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The renaissance of carbon capture and storage in Germany and the politics of conditionality

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ABSTRACT

Carbon capture and storage (CCS) is currently experiencing a renaissance, especially as a means to address so-called hard-to-abate emissions and achieve net-zero climate targets through carbon dioxide removal. However, the role of CCS in climate policy is controversial, given concerns over reinforced carbon lock-in and its potential to weaken other mitigation efforts (mitigation deterrence). We investigate why and how CCS has made a comeback in Germany. Based on approaches from critical political economy and historical-materialist policy analysis (HMPA) we find that the main fault line is whether CCS should be applied only conditionally to hard-to-abate emissions or in a technology-open approach. Our results reveal coalitional, discursive and institutional factors that undermined a limited, conditional approach to CCS that would have reduced the risk of carbon lock-in compared to a technology-open approach.

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KEYWORDS Carbon dioxide removal; carbon management; historical-materialist policy analysis; mitigation deterrence; net zero

1. Introduction

Despite current climate policy rollback, net-zero targets remain legally anchored in the EU and its member states. Germany aims to achieve net-zero by 2045 (UBA 2025). Scenario modeling underlying these climate targets assigns a crucial role to CCS (Carbon Capture and Storage) (European Union 2024), particularly in countries such as Germany with large industrial and so-called hard-to-abate sectors (e.g. the concrete and lime industry). Besides reducing emissions at point sources, CCS can help generate negative emissions

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via carbon dioxide removal (CDR) when the captured carbon originates from organic material (BECCS) or is directly extracted from the air (DACCS) (Smith *et al.* 2024). Such negative emissions are increasingly considered crucial to balance residual emissions (Smith *et al.* 2024).

At the same time, the role of CCS and CDR in climate change mitigation is highly controversial, both in scientific debate (Anderson *et al.* 2023) and policymaking (Brad and Schneider 2025), especially given major concerns over its potential to reinforce carbon lock-in (Faber *et al.* 2025), prompt mitigation deterrence (Brad and Schneider 2023, Carton *et al.* 2023) and provoke political resistance from communities and environmental organizations (Waller *et al.* 2024). Against this backdrop, both scientific and civil society actors are increasingly calling for a strictly limited and conditional use of CCS and CDR (Edelenbosch *et al.* 2024, Markusson 2024). However, the actual politics of implementing such a limited and conditional approach in climate policymaking processes has hardly been investigated to date.

We focus on the politics of integrating CCS into climate policy in Germany – a country traditionally highly averse to CCS. The federal government from 2021 until the end of 2024 – comprising the Social Democrats, the Green Party and the Liberal Party (the so-called traffic light coalition) – took initial steps to put CCS back on the political agenda. These efforts included revising the Carbon Dioxide Storage Act (KSpG, hereinafter: CCS Act), introducing a Carbon Management Strategy (CMS) and developing a Long-Term Strategy for Managing Unavoidable Residual Emissions (hereinafter: Residual Emissions Strategy). The political revival of CCS in Germany is particularly noteworthy, as an earlier attempt in the late 2000s faced strong resistance and low public acceptance (Inderberg and Wetterstad 2015), preventing successive German governments from reconsidering CCS – despite its persistent presence in climate modeling (Ariadne 2022). In this context, the term ‘carbon management’ has emerged as an umbrella term that aggregates CCS, Carbon Capture and Utilization (CCU) and increasingly also CDR. The term has political appeal as it reframes and depoliticizes CCS (Schenuit *et al.* 2023, Brad *et al.* 2024).

This article reconstructs how this political renaissance came about and examines the conflicts and related constellations of actors, focusing specifically on the dispute on whether and how CCS should be used exclusively for hard-to-abate emissions (what we call a conditional approach). The German case is particularly instructive for studying the politics of conditionality of CCS: Unlike countries such as Denmark or France – where renewables or nuclear power dominates the electricity mix – fossil-based electricity generation remains significant in Germany, making the risk of carbon lock-in through CCS particularly acute. At the same time, historically entrenched public skepticism toward CCS could be expected to favor a restrictive approach, making Germany a most-likely case for a conditional approach.

Meanwhile the important role of fossil energy and energy intensive industries in the German economy can be expected to strengthen interests favoring a more expansive, non-conditional stance. The article contributes to the debates on socio-ecological transformation conflicts (Kalt 2024), risks of carbon lock-in (Unruh 2000), mitigation deterrence (Markusson *et al.* 2018, Carton *et al.* 2023) and the politics of conditionality (Bulfone *et al.* 2025).

The article is structured as follows: We first situate our analysis within debates on transformation conflicts under capitalism (section 2) before presenting our conceptual framework (section 3) and, building on this, outline our methodological approach based on historical-materialist policy analysis (HMPA) (section 4). HMPA follows a three-step process of context analysis, actor analysis and process analysis, which also structures the main part of this paper: The context analysis (section 5) outlines contextual and historical factors that shaped recent conflicts surrounding CCS in Germany. The actor analysis (section 6) then focuses on the constellation of actors and fault lines, distinguishing four main groups of actors. The process analysis (section 7) reconstructs the course of conflicts related to the revision of the CCS Act, the CMS, and the Residual Emissions Strategy prior to the parliamentary elections in February 2025, following the collapse of the traffic light coalition. We end by discussing key reasons why efforts to limit the application of CCS to hard-to-abate emissions failed in Germany, highlighting broader insights into the politics of CCS and conditionality (sections 8 and 9).

2. Transformation under capitalism and the contested role of CCS

Historically, the emergence and dynamism of capitalism have been premised on the extraction and burning of fossil fuels (Malm 2016), creating strong path dependencies which Unruh (2000) captured with the term ‘carbon lock-in’. However, despite strong forces of inertia, the capitalist mode of production and the energy systems underpinning it have also proven dynamic (Newell and Paterson 2010). For example, Podobnik (2006) shows that the global energy regime shifted from a coal-based energy system to one primarily based on various fossil fuels. More recently, there has been a significant expansion of renewable energy sources in the face of worsening impacts of the climate crisis and geopolitical conflicts revealing fossil dependencies. At the same time, renewable energy sources have mostly complemented rather than replaced fossil energy (Fressoz 2025).

