to (social place/physical place), and how they are expressing their attachment (through what behaviours, emotions, reasoning). Is there a place that represents the soul of the community? Is there a local environment (e.g. a river) that constitutes part of regional identity? [Reversed:] Which place, if destroyed, would destroy the soul of the community?

Where are the boundaries between "us" and "them"? How do these boundaries affect interpersonal and intergroup relationships? Is it impossible/difficult/easy to cross this boundary?

Narratives:

The following figure summarises the different narratives that will be discussed above: mainstream CCIR narrative and alternative narratives that depart from the mainstream, consisting of on-stream and off-stream narratives that potentially could lead to a transformation pathway.

Figure 1: Mainstream and Alternative Narrative Framework



Source: Lieu J, Sorman H A, Johnson O, Virla L, and Resurrección, P B (2020). "Three sides to every story: Gender perspectives in energy transition pathways in Canada, Kenya and Spain". Energy Research and Social Science. 68. https://doi.org/10.1016/j.erss.2020.101550

Indicators to consider in the case study

The following potential indicators for the case study context including geography, business, politics and society are initial indications and not meant to be comprehensive. Indicators will differ from case study to study and need to be verified. If the indicators you're using are not present in the table, please add it to the table and inform WP5 leads.

Potential indicators for context including geography, economics, business, politics & society

Variable type	Variable examples	Key Questions
General context		
Demographics	Population	Who lives in the carbon-intensive regions

	Composition of gender Education levels Age pyramid Migration patterns Life expectancy *(only relevant over longer time frame)*	(demographics, gender, minorities)? What are they doing in terms of jobs and education? What (if any) migration patterns can be observed? What are the ongoing trends?
Socio-economic trends and changes	GDP Household income levels Poverty rate Energy poverty rate Employment and unemployment levels (by gender and age, if possible) Productivity level	What are the economic, social and human resources and capacities available to transform the region?
Business/industry context		
Importance of incumbent dominant industry (e.g. coal, steel)	Number of employees / share of local employment Contribution to local GDP Subsidies / subsidies relative to turnover, value-added Production output (e.g. MW, tonnes of coal)	What is/has been the dominant sector (WP4)? what is the CCIR's economic contribution to the region Is the CCIR dependent in upstream energy-extractive and/or in downstream carbon- and energy-intensive industry? Who are the incumbents and dominant industry actors? How important are they for the local economy and employment market? What is the local economic

		contribution and value of the incumbent industry? How much public subsidies in relation to value added do they receive?
Presence and importance of other sectors	Number of companies employing 10%, 20%, 25% of the workforce Share of public vs. private sector in Regional GDP Employment Number of employees / share of local employment Contribution to local GDP Number/ % of SMES	What resources do the mainstream stakeholders and their institutions have access to? (e.g. natural resources, finance, political power) (WP6)
Presence and importance of low carbon sectors	Number of employees / share of local employment Number of companies active in the regions Contribution to local GDP Subsidies / subsidies relative to turnover, value-added Skills needed for expansion	Are new "green" companies present? Can they step up and grow into the niche left by the carbon-intensive business? How important are they for the local economy and employment market? What is the local economic contribution and value of the green industry? How much public subsidies in relation to value added do
Investments (e.g., public private,	Expand existing operations	Expand local value creation, new jobs

foreign direct investment)	Found new operations	Expand local value creation, new jobs
	Relocate from another region	
Entrepreneur initiatives	Start-ups and technology and business innovation	Establish a flexible and supportive business environment for start-ups and other entrepreneurial innovations
Political context		
Political composition of government	EU parliament National government State government Local government	Who are the mainstream stakeholders currently in power and their corresponding institutions (WP6) Stakeholder's demographics and traits: identify the demographics and traits that influence the CCIR (WP 1, 2) including their gender, ethnicity/ethnic majority, age, political affiliation (WP3)…. Who are the governing actors and who is in opposition? What is their position on COAL or carbon intensive industries? What role does COAL or carbon intensive industries play in legitimising their power?
Public opinion on national, regional and local level	Acceptance of climate science Acceptance of renewable energy deployment	What is the current governance system that has enabled the development of the technology?

