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Governing green industry in turbulent conditions - the role of network governance strategies and EU affiliation in Norway and Denmark

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Abstract

This thesis examines how governments experience and manage turbulence when scaling green industries under the European Green Deal (EGD). Focusing on Denmark and Norway, it compares how turbulence manifests and assesses the role of network governance and EU affiliation in shaping robust governance across three sectors: wind, hydrogen, and carbon capture and storage (CCS). The qualitative comparative case study draws on scholarships relating to turbulence theory, network governance, and multi-level governance.

Findings show turbulence is inherent in green industrial governance, but also that its intensity and character vary across the turbulence dimensions of shifting parameters, intercurrence, and temporal complexity. Denmark's institutionalized public–private networks and EU membership enabled recalibration and adaptation, though risks of administrative overload persist. Norway's fragmented, market-oriented governance amplified turbulence, with robustness emerging mainly in the state-led Longship CCS project. EU membership enhanced Denmark's anticipatory and scale capacity, while Norway's EEA-based affiliation generated turbulence through regulatory uncertainty and legislative delays. The study highlights turbulence as dimension-specific and robustness as an imperfect practice as European countries aim to scale their green industries.

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1. Introduction

The 2019 European Green Deal (EGD), represents a paradigm shift in EU climate policy, establishing new targets, timelines, and governance instruments to achieve carbon neutrality by 2050. Aiming to accelerate deployment and European domestic production of specific clean technologies, the 2023 Net Zero Industry Act (NZIA) marked a shift towards an industrial perspective on EU decarbonization goals (Wolf, 2024, p. 267). The EGD industrial pillar also introduced new discussions on competencies and roles for involved actors (Dullien, 2024, p. 251) and uncertainties regarding policy design, institutional coordination, and governance strategies. While the EU has produced a strong policy signal to Member States, its translation into national governance structures has proven uneven, and the green industrial policy landscape in Europe varies across EU-affiliated countries (Veugelers et al., 2024, p. 13).

This divergence raises important questions about how countries govern complex industrial development under EU climate ambitions. Contemporary public governance increasingly operates under *turbulent* conditions "where events, demands and support interact and change in highly variable, inconsistent, unexpected or unpredictable ways" (Ansell & Trondal, 2018, p. 45). As the EGD shifts parameters for a broad range of policy, introduces interdependencies, develops with high speed, and sees overlapping national goals, it is argued to generate turbulence (Christou, 2021, p. 366; Dobbs et al., 2021, p. 320). Turbulence challenges the traditional capabilities of governments to act decisively or coherently, especially in politically contentious and economically high-stakes policy arenas such as green industrial scaling. As rapid decarbonization goals intersect with complex multi-level political structures, the challenge for governments is not merely overcoming disruption, but learning to manage turbulence (Dobbs et al., 2021, p. 318). Thus, this thesis is interested in understanding how governments deal with the turbulence they experience in scaling green industries, and what can explain potential variation in turbulence management. To do so, it turns to the Nordic region, at the forefront of green efforts (NordForsk, 2022).

While both Norway and Denmark are wealthy, coordinated market economies with ambitious climate goals, the two countries experience different trajectories in scaling up green industry under the EGD. In the UN Green Industrial Performance Index, Denmark ranks second globally, and Norway only 22nd place (de Alba & Todorov, 2023, p. 3292). Denmark has consolidated its role as a European frontrunner with cleantech being its fastest-growing sector (Danish Ministry of Foreign Affairs, n.d.). Denmark's green industrial governance is characterized by its EU-embeddedness and “best-in-class" state coordination of private sector actors in public-private climate partnerships and strategic industrial missions (Guzhva et al., 2023; Kristoffersen et al., 2024).

By contrast, the petrostate Norway has struggled to convert its renewable electricity advantage into broader green industrial innovation (Ministry of Climate and Environment, 2023, p. 71). Its green industry strategy identifies key sectors for development (Norwegian Ministry of Trade, Industry and Fisheries, 2024a), aligned with net-zero technologies set out by the NZIA, but with different institutional support than the Danish architecture. Norway sees the least structured initiatives of public-private collaboration among the Nordics (Bragadóttir, 2024, p. 46). Strong sectoral governance traditions leave cross-ministerial coordination weak, and partnerships with private actors remain ad hoc (Szulecki et al., 2025). Green industrial stakeholders express frustration with long permitting processes, unclear responsibilities, and a growing gap between ambition and action (Laribi, 2024). Furthermore, Norway’s status as a non-EU member compounds uncertainty regarding what climate, energy, and industrial frameworks Norway will adopt through its European Economic Area (EEA) agreement (Mørk, 2025; Standal, 2024).