Technological and energy system transformations in response to ecological crises are fundamentally contested under capitalist social relations, as highlighted by the concept of the ‘transition conflict’ (Kalt 2024). In most cases, such conflicts are fueled by powerful incumbent factions of capital that resist change, as it threatens established business models as well as related

economic assets and profit expectations (Colgan *et al.* 2021). Moreover, fossil fuel extraction and combustion are not only linked to processes of capital accumulation but also to jobs and modes of living (Brand and Wissen 2021). Accordingly, policies in support of socio-ecological transformations often turn into battlegrounds over the reorientation of societal development paths.

The ongoing integration of CCS into climate policy has given rise to a particular set of transformation conflicts (Krüger 2017). Unlike the renewable energy rollout, where a 'green' actor coalition can be clearly distinguished from an incumbent, status quo-oriented actor coalition that includes fossil capital factions (Haas 2019), actor constellations emerging around CCS policy differ markedly (Brad *et al.* 2024). At least on the discursive level, it has mostly been fossil capital factions that push for CCS as a technical solution to climate change, whereas the 'green' actor spectrum is more skeptical, particularly due to concerns that expectations of CCS could delay emission reduction efforts (Markusson *et al.* 2018, Faber *et al.* 2025). At the same time, there is relatively broad openness to CCS and associated technologies such as BECCS and DACCS among climate modelers (Beck and Oomen 2021). As Markusson *et al.* (2012, p. 6) observed early on, CCS has often acted as 'a glue between the climate policy community and the fossil regime', binding together 'a heterogeneous coalition of actors with very different objectives'.

National policy approaches toward CCS have been found to diverge substantially (Meadowcroft and Langhelle 2009, Inderberg and Wetterstad 2015), ranging from highly supportive first-movers such as Norway (Tjernshaugen 2011, Wettstad *et al.* 2024) to hesitant latecomers such as Austria (Brad *et al.* 2024). These differences reflect contested political choices among technological mitigation options. As highlighted in early contributions to the political economy of CCS (Meadowcroft and Langhelle 2009, Torvanger and Meadowcroft 2011), such choices are shaped by multiple factors and considerations, including existing energy systems and trade relations, fossil fuel and other resource endowments, prevailing industrial structures and specializations, employment and regional development potentials, the economic and political clout of (fossil) energy incumbents and energy intensive industries, as well as the perception of risks and how technological potentials are constructed in political debates.

3. Conceptual approach: actors, narratives and the state

Our study rests on a set of distinct analytical concepts, operationalized through historical-materialist policy analysis (HMPA) (Brand *et al.* 2022) to analyze the conflicts over CCS in Germany and explain the country's recent policy shift. First, while our analysis departs from the structural level of Germany's capitalist development model, we are specifically interested in

how different actors position themselves, and which fault lines and alliances emerge. We assume that economic structures shape, but do not determine actors' positions and strategies.

Second, while this distinguishes our approach from accounts that focus on the social construction of knowledge, shared belief systems and related advocacy or discourse coalitions (e.g. Sabatier 1998, Fischer *et al.* 2017), we follow cultural political economy (Sum and Jessop 2013) to account for how actors construct and advance competing imaginaries of the future, communicated through narratives but linked to material interests and social structures. Studies of CCS imaginaries in Scandinavian climate politics illustrate this dynamic well, showing how the desire to preserve the industrial base shapes academic and policy discourse while technological uncertainties are systematically de-emphasized (Lefstad *et al.* 2024, Hougaard and Christiansen 2025).

Third, drawing on materialist state theory (Jessop 1990), we assume that the state and its policies are the central terrain on which transformation conflicts are played out. The state and its institutions, as well as the political parties staffing key positions within the state, seek to mediate competing societal interests. Given its relative autonomy, the terrain of the state is asymmetric in that it 'filters' interests, actors and strategies according to historically shaped strategic and structural selectivities (e.g. privileged access of some interest groups to certain decision-makers, exclusion of other actors from consultation processes).

Empirically, our contribution specifically focuses on a key, yet understudied fault line that has emerged with the integration of CCS into climate policy: whether and how policy design can prioritize or restrict the use of CCS to so-called hard-to-abate emissions in order to prevent it from reinforcing carbon lock-in (Schenuit *et al.* 2023, Brad *et al.* 2024). Literature on CCS has discussed options to determine priorities and design criteria for public CCS funding (cf. Torvanger and Meadowcroft 2011). However, the politics of such conditionality, i.e. which actor coalitions support what type of approaches to restrict, prioritize or qualify the use of CCS through certain policy designs, has hardly been systematically investigated to date.

To analytically capture this distinctive political fault line, we draw on the concept of conditionality developed by Bulfone *et al.* (2025), who understand it as provisions that structure public support for private firms by linking support to the fulfillment of specific targets (e.g. export quota), compliance with certain requirements (e.g. local content requirements), or acceptance of some form of public corporate control. While Bulfone *et al.* developed this concept in the context of industrial policy more broadly, we adapt it for our analytical purposes to capture a similar logic in CCS policy: here, conditionality refers particularly to linking public support for CCS (in terms of lifting the storage prohibition, providing subsidies, developing relevant

infrastructures) to specific conditions regarding the source of CO₂ emissions and whether alternative ways to mitigate these are available (i.e. whether they are recognized as hard-to-abate).

