Who owns the present, owns the future?

Rethinking socio-ecological transformations through infrastructure ownership

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Abstract: *In the face of rising global temperatures and their devastating consequences, the urgency of socio-ecological transformation is increasingly evident. However, transformative change remains difficult to achieve. This contribution attempts to examine how infrastructure ownership influences the speed and direction of the socio-ecological transformation. An initial theoretical discussion on the role of infrastructure ownership in the transformation is empirically exemplified by an analysis of the European Union's strategic turn toward hydrogen as a key energy carrier, despite scientific debates about its scalability and capacity. A thematic analysis of selected documents during the policy-making process reveals that the narrative of private, profit-oriented incumbent companies mirrors the policy shift on the EU level. Thus, it shows that private, profit-oriented ownership of incumbent infrastructures and related power dynamics can delay transformative change. Ultimately, the contribution emphasizes the need for critical research to start with material conditions and their subsequent power dynamics when examining the reality of socio-ecological transformations.*

1. Introduction

Recent heat waves, wild fires, and devastating floods in Europe and many other places in the world, have demonstrated the urgency of socio-ecological transformation. The Intergovernmental Panel on Climate Change (IPCC) has repeatedly warned that incremental changes are not enough; only transformative shifts in energy, production, and consumption patterns can keep global warming below critical thresholds (IPCC, 2023). Yet, despite widespread recognition of this imperative, today, transformative change towards a cli-

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mate-friendly future seems further away than ever. Even without taking current developments in the US, and their drastic consequences, into account, the 1,5 °C goal is now almost impossible to achieve (IPCC, 2023). So, the question remains: Why do transformation efforts often fail?

A growing body of scholarship has sought to answer this question by focusing on the role of infrastructures as possible barriers to socio-ecological transformation by creating "carbon lock-ins" (Unruh, 2000; Geels et al., 2016). While this perspective provides a first valuable insight in the dynamics at work, it treats technical infrastructures as mere socio-technical systems. More recent work in various disciplines of the social sciences hints at seeing infrastructures rather as socio-political objects that are politically chosen and heavily shape questions of costs and burdens in the transformation (Malm, 2016; Kropp, 2024; Wansleben & Terhorst, 2025). Building on Chancel & Rehm (2024), this contribution highlights the interplay between inequality and the climate crisis by looking at the ways in which infrastructure ownership shapes both the possibilities and limits of socio-ecological transformation. In the following sections, the contribution first gives an overview of how social science literature engages with the role of infrastructures in the socio-ecological transformation. Then it expands this literature by revisiting Chancel & Rehm's (2024) notion of ownership carbon inequality. Their study shows that carbon emissions are not distributed equally among individuals or countries but are deeply linked to ownership structures: those who own and control productive assets, e.g. factories, vehicles, power plants, also own the means by which carbon is emitted. This insight compels us to look beyond individual consumption patterns and toward ownership emissions. In addition, ownership shapes not only who profits from infrastructures but also whose interests guide their design, deployment, and maintenance. Finally, the contribution refers to an empirical example of a policy decision for a certain infrastructure where profit-driven and centralized ownership hindered deep ecological transformation: The European Union's turn towards hydrogen as a key energy carrier in the beginning of the 2020s. This empirical example is analyzed by a first consideration of ownership structures of incumbent infrastructure and points to an important forum for policy influence: The Gas Regulatory Forum, or Madrid Forum. In a second step, a thematic analysis of the presentations of this forum is conducted. By theoretically discussing the role of ownership in socio-ecological transformation and showing empirically how influential this incumbent forum was in the policy-making process, this contribution aims to lay the groundwork for a more materially grounded answer to the question of why transformation efforts fail.

2. Infrastructures & the socio-ecological transformation: an emerging topic in the social sciences

Infrastructures have become increasingly central to debates on climate protection across a wide range of social science disciplines. Across social science disciplines, infrastructures are often understood as interconnected systems and facilities designed to provide, store, and transform goods and services for collective use, forming the foundation for essential public services like water, energy, healthcare, and transportation. The longest tradition of looking at infrastructures can be found in the *transition studies* literature. Transition scholars emphasize that infrastructures are not merely technical, but deeply embedded socio-technical systems that can both enable and constrain sustainability transitions. Publications in this field of study have established the idea of "lock-in"-effects of existing systems, highlighting how material, institutional, and economic path dependencies constrain the pace and direction of change (Unruh, 2000; Geels et al., 2016; Seto et al. 2016). Critically reflecting on those lock-in effects, Andreas Malm (2016) powerfully argues that fossil-fuel infrastructure is not a neutral structure but a material force that actively shapes and constrains social choices. He writes:

> "The choice to travel in [cars] rather than in trams or buses or on bicycles is conditioned by a vast infrastructure of oil terminals, petroleum refineries, asphalt plants, road networks, gasoline stations—not to [mention] the film industry, the lobbying groups, the billboards—which did not fall from the sky in this moment but was built up over time, eventually amassing such weight and inertia that other modes of transportation are now excluded, or at least prevented from rising to predominance. This is what some refer to as 'carbon lock-in': a cementation of fossil-fuel–based technologies, deflecting alternatives and obstructing policies of climate-change mitigation." (Malm, 2016, 7)

The concept of carbon lock-in underscores how deeply entrenched infrastructures privilege carbon-intensive technology and obstruct climate mitigation. But existing infrastructures are not creating carbon lock-in by their mere existence, rather, it's a political choice which infrastructure is chosen and how it is designed. This point of view is often claimed by scholars in the field of heterodox economics. The foundational economy gives importance to infrastructures because they shape the social, economic, and ecological conditions of specific regions and are crucial for ensuring equal access and societal participation. Thus, it situates infrastructures at the core of a politics of provisioning and advocates for socio-ecological infrastructures (Bärnthaler et al., 2021; Foundational Economy Collective, 2022). Relating to this call to revalue the everyday infrastructure that sustains social life, Kohei Saito's work pushes these insights into a more radical ecological and systemic critique. Drawing on Marx's theory of the metabolic rift, he argues for a shift away from mass consumption and toward public goods that serve collective needs: compact, energy-efficient cities with strong public transit, minimal packaging and advertising sectors, and a greater focus on properly maintained, socially owned infrastructure (Saito, 2020). Recently also more and more sociological literature has acknowledged that only a profound change in infrastructure systems will limit climate change and its consequences (Neckel 2022; Kropp, 2024; van Dyck et al., 2024; Wansleben & Terhorst, 2025). Those sociological discussions of the role of infrastructures in the socio-ecological transformation highlight their immense relevance for understanding the nexus between inequality and the climate crisis. Kropp (2024) holds that social differences between rich and poor and between the provision of resources in the Global South and their use in the Global North are anchored and perpetuated in infrastructure systems. Similarly, Wansleben & Terhorst (2025) argue for the strategic importance of infrastructures for the investigation of inequality in the climate crisis. By distinguishing between 'upstream' concentrated versus diffuse investment requirements and between profit-oriented versus public welfare-oriented institutional embedding of infrastructures, they also offer an initial analytical framework for analyzing such infrastructure-related distributional effects (Wansleben & Terhorst, 2025). This interdisciplinary body of work highlights that infrastructures are not neutral structures, but they shape who benefits from transformation, who bears its costs, and which futures remain viable. In this light, infrastructures must be understood not only as technical challenges, but as political objects—and the investigation of such is essential, especially to understand the nexus between climate crisis and inequality.

3. On inequality and ownership of infrastructures

Interlinkages between inequality and the climate crisis have empirically been demonstrated by the team around Lucas Chancel associated with the World Inequality Lab for the past years (Chancel & Piketty, 2015; Chancel et al., 2023). Chancel's recent work with his colleague Yannick Rehm adds one dimension of inequality that is especially interesting to look at within the discussion of infrastructures in the socio-ecological transformation: ownership-based carbon inequality. Their research explores the carbon footprint of individuals by incorporating emissions from both consumption and asset ownership, such as real estate, equities, and pensions and introduces a novel framework: ownership-based emissions (Chancel & Rehm, 2024). Key findings reveal significant inequality in carbon emissions across wealth groups in the United States, Germany, and France. The wealthiest 10% emit far more CO_2-equivalent annually when ownership emissions are included, compared to their consumption-only emissions.[1] According to their study, the top 10% wealthiest people on the planet are responsible for 70–85% of emissions tied to capital ownership, with wealth-related emissions being more unequal than wealth distribution itself due to the carbon intensity of assets owned by the wealthy. Looking at future developments of such inequality, Chancel and his team argue in a recent publication that the way capital for the green transition is funded and owned, whether by the public or private sector, could significantly impact the global distribution of wealth in the future (Chancel et al., 2025). If governments take the lead and retain ownership of climate-related infrastructure, public wealth could grow substantially. In contrast, if private actors dominate these investments, the wealth gap could widen, with the top 1% potentially capturing an even larger share of global assets (Chancel et al., 2025). Thus, decisions made today about how to finance climate investments, especially in renewable infrastructure, will have long-lasting effects on economic inequality. But not only do incumbent ownership structures deeply affect future inequality scenarios, they also heavily influence how socio-ecological transformation is taking place. Van Dyk et al. (2024) make the claim that the ownership of infrastructures, such as energy supply, transport systems, and digital networks, can represent key obstacles to achieving a sustainable and just transformation. In