	Support of government Trust in government Civil engagement and own participation in public consultations Corruption perception	Future development vision: what is the mainstream stakeholders' perspective about their future regional energy development? What sentiments do local and regional community members convey about questions of climate change, acceptance of renewable energy, trust in government bodies and their own participation in transformation processes?
Public budgets	Funding for different levels/ ministries, branches of government (total or spending per capita) Climate protection Energy funding/ subsidies Labour (retraining and upskilling measures) Social welfare Research and Education Innovation Public spending/investments relative to GDP Local/municipal Regional National	What policy instruments, strategies and programmes have been supporting the mainstream? Are public investments or public investment support programmes possible? Do public investments or public investment support programmes already exist, and can the region tap into them? Are the public budgets balanced? Is there room for additional spending? Are existing investments or other structural change programmes available? Public debt relative to GDP

Media discourse	Media or political coverage of COAL/CARBON (intensity) Number of newspaper articles Number of public service TV (news) reports Number of online newspaper articles or social media (Facebook, Instagram) Media coverage of COAL (direction) Number of positive (pro-closing, pro-transition) and negative (anti-closing, anti-transition) newspaper articles Number of positive/negative public service TV (news) reports Number of positive/negative online newspaper articles or social media (Facebook, Instagram)	How often does the COAL (or carbon intensive industries) appear in the local news (newspapers, online news, social media)?
Other variables?	Other examples?	Other questions? What are the key aspects of the physical environment (e.g. resource rich, climate zone, forest coverage, biodiversity hotspot etc.) that impact the CCIR's development?

Potential indicators for social psychology and social anthropology

Key indicators should be examined from a systemic point of view as emerging variations in each of the following indicators, in the behaviours and in the meaning-making process. These variations can be observed and inferred from the outside (i.e., I see that behaviours have changed), and/or recognised by people themselves (i.e., emic; Locals acknowledge that they changed their behaviours). The external and internal views could coincide (I see change / they acknowledge) or not (I see change / they don't; I don't see changes / they do). Variations could be assessed qualitatively or quantitatively (preferably with validated scales).

Variable type	Variable examples	Possible questions
Consciousness (individual and shared)	Knowledge, Experience, Awareness, Concerns, Values, Social capital	What do they know? Do they refer to any direct or mediated experience? Are they aware of the risk? What are they concerned about? Do they express any emotion? Positive negative? Which values guide their understanding and action?
Event Appraisal	Positive / Negative, Relevant / Irrelevant, Close / Distant, Attitude	How is the event evaluated? Is it perceived as relevant or not? Is it perceived as related to self/community? Do they display a positive or negative attitude towards the object?
Cognitive barriers	Bias, Heuristics, Forms of denial, Learned helplessness, Discredence	Do they systematically perceive a distorted reality? Do they show wishful thinking? Do they have positive/negative views of self and others that are not realistic?

		Do they deny the gravity of reality? Or deny their role in it? Do they feel helpless?
Individual and intragroup determinants (psychosocial + anthropological)	Drivers (e.g. need for power, need for closure) Norms & Social comparison	What is their inner motivation to do so or to keep a specific position? Are they just conforming to social norms (prescriptive or descriptive)? What are the costs of doing or saying something different? What is the event's role in the community's identity building processes? is it useful in order to assimilate and/or differentiate actors?
Societal and intergroup determinants (psychosocial + anthropological)	Identity, Social representations, Ideologies, Perceptions of injustice / grievance / deprivation, Temporalities, Local conflicts, Activation of exchange circuits, Creation or enhancing of networks' cohesion	Has individual identity changed? How does he/she narrate his/her life, the story of his/her family and community? Has social identity and belonging changed? How are 'the others' perceived? Do representations about technologies, policies or the environment influence particular actions? How is the issue at stake represented? Is it a hegemonic representation? How are novelties represented? How are memories and history 'used' to understand novelties? How does the past affect the vision of

		the future? What is the event's role in the community's identity building processes? is it useful in order to assimilate and/or differentiate actors? Do shared meanings lead to the development of alliances?
Coping appraisal and responses	Perception of individual and shared resources, Coping behaviours	Are symbolic and material resources (perceived as) available within the community and effective? Is there any (perceived)difficulty to access the economic resources? Is there low/high social capital? What is the perceived level of agency?