This thesis will identify how turbulence manifests in the governance of green industries in Denmark and Norway and examine the role played by the countries’ differing network governance strategies and EU affiliation in enabling or halting public turbulence management. While prior scholarship has begun to link turbulence theory to EU climate and energy governance (Christou, 2021; Dobbs et al., 2021; Dupont & Torney, 2021; Leiren & Farstad, 2024; Siddi, 2021), few empirical studies systematically examine how turbulence plays out in national governance settings under the EGD, and only non-member states have been studied (Leiren & Farstad, 2024). By extension, empirical studies of government responses to turbulence are lacking.

The turbulence literature identifies robust governance, characterized by balancing stability and change in the face of unpredictability, as the ideal type to handle turbulence (Ansell et al., 2024, p. 34). Public-private governance arrangements are frequently proposed as tools for governments to enhance such robustness and *govern with* the turbulence they experience (Ansell et al., 2023, p. 6; Dobbs et al., 2021, p. 322; Greve & Ysa, 2023, p. 3). Governance networks, relatively stable collaborations between interdependent but autonomous public and private actors (Torfing & Sørensen, 2014, p. 334), arise as a suitable analytical concept. Furthermore, the industrial policy dimension of the EGD explicitly promotes strategic inclusion of private actors in governance to ensure a European clean technology lead (Tagliapietra & Veugelers, 2021). While the strategic inclusion of private actors is promoted by stakeholders, including the European business community, and recognized as useful in EU multi-stakeholder governance (Börzel & Heard-Lauréote, 2009; Di Feo & Martino, 2022; World Economic Forum, 2024), little is known about whether these arrangements help governments govern more robustly under turbulence, or whether they contribute to further friction.

Using a comparative case design, this study addresses the above gaps by first identifying how turbulence manifests in green industrial governance in Norway and Denmark. Second, it asks what role network governance and EU affiliation play in understanding how the countries experience and manage turbulence in green industries under the EGD. While the two countries are often bunched as "Nordic" or "Scandinavian" regimes with similar policy ambitions, they see important differences in green industrial governance (Sanchez Nieminen & Laitinen, 2025, p. 2). Denmark has embraced strategic collaborative governance with strong EU-anchoring, while Norway exhibits more fragmented approaches to green industrial policy and adoption of EU legislation. Moreover, numerous factors impact the nations' governance of transitions (Radtke & Renn, 2024, p. 2). Comparing these similar-yet-different cases can provide insight into how similar countries with different public-private governance arrangements and institutional configurations shape the capacity to govern robustly with turbulence in net-zero industrial sectors. This study aims to answer calls for greater insight into green industry dynamics (Köhler et al., 2019, p. 11), the EGD's influence on national policy development (Norwegian Ministry of Foreign Affairs, 2024) and the nature of stakeholder participation in green industrial governance (Massuga et al., 2024, p. 674; Radtke & Renn, 2024, p. 16). Its accompanying focus on EU affiliation allows for a meaningful exploration of how being inside or outside the EU impacts governance dynamics.

The thesis proceeds as follows. Chapter two situates the thesis in the scholarship on green industrial policy, governance turbulence, network governance and multi-level governance through a literature review. It will introduce green industrial policy under the EGD, and connect its governance to the turbulent condition it exists in. The review then engages with proposed solutions to manage such conditions, emphasizing notions of networked governance and insights from EU integration scholarship. Chapter three covers methodology, which involves a qualitative comparative case study, based on policy documents, government reports, and industry announcements and -publications, derived from the Danish and Norwegian contexts. Chapter four represents the case study, which will identify how turbulence manifests and is managed in Denmark and Norway's green industrial governance. Chapter five will discuss and compare the findings to analyze the role of network governance and EU affiliation in explaining how turbulence is experienced and managed. Finally, chapter six concludes that turbulence is a defining feature of green industrial governance. Robust governance emerges as an imperfect practice, where network governance and EU-affiliation play respective parts.

2. Literature review

This chapter reviews the literature on green industrial policy, turbulence, network governance and multi-level governance that inform this thesis. First, it introduces the EGD industrial pillar. Second, it outlines how governance turbulence is understood, and the proposed solutions for states to manage the turbulent governance condition through robust governance involving public-private networks. Although research on Norwegian and Danish climate and industrial governance often highlights coordination challenges (Bauknecht et al., 2020; Budde, 2013; Ibsen et al., 2023), few studies explicitly analyze these dynamics through the lens of turbulence. As a result, they risk underestimating the degree to which instability, competing timelines, and emerging institutional entanglements are shaping national responses to the EGD. By applying turbulence theory to the case of EGD governance in Norway and Denmark and linking work on robust governance to familiar theories of network governance and MLG, this study contributes a novel analytical lens to understand variation in green industrial governance in Europe.