However, as conditionality has to be imposed on powerful factions of capital, establishing conditionality is not just a matter of technical policy design, but critically hinges on political economy factors highlighted by Bulfone *et al.* (2025). These can be linked back to the three core analytical tenets of our theoretical framework: First, coalitional factors, i.e. to what extent broad political coalitions spanning private capital, civil society and state actors can be forged in support (or in rejection) of conditionality; second, ideational factors, i.e. how dominant or hegemonic ideas, ideologies and discourses facilitate (or hinder) the design and implementation of (certain types of) conditionality; and third, institutional factors, i.e. how governance structures – specifically state structures and their selectivities – shape the capacity to impose conditionality.

4. Methodological approach: historical-materialist policy analysis

Our conceptual approach is operationalized through the HMPA framework (Brand *et al.* 2022). By focusing on moments of open political contestation, this approach seeks to reconstruct how policy outcomes are shaped by contradictory interests and imaginaries and how they are mediated on the asymmetric terrain of the state (Kannankulam and Georgi 2014). HMPA essentially rests on a three-step approach: analyzing the broader historical and structural context of the policy conflict under investigation, mapping the constellation of actors, interests and narratives based on how actors react (differently) to the policy conflict and examining the dynamics of the policy process by identifying key moments and turning points that shaped the policy outcome. While direct causal inference lies beyond the scope of this approach – not least because parts of the policymaking process remain opaque and therefore impossible to reconstruct in full – our process analysis aims to map the sequence of events as comprehensively as possible (Beach 2016). Our study focuses on the period from November 2021, when the traffic light coalition took office, to February 2025 when a new parliament was elected. It combines document analysis with expert interviews. The document analysis covers 81 documents from 34 actors who explicitly engaged with CCS during the study period. These documents include (draft) laws, official protocols, committee hearing records, press releases, position papers, joint open letters regarding the deployment of CCS in Germany and other relevant, publicly available materials and statements from various political bodies. In addition, we analyzed six documents obtained via Freedom of Information Act requests. These internal documents, including communications between the Federal Ministry for

Economic Affairs and Climate Action and NGOs, allowed a more detailed reconstruction of key developments – for example, the point at which CCS at gas-fired power plants became part of the policy debate. All documents are listed in Appendices a–d.

To complement the analysis, triangulate findings and clarify remaining ambiguities, particularly regarding strategic motives and actor interests, we conducted 25 semi-structured interviews in two phases. The interviewees included policymakers, environmental organizations, representatives from trade associations and labor unions. Interview partners were selected specifically to address gaps and unresolved questions that emerged from the document analysis. In the first survey phase, between January and July 2023, we conducted 14 interviews that focused primarily on the implications of disputes over CCS in the 2000s for the current developments. In the second survey phase, between November and December 2024, we conducted 11 interviews that focused predominantly on the disputes over the amendment of the CCS Act, the CMS and the Residual Emissions Strategy, informing the actor and process analysis (see Appendix e for details).

Based on this combined dataset, actors' positions were systematically coded to identify the positioning of actors and actor coalitions on CCS, and areas of alignment as well as fault lines arising from divergent views. In cases where individual actors made multiple public statements during the period of investigation, these were systematically compared to trace potential shifts in positioning over time. Finally, actors were aggregated into coalitions based on significant overlaps in policy positions and material interests, as identified through document analysis and validated through expert interviews.

5. Context analysis

The German economy is characterized by a broad industrial base, with the industrial sector's share of economic activity significantly higher than in most other EU countries. Industrial emissions are correspondingly high, amounting to 179 million tons in 2021, or around 23% of the country's total emissions (Agora Energiewende 2022, p. 13). There is therefore significant pressure to decarbonize the industrial sector.

In 2019, the German parliament passed a national climate protection law for the first time. Germany is obliged to reduce its emissions by 65% by 2030 compared to 1990 levels, with net zero emissions to be achieved by 2045 (Haas and Schoppek 2024). The climate protection law poses a twofold challenge. On the one hand, there is a need for drastic emission reductions. On the other hand, some emissions will continue to be released after 2045 (so-called 'residual emissions'), so compensatory measures must be taken to remove CO₂ from the atmosphere (Boettcher *et al.* 2023). As CCS can

potentially make a contribution to both emission reduction and removal, it plays an important role in the modeling of pathways to achieve the net zero target. The five main net zero scenarios for Germany assume a storage requirement of between 34 and 73 million tons CO₂ per year for 2045, with varying proportions of CO₂ from fossil sources (CCS), biomass (BECCS) and ambient air (DACCS) (Ariadne 2022, p. 38).

Despite its presence in climate models, the political renaissance of the technology during the legislative period of the traffic light coalition is remarkable given the failure of the first attempt to implement CCS in Germany in the 2000s. There were several reasons for this. First, CCS was only discussed in connection with coal at the time (Praetorius and Stechow 2009). Second, strong opposition emerged in communities near the proposed CO₂ storage sites, with little overall public support for CCS (Dütschke *et al.* 2016). This was compounded by strategic mistakes in the part of CCS proponents. According to relevant actors engaged in the CCS conflict at the time, they thought about the technology predominantly from an engineering perspective and did not anticipate risk perceptions and possible resistance. Consequently, the counter-campaign successfully won the battle over public opinion (interviews industry 1, 2, 4, Bellona, SRU). Against this backdrop, no CCS legislation was passed under the first Merkel government, which ended in late 2009. CCS was politically sidelined and the 2012 CCS Act offered no prospects for the further development of the technology (Inderberg and Wetterstad 2015, Haas *et al.* 2024).

Today, however, CCS is being negotiated under different circumstances than in the 2000s. There is a new momentum for CCS under the umbrella label of ‘carbon management’, not only in Germany but worldwide. The Global CCS Institute (2023, p. 8) rejoices: ‘That decade [between 2010 and 2020] was characterized by cost discovery through studies and the subsequent cancellation or delay in project developments due to economic non-viability. Now there are far fewer cost surprises and policy drivers are much stronger. The game has changed.’ Nevertheless, as a direct consequence of the initial failure to implement CCS, the technology remains poorly accepted by the public and doubts about the scalability of CCS persist. These uncertainties and past disputes have also shaped recent conflicts over CCS.