1 Ownerhip-based emissions: 102 tonnes in the US, 50 tonnes in Germany, and 38 tonnes in France vs. Comsumption-based emissions: of 52 tonnes in the US, 18 tonnes in Germany, and 16 tonnes in France.

their work, private ownership of infrastructure is critically examined, as it is often geared toward profit maximization, which can exacerbate social inequalities and ecological damage. At the same time, they discuss how alternative forms of ownership, such as commons or public infrastructure, could play a crucial role in advancing the socio-ecological transformation (van Dyck et al., 2024). A prominent example of their claim is the continued existence of fossil fuel infrastructure, particularly natural gas facilities, in regions where private companies have a strong interest in maintaining these assets. This vested interest can significantly slow down the transition to renewable energy sources, a point that will be discussed in more detail later in this text. Taking these considerations together, they hint at a research avenue for understanding barriers for socio-ecological transformation: The way infrastructures, the interconnected systems and facilities designed to provide, store, and transform goods and services for collective use, are organized and owned. Especially looking at ownership and organization of those infrastructures that need to be transformed for an ecological future, such as energy infrastructure, seems essential. Therefore, to understand the processes of socio-ecological transformations, it appears crucial to pose the following questions: Who owns the incumbent infrastructures today, and how do these ownership structures influence the possibilities for transformation?

4. The European Union's turn to hydrogen

One productive line of inquiry to find out how ownership structures influence the possibilities for transformation is to investigate policy cases that delay or divert deep transformation, particularly where incumbent actors succeed in reshaping climate agendas to preserve their assets and influence.

4.1 Case selection & description

A compelling case to explore in light of the posed question is the European Union's strategic turn[2] toward hydrogen as a key energy carrier. In her 2022

2 Important to note here is that this shift, that is explained in detail below, does not necessarily describe a shift within the European industry sector towards using hydrogen, it only describes a noticeable shift of focus on hydrogen and other renewable gases in the strategy documents and directives of the European Union from 2020 onwards.

State of the Union address, European Commission President Ursula von der Leyen highlighted that hydrogen could be a potential game-changer for Europe's energy system. However, before 2020, unlike the steady rise of the importance of renewables in policy discourse over the decades, hydrogen had not been a central focus in the EU's renewable energy transition. While interest in hydrogen dates back to the 1970s oil crisis, technological and structural challenges kept it on the sidelines, with investments favouring other energy solutions. Recently, this has shifted. Many EU member states have introduced national hydrogen strategies, increased funding for hydrogen projects, and integrated hydrogen more prominently into energy policies. Germany has, for example, even set up a National Hydrogen Council and a Hydrogen Coordination Office to follow through on its goals of producing, importing and using hydrogen in all industry sectors.[3] At the EU level, strategy documents like the "A Hydrogen Strategy for a Climate-Neutral Europe" and "REPower EU" reflect this growing emphasis. New is also the European Hydrogen Bank, which has awarded nearly €1 billion to 15 renewable hydrogen projects through its second auction.[4] Yet, the rapid embrace of hydrogen as a "solution fuel" overlooks ongoing scientific debates about its scalability and capacity. Fossil fuels dominate current hydrogen production due to the availability of energy inputs and the higher costs and limited technology associated with alternative hydrogen production methods (Moraga et al., 2019; Nikolaidis and Poullikkas, 2017). As of 2023, most hydrogen is produced using natural gas and coal without carbon capture and storage (CCS) technology, while less than 1% is derived from renewable energy electrolysis. Notably, carbon dioxide emissions from hydrogen production have risen by 1.5% compared to 2022 levels (IEA, 2024, 2022, 2021; Lagioia et al., 2023). This hydrogen is primarily used in heavy industries like refining and steel production. Critics highlight the lack of scalable, cost-competitive technology for clean hydrogen production in the short term (Löffer et al., 2022). In Europe, challenges in producing green hydrogen domestically have prompted energy partnerships with regions such as Latin America and MENA. Concerns persist about future hydrogen availability and pricing relative to other fuels, especially as integrating hydrogen into energy grids requires substantial investment. This includes either building new hydrogen-specific