2.1. Green industrial policy in Europe

Climate, energy and industrial policy are increasingly interlinked through "green industrial policy" as governments pursue economic restructuring aligned with decarbonization (Johnstone et al., 2021, p. 1). In this context, climate policy sets overarching emission reduction targets, through both national commitments and international agreements, like the EGD (Siddi, 2020). Energy policy serves a dual purpose by facilitating deployment of low-carbon alternatives to achieve said climate goals (IEA, 2021) and expanding industrial capacities relating to renewable energy manufacturing, green industrial efforts (Johnstone et al., 2021, p. 1). As part of a broader national vision, industrial policy actions are connected to the wider policy landscape by underpinning sustained economic growth, technological advancement and socio-economic transformation (Oqubay, 2025, pp. 8–9). Green industrial policy thus provides governance tools to align environmental objectives with economic competitiveness, particularly by scaling renewable energy, enhancing innovation, and creating new markets (Fontana & Vannuccini, 2024, p. 4; Mazzucato, 2022).

National industrial policy approaches vary across Europe, reflecting different structural contexts, political economies and government action rationales (Johnstone et al., 2021, p. 3). However, industrial policies do not exist in a national vacuum. Constrained by WTO rules and EU competition law, a key feature of industrial policy is its adaptation to both international and domestic environments (Oqubay, 2025, p. 10). Indeed, green industrial policy has gained renewed traction at the EU-level, as Europe struggles to maintain international competitiveness (Draghi, 2024, p. 14; Scheinert, 2023). This is reflected in the EGDs industrial pillar.

The NZIA defined that EU net-zero manufacturing capacity should cover a minimum of 40% of the EUs annual net-zero deployment needs. It identifies 19 priority technologies, including hydrogen, wind and carbon capture and storage (CCS), and introduces a Union-wide CO_2-storage target (European Commission, n.d.). The Clean Industrial Deal (CID) compliments this by simplifying regulation and opening up state aid expansion to scale investments (Klapwijk & van Ahee, 2025). Collaborative instruments such as public-private partnerships and networks are emphasized by EU-level industrial strategies to address fragmentation, attract private capital, and improve implementation (European Commission, 2025; Regulation (EU) 2024/1735, 2024). These developments reflect a broader reconfiguration of the state's role in steering green industries and industrial competitiveness, contrasting the "technology-neutral" and market liberal policy tradition of the EU (McNamara, 2024).

Both Denmark and Norway prioritize energy-related technology in their green industry strategies. The EGD was a major step in the convergence between energy and climate policy in the EU (Christou, 2021, p. 364), and now industrial policy, which has typically been reserved for national policymaking. In this paper, the EGD is referenced with respect to the overarching policy shift it represents, and implementation of the ambitious strategy faces a context of substantial *turbulence* (Dobbs et al., 2021, pp. 316–317). To fully capture the complex dynamics of contemporary governance, this paper proceeds to deploy governance turbulence literature.

2.2. Governance turbulence and the European Green Deal

Existing scholarship on the EGD and its governance draws on frameworks such as Europeanization (Maris & Flouros, 2021) and multi-level governance (MLG) (Poyraz & Szalmáné Csete, 2023; Pūķis et al., 2023) to understand how the EGD is implemented across levels and sectors. While these perspectives offer important insights, they often presuppose a relatively stable policy environment and focus on coordination as a normative goal. What these accounts tend to overlook is the unsettled, fluid, and unpredictable nature of the current policy landscape, a condition better captured by the concept of *governance turbulence* (Ansell & Trondal, 2018). In turbulence, politics sees a rapid pace with reorientation continuously occurring as temporal complexity increases, parameters shift, and priorities, concerns, expectations, and opportunities are introduced by current and anticipated events. The deepest causes of governance turbulence are argued to be the result of relentless shocks coming out of neoliberal capitalism, globalization, and other practices of domination, including colonialism. Turbulence differs from crisis in that it does not assume the return to a "normal" but considers a constant state of change, uncertainty and volatility as structures, interactions and temporalities realign and shift (Shipton & Dauvergne, 2023, pp. 3–4). Climate-related governance is particularly susceptible to turbulence due to its transboundary nature and reliance on coordination across multiple sectors, actors, and governance levels (Siddi, 2021, p. 328).

Governance turbulence manifests through three dimensions set out by Ansell & Trondal (2018): shifting parameters, intercurrence, and temporal complexity (Ansell & Trondal, 2018, pp. 45–47). First, shifting parameters challenge the once stable political, technological and financial basis underlying the operations of organizations and institutions. Second, intercurrence refers to unexpected institutional entanglement and interplays between originally independent levels and organizations. Intercurrence is likely to intensify with a growing number of involved institutions and as mandates shift and expand. However, the entanglements and interplays of intercurrence can also enhance synergies between actors. Third, temporal complexity refers to multiple competing timelines and paces, which decision makers and organizations must manage (Ansell & Trondal, 2018; Dobbs et al., 2021, p. 317; Shipton & Dauvergne, 2023, p. 3). These three dimensions make up turbulence as a new normal for public governance and include the possibility for turbulence to be positive and create new opportunities (Dobbs et al., 2021, pp. 317–318). The dual potential of turbulent governance conditions warrants further understanding of the governance strategies actors adopt to cope with turbulence in the context of European green industrial policy under the EGD.