6. Actor analysis

Based on substantial overlaps in terms of interests, narratives and strategies, we distinguish between four main groups of actors and related coalitions shaping German politics on CCS. While some actors continue to oppose CCS in principle, the main fault line we identified is no longer whether or not to allow CCS, but *how* and *for whom*. More specifically, conflicts in our period of investigation center on whether to adopt a ‘technology-open’ approach or strictly limit CCS to so-called hard-to-abate sectors (however defined),

excluding use for gas-fired power plants. Another area of contention is whether CO₂ storage should be permitted onshore or exclusively offshore, and whether CCS projects should enjoy regulatory privileges by considering them as being of ‘overriding public interest’ (see [Table 1](#)).

6.1. Principled opponents

A spectrum of NGOs, such as Greenpeace, BUND (German Federation for the Environment and Nature Conservation), DUH (Environmental Action Germany), and PowerShift, as well as local citizen initiatives, and the Left Party continue to oppose CCS in principle. Besides fundamental skepticism about the technical viability of the technology, the key narrative advanced by these actors is that CCS might be instrumentalized by corporate interests to delay or undermine the phase-out of fossil fuels. These actors also emphasize the negative environmental impacts (e.g. on marine habitats) associated with CO₂ storage (DUH 2024; Greenpeace Germany 2024) and rejected the draft legislation for the revision of the CCS Act from February 2024 (see [Table 2](#)). In particular, these actors took issue with the potential application of CCS at gas-fired power plants, the dimensions of planned CCS infrastructure envisioned in the draft law, the private-sector-led deployment of CCS, and business actors’ push for classifying CCS and related infrastructures as being of overriding public interest. One interviewee from this coalition summarized the draft bill as follows: ‘No one who is committed to climate protection can want what is currently in the draft bill’ (interview NGO 4).

Instead, these actors advocate for a more transformative approach, focusing on sufficiency and a comprehensive phase-out of fossil fuels (BUND 2024; PowerShift 2024; interviews NGO 3, 4). With limited access to relevant policymaking terrains (interviews SPD, NGO 4), they focused strategically on popular mobilization, particularly through alliances with local anti-CCS protests and position papers to influence public discourse. However, some also sought dialogue with the SPD and the Greens as governing parties, trying to mold its positions on CCS (e.g. regarding CCS on gas-fired power plants) (interviews SPD, NGO 5). Despite limited financial and organization power resources, they could leverage public CCS-skeptic public opinion, drawing on the experiences of organizing and mobilizing against CCS in the 2000s.

6.2. Cautiously conditional proponents

However, German environmental organizations were far from united on CCS. As an interviewee from German industry observed not without satisfaction, ‘some environmental NGOs have undergone a certain change of opinion and have become somewhat more open’ (interview industry 3). One

Table 1. Actor constellation in German CCS politics.

Group	Main actors	Position	Strategy	Selected evidence and examples from interview material
Principled opponents	Greenpeace, BUND, PowerShift, DUH, Left Party, local citizen initiatives	Principle rejection of CCS due to technological uncertainties, negative environmental impact and risk of reinforced carbon lock-in. Insistence on transformative mitigation policy (e.g. fossil phase-out, sufficiency orientation). Emissions from waste incineration and cement production are not simply 'unavoidable'.	Popular mobilization, alliances with local protests and initiatives against CCS, position papers to intervene in public discourse and leverage CCS-skeptic public opinion.	"Some environmental organizations say we completely reject CCS because it can potentially be misused as an excuse for business as usual, as a way for fossil fuels to sneak back in, thereby undermining the phase-out and harming environmental protection." (Interview NGO 3) "There are [...] environmental organizations that argue much more strongly in favor of sufficiency and degrowth, saying that we need to tackle the underlying causes and reduce these processes, and that we therefore do not need CCS." (Interview NGO 4)

(Continued)

Table 1. (Continued).

Group	Main actors	Position	Strategy	Selected evidence and examples from interview material
Cautiously conditional proponents	NABU, WWF, Germanwatch, Agora, parts of Green Party and SPD, environmental agencies (UBA, BNF), BUMV, renewable energy sector	Limited use of CCS excluding fossil energy, narrow definition of technically hard-to-abate and residual emissions (specifically cement, lime, waste) and no onshore storage.	Influence policy making through party channels. Environmental organizations: leverage trust among the public while making pragmatic compromises with unrestricted CCS-promoters.	"It is simply a strategy to say, we are entering into discussions with business associations in order to perhaps influence them in our favour [...] it can be a case of give and take, and then perhaps we will have the BDI more on our side afterwards, and in return we will make concessions to them, but then we can jointly draw up climate protection demands which will then be heard more strongly by politicians than if we did it alone." (Interview NGO 4) "If you want to have some influence, you can either refuse to participate altogether and say, we just don't want this [...] or you can say, yes, we want to be part of the discussion. Fortunately, in Germany we have reached the point where we say that climate change exists and we have to do something about it, and even the industry is now on board. The acknowledgement that we probably can't achieve it with emission reductions and natural sinks alone, is now the next message that we unfortunately have to spread widely to the public." (Interview NGO3)

(Continued)

Table 1. (Continued).

Group	Main actors	Position	Strategy	Selected evidence and examples from interview material
Unrestricted promoters	Equinor, Wintershall Dea, representatives of cement, steel, waste, chemical industry, mechanical engineering, CDU, FDP	Unrestricted 'technology-open' integration of CCS into climate policy, regulatory relaxations (e.g. CCS projects as overriding public interests). Partly: federal regulation for onshore storage and push to broaden definition of hard-to-abate towards economic considerations.	Narratives of deindustrialization and relocation without CCS, natural gas with CCS as transitional technology, professional events and strategically selective reference to scientific evidence.	"It's a huge amount of emissions that we couldn't possibly eliminate through avoidance or natural sinks, but we actually have to eliminate them because, as I always say, there's no such thing as good and bad emissions." (Interview FDP) "Reducing emissions is a priority. But we simply depend on CCS to achieve this transformation, the entire phase up to 2045 in Germany. Without CCS, we will not be able to do it, precisely because of these unavoidable or non-avoidable process emissions. So, of the many different components, CCS is definitely a major one." (Interview industry 6) "What we would like to see is a regulatory framework that is so technology-neutral that every company can sit down, look at its options and then choose the most cost-effective way to decarbonize." (Interview industry 5)

(Continued)

Table 1. (Continued).