Potential indicators for policy & other interventions

Intervention indicators	Intervention example	Intended effect
Policy interventions		
Public investments	Build new infrastructure (rail, road)	Improve transport of goods and people to/from the region; allow longer commuting
Investment support	Public-private partnerships	Subsidies for private actors investing in the region to trigger investments in new economic activity, jobs creation
	Soft loans	Low-interest loans for regional

		investments to trigger investments in new economic activity, jobs creation
Subsidies	Subsidies or tax exemptions for companies present	Keep companies in the region, maintain employment
	Subsidies or tax exemptions for companies expanding in or to the region	Attract further companies to the region, create further jobs in already existing businesses
Education R&D	Fund university, fund new university program	Attract young, qualified students to the region; create the skills needed for the envisioned transition
	Found or move R&D institute	
Deliberation processes	Local engagement process	Build new vision for region
Population management	Support for families moving away	Reduce unemployment in affected region, create new opportunities for citizens and other regions
	Lower property tax, soft loans for buying property in regions	Keep population in the region by supporting house ownership
Local interventions	Fund local initiatives and associations	Support local social capital
Societal interventions		
Education & Training	Re-train existing employees	Enhance skills, direct skills towards what is needed in future (keep existing

		employees employed)
	Train new employees	Teach new employees necessary skills for future operations, scope of company
	Work with government to design new education programs, university foci	Teach new employees necessary skills for future operations, scope of company and the governmental vision for the region
Societal interventions		
Citizen initiatives	Network support for businesses and other stakeholders	Create movement of orchestrated policy, business and civil society actions to achieve new vision for the region
	Bottom-up visionary discussion processes	Build new vision for region, build social trust and associational networks
Education	Information campaigns about environmental awareness and health	Create awareness, educate and build local social capacity
Social networks	Collective action	Support local initiatives and NGOs in order to create or maintain social capital

Guidance for 5.2 “Case Study Key Findings”

Update:

Based on an in-person meeting in Potsdam on April 27& 28th 2022, WP leads drafted key questions and key indicators to consider an interdisciplinary perspective to your case studies. These questions and indicators are to be mainly considered in the narratives (values and identity, policy and politics and economic potential) and in the context discussion (geography and migration).

These questions and indicators (see below) are intended to help with framing your research to cover geography, social psychology, policy and economic disciplines. Most of these aspects you already touch on but may need further elaboration. 2.

We have inserted these questions in the context and narrative part of the guidance document (in blue text) so you can see where you can consider these questions and indicators.

Geography & Migration (Work Package 1)

Are there any population/migration movements in the region?

If so, what are the demographics of migration by age, education, gender, rural/urban etc. (based on easily available secondary data)?

What is the key motivation for migration (based on the data already collected)?

1. Geography & Migration indicators	Examples
1a. population NUTS 1, 2 & 3 **here** 1b. composition of gender 1c. education levels 1d. age pyramid 1e. migration patterns 1f. life expectancy *(only relevant over a longer time frame)*	Presentation of population and demographic data graph.

Values and Identity (Work Package 2)

What are the key identity and values dominant in the region (based on the data already collected)?

Has there been value and/or identity change over the course of the transition in the region?

Does identity (change) and values (change) reflect on electoral behaviour and electoral platforms?

2. Values and identity indicators	Examples
2a. political parties' positions 2b. political parties' representations *(used as proxies for value orientations)*	A list of key governing and opposition parties. Description of political parties' stances on energy transition. Share of seats of political parties (i) supporting pro-coal and carbon intensive energy and (ii) supporting any alternative pathways (national government, regional government).

Policy & Politics (Work Package 3)

What have been the key policy interventions over the course of the case study leading to energy transition? (Note: intervention can be policies, strategies, programmes and projects.)

Has there been specific support/lack of support of policies by political parties?

3. Policy indicators	Examples
3a. public investments 3b. investment support 3c. subsidies 3d. taxes 3e. policy planning documents	A list and short description of key relevant policy interventions and if relevant, indicate if/how the policies are supported/not supported by political parties.

Economic Potential (Work Package 4)

- Is there an alternative to the mainstream that is seen as economically viable?

4. Qualitative indicators on economic opportunities	Examples
4a. Key stakeholders' opinion on (new) economic opportunities	Presentation of the narratives of the interviewed stakeholders.

Preamble

This guidance is a follow-up to the initial guidance you used for defining the context of your case study, identifying the mainstream, and alternative narratives. and characterising the region. The information you have provided or emerged during the two first Integration Workshops is systematised in the Case Study Database (see Figure 1).