2.3. Robust governance to manage turbulence

Governments operating under turbulent conditions must develop long-term governance capacities that support flexibility, dynamism, and resilience in policy outcomes (Christou, 2021, p. 362). Such capacities facilitate more effective and timely responses to changing circumstances (Dobbs et al., 2021, p. 318). Robust governance is understood as an ideal type that enables governance systems to remain functional and legitimate despite uncertainty and disruption. It is characterized by the ability to balance stability and change, ensuring both adaptability and institutional coherence in the face of unpredictability (Ansell et al., 2024, p. 34; Dobbs et al., 2021, pp. 319–320). According to Ansell et al. (2024), robust governance is achieved when decisions lead to outcome effectiveness and perceived legitimacy with those affected. To do so, public governors require ability to position "oneself as a central point of contact for a plurality of social and political actors" and manage skepticism toward change by framing innovation as a form of adaptation (Ansell et al., 2024, pp. 34–36). This governance between extremes is an imperfect balancing act involving flexible adaptation without losing sight of original values, goals and objectives (Dobbs et al., 2021, p. 320).

Several strategies are highlighted in the literature for achieving robustness. A central component is the involvement of non-government stakeholders, which increases problem-solving capacity, enables more flexible interventions, and facilitates responses to transboundary and complex challenges. However, increased stakeholder involvement also introduces new risks, as the number of stakeholders and complexity grow, lengthy negotiation in governance networks can instead create turbulence (Ansell et al., 2024, pp. 3–12). Additionally, the link between neoliberal and capital practices as sources of turbulence themselves complicates the analysis of how to involve market actors with profit-seeking motivations in public governance (Shipton & Dauvergne, 2023, pp. 3–4), referencing the de-risking literature (Gabor, 2023).

The literature on network governance in green industries aids understanding of this dynamic. Globally, private actors are attributed a vital role in solving climate deterioration (Westman et al., 2019, p. 16), reflecting a broader neoliberal governance turn, transnationalization of climate governance and the capitalist coupling of sustainability transformations to continued economic growth (Pattberg & Stripple, 2008; Pinilla-De La Cruz et al., 2022, p. 1373). By extension, private sector involvement is described as central to EGD governance and European green industrial policy efforts (Bălan & Dan, 2022; Tagliapietra & Veugelers, 2021). This shift is criticized for privatizing global policy responses (Pattberg & Stripple, 2008, p. 380), while others highlight its utility for managing complex green transformations that demand long-term commitments and broad consensus (Altenburg & Assmann, 2017, p. 99).

In this thesis, *private sector involvement* in green industrial policy is conceptualized through the lens of *governance networks*. Governance networks (GNs) typically refer to relatively stable collaborations between interdependent but autonomous public and private actors (Torfing & Sørensen, 2014, p. 334). Related literature involves collaborative governance (Wang & Ran, 2023) and public-private partnerships (Velotti et al., 2012). Compared to hierarchical and market-based governance modes, GNs are flexible and adjustable to specific purposes (Sørensen, 2014, pp. 5–6), and can structure interdependencies and align involved actors (Trondal et al., 2022, pp. 3–4). On the other hand, they can lack accountability, capacity and authority. Critics warn about policy fragmentation, hollowing out the state and de-risking practices draining public funds for private gains without sufficiently following up on decarbonization targets (Gabor, 2023, p. 25; Marquardt, 2017, p. 168). As a form of hybrid public-private partnership of increasingly voluntary nature, trust and strong institutional foundations become crucial. Key challenges therefore include clarifying how actors are institutionalized and who can exercise what authority, to ensure the sustainability of GNs over time where funding includes grants and technological and financial risk is high (Pinilla-De La Cruz et al., 2022, pp. 1371–1378).

To manage such risks, platform-based governance has been proposed as an institutional architecture that can foster robust network governance. Platforms enable rapid mobilization, build swift trust among actors, and manage the tension between hierarchy and networks by clearly specifying roles and aligning actor engagement. They facilitate the temporary and adaptive formation of purpose-built task forces, partnerships, and cross-sectoral networks that are better suited for managing turbulent problems. By managing the tension between change and stability, platforms enhance robust governance (Ansell et al., 2024, pp. 54–73). Moreover, turbulence and its management shaped by factors across multilevel systems like the EU.