Group	Main actors	Position	Strategy	Selected evidence and examples from interview material
Pragmatic mediators	BMW, BDI, DGB, Chancellery, Bellona	Achieve climate neutrality while maintaining industrial base, competitiveness, and employment through CCS, no exclusion of fossil energy but prioritization of broad array of hard-to-abate sectors (without clear definition).	BDI, DGB: build compromise with more credible environmental organizations. Mediate competing interests through prioritized funding (rather than access ban for fossil energy producers).	"As things stand, if you take climate neutrality seriously, there is simply no other way. You have to be a little honest about that. You can take the position and say, yes, in 30 years we will have technology that can do that. But that's not how the economy works. You need a degree of planning security, otherwise a company will simply go elsewhere. It will say that the conditions here are not such that I can still be producing here in 10 years' time. So I'll just go somewhere else. For us, that means massive job losses, but also a loss of value creation and welfare. And there has also been a rethinking in the environmental association landscape, with a strong commitment to Germany as an industrial location. And that is good and right. We gain nothing if industry relocates and we have carbon leakage here. And then production takes place in other countries with poorer environmental and social standards." (Interview DGB) "Our motivation was to say that we need to join forces with players who have more credibility in this area. That's why I believe that they will continue to play a huge role. [...] This is also a task that environmental NGOs can accomplish, to strengthen the understanding and trust in this technology." (Interview industry 5)

Source: Authors elaboration.

Table 2. Core events of the policy process.

1. Phase: resurgence	2. Phase: dynamization	3. Phase: decision
24.11.2021: Coalition agreement: Commitment to the necessity of technical negative emissions	24.11.2023: Party Congress of the Greens: Repositioning on CCS for “technically unavoidable emissions”	26.02.2024: Draft amendment to the KSpG: CCS is only excluded in the context of coal (Art 1, § 33, Abs. 5).
21.12.2022: Evaluation report of the KSpG	12.12.2023: Decision of the Green parliamentary group: CCU/S should not be used in the energy sector	Core points of the Carbon Management Strategy: Technology-neutral deployment of CCS/CCU: no exclusion of the energy sector, but no subsidies
06.01.2023: Minister Habeck’s visit to Norway	10.01.2024: BDI-coordinated policy paper: “Industrial Transformation in One Piece” (BDI, DGB, NABU, WWF)	21.06.2024: Government’s draft bill for the KSpG: Only coal-fired power plants are excluded
24.03–29.08.2023: Stakeholder process for the Carbon Management Strategy	30.01.2024 Statement from a coalition of environmental organisations in response to the BDI paper: “CCS: Broad environmental alliance warns of dangerous wrong path”	27.09.2024: First reading of the bill in the German parliament
17.08.2023: BMWK meeting with environmental organisations: According to the BMWK, CCS/CCU excluded from the energy sector		Open letter from environmental organisations: “Environmental organizations oppose carbon capture and storage (CCS) for fossil fuels and other industrial processes that can be decarbonized” 06.11.2024: Collapse of the traffic light coalition 21.11.2024: Statement from an industry alliance calling for a fast adoption of the KSpG: “Take action, stop hesitating: Adopt KSpTG now – for climate protection and location preservation”

Source: Authors elaboration.

of the most crucial factors for the recent dynamics of CCS politics in Germany was that some environmental organizations, notably the federal associations of WWF Germany and NABU (The Nature and Biodiversity Conservation Union), came out publicly in favor of CCS, arguing for its highly restricted use. Our interview evidence suggests that this shift was primarily motivated by the assessment that climate change mitigation in

the mid-2020s is much more urgent than 15 years ago, requiring different measures, including CCS (interview NGO 5). This led them to publish a joint position paper with the BDI (Federation of German Industries) and the DGB (German Trade Union Confederation), prompting some of our interview partners to speak of ‘two camps’¹ (e.g. interviews NGO 3, 4), and even a ‘massive rift’ (interview NGO4), among environmental organizations.

Besides WWF and NABU, the coalition advocating for a conditional approach to CCS deployment includes various other NGOs (e.g. Germanwatch), representatives from the renewable energy sector as well as parts of the Green Party and of the SPD (notably its parliamentary group in the Bundestag). It also included state apparatuses such as the Federal Environment Agency, and the Federal Ministry for the Environment. Essentially, these actors converged around the narrative that so-called ‘technical’ carbon sinks have become necessary to meet Germany’s climate targets if Germany’s strong industrial base is to be preserved. They maintained that CCS can no longer be considered a ‘high risk’ technology (interview NGO 3), but its use should be strictly limited to narrowly defined unavoidable residual emissions, predominantly from the cement, lime and waste industries, excluding CCS in gas-fired power plants (NABU 2024; SPD Bundestagsfraktion 2023; WWF Germany 2024a). Representatives from the renewable energy sector specifically sought to ensure that CCS does not incentivize any form of carbon lock-in (BEE 2024; Green Planet Energy 2024).

