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DRAFT CLIMATE POLICY ONTOLOGY REPORT

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Draft climate policy ontology report

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General Information

Summary

The climate crisis has led to increased engagement from governments around the world to mitigate emissions. At the same time, academia has increasingly focused on how this can be done as quickly as possible, and lively debates have emerged on the effectiveness of different policies at reducing greenhouse gas emissions. Yet, academics are often constrained by a lack of cross-country, comparable and detailed information on policies.

This is partly because of the way that data is gathered: until now, there has been no unified method and definition for climate policy and its sub-components of climate policy instruments. We discovered this issue as part of our work on gathering data on climate policies within NFDI4Energy Task Area 2: several attempts at gathering and publishing data exist, but they are not consistent, which makes analysis difficult, because there was no unified or even explicit ontology on climate policy instruments. This means that climate policy data lacks interoperability and cannot be combined across sources – hindering researchers from being able to analyze policies, including their effectiveness. This, in turn, means that empirical knowledge of what works in climate policy is patchy and limited to the few single cases with good data availability. Multi-case and cross-temporal policy instrument analysis is rare.

We therefore create a climate policy instrument ontology which includes various climate policy instruments governments use to lower greenhouse gas emissions. Our ontology of potential policy instruments is based on the Open Energy Ontology (OEO), and typologies that institutions use to gather climate policy data from Climate Policy Database (CPDB) and Climate Policy Radar (CPR). This is also complemented by a preliminary academic literature review and input from climate policy researchers. This results in this draft ontology. At the time of writing this document, we are validating, cross-checking and, wherever needed or helpful, updating it through a systematic literature review.

Our ontology demonstrates the importance of systems to harmonize the collection and analysis of climate policy data, which are currently lacking. In addition, it reveals blind spots in the current academic research on how different instruments impact emissions and decarbonization, for example on regulatory instruments, which may be due to a lack of cross-national and machine-readable data given the lack of comparable categorizations through ontologies.

Deliverable within NFDI4Energy

The main tasks in this deliverable were to draft an ontology for climate policy instruments and create an Excel spreadsheet with OEO-compatible definitions. The ontology should serve as a basis for data collection in the energy research community, and within NFDI for TA4 to ensure appropriate metadata standards and domain-specific ontologies. We also use this policy ontology to carry out our work in TA2, gathering data on energy policy instruments. Specifically, this deliverable is tightly linked to TA2.2, especially Deliverable 2.2.2.1 and Deliverable 2.2.1.1. These datasets provide both a use case and illustration for the draft policy ontology and a test of its robustness.

Introduction

There are about as many ways as categorizing information on climate policy instruments as there are analyses on the topic. We outline a few of the main kinds of ways that data are gathered and the typologies used, and why we need an ontology that provides robust, interoperable definitions.

First, there are institutions that gather data on broad climate policies, creating datasets that count **the number of policies and provide some details on them**, such as Climate Policy Database or Climate Policy Radar. These datasets draw on other sources or datasets, sometimes published by institutions like the International Energy Agency (IEA) and EU. The advantage of such datasets is that they allow researchers to compare policies across many different countries. The disadvantage is that their policy typologies use different definitions and coding schemes, and therefore cannot be combined. They also are generally not machine-readable at the level of detail needed to assess policy effectiveness, which is a problem we address in further deliverables of NFDI.

Second, there are projects that gather data on **a single policy instrument across countries and time**, such as the AURES dataset[1] which has information on auctions of renewable energy capacity, or the World Bank Carbon Pricing Dashboard.[2] While these are very helpful for learning about a specific instrument, they are not interoperable with each other, or with broader datasets like the IEA/CPR/CPDB. They often do not contain basic definitions of instruments or public information on their codebooks. One therefore cannot compare the effectiveness of different instruments, or how they interact, to name two resulting problems.

Finally, there are **case studies** of specific countries and their policies to enable analyses of policy effectiveness. For these, authors use their own definitions or refer to different streams of academic literature, making it impossible to compare their results to others.

We therefore propose an ontology to systematically categorize climate policies and climate policy instruments, which should facilitate the collection of interoperable climate policy data.