Figure 1. Access database of the tipping plus case studies. Information on stakeholders, technology, institutions, narratives, and case study industry has been collected.

While our main focus now is on Trends, Indicators and Hints for Tipping Points, please first revisit your initial analysis, complete or update it as needed. For some case studies, the initial analysis carried was quite complete, for others less so.

Important: This deliverable is intended to support you in the publication of a book chapter or an article for the special issue. Please indicate your order of preference for the TIPPING+ book (June 10th, 2022, full book submission) or special issue (Nov-December 2022).

My first preference is:............

My second preference is:............

I'd rather not participate in TIPPING+ book and special issue - I prefer to use this material for another journal/publication:............

Please submit this document (labelling the file with your country case study name) in the folder: https://tipping-cloud.globalclimateforum.org/index.php/f/2262

Defining the problem:

1. Context (~0.5 page)

This section is based on your empirical case study findings and already include references throughout the text using the Harvard referencing style

Define the high carbon/coal intensive region (see case study guidance)

Briefly describe the 'societal problem'- social, economic, environmental etc.

Briefly describe the research problem, and from which discipline(s) you are addressing it

Formulate your case study research question(s)

In the context description please highlight the following regarding geography and migration.

Geography & Migration (Work Package 1)

Are there any population/migration movements in the region?

If so, what are the demographics of migration by age, education, gender, rural/urban etc. (based on easily available secondary data)?

What is the key motivation for migration (based on the data already collected)?

1. Geography & Migration indicators	Examples
1a. population NUTS 1, 2 & 3 1b. composition of gender 1c. education levels 1d. age pyramid 1e. migration patterns 1f. life expectancy *(only relevant over a longer time frame)*	Presentation of population and demographic data graph.

Analysing the problem:

2. Research Methods and Tools applied (~0.5 page)

Describe the research frameworks, models and/or theories you used or developed to analyse your case study narratives and findings (please include citations using *Harvard referencing style*).

Describe the qualitative and/or quantitative methods and tools you are applying to analyse your research question(s).

3. Narratives (~2-3 page summary):

Complete or update the three tables of narratives based on the Narratives framework we introduced in the Integration Workshops (see Lieu, et. al) of your case study. There is one section per narrative type (mainstream, on-stream, off-stream). Feel free to copy-paste the content from your earlier description following the initial case study guidance if they have not changed or update them when necessary. If there is a narrative type that you have not found, please explain in a paragraph why this is the case. Please include the following for:

The Mainstream narrative description & The alternative (on-stream and/or off-stream) narrative description

In the narrative description please highlight values and identity, policy and politics, and economic potential questions and support these by answering the questions and support evidence with indicators, where possible.

Update:

Based on an in-person meeting in Potsdam on April 27& 28th 2022, WP leads drafted key questions and key indicators to consider an interdisciplinary perspective to your case studies. These questions and indicators are to be mainly considered in the narratives (values and identity, policy and politics and economic potential) and in the context discussion (geography and migration).

These questions and indicators (see below) are intended to help with framing your research to cover geography, social psychology, policy and economic disciplines. Most of these aspects you already touch on but may need further elaboration.

Please update your case studies considering the following questions and indicators and submit them in the TIPPING+ cloud folder here by June 20th, 2022.

We have inserted these questions in the context and narrative part of the guidance document (in blue text) so you can see where you can consider these questions and indicators.

Geography & Migration (Work Package 1)

Are there any population/migration movements in the region?

If so, what are the demographics of migration by age, education, gender, rural/urban etc. (based on easily available secondary data)?

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What are the key identity and values dominant in the region (based on the data already collected)?

Has there been value and/or identity change over the course of the transition in the region?

Does identity (change) and values (change) reflect on electoral behaviour and electoral platforms?

2. Values and identity indicators	Examples
2a. political parties' positions 2b. political parties' representations *(used as proxies for value orientations)*	A list of key governing and opposition parties. Description of political parties' stances on energy transition. Share of seats of political parties (i) supporting pro-coal and carbon intensive energy and (ii) supporting any alternative pathways (national government, regional government).

Policy & Politics (Work Package 3)

What have been the key policy interventions over the course of the case study leading to energy transition? (Note: intervention can be policies, strategies, programmes and projects.)

Has there been specific support/lack of support of policies by political parties?