6.3. Unrestricted proponents

A coalition advocated for an unrestricted, ‘technology-open’ integration of CCS into German climate policy. It comprises actors from the oil and gas industry (e.g. Equinor, Harbour Energy and Wintershall Dea) and machine engineering (MAN Energy Solutions), but also so-called hard-to-abate sectors, i.e. the cement industry (e.g. Cemex, Association of German Cement Works (VDZ), Heidelberg Materials), the lime industry (e.g. Federal Association of the German Lime Industry (BVK)), the chemical industry and related trade unions (e.g. Association of the Chemical Industry (VCI), Industrial Union of the Chemical, Mining and Energy Industries (IG BCE)), the steel industry and the waste sector (e.g. Interest Group for Thermal Waste Treatment Plants in Germany (ITAD)). On the party-political level, the stance of unrestricted CCS promotion was adopted by the FDP and CDU/CSU (interviews NGO 2, 5, industry 7).

Notably, unlike in other studies (e.g. Brad *et al.* 2024 on Austria), we did not find that hard-to-abate industry actors demanded privileged, technology-selective access to CCS subsidies or storage – at least not publicly. Nevertheless, substantial heterogeneity of interests can be assumed:

industries whose status as hard-to-abate is uncontroversial (cement, lime, waste) mainly pushed for faster legislation, infrastructure scale-up and onshore storage options, facing the expiration of free allocation in the EU ETS (VDZ 2024; BVK 2024b; interview industry 3). Meanwhile, the chemical, paper and glass industries primarily sought nominal recognition as hard-to-abate sectors requiring CCS (VCI 2024a, 2024b; interviews NGO 3, industry 6), while the steel industry insisted on inclusion in CCS infrastructure, despite available decarbonization alternatives (e.g. via green hydrogen). As one interviewee put it ‘we have a great many industries that have actually lobbied for becoming potential beneficiaries of a CCS infrastructure’ (interview NGO 3). Importantly, while these sectors framed their process emissions as unavoidable, the oil and gas industry, alongside the CDU/CSU and FDP, sought to expand the concept of residual emissions – hitherto focused on *technically* hard-to-abate emissions – to include those that are *economically* hard to abate (Harbour Energy 2024; Equinor Germany 2024; Deutscher Bundestag 2024).

Beyond conventional lobbying strategies, these actors promoted the narrative that core parts of German industry would have to move overseas without CCS (‘carbon leakage’), strategically referencing scientific reports on the necessity of CCS to achieve climate targets and organizing numerous professional events around CCS (interviews DGB, industry 3, NGO 5). In addition to its considerable financial and organizational power resources, the oil and gas industry’s knowledge of potential storage sites represents a distinct structural power resource. CCS at gas-fired power plants is specifically legitimized by portraying it as a transitional technology needed during periods of low renewable generation (‘dark doldrums’) (interview NGO 6). This suggests that, for the unrestricted proponents, CCS imaginaries serve above all to legitimate the prolongation of existing fossil fuel-based or other emission intensive corporate strategies under the banner of net zero.

6.4. Pragmatic mediators

A fourth group of actors sought to mediate diverging positions on CCS and articulate a viable political compromise on the role of CCS in German climate policy. Correspondingly, the main actors of this group are key state apparatuses – the Federal Ministry for Economic Affairs and Climate Action (BMWK) and the Chancellery – as well as the BDI as the key umbrella organization of German industrial capital and the German Trade Union Confederation (DGB). The more conservative and influential wings of the SPD and the Green Party, which enjoyed close ties to the government in the investigation period, can also be considered part of this group (interviews NGO 4, DGB, SPD, FDP 2). Its key objective was to square climate neutrality with competitiveness and maintain high-quality employment under

collective bargaining, pre-empting de-industrialization and job losses through ‘carbon leakage’. The Norwegian NGO Bellona, which established an office in Berlin in 2021, can be considered a part of this group, as it actively pushed for CCS without political inhibitions allying itself with the oil and gas industry.

The group essentially supported (and in part drafted) the legislative proposal for an amended CCS Act, seeking to mediate competing interests and positions by prioritizing the use of CCS for emissions considered hard to abate – without, however, explicitly excluding CCS on fossil energy production and clearly defining which emissions should be considered hard to abate and on what grounds (i.e. purely technical or also considering economic aspects, supply security, etc.) (interviews DGB, NGO 5; BDI et al. 2024). Most actors in this group also welcomed the opt-in clause for onshore storage (predominantly for reasons of cost-efficiency), but emphasized challenges for maintaining ‘social acceptance’.

7. Process analysis

We conceptualize the political conflict over CCS in Germany as progressing through three phases. In the first phase, from November 2021 until August 2023, the topic of CCS was slowly built up. The second phase, from September 2023 to January 2024, is marked by intensified conflicts and shifts within the actor constellation. In the third phase, from February 2024 to January 2025, concrete legislative proposals were debated, but ultimately not passed due to the premature end of the traffic light coalition (see [Table 2](#)).

7.1. Resurgence

Given the relatively widespread rejection of CCS in Germany in the 2000s, initial steps focused on reintroducing the technology into the political debate. Three key events reignited the CCS debate: The coalition agreement between the SPD, Greens and FDP, the legally mandated evaluation report of the CCS Act and Minister of Economic Affairs and Climate Action Robert Habeck’s visit to Norway.

Although CCS was not explicitly mentioned in the coalition agreement in November 2021, the FDP secured a commitment to the ‘necessity of technical negative emissions’ (interview FDP 2). Almost all climate scenarios for Germany’s net zero pathway assume BECCS and DACCS as necessary – both linked with CCS. Thus, this wording in the coalition agreement opened the door to CCS, especially since the coalition agreement quantified unavoidable residual emissions at about 5% (Coalition Agreement 2021).

The CCS Act was passed in 2012. The evaluation report from December 2022 concluded that CCS technologies are part of a strategy to

achieve greenhouse gas neutrality established in the Climate Protection Act, necessitating changes to the law (BMWK 2022). This report, according to several interviewees, energized the CCS debate by framing it as an indispensable climate protection technology and discussing possible instruments for its development (interviews industry 3, 6, NGO 4). One interviewee commented on the evaluation report as follows: ‘And this has [...] opened the window so that we can talk about it again. But of course, at the same time, there is also a lot of pressure from industry [...] to focus more intensively on this issue again’ (interview NGO 4).