Method

In order to create this ontology, we draw from both the academic literature, and existing typologies of climate policy instruments. This includes among other sources:

- **Climate Policy Database (CPDB)** (note: this source gathers data from the following key datasets and more: Climate Action Tracker, ECOLEX, EU Climate Mitigation Policies and Measures, IEA, UNFCCC, Climate Change Laws of the World, OECD, RES Legal, WTO Environmental Database. See https://climatepolicydatabase.org/methodology for more details).
- **Climate Policy Radar (CPR)** (note – similar to the CPDB, this draws from many sources, and uses AI to code policy and instrument types. Information on their coding procedure can be found here: https://github.com/climatepolicyradar/methodology/tree/main).
- **The Open Energy Ontology (OEO).** https://openenergyplatform.org/ontology/
- **Hafner and Lilliestam [1].**
- **Peñasco, et al. [2].**
- **Howlett [3].**
- **Bemelmans-Videc, et al. [4]**
- **IPCC [5].**

[1] http://aures2project.eu/auction-database/

[2] https://carbonpricingdashboard.worldbank.org/

Our method of ontology data collection included, first, identifying all the different ways that policies are categorized. This differed depending on the source – for example, CPDB had 71 categories in its typology, while CPR had 30. Because some sources also lack definitions for their categories, we began communicating with policy stakeholders to understand their typology definitions and methods at this stage.

The next stage was for us to develop a typology draft that could encompass the categorizations used by important stakeholders such as CPDB and CPR, which would also be compatible with the OEO and useful for recording data. As part of this process, we checked and validated their definitions in the academic literature, and performed a first literature review to identify further policy instruments that could potentially be included.

This first draft was then presented to the CPDB, CPR and OEO for their feedback and comments. After integrating their comments, we then presented the draft typology at the 2024 session of the European Consortium for Political Research to energy policy researchers and integrated their feedback. The Draft Ontology presented in this document is the third round of the Climate Policy Ontology.

About the ontology

Scope and key definitions

This ontology focuses on **public policies**, which we define following Howlett as "efforts made by governments to alter aspects of their own or social behavior in order to carry out some end or purpose and are comprised of complex arrangements of policy goals and policy means" [3, p. 282].

Policy goals are an element of public policy wherein governments determine operationalizable policy objectives including specific policy targets, the aim of which is to guide decision-making. In terms of policy goals, we focus on targets: that is, a policy goal that contains statements about a desired future state of a system that an actor commits to in either a legally binding or non-legally binding way. This definition for policy goals is derived from the Open Energy Ontology.

Policy instruments, or policy means, are the specific policy tools by which the government aims to achieve its objectives. [3]. Our main policy instrument categories are **economic instruments, regulatory instruments, information instruments, and voluntary instruments**.

We define an **economic instrument** as a policy instrument that hands out or takes away material resources while the addressees are not obligated to take the measures involved [6]. Examples of economic policy instruments include purchase grants, feed-in tariffs, loans with preferential conditions, taxes etc.

In contrast, a **regulatory policy instrument** mandates action in accordance with rules and directives prescribing the abandonment or adoption of desired processes, technologies, products or results. Failure to comply may incur financial penalties and/or legal sanctions [5]. Examples of regulatory policy instruments include product standards, bans, purchasing requirements, requirements to install certain technologies etc.

An **information instrument** is a policy instrument that aims at providing knowledge to persons, companies and/or institutions to stimulate transformative measures, without containing any economic incentives. This definition is derived from the OEO, and is equivalent to other definitions such as for example [6]. Examples of information instruments are educational programs or public information campaigns.

Voluntary instruments are policy instruments where the government acts in a coordinating role, but not as a central designer and implementer of policies; measures may be initiated by governments, but also non-state actors such as firms or NGOs [5]. One example of a voluntary instrument is a public voluntary scheme such as eco-labels, such as the German Blue Angel – a firm can choose whether or not to comply with a program or performance criteria developed by a regulator.

How the ontology is organized

The ontology is currently organized into seven levels. It can be thought of as a tree, where each parent definition contains its child definitions.

Level_0 of the ontology is "Public policies" (as defined above), which indicates that the policy belongs to the group of public policies and is not, for example, a company policy.

Level_1 indicates what type of public policy, i.e. policy instruments versus policy goals.

Level_3, Level_4, Level_5 etc. indicates the next level of detail down. For example, for policy goals, we record information on targets, and non-binding targets. For economic instruments, we include information on sub-types of economic instruments such as trading schemes (See Table 1).