3 Germany's National Hydrogen Strategy: https://www.bundeswirtschaftsministerium.de/Redaktion/EN/Hydrogen/Dossiers/national-hydrogen-strategy.html

4 More information on the European Hydrogen Bank: https://energy.ec.europa.eu/topics/eus-energy-system/hydrogen/european-hydrogen-bank_en

infrastructure or retrofitting existing gas systems, which is complicated by hydrogen's unique chemical properties. These factors increase the risk of leaks, require higher system pressure, and necessitate significant retrofitting or reconstruction, potentially entrenching reliance on fossil fuels for transportation (Baasch et al., 2024; Hollenhorst, 2023; Lagioia et al., 2023; Moraga et al., 2019). Thus, framing hydrogen as a green solution for the EU's sustainable future remains highly contentious. Rather, it might lead to the cementation of an energy infrastructure relying on natural gas for decades to come, instead of transforming the European energy system sustainably.

4.2 Method

If analyzed through the lens of infrastructures as socio-technical systems, the described case could be simply interpreted as a case of carbon lock-in: the incumbent gas infrastructure in Europe functions here as a barrier to deep transformation and steers the European Commission towards a decision that keeps the infrastructure alive. However, and here is the critical point, such an explanation completely misses an understanding of why this happens. Here, the look at ownership structures and power is essential. Especially in this case, where the shift toward hydrogen came so suddenly, ownership structures of incumbents and their power in political decision-making might also explain the suddenness of the turn. To understand why the European Commission opted to shift its focus on hydrogen as an energy carrier, the analysis thus started with what was argued for previously: the ownership structures of incumbent infrastructure. Those were examined through already existing literature. This contextual analysis led to the focus one specific event: the Gas Regulatory Forum, also called the "Madrid Forum", a forum set up by the European Commission, to meet with the gas industry twice a year. A systematic thematic analysis of all presentations held at the 32nd Madrid Forum in 2019, which took place on June 5th–6th, 2019 and the 33rd Madrid Forum on October 23rd–24th, 2019, was then employed to reveal the discursive strategy and narratives of the gas industry prior to the noticeable shift in 2020 in EU strategy papers. Those presentations were held by representatives of think tanks, companies, or business associations invited to the forum by the European Commission. All 65 available documents were collected from the official website of the European Commission.[5] The collected texts were prepared for analysis by converting them into .txt files and then imported into the MAXQDA software[6] for coding and analysis. The thematic analysis of this data set was then conducted following the six-phase framework proposed by Braun and Clarke (2006):

> First, the researcher immersed herself in the data by reading and rereading the transcripts to gain a deep understanding of the content.
> Second, the researcher coded the data systematically by inductively identifying meaningful segments of text.
> Third, the researcher then grouped the codes into broader themes by identifying patterns and relationships across the data.
> Fourth, the researcher reviewed and refined the themes to ensure they accurately represent the data.
> Fifth, the researcher named the themes.
> Sixth, the researcher organized the themes into a coherent narrative and supported it by illustrative quotes from the data.

It is acknowledged that thematic analysis is an inherently interpretive method, and the findings may be influenced by the researcher's own biases. But to minimize the biases and ensure reliability, another researcher independently coded a subset of the texts.

4.3 Context & Ownership

In 2019, Corporate Europe Observatory published the results of its study on the ownership of gas infrastructure in Europe. The report shows that gas pipelines are concentrated in the hands of a few powerful Transmission System Operators (TSOs), many of which are partially or fully state-owned, while also involving major institutional investors. Companies like Italy's Snam, Spain's Enagás, France's GRTgaz, Belgium's Fluxys, and Germany's Open Grid Europe control large portions of the continent's pipeline networks and Liquefied Natural Gas (LNG) terminals. These operators are often backed by

5 Documents were retrieved from: https://commission.europa.eu/publications/32nd-madrid-forum-presentations_en & https://commission.europa.eu/publications/33rd-madrid-forum-presentations_en