Shortly after releasing the report, in January 2023, Minister Habeck visited the Norcem cement plant in Brevik, Norway, the first cement plant in the world that was retrofitted with a CCS system. Having once been a firm opponent of CCS in the 2000s, this visit lent significant momentum to the process (interviews NGO 5, industry 7). This is also due to the fact that ‘with Mr. Habeck, we have gained a determined minister in this regard, who naturally has a different level of credibility than if this had been tackled by a minister from the conservative or liberal party’ (interview oil and gas).

Following these developments, the federal government decided to develop a Carbon Management Strategy (CMS). This strategy aimed to specify potential applications for CCS and CCU and outline a regulatory framework for possible deployment in Germany. Between March and August 2023 four stakeholder dialogues with representatives of over fifty institutions were held. Several interviewees (interviews industry 3, DGB, NGO 2) noted that the process aimed to organize consent for the technology. Crucial in terms of the strategic selectivity of the process, the citizens’ initiatives against CCS were not even invited. Its goal was to build consensus on an amended CCS Act, defuse potential social tensions, bring the issue further into the public debate and achieve public reassurance (interview BMWK). While the CMS focused on CCS and CCU, the removal of CO₂ from the atmosphere was to be addressed as part of the long-term Residual Emissions Strategy (Haas *et al.* 2024).

7.2. Dynamization

Two pivotal events intensified disputes over CCS in Germany: the Greens’ repositioning on CCS at their November 2023 party congress and the aforementioned joint policy paper by BDI, DGB, WWF, and NABU in January 2024. These occurred amid mounting discussions over Germany’s economic crisis and the threat of industrial decline (interview industry 5), favoring narratives which framed CCS as a key technology to secure the long-term existence of Germany’s industrial base in the context of geopolitical shifts and net-zero climate targets.

Historically, the Green Party had categorically opposed CCS, making it all the more striking that Robert Habeck began to actively promote the

technology (interview industry 4). However, the Green Party had signaled a shift in its position at its November 2023 congress by expressing support for the use of CCS for ‘technically unavoidable emissions’ (Die Grünen 2023). In December 2023, the Green parliamentary group clarified that CCS/CCU should *not* be used in the energy sector (Die Grünen Bundestagsfraktion 2023). Minister Habeck found himself caught between pressure from unrestricted proponents to adopt a technology-open approach and his party’s call for a much narrower scope (interviews SPD, FDP 2). Parallel to the Green Party, the Environment Agency and NABU – which have historically spoken out against CCS (Environment Agency) or have not taken a definitive position on it (NABU) – also began advocating for a conditional application of CCS (interview NGO 1). This reorientation significantly weakened the coalition of principled opponents (interview NGO 4).

Against this backdrop, NABU, WWF and DGB signed the aforementioned BDI-coordinated policy paper ‘Industrial Transformation in One Piece’ (BDI et al. 2024). The environmental NGOs aimed to influence the BDI with this unusual alliance, amplify climate protection voices and increase their chances to actively shape climate policymaking. The BDI, for its part, sought to gain broader societal acceptance for CCS by aligning itself with credible environmental actors (interview industry 5). Released at a point when the process was stalling, the paper sought to energize the political debate. It supported CCS/CCU as a tool for economic transformation, stating: ‘It is correct to use CCS and CCU now primarily where CO₂ emissions cannot be avoided with current technology’ (BDI et al. 2024). The text purposefully avoided strict definitions of residual emissions, allowing each party to interpret the term as suited to their respective position – environmental NGOs could interpret ‘unavoidable’ narrowly, while the BDI interpreted it more broadly. One interviewee remarked: ‘The problem was that NABU and WWF, together with BDI, published a paper saying CCS is great, limited to unavoidable or hard-to-avoid emissions. But, of course, the spin that came with it was: “Haha, now environmental NGOs are pro-CCS”’ (interview NGO 4).

Media attention framed the paper as a shift within the environmental movement (interviews DGB, NGO 4). Its primary impact was to legitimize CCS and weaken the anti-CCS coalition, as environmental organizations became divided between principled opponents and cautiously restrictive proponents: ‘With this paper, there was suddenly a division, so to speak, where you could say there are those who sit at the table with the BDI, and there are those who do not’ (interview NGO 4). Against this background Greenpeace and other principled opponents responded in force, declaring CCS ‘the opposite of climate protection’ and a ‘fake solution’ in a joint position paper (BUND et al.

2024). This public stance highlighted the split within the environmental movement and weakened its negotiating position (interview NGO 4).

7.3. Decision

In February 2024, Habeck presented a draft amendment to the CCS Act and core points of a CMS. Driven by pressure from the FDP and the fossil energy industry, the drafts adopted a mostly technology-open stance, only explicitly excluding CCS in combination with coal power (interviews FDP, NGO 2, NGO 4). The key points of the CMS explicitly state: ‘In the spirit of technological openness, the use of CCS/CCU for power generation plants with gaseous energy sources [...] should be made possible’ (BMWK 2024b). However, subsidies were to target projects tied to unavoidable emissions.

Environmental groups criticized the technology openness approach – particularly with respect to gas-fired power plants, which had not played an important role in earlier consultations. On the contrary, in August 2023, the BMWK had assured the environmental organizations that there would be no opening for CCS with gas-fired power plants (IFG 2023d). The BMWK’s drafts, in turn, brought together the environmental organizations, previously divided into principled opponents and cautiously conditional proponents, whose common interest was to prevent the use of CCS in the electricity sector. The unrestricted proponents welcomed the draft legislation, especially the ‘technology-open’ approach that did not discriminate against combining CCS with specific technologies or energy carriers (e.g. natural gas). They also advocated for regulatory relaxations, e.g. accelerated permitting procedures by classifying CCS projects as being of ‘overriding public interest’ (interviews industry 6, 7), and partially for a (mandatory) uniform federal regulation for onshore storage (BVK 2024b).