3. Policy indicators	Examples
3a. public investments 3b. investment support 3c. subsidies 3d. taxes 3e. policy planning documents	A list and short description of key relevant policy interventions and if relevant, indicate if/how the policies are supported/not supported by political parties.

Economic Potential (Work Package 4)

- Is there an alternative to the mainstream that is seen as economically viable?

4. Qualitative indicators on economic opportunities	Examples
4a. Key stakeholders' opinion on (new) economic opportunities	Presentation of the narratives of the interviewed stakeholders.

4. Trends and indicators for sustainable transformations (1page)

In this section we focus on the trends and indicators that help explain the emergence of tipping points or other types of transformation in your case study.

Example to illustrate the meaning of trends and indicators derived from the narratives:

The Figure 2 below shows a trend of how a combination of policies and events have impacted coal production and employment in the UK coal power sector over a period of 55 years. This could be for example, the perspective from the coal power producers and those employed by coal power plants: i.e. the mainstream narrative. The indicators that we can use to measure these trends are change in coal production and change of number of employed people in the coal sector. These indicators and trends provide some evidence and insights that can help to describe the declining trends of the coal sector, which may be linked to a sustainable transformation, or conversely demonstrate the barriers to preventing a transformation.

Figure 2. United Kingdom: coal production and employment 1960-2015. Source: World Bank, 2018

Across all narratives (mainstream and alternative narratives), do you observe any trends that help describe sustainable transformations in your case study? Please elaborate.

4.2 What indicators would help you describe such transformation trends? (you may use the indicators as provided in the case study guideline).

4.3 What other trends or indicators from other factors (not included in the narratives) could help describe possible sustainable transformations in your case study?

Table 1: Indicators and trends derived from the narratives

Observed in:	Name of the narrative or other factors	Trends observed in the narrative (qualitative description)	Indicator(s) that helps describe the trend (way to measure)	Indicator discipline(s) e.g. economics, policy, etc.
Mainstream narrative				
On-stream narrative				
Off-stream narrative				
Factors not derived from narratives				

5. Summary of key findings (1 page summary)

5.1 Feel free to apply a framing of your choice to discuss the key findings

5.2 Discuss Key enablers and barriers to a potential tipping point (positive and/or negative)

5.3 Other key findings

6. Reflection on inter- and transdisciplinary research approach (0.5 page summary)

What disciplines does your case study and analytical approach draw from? Is it an interdisciplinary or multidisciplinary approach?

What aspect of the research is transdisciplinary, that is the co-designing and/or co-development with stakeholders of:

1) Framing the research problem (research questions in case studies): which stakeholder groups were consulted and how did they contribute to framing the research problem?

2) Analysing the problem and knowledge development: which stakeholder groups were consulted and how did they contribute to analysing the problem or developing knowledge?

3) Exploring impact: which stakeholder groups were consulted and how did they contribute to the research impact/output? (you might not answer this question until later on this year when discussing potential strategies with stakeholders.

How does your research project (potentially) contribute to solving the societal problem (described by the stakeholders)?

D5.2 is followed up by the last deliverable D5.3 "Regional Strategies Booklet" where we work on 'exploring impact' through co-developing regional strategies with stakeholders. Recall (text from case study guidance you already used):

Region:

Formal region: "has definite borders and shares cultural homogeneity (sameness); it is uniform in nature. For example, an area that follows the same laws or speak the same language or follows the same physical features would be a formal region" [1]{examples not limited to political/administrative/governance}

e.g., Alberta (province), Canada (country) (historical colonial group and present day settler group), Jiu Valley, Romania (geographical boundary cutting across several administrative areas; valley with a history of 160 years of coal mining) or the Schengen region (free flow of goods and services, no visa needed)

Functional region: is based on horizontal spatial *social* and *ecological* flows across a geographic area, i.e., functional links or interactions constituted around common interests, needs, goals or strategies, which are represented by flows of persons (commuting to work, for shopping, healthcare, etc.), or of capital, information, goods, resources or other related to stocks and flows of pollution (e.g., GHG) which also ultimate affect the dynamics of the region

e.g., the region receiving electricity from a coal fire plant; the region in which workers at a coal mine live and work (across nations); oil sands open pit mining supplying jobs to surrounding area; a region developing green hydrogen technology and infrastructure. Note: a coal-and-carbon-intensive region is one of the functional definitions of a region.