Table 1 Ontology structure example

Level_1	Level_2	Level_3	Level_4
Policy goal: A policy goal is a public policy wherein governments determine operationalizable policy objectives including specific policy targets. The aim of these goals is to guide decision-making.	**Target**: A target is a policy goal that contains statements about a desired future state of a system that an actor commits to in either a legally binding or non-legally binding way.	**Non-binding target**: A non-binding is a target that is not enshrined in law or presidential decree but adopted through policy documents published by government agencies.	
Policy instrument: A policy instrument is a public policy wherein the government employs specific policy tools to achieve its objectives.	**Economic instrument**: An economic instrument is a policy instrument that hands out or takes away material resources while the addressees are not obligated to take the measures involved.	**Trading scheme**: A trading scheme is an economic policy instrument where a limit or standard has been established for environmental performance; certificates of performance or credits can be traded in a marketplace to incentivize environmentally-friendly performance	**Green certificate trading scheme**: A green certificate scheme is a trading scheme where the government has established a quota for the generation of tradable renewable energy certificates; these can be traded to incentivize emissions reduction.
Policy instrument: A policy instrument is a public policy wherein the government employs specific policy tools to achieve its objectives.	**Economic instrument**: An economic instrument is a policy instrument that hands out or takes away material resources while the	**Trading scheme**: A trading scheme is an economic policy instrument where a limit or standard has been established for environmental performance; certificates of performance or credits can be traded in a marketplace	**White certificate trading scheme**: A white certificate scheme is a trading scheme where the government has established a quota for the generation of tradable energy savings certificates produced by

	addressees are not obligated to take the measures involved.	to incentivize environmentally-friendly performance	energy efficiency activities measured against a baseline; these can be traded to incentivize emissions reductions

Note: some cells in the excel spreadsheet of the draft ontology contain references to the source of the original definition, whether this came from CPDB, CPR, the OEO or another source. These will be deleted in the final version of the ontology, and are purely for stakeholder communication purposes.

The final version of the ontology will also contain information on how the different terms relate to each other, for example that the policy instrument "emissions cap" influences the policy instrument "GHG emissions trading scheme".

Interoperability with Climate Policy Radar, Climate Policy Database, and the OEO

We have designed our ontology to be interoperable with the other main climate and energy data typologies (the CPR, CPDB, and OEO) whenever possible. However, this was not always possible given the level of detail we need for our typology.

We provide information on the cases where our definitions directly correspond to other typologies; cases where there is a relation, but they should only be used with caution; and cases from CPR/CPDB which do not have an equivalent value for our ontology (See Table 2-Table 4).

Directly comparable terms

Table 2 Directly comparable terms in our ontology and CPR, CPDB and OEO.

NFDI4Energy	**CPR**	**CPDB**	**OEO**
Adoption target		Renewable energy (RE) target	
Auditing institution		Auditing	
Building standard		Building codes and standards	
Carbon tax		CO_2 taxes	Carbon tax
Climate fund	Provision of climate funds		
Climate target		GHG emissions reduction target	
Comparison label standard		Comparison label	
Coordinating body for climate strategy		Coordinating body for climate strategy	
Direct infrastructure investment		Infrastructure investments	
Direct investment	Direct investment	Direct investment	
Direct R&D funding	Research and development knowledge generation	R&D funding	
Disclosure standard	Disclosure obligations		
Economic instrument	Economic	Economic	Economic

		instruments	instrument
Energy efficiency target		Energy efficiency target	
Energy tax		Energy and other taxes	
Green certificate trading scheme		Green certificates	
Green public procurement	Green procurement		
Grid access and priority for renewables		Grid access and priority for renewables	
Implementation aid		Advice and aid in implementation	
Industrial air pollution standard		Industrial air pollution standards	
Information instrument	Information	Information and Education	Information instrument
Information scheme		Information provision	
Institutional creation	Institutional mandates	Institutional creation	
Insurance	Insurance		
Moratoria or ban	Moratoria and bans		
Monitoring, reporting and verification (MRV) of emissions	Monitoring, reporting and verification (MRV)		
Participation scheme	Subnational and citizen participation		
Regulatory instrument	Regulation	Regulatory instruments	Regulatory instrument
Standard		Codes and Standards	
Target		Target	
Tax incentives	Tax incentives	Tax relief	
Trading scheme		Market-based instruments	
Voluntary measure		Voluntary approaches	
Zoning and spatial planning regulation	Zoning and spatial planning		

Cross-comparison of terms across ontologies: combining categories

The existing categorizations of climate policy instruments by CPDB and CPR were in some cases not detailed enough for the detailed data on climate policies we aim to collect. For example, CPDB has the category “Feed-in Tariff/Feed-in Premium”, but we collect data on both FITs and FIPs which are distinct instruments. Therefore in our ontology, these terms are separated.

This means that if someone were to employ our policy ontology to work with CPDB data, they would have to combine our separate instruments "FIT" and "FIP" in order for the CPDB typology and our ontology to be equivalent. Below, we show all cases where we have terms with a slightly different scope or definition between our ontology and others.