The June 2024 submission remained largely consistent with the February draft and some interviewees argued that it was even more favorable to unrestricted proponents (interviews NGO 3, 4, 5). The FDP pushed to broaden the subsidy base, expanding it from technically unavoidable to economically hard-to-abate emissions (interviews industry 5, FDP 2). BMWK and FDP aimed to pass the amendment before the 2024 summer recess, but resistance from SPD, Greens and the Federal Ministry for the Environment prevented the adoption of the drafts (interviews FDP 2, 4, NGO 4, 5). With the collapse of the traffic light coalition in November 2024 neither the amendment to the CCS Act nor a CMS or Residual Emissions Strategy were finally adopted before the federal elections in February 2025.

8. CCS and the politics of conditionality

Under the Merz government, which took office in May 2025, Germany has adopted a revised CCS Act. While it retains the focus on offshore storage, the conditional approach at the heart of the policy conflict investigated here has been weakened to insignificance: The CCS Act only excludes coal-fired power plants, which will be phased-out by 2038 anyway. Meanwhile, the federal government's power plant strategy projects an additional capacity of 12 GW (mostly gas-fired power plants), which is to be decarbonized in a 'technology-open' way until 2045 (BMWE 2026), opening the door wide open to carbon lock-in associated with CCS (Faber *et al.* 2025).

Our study sheds light on the emergence, contestation and factors leading to the ultimate failure of a conditional approach to integrating CCS into Germany's climate policy. These findings echo recent contributions on green industrial policy which argues that conditionality should not just be regarded as a question of optimal policy design, showing that political, institutional and ideational constraints determine 'which and how conditionalities are applied' (Schmitz *et al.* 2026, p. 337). Given substantial public skepticism and a critical stance of environmental organizations toward CCS, the question of how to restrict and condition the use of CCS to hard-to-abate emissions, thus avoiding carbon lock-in, emerged as a key policy conflict in Germany. Notably, it was environmental organizations, along with environmental agencies and parts of the Greens and the SPD – rather than the hard-to-abate sectors themselves – that called for conditional integration of CCS into German climate policy (as cautiously conditional proponents).

The politics of conditionality framework adapted from Bulfone *et al.* (2025) points to key factors which have contributed to the failure of the conditional approach indicating several pitfalls and risks in pursuing a strategy of conditionality that appear relevant beyond the German case. First, with respect to the coalition dynamics, the initial rift among environmental organizations following NABU's and WWF's decision to conditionally support CCS with the DGB and the BDI seems to have significantly weakened the overall position and influence of environmental organizations in the subsequent policy formulation process.

Second, regarding discursive and ideational factors, the media framed this positioning of NABU and WWF as broadly supportive of CCS, while the conditional nature of their support was largely lost in public discourse. Thus, while the move toward conditional support by some environmental organizations and the Green Party was decisive for re-opening the policy debate on CCS in Germany, the political and discursive backing for a strict conditional approach was fragile from the outset. As the process analysis suggests, the conditional approach became subsequently weakened in the policy process due to pressure from the unrestricted proponents.

Third, our findings indicate that on the institutional level, selectivities of the state in the policy formulation process undermined the scope for enforcing strict conditionality: While local protest initiatives were excluded from the consultation process, the divided environmental organizations failed to anchor a clear commitment to conditionality. This, in turn, enabled other actors to dilute conditionality under the banner of technology openness after the consultation process, i.e. in a policy formulation stage that was far less permeable to civil society actors. This dilution was likely further facilitated by excluding the definition of residual emissions from the CMS and moving it to a separate strategy, allowing actors to push for the broadening of the scope of hard-to-abate emissions from technically to economically hard-to-avoid.

9. Conclusion

In this article, we investigate the contextual factors, actor constellation, and conflictual dynamics that have led to the renaissance of CCS in Germany. We show that the main point of contention was whether the application of CCS should be strictly confined to hard-to-abate emissions to avoid carbon lock-in and mitigation deterrence effects, especially when CCS is combined with fossil power generation.

Our results underscore the challenges of implementing and enforcing a conditional approach to CCS, particularly in the face of resistance from fossil and industrial incumbents. Despite clear and strong demands for such an approach from civil society actors and the scientific community (Edelenbosch *et al.* 2024, Markusson 2024), and despite frequent statements by political actors that CCS should primarily serve this purpose, implementation has proven difficult. They reveal the coalitional, discursive and institutional factors why even in Germany – arguably a most-likely case for a strictly limited CCS approach, given broad public skepticism toward the technology – the conditional approach failed.

Conversely, our findings suggest two crucial insights into how a conditional approach can be strengthened: First, advocating a conditional approach (and eventually asserting it against powerful incumbents on an asymmetric institutional terrain) requires cohesive and well-coordinated coalitions that align on clearly defined and communicated conditions and framings, echoing broader accounts on the centrality of coalitional power to assert climate policy against incumbent interests in transition conflicts (Meckling and Karplus 2023, Kalt 2024). In contrast, a split between civil society actors principally opposing and conditionally supporting CCS can be exploited for a technology-open approach. Second, a conditional approach needs to be specific on the scope of residual, hard-to-abate emissions (Buck *et al.* 2023). Unless these are anchored in policy documents, a commitment to a conditional approach, focusing CCS on hard-to-abate emissions, can

easily be undermined by subsequently inflating the scope of *hard-to-abate-ness* and the anticipated level of residual emissions. To be sure, determining what is hard-to-abate and which emissions are residual raises intricate questions of technical possibility and social necessity (Lund et al. 2024). If anything, this underscores that the role of CCS cannot be reduced to questions of technological and economic feasibility, but raises far-reaching societal and political questions about the shape and direction of social-ecological transformation toward net-zero.

Note

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