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Where are the boundaries between "us" and "them"? How do these boundaries affect interpersonal and intergroup relationships? Is it impossible/difficult/easy to cross this boundary?

Narratives:

The following figure summarises the different narratives that will be discussed above: mainstream CCIR narrative and alternative narratives that depart from the mainstream, consisting of on-stream and off-stream narratives that potentially could lead to a transformation pathway.

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Potential indicators for context including geography, economics, business, politics & society

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Socio-economic trends and changes	GDP Household income levels Poverty rate Energy poverty rate Employment and unemployment levels (by gender and age, if possible) Productivity level	What are the economic, social and human resources and capacities available to transform the region?
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Importance of incumbent dominant industry (e.g. coal, steel)	Number of employees / share of local employment Contribution to local GDP Subsidies / subsidies relative to turnover, value-added Production output (e.g. MW, tonnes of coal)	What is/has been the dominant sector (WP4)? what is the CCIR's economic contribution to the region Is the CCIR dependent in upstream energy-extractive and/or in downstream carbon- and energy-intensive industry? Who are the incumbents and dominant industry actors? How important are they for the local economy and employment market?

		What is the local economic contribution and value of the incumbent industry? How much public subsidies in relation to value added do they receive?
Presence and importance of other sectors	Number of companies employing 10%, 20%, 25% of the workforce Share of public vs. private sector in Regional GDP Employment Number of employees / share of local employment Contribution to local GDP Number/ % of SMES	What resources do the mainstream stakeholders and their institutions have access to? (e.g. natural resources, finance, political power) (WP6)
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Investments (e.g., public private, foreign direct investment)	Expand existing operations	Expand local value creation, new jobs
	Found new operations	Expand local value creation, new jobs
	Relocate from another region	

Entrepreneur initiatives	Start-ups and technology and business innovation	Establish a flexible and supportive business environment for start-ups and other entrepreneurial innovations
Political context		
Political composition of government	EU parliament National government State government Local government	Who are the mainstream stakeholders currently in power and their corresponding institutions (WP6) Stakeholder's demographics and traits: identify the demographics and traits that influence the CCIR (WP 1, 2) including their gender, ethnicity/ethnic majority, age, political affiliation (WP3)…. Who are the governing actors and who is in opposition? What is their position on COAL or carbon intensive industries? What role does COAL or carbon intensive industries play in legitimising their power?
Public opinion on national, regional and local level	Acceptance of climate science Acceptance of renewable energy deployment Support of government Trust in government Civil engagement and own participation in public consultations Corruption perception	What is the current governance system that has enabled the development of the technology? Future development vision: what is the mainstream stakeholders' perspective about their future regional energy development? What sentiments do local and regional community members convey about questions of climate change, acceptance of renewable

		energy, trust in government bodies and their own participation in transformation processes?
Public budgets	Funding for different levels/ ministries, branches of government (total or spending per capita) Climate protection Energy funding/ subsidies Labour (retraining and upskilling measures) Social welfare Research and Education Innovation Public spending/investments relative to GDP Local/municipal Regional National	What policy instruments, strategies and programmes have been supporting the mainstream? Are public investments or public investment support programmes possible? Do public investments or public investment support programmes already exist, and can the region tap into them? Are the public budgets balanced? Is there room for additional spending? Are existing investments or other structural change programmes available? Public debt relative to GDP
Media discourse	Media or political coverage of COAL/CARBON (intensity) Number of newspaper articles Number of public service TV (news) reports Number of online newspaper articles or social media (Facebook, Instagram) Media coverage of COAL (direction)	How often does the COAL (or carbon intensive industries) appear in the local news (newspapers, online news, social media)?

	Number of positive (pro-closing, pro-transition) and negative (anti-closing, anti-transition) newspaper articles Number of positive/negative public service TV (news) reports Number of positive/negative online newspaper articles or social media (Facebook, Instagram)	
Other variables?	Other examples?	Other questions? What are the key aspects of the physical environment (e.g. resource rich, climate zone, forest coverage, biodiversity hotspot etc.) that impact the CCIR’s development?

Potential indicators for social psychology and social anthropology

Key indicators should be examined from a systemic point of view as emerging variations in each of the following indicators, in the behaviours and in the meaning-making process. These variations can be observed and inferred from the outside (i.e., I see that behaviours have changed), and/or recognised by people themselves (i.e., emic; Locals acknowledge that they changed their behaviours). The external and internal views could coincide (I see change / they acknowledge) or not (I see change / they don’t; I don’t see changes / they do). Variations could be assessed qualitatively or quantitatively (preferably with validated scales).