The conditioning role of multi-level governance

A second comparative dimension in this study concerns how the differentiated EU integration between Norway and Denmark shape national capacities to govern green industrial policy under turbulence. This variation can be examined through the lens of Multi-Level Governance (MLG) (Hooghe & Marks, 2001), which conceptualizes policymaking as co-produced across EU, national, subnational and actor-specific levels, in decentralized, networked governance. Within this framework, governance turbulence arises not only from policy content or actor contestation but from the inherent complexity of multi-level decision-making, referencing turbulence of scale (Ansell et al., 2017, p. 42). *Scalar turbulence* can be felt vertically and horizontally, and occurs in MLG-structures when a decision made at one level significantly impacts another level (Dobbs et al., 2021, p. 319; Siddi, 2021, p. 330). For instance, European Commission efforts to reduce internal EU turbulence through stronger coordination, can simultaneously generate political and administrative turbulence at the member state level. Scalar turbulence is frequent in Europe (Ansell et al., 2017, p. 47), and some scholars argue that, in practice, vertical differentiation across EU member states and affiliated countries lead to fragmented policy processes (Marquardt, 2017, p. 168).

On the other hand, the literature on robust governance opens for multi-level governance to enhance robustness by offering a conditioning role. Ansell et al. (2024) argue that differentiation and polycentricity, two core traits of EU governance, may support robustness by allowing diversity and modularity in policy response. Furthermore, the complexity of this multilayered EU architecture paves way for experimentation and contestation to a greater extent than smaller, nation-state polities alone (Ansell et al., 2024, pp. 55–59; Sottilotta, 2022). *Scale capacity*, defined as the ability to integrate and govern at multiple levels of authority, further conditions the robustness of governing systems and processes. In practice, this means robustness is enhanced when multi-level institutional resources can be easily combined, and hampered when there is competition and isolation between levels of authority

(Ansell et al., 2024, p. 59). By comparing an EU member and a closely affiliated non-member, this study probes the potential of EU affiliation to shape national level capacity for robust governance in green industrial development

2.4. Analytical expectations

This study does not aim to test hypotheses or trace causality in a traditional positivist sense. Rather, it seeks to understand how governance turbulence manifests in the green industrial developments of Norway and Denmark, and how specific governance arrangements, particularly network governance and institutional affiliation with the EU, may condition governments' ability to manage this turbulence. The aim is exploratory and interpretive, guided by theoretical insights from the literature on governance turbulence (Ansell et al., 2017; Ansell & Trondal, 2018; Dobbs et al., 2021; Shipton & Dauvergne, 2023; Trondal et al., 2022), robust governance (Ansell et al., 2024) including network governance (Torfing & Sørensen, 2014) and MLG (Hooghe & Marks, 2001; Marquardt, 2017). The thesis signals some key explanatory factors for differences between the two countries. Robust governance is expected to emerge when public authorities, under turbulent conditions, manage to combine institutional flexibility and legitimacy. The above review further suggests that institutionalized and role-clarified network arrangements enhances both flexibility and legitimacy, and that EU affiliation can provide scale capacity, ultimately leading to more robust governance.

3. Methodology and research design

This chapter outlines the methodological choices guiding this thesis and justifies the research design, case selection, data collection, and analytical strategy, before discussing methodological limitations. The study explores how Norway and Denmark experience governance turbulence in green industries under the EGD, and how different governance configurations shape the public sector's capacity to manage such turbulence robustly. It adopts a qualitative comparative case study approach, grounded in interpretivist epistemology, well-suited to perform a nuanced analysis of understudied phenomena (Vromen, 2018, p. 243). Informed by theories of governance turbulence and robust governance, network governance practices and EU affiliation receive conceptual focus. By interpreting empirical findings through turbulence-concepts, it adds empirical insight to the literature on turbulence and governance of green industries under the EGD.

3.1. Case selection

Norway and Denmark were selected as most-similar-yet-different cases. Both are high-trust, advanced welfare states with consensus-oriented political cultures and strong state capacity (Christensen et al., 2024, p. 60). Both countries have ambitious climate and industrial policies closely linked to their energy sectors but differ in energy profiles. Denmark is an EU member with a mature network governance architecture for green industries, while Norway is a non-member with more fragmented coordination and continued petroleum-export dependence. The NZIA became enforceable in Denmark, as in all Member States, in June 2024. Norway, affiliated through the EEA Agreement, has signaled support for the NZIA, which the Commission has deemed EEA-relevant, but has not yet decided whether to incorporate it into the EEA framework and transpose its provisions into national law (Norwegian Government, 2024). By examining the two different national contexts and EU affiliations, the role of governance networks is linked to the wider context that may hinder or promote green industry under the EGD (Ryan, 2017, p. 284).

To focus the analysis, the study examines three of the 19 technologies prioritized under the NZIA: onshore and offshore wind, hydrogen, and carbon capture, transport and storage technologies (CCS) (Regulation (EU) 2024/1735, 2024). Prioritization of specified technologies is relatively novel in the EU context, placing added political, financial, and organizational pressure on national authorities and industries to deliver rapid progress (Tagliapietra et al., 2023). The three selected technologies are central to both EU-level and national industrial strategies and span different levels of maturity. Given differing national prerequisites for scaling these technologies, analyzing multiple sectors offers a broader view of green industrial governance in Norway and Denmark.