Table 3 Terms with different contents in the NFDI4Energy ontology compared to CPR, CPDB and OEO.

NFDI	CPR	CPDB	OEO	Notes
Binding target; Adoption target		formal and legally binding RE Target		these are combined in their typology, we separate them for our ontology
Binding target; Climate target		formal and legally binding GHG reduction target		these are combined in their typology, we separate them for our ontology
Binding target; Energy efficiency target		formal and legally binding EE Target		these are combined in their typology, we separate them for our ontology
Education instrument	Education training and knowledge dissemination; Capacity building	Information and Education	Education instrument	note: in CPDB, "Information and Education" also includes comparison and endorsement label; in our ontology, comparison label standard is under regulatory instruments, and endorsement label is under Public voluntary scheme
Emissions cap; GHG emissions trading		GHG emissions allowances		these are combined in their typology, we separate them for our ontology
Feed-in Premium; Feed-in Tariff		FIT/FIP	FIT	these are combined in CPDB and separate in OEO, we separate them for our ontology
Fiscal incentives		Fiscal or financial incentives		Our definition of fiscal incentives does not include the category "net metering" which is included in CPDB; we categorize this as a regulatory policy (within market design)
Grants		Grants and subsidies		these are combined in their typology, we separate them for our ontology
Market premium	Subsidies	Grants and subsidies	Market premium	these are combined in their typology, we separate them for our ontology
Offsetting scheme; offsetting		GHG emissions reduction		these are combined in their typology, we separate them for our ontology

rules		crediting and offsetting		
Public voluntary scheme		Endorsement label		our definition of public voluntary scheme includes endorsement labels and eco-labels; this may therefore not be directly equivalent
Standards	Standards obligations and norms			our definition of standards includes further sub-types; this may therefore not be directly equivalent
Strategic planning process	Planning; Processes plans and strategies	Strategic planning		these are separate in their typology, we combine them for our ontology
GHG emissions trading scheme; Carbon Tax	Carbon pricing and emissions trading			these are combined in their typology, we separate them for our ontology

Terms from other typologies for which we do not have an equivalent

We do not use all terms from other typologies in our ontology. This is either because they are already captured in another category in our ontology, or they are too broad and rather describe the target of the instrument, rather than the mechanism. For example, CPDB's category "demonstration project" could be supported by any number of regulatory or economic instrument. Below we list all terms that are included in the Climate Policy Radar and Climate Policy Database, but do not appear in our ontology, and the reasons why (Table 4). All categories from the OEO having to do with policy instruments are included in our ontology, therefore these are not mentioned below.

Table 4 Terms from other typologies without an equivalent in our ontology.

From Climate Policy Radar	
Instrument name	**Why we do not include it**
Climate finance tools	Removal as can be any instrument
Early warning systems	Removal as can be any instrument
Ecosystem restoration	Removal as can be any instrument
International cooperation	Removal as can be any instrument
Governance	Removed as children moved to other categories (includes capacity-building, institutional mandates, international cooperation, MRV, Other, Planning, Processes plans and strategies, subnational and citizen participation)
Nature based solutions	Removal as can be any instrument
Other direct investment	Removal as can be any instrument
Other economic	Removal as can be any instrument
Other governance	Removal as can be any instrument
Other regulation	Removal as can be any instrument

From Climate Policy Database	
Instrument name	**Why we do not include it**

R&D Out	Removal as can be any instrument
Demonstration project	Removal as can be any instrument
Formal and legally binding climate strategy	Removal as very similar to legally binding targets, and only a few obs. Child of "Climate strategy": "Climate change economy-wide strategies which are enshrined in law"
Funds to sub-national governments	Removal as can be any instrument
Barrier removal	Removal as can be any instrument; children moved to other categories (removal of fossil fuel subsidies, removal of split incentives, grid access and priority for renewables)
Climate strategy	Removal as children moved to other categories (coordinating body); other children are moved to targets.
Policy support	Removal as children moved to other categories (institutional creation, strategic planning)
Performance label	Removal as children moved to other categories (endorsement and comparison label)

Limitations and future works

It is important to highlight that this is a preliminary, draft version of the NFDI4Energy climate policy ontology. While we have done our best to ensure that it is detailed and well-structured, there may still be ways to improve it. Therefore, in parallel to this deliverable, we are conducting a systematic literature review as well as data collection on climate policies. These workstreams will feed back into the draft typology, and ensure that it is robust and applicable for different researchers. Over time, we also expect to update the ontology as further policy instruments are developed. Ultimately, we will integrate this into the OEO, in the frame of NFDI4Energy Measure 4.5 and continue to update it as needed.

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