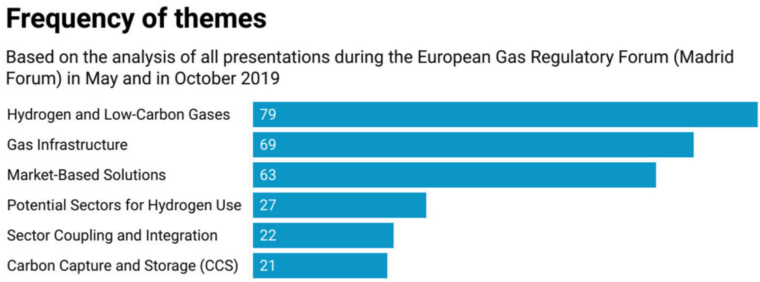
6 MAXQDA is a software program for analyzing various types of data, including text, audio, video, images, and survey results. MAXQDA helps organizing, coding, and analyzing data, as well as visualizing relationships and patterns within the data.

sovereign investment arms—such as Cassa Depositi e Prestiti Reti S.p.A. (CDP Reti) in Italy—and global financial actors like BlackRock and Lazard Asset Management, which hold significant shares. Furthermore, these companies are not merely passive infrastructure managers; they play an active role in shaping EU energy policy through bodies like ENTSO-G, the European Network of Transmission System Operators for Gas. This dual position, owning physical infrastructure while participating in regulatory planning, enables them to safeguard and extend their assets, often pushing for continued gas investments under the guise of energy security or transition. Consequently, Corporate Europe Observatory comes to the conclusion that the result is a structurally embedded system where gas interests can delay decarbonization efforts and influence the trajectory of Europe's energy transition (Corporate Europe Observatory, 2019). In addition, Szabo (2022) notes that a unified industry coalition emerged around the idea that gas infrastructure could support the transition by transporting decarbonized fuels, such as hydrogen. This narrative shift also allowed gas incumbents to position natural gas as the foundation for a low-carbon future through blue hydrogen. According to Szabo (2023), industry actors, particularly transmission system operators and gas producers, used forums like the European Gas Regulatory Forum, where critical voices are systematically excluded, to influence the European Commission. Therefore, to understand how the gas industry influenced the policy-making process, it is essential to look at what happened at the European Gas Regulatory Forum. The turn towards hydrogen in EU strategy papers happened between 2019 and 2020. In the European Green Deal, published in 2019, hydrogen only had a minimal role, while it gained prominence in the policy discussion on the transition in 2020 with the publication of the 'Hydrogen Strategy for a Climate-Neutral Europe'. Thus, the following analysis will focus on the European Gas Regulatory Forums in 2019. In 2019, the European Gas Regulatory Forum met twice, once in June and once in October.

4.4 Findings of thematic analysis

The thematic analysis revealed six distinct themes that were discussed most in the presentations: "Hydrogen and Low-Carbon Gases", "Gas Infrastructure", "Market-Based Solutions", "Potential Sectors for Hydrogen Use", "Sector Coupling and Integration" and "Carbon Capture and Storage (CCS)". However, there is a significant difference in the frequency of their occurrence within the Madrid Forum presentations (see Figure 1).

Figure 1: The figure shows how often concepts that were clustered in the 6 themes were coded throughout the 65 documents.



Source: own illustration of results with www.datawrapper.de

The theme that came up the most throughout the documents was named *Hydrogen and Low-Carbon Gases.* It summarizes all segments of the texts that dealt with hydrogen and low-carbon gases and their role in the decarbonization of European industries. Decarbonized, low-carbon gas, such as blue hydrogen, is often discussed as a good solution to reduce emissions. *Gas Infrastructure Europe (GIE)* writes, for example: "decarbonized gas which could substantially decrease the emission of greenhouse gases". In addition, equal importance for decarbonization is given to low-carbon cases and renewable gases. The consultancy company *Navigant,* holds, for instance: "Not scaling up renewable and low carbon gas and decommissioning gas infrastructure will lead to unnecessary costs." Here, also cost-efficiency of the use of low-carbon gases is mentioned.