3.2. Analytical framework and methodological reflections

The empirical analysis applies qualitative content analysis (Preiser et al., 2021, p. 274). By adopting a case-oriented, instead of a variable-oriented, analysis, the study seeks to understand the complex interdependencies of variables in green industrial governance, rather than simplified cause-and-effect relationships (Pahl-Wostl et al., 2021, pp. 284–288). Turbulence is conceptualized along three dimensions; shifting parameters, intercurrence and temporal complexity. Network governance practices and EU affiliation act as interpretive lenses to analyze the presence of robust governance in the two countries. Network governance in green industrial policy is observed through the structure and role of public-private collaboration, including the existence of platforms and the intensity of consultation. EU affiliation refers not only to formal membership (Denmark) versus external alignment (Norway) but is also assessed through the degree of regulatory alignment and access to EU instruments. These elements are not treated as strict, independent variables, but as conditions that shape the institutional capacity for robust governance.

Empirical material was collected through document analysis of publicly available strategies, reports, consultation records, industry publications, and media from Denmark and Norway, supplemented by EU-level documents and academic literature. The selection spans the post-EGD period (2019-2025) and includes materials in Norwegian, Danish, and English. To ensure focus on the central theme of public-private coordination, particular attention was given to sources documenting actor interaction in green industrial governance. A full overview of analyzed documents, including those not directly cited in the thesis, is provided in *Appendix 1*.

As a small-N qualitative study, this research prioritizes depth into two country cases over Europe-wide generalizability. The careful selection and conceptualization of explanatory variables aid the ability to synthesize observed configurations and ensure consistent interpretations (Pahl-Wostl et al., 2021, p. 288). The more extensive Danish public-private practice may lead to a bias in more data on GNs being available for Denmark than for Norway. This is addressed by focusing on sectors where both countries have comparable data, and triangulating across multiple data sources. Data availability was enhanced by drawing on sources in Norwegian, Danish and English. Even if the replicability of this study is somewhat compromised by its dependence on deep case study knowledge (Pahl-Wostl et al., 2021, p. 288), it provides understanding of the mechanisms and strategies that may enable or hinder governance of green industries in turbulent conditions.

4. Case study analysis

The overall goal of this chapter is to empirically assess how governance turbulence manifests in the NZIA-industries in Norway and Denmark, and to evaluate any efforts of the respective governments to manage such turbulence. The Danish and Norwegian cases are presented separately, applying a parallel internal structure for later comparative discussion. The governance context is introduced before identifying how governance turbulence manifests in green industrial policy, focusing on the three defined NZIA industries: wind, hydrogen and CCS. While examples from all three industries are analyzed, the manifestations are taken together and organized along the three core dimensions of turbulence: shifting parameters, intercurrence, and temporal complexity. Considering the research focus, findings related to network governance and EU affiliation are emphasized.

4.1. Denmark

Denmark, an EU member since 1973, is widely seen as a proactive supporter of EU climate and energy policy. The Danish national climate ambition increased with the adoption of the EGD regulation and is currently more ambitious than the EU target, aiming for a 70% reduction in CO^2 by 2030. This target is bound by law through the landmark 2020 Climate Act, obligating the Danish government to develop annual action plans, monitored by the Danish Council on Climate Change (DCCC). Denmark saw massive initiative on green industrial efforts parallel to the EGD rollout, and is on its way to achieve its national climate targets by 2030 (Bäckstrand, 2025, pp. 283–284).

Denmark has built strong industrial capabilities in green technology manufacturing and export (OECD, 2021, p. 2) with wind serving as the backbone, preceding the EGD. State-owned Ørsted transitioned away from hydrocarbons in 2008, with EU renewable energy targets as a strong motivation (Algers & Kattel, 2021, p. 4; Ørsted, n.d.). Beyond its mature wind energy industry, hydrogen-relevant Power-to-X technologies (PtX), and CCS were prioritized in 2020 (Danish Ministry of Climate, Energy and Utilities, 2020). These are partially pursued through mission-driven partnerships which combine public and private actors across the value chain with NexGenerationEU co-funding (Innovation Fund Denmark, 2021). The national 2021 PtX-strategy exemplifies Denmark's coordinated approach, developed with several Climate Partnerships (State of Green, 2021, p. 31), and emphasizing multi-level partnership structures to realize the strategy (Vested, 2021, p. 40).