Variable type	Variable examples	Possible questions
Consciousness (individual and shared)	Knowledge, Experience, Awareness, Concerns,	What do they know? Do they refer to any direct or mediated experience? Are they aware of the risk?

	Values, Social capital	What are they concerned about? Do they express any emotion? Positive negative? Which values guide their understanding and action?
Event Appraisal	Positive / Negative, Relevant / Irrelevant, Close / Distant, Attitude	How is the event evaluated? Is it perceived as relevant or not? Is it perceived as related to self/community? Do they display a positive or negative attitude towards the object?
Cognitive barriers	Bias, Heuristics, Forms of denial, Learned helplessness, Discredence	Do they systematically perceive a distorted reality? Do they show wishful thinking? Do they have positive/negative views of self and others that are not realistic? Do they deny the gravity of reality? Or deny their role in it? Do they feel helpless?
Individual and intragroup determinants (psychosocial + anthropological)	Drivers (e.g. need for power, need for closure) Norms & Social comparison	What is their inner motivation to do so or to keep a specific position? Are they just conforming to social norms (prescriptive or descriptive)? What are the costs of doing or saying something different? What is the event's role in the community's identity building processes? is it useful in order to assimilate and/or differentiate actors?
Societal and intergroup determinants	Identity, Social representations,	Has individual identity changed? How does he/she narrate his/her life, the

(psychosocial + anthropological)	Ideologies, Perceptions of injustice / grievance / deprivation, Temporalities, Local conflicts, Activation of exchange circuits, Creation or enhancing of networks' cohesion	story of his/her family and community? Has social identity and belonging changed? How are 'the others' perceived? Do representations about technologies, policies or the environment influence particular actions? How is the issue at stake represented? Is it a hegemonic representation? How are novelties represented? How are memories and history 'used' to understand novelties? How does the past affect the vision of the future? What is the event's role in the community's identity building processes? is it useful in order to assimilate and/or differentiate actors? Do shared meanings lead to the development of alliances?
Coping appraisal and responses	Perception of individual and shared resources, Coping behaviours	Are symbolic and material resources (perceived as) available within the community and effective? Is there any (perceived)difficulty to access the economic resources? Is there low/high social capital? What is the perceived level of agency?

Potential indicators for policy & other interventions

Intervention indicators	Intervention example	Intended effect
Policy interventions		

Public investments	Build new infrastructure (rail, road)	Improve transport of goods and people to/from the region; allow longer commuting
Investment support	Public-private partnerships	Subsidies for private actors investing in the region to trigger investments in new economic activity, jobs creation
	Soft loans	Low-interest loans for regional investments to trigger investments in new economic activity, jobs creation
Subsidies	Subsidies or tax exemptions for companies present	Keep companies in the region, maintain employment
	Subsidies or tax exemptions for companies expanding in or to the region	Attract further companies to the region, create further jobs in already existing businesses
Education R&D	Fund university, fund new university program	Attract young, qualified students to the region; create the skills needed for the envisioned transition
	Found or move R&D institute	
Deliberation processes	Local engagement process	Build new vision for region
Population management	Support for families moving away	Reduce unemployment in affected region, create new opportunities for citizens and other regions
	Lower property tax, soft loans for buying property in regions	Keep population in the region by supporting house ownership
Local interventions	Fund local initiatives and associations	Support local social capital

Societal interventions		
Education & Training	Re-train existing employees	Enhance skills, direct skills towards what is needed in future (keep existing employees employed)
	Train new employees	Teach new employees necessary skills for future operations, scope of company
	Work with government to design new education programs, university foci	Teach new employees necessary skills for future operations, scope of company and the governmental vision for the region
Societal interventions		
Citizen initiatives	Network support for businesses and other stakeholders	Create movement of orchestrated policy, business and civil society actions to achieve new vision for the region
	Bottom-up visionary discussion processes	Build new vision for region, build social trust and associational networks
Education	Information campaigns about environmental awareness and health	Create awareness, educate and build local social capacity
Social networks	Collective action	Support local initiatives and NGOs in order to create or maintain social capital

[1] Washoe County School District, 2017