Related to this main theme, additional attention was also given to the CCS technology and its prospects for decarbonizing hydrogen. All segments of the text referring to this technology were summarized in the theme "Carbon Capture and Storage (CCS)". Especially given the scarcity of green hydrogen, CCS is framed as necessary for the energy transition. The voice of Europe's national energy regulators at both the EU and international levels, the *Council of European Energy Regulators (CEER)* writes for example: „Nevertheless, to reach the ambitious 2050 emission target, in the long-term the use of natural gas has to be faded out or, at least, drastically reduced, unless decarbonisation technologies such as Carbon Capture and Storage (CCS) are widely deployed." In addition, it using CCS is also seen as the most cost-effective way of producing hydrogen. The *International Association of Oil & Gas Producers (IOGP)* writes on this for example: "CCS is a proven technology necessary to achieve climate neutrality in Europe in a cost-efficient manner, and to enable negative emissions. All credible scenario modelling shows that CCS will be essential to meeting the targets set by the Paris Agreement."

Hydrogen and low-carbon gases, including those produced with CCS are discussed frequently to be essential in the decarbonization of all so-called hard-to-abate sectors. The theme "Potential Sectors for Hydrogen Use" summarizes text segments that specify certain sectors for hydrogen use. Long-distance transport and energy-intensive industries are mentioned the most. This holds true not only for gas and industry actors, but also for electricity sector participants. *Eurelectic*, the European electricity industry's leading association, even holds: "Europe should strive to maintain leadership in green molecules, including green hydrogen, which are needed to decarbonize, especially specific segments of industrial activity and heavy-duty transport".

A significant amount of attention is also given to the potential application of hydrogen for sector coupling and integration, including discussion of its role as storage and the application of power-to-gas (P2G) technology. All text segments that discussed hydrogen concerning these were summarized in the theme "Sector Coupling and Integration". For many participants in the Madrid Forum, sectoral integration is crucial for decarbonizing the energy sector, and hydrogen is regarded as an especially useful tool. This view is shared across the board, from energy regulators to gas and electricity industry members. *Gas Infrastructure Europe (GIE)* highlights, for example, the "key role of Power to Gas (P2G) in coupling electricity and gas systems as well as between important demand sectors." And even *Eurelectic*, agrees with this and states that "significant benefits and synergies can be found through the coupling of electricity and gas sectors."

One conviction that runs through most of the documents is that market-based solutions are considered more important than regulations for the decarbonization of the European energy systems. Text segments that express this belief are summarized in the theme "Market-Based Solutions". This argument is often expressed as a more general push for a 'technologically neutral' approach to regulation. This insistence on technological neutrality implies levelling the playing field by not ensuring favourable conditions for specific energy carriers over others; for example, not punishing 'low-carbon' solutions in favour of renewables. In this context, Guarantees of Origin (GOs)[7] are discussed as a potential solution. In the presentations of the Madrid Forum, the demand that GOs should also be issued for low-carbon gases appears frequently. The European think tank *Hydrogen Europe* holds, for example, that GOs should be extended to cover renewable and low-carbon gases, because "this would provide a consistent means of proving to final customers the origin of renewable and low-carbon gases, including hydrogen, facilitating greater cross-border trade in such gases."

And lastly, the theme "Gas Infrastructure", relates to all passages that discuss the role of gas infrastructure in energy systems and its readiness for hydrogen. First of all, there is a broad consensus among the analyzed documents that it is important to consider the repurposing of gas infrastructure for decarbonization. The Brussels-based association *Gas Infrastructure Europe (GIE)*, representing the interests of European gas infrastructure operators, argues, for instance, to view "gas infrastructure and green gases as a key pillar of a sustainable energy system." In addition, it is often argued that using the gas infrastructure is the most cost-effective solution to ensure hydrogen integration into the energy sector. The *International Association of Oil & Gas Producers (IOGP)*, a global forum for the upstream oil and gas industry, writes, for example: "CO_2 can be transported in existing steel pipelines, driven by compressors, without the need for costly infrastructure upgrades." This statement also suggests the readiness of existing gas infrastructure to integrate hydrogen. The Brussels-based, non-profit organization that advocates for the widespread adoption of biogas and biomethane as sustainable solutions, the European Biogas Association (EBA), states in its vivid claim: "Gas infrastructure exists—use it!"

In contrast, what appeared only to a limited extent was a critical perspective on the technical capacity and scalability of hydrogen. Critique was limited to the recognition that green hydrogen is scarce. The feasibility of CCS technology also went largely unquestioned. The Madrid Forum participants adhered to the notion that hydrogen can be successfully scaled up; recognition of technological immaturity was only considered in the context of advocating for more financial investment to achieve guaranteed maturity. Furthermore, gas industry actors in the Madrid Forums insisted on the readiness of existing gas in-

7 GOs are electronic certificates that prove a specific amount of energy was produced from renewable energy sources. They are traded and used to demonstrate the renewable origin of electricity, ensuring transparency and preventing double-counting.

frastructure to integrate hydrogen. There were no discussions about the actual feasibility of doing so.