The Danish capacity to tackle major societal challenges is attributed to close and sustained collaboration between relevant stakeholders in green industrial governance (Krogh et al., 2022, p. 258). Public-private partnerships and platforms are Denmark's hallmark method for converting climate measures into tangible climate action, policies and long-term commitment (State of Green, 2022, p. 15). Combined with stable political and regulatory integrative frameworks, the model has fostered central innovations and breakthroughs in new Danish energy solutions for decades (K. B. Hansen & Enevoldsen, 2022, p. 151). The 2020 Climate Act institutionalized mechanisms for stakeholder participation and accountability (Bäckstrand, 2025, pp. 289–290) and was followed by the launch of the Climate Partnerships in 2019 to create sectoral roadmaps for emission reduction in the context of the EGD rollout (Office of the Danish Prime Minister, 2019). The 14 flagship governance networks are grounded in sectoral forums spanning the Danish economy, chaired by industry-leading firms, and consist of sector representatives that contribute to governmental strategies and implement targeted strategic efforts. Over 400 proposals have emerged from this initiative, including the artificial offshore energy islands, now part of national infrastructure planning (Danish Ministry of Climate, Energy and Utilities, 2024, pp. 213–214; Mernild, 2022, pp. 1364–1365).

Beyond national sectoral transitions in the Climate Partnerships, the Danish government launched eight "Commercial Beacons" (*Erhvervsfyrtårne*), after the COVID-19 pandemic with EU Recovery and Resilience funding (Danish Business Agency, 2022). These are long-term regional public-private partnerships developing innovation and export ecosystems for selected green technologies, providing a spatially anchored model for industrial innovation and investment building on existing characteristics and advantages (European Commission, 2023). The next section will elaborate on the Danish practice and its link to turbulence manifestations.

Manifestations of turbulence in Denmark's green industrial governance

Shifting parameters

Turbulence from shifting parameters refers to changes in the political, financial, or technological environments in which public organizations operate, disrupting existing plans and routines in ways that compromise public planning and existing investments (Ansell & Trondal, 2018, p. 13). The industrial turn of the EGD was largely anticipated due to Denmark's high climate ambitions and active participation in shaping the EU's green industrial policy to align national and supranational frameworks. Denmark has also maintained a relatively coherent green industrial commitment, linking its industrial competitiveness with sustainability, which while demandingly ambitious, contributes to predictability and stability for Danish stakeholders (Amangku, 2025, p. 57).

However, post-pandemic economic volatility, such as rising interest rates and inflation, has increasingly disrupted this predictability (Ambrose & Partridge, 2025). Soaring costs across global supply chains led Ørsted to revise their renewables targets and cancel offshore wind and hydrogen projects (Conboye & Millard, 2024). This includes exiting the "Green Fuels for Denmark" hydrogen consortium, despite substantial state aid and status as a European Commission designated Important Project of Common European Interest (Martin, 2024). The exit led to the dissolvement of the consortia, representing a high-profile example of how shifting financial and technological parameters can undermine green industrial coordination, with respect to both network arrangements and EU embeddedness. Technical uncertainty also contributes to turbulence. Limited domestic experience and developing sufficient storage capacity remains a key challenge to the Danish CCS ambitions (Walstad, 2024). In August 2025, Ørsted also withdrew from a CCS tender, as it redirects focus to European offshore wind (Kristensen, 2025). This return to core-competencies, illustrates the difficulty of establishing new markets and sectors based on preconditions, and market competition crowding out project feasibility.

These shifting parameters are not reserved for Denmark only. Clean energy is more sensitive to interest rate changes than fossil fuels, and a stronger economic logic is increasingly replacing climate-target-induced renewables growth globally (Conboye & Millard, 2024). The volatility of market conditions was also evident in the 2024 North Sea offshore wind license auction, which attracted no bids due to being misaligned with unfavorable market conditions. This prompted rapid government recalibration, including the announcement of up to EUR 7.5 billion in new subsidies (Reuters, 2025) and flexible conditions (State of Green, 2025b). This result came out of a government-ordered market dialogue on the same day as the failed bids (Danish Energy Agency, 2024c). The need for a rework of the framework suggests a prior network-miss leading to the auction design drifting from market realities but shows the effectiveness of the Danish corporatist tradition in recovery when facing shifting parameters.

Public support for both climate efforts and the green industries is generally high in Denmark. However, lack of community acceptance to specific, large-scale projects involving international investors has slowed further expansion of onshore wind and lengthened bureaucratic processes (Krogh et al., 2022, p. 252; Lind et al., 2025, pp. 4–17). This is linked to intercurrence in spatial planning and permitting.

Intercurrence

Intercurrence captures overlapping governance developments across policy domains and administrative levels. Overall, this type of turbulence is relatively muted at the Danish macro level, where climate, energy, and industrial policies are closely integrated in the Danish Ministry of Climate, Energy and Utilities (Pedersen, 2022, p. 5). This holistic approach matches well with the cross-sectoral nature of the EGD, and institutional entanglements are anticipated through the alignment of relevant policy domains in ministerial organization (Leiren & Farstad, 2024, p. 4). Indeed, Denmark often leverages policy entanglement as an opportunity for innovation, as illustrated in strategic documents and network compositions.