4.5 Discussion

What the findings of the thematic analysis clearly show is that there had indeed, as Szabo (2023), mentioned, been a consensus among industry actors that hydrogen will be one of the key energy carriers for the future. But instead of focusing on renewable hydrogen, most actors promoted low-carbon hydrogen, produced from natural gas, as well as blue hydrogen, produced from gas with Carbon Capture and Storage (CCS) technology. In addition, gas infrastructure is argued to be "hydrogen-ready", even though the scientific community shows that this is not yet the case (Baasch et al., 2024; Hollenhorst, 2023; Lagioia et al., 2023; Moraga et al., 2019). In general, there is little to no reference to controversial discussions in academia. And if we look at the legal translation in the revision of Renewable Energy Directive from 2023, the themes emphasized in the Madrid Forum can be detected. In the legal text, it says that the European Commission encourages Member States to support renewable hydrogen via contracts for difference, subsidies, or quotas and a binding target is set. But only 42% of hydrogen used in industry must be renewable by 2030, and 60% by 2035. And it also allows Member States to issue GOs for low-carbon hydrogen (e.g., blue hydrogen) if emissions are significantly lower than those from fossil fuels (European Union, 2023). Thus, not only did the presented narrative seem to have influenced EU strategy papers, but also legislative action. Now, what does this mean in the context of ownership? The case of the European Union's policy decision to turn towards hydrogen reveals how strong the influence of incumbent infrastructure owners is. The thematic analysis of the Madrid Forum documents shows that the narrative created by the companies owning the pipelines and supplying gas seems to be the one adopted by the European Commission—a narrative that ignored scientific knowledge but secured the material interests of incumbents.

5. Conclusion

Efforts to tackle the climate crisis are often not reaching its goals. A growing body of literature suggests that this could be caused by existing infrastructures and the way they are designed. This chapter expanded on this thought by drawing on the notion of ownership-based emissions (Chancel & Rehm, 2024), and demonstrated how ownership of infrastructures and related power dynamics can hinder transformative change. To illustrate this, it provided the example of the European Union's strategic turn toward hydrogen. With the help of existing research on the gas industry, it has revealed that incumbent actors, particularly those owning gas infrastructure, have leveraged their power to reframe hydrogen as a key energy solution, despite its reliance on fossil fuels and limited scalability. This contribution reminds us that the socio-ecological crisis we are facing today demands critical research that does not ignore the effects of material conditions and related power asymmetries, but puts them at the heart of its work. Who owns the material foundations of societies, such as, for example, gas grids, shapes not only who benefits from current arrangements but also determines who has the power and responsibility to drive or resist change. Thus, to understand current failures in dealing with climate change, we must ask: who owns what, and what does that mean for power, responsibility and resistance? Not addressing this question has far-reaching political implications. The failure to incorporate a clear analysis of ownership in policy has contributed to public backlash. Carbon pricing mechanisms like CO_2 taxes, for example, designed as well-intentioned as tools for emissions reduction, frequently impose disproportionate burdens on low-income households, while leaving large corporate polluters untouched. Moreover, ownership interests can, as discussed in this contribution, act as barriers to transformative change. Fossil fuel companies, and infrastructure providers are not passive stakeholders, but actively shape policy outcomes to protect their assets. To deepen the understanding of such dynamics, efforts in critical research on the socio-ecological transformation should begin with a critical analysis of existing ownership structures. While the analysis in this contribution simply used ownership as a starting point for contextualizing its case and determining crucial events to analyze, future research could expand on this by combining a deep analysis of ownership structures e.g. though ownership mapping with qualitative methods of similar cases. Such a combination might deeply enhance our understanding of the dynamics in socio-ecological transformation. It also allows us to reevaluate the transformation of infrastructures as a political struggle over ownership and to imagine alternative scenarios. Public ownership, cooperative models and community-based governance offer viable alternatives to concentrated corporate control. Reclaiming infrastructure for the common good could redistribute power, reduce inequality and vulnerability, and might even strengthen democracy. Consequently, a social and ecological future begins with the question: Who owns the present?

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