Instead, intercurrence manifests at operational levels. The national level Climate Partnerships are proven effective in producing consensus along goals, strategies and proposed initiatives, as they enable more efficient information sharing, than general participation procedures. However, evaluations also reveal concerns over the pace of subsequent governmental decision-making, execution and follow-up of industry proposals, as the public sector is perceived to increasingly lack resources and commitment. Upholding the relevance of the Partnerships as targets increase and policy environments evolve, is also a highlighted challenge (Bragadóttir, 2024, pp. 16–17). In 2022, a PtX Taskforce mandated to coordinate across public authorities and remove regulatory barriers were added to the Danish PtX strategy (Danish Ministry of Climate, Energy and Utilities, 2022, p. 6). Evaluations of the taskforce revealed unmet needs for increased coordination-capacity and resources from public actors, to manage the processes and timelines, and follow up on requests from the private participants (Danish Energy Agency, 2024a, 2024b). Despite networked mitigation efforts, the administrative realities of green industry coordination led the taskforce to a halt two years early. Insufficient role-allocation for public actors across the national and regional level is also a source of intercurrence turbulence for the Beacons, that simultaneously triggers temporal complexity. Evaluations of the Beacons asserts success in catalyzing significant additional investments and stimulating synergies for innovation and value-creation. However, Beacons that struggle to identify the relevant public actor have a harder time mobilizing the desired involvement and advance project planning, while those with clearly defined public actor roles perform the best (Danish Business Agency, 2025, p. 12).

Specific governance initiatives are established to manage these downside manifestations of intercurrence in governance networks. To identify and remove barriers for green energy expansion, the Danish government appointed the NEKST working groups, consisting of energy sectoral, governmental and municipal actors, but also private firm representatives (Lind et al., 2025, p. 27; NEKST, 2024, p. 13). NEKST was created in alignment with the NZIA (Climate Partnership for Finance, 2025, p. 34), and successfully resulted in the implementation of regulatory recommendations that lowered permitting-timelines for renewable energy projects after only half a year. This working group differed from other mentioned network initiatives in its clear assignment of actions to different public institutions and agencies, all the way from ministerial to grid company level. The NEKST method involves defined and intensive "sprints", enabling rapid action and adaption while work is ongoing (Danish Ministry of Climate, Energy and Utilities, n.d.; NEKST, n.d.). Thus, while Denmark's integrative macro-structures help mute intercurrence, turbulence in green industries persists at the local and operational level. The state has responded by ad-hoc mechanisms like NEKST that reduce frictions, though administrative capacity remains stretched in other governance networks like the Beacons and Climate Partnerships.

Temporal complexity

Temporal complexity arises as a particular challenge in green industries, as fast-moving political agendas contrast long lead- and investment timelines characterizing industrial operations (IEA, 2023). In Denmark, temporal complexity arises primarily from the mismatch between ambitious green industrial goals and the slower time frames of permitting and infrastructure delivery. A salient example is the planned Denmark-Germany hydrogen pipeline, which was postponed from 2028 to 2031 due to extended environmental assessments, technical complexity, and coordination challenges across jurisdictions and Danish, German, and EU regulatory systems (Wettengel, 2024). The Danish PtX industry cites access to such export pipelines and renewable electricity as the key obstacles (Skipper & Nielsen, 2024). The Danish the government recently announced a multi-billion DKK investment for a hydrogen pipeline to Germany, asserting 2030 as the start of operations (State of Green, 2025a). Temporal complexity thus leads to delays and in this case also a need for state aid to continue green industrial development.

Furthermore, despite being an EU member, Denmark is not free from turbulence stemming from the pace of implementation of the third Renewable Energy Directive accompanying the EGD (amendment of Directive (EU) 2023/2413). Even as the only Member State to fully transpose the directive on time (Enerdata, 2025), the pace of transposition of this directive into Danish law is cited as a barrier to green industrial development (Climate Partnership for Finance, 2025, p. 105). This illustrates that even for frontrunner states, the pace of EU implementation can create turbulence in industry planning.

4.2. Norway

Norway’s green industrial governance context is shaped by its status as a non-EU member simultaneously aligned with and structurally separated from the EU through the EEA-agreement. This affiliation obliges Norway to implement large parts of EU energy and climate legislation, including key components of the EGD (Norwegian Ministry of Climate and Environment, 2025a), while excluded from formal EU decision-making. Norway retains greater sovereignty in industrial policy and considers its offshore ventures outside of EEA-scope (Norwegian Ministry of Foreign Affairs, 2024, p. 64), but increasingly faces obligations under the EEA that require adapting to evolving EU frameworks (Norsk Industri, 2025). Norway has entered strategic partnerships with the EU, like in critical raw materials and battery value chains, underscoring its targeted integration into green industrial policy and European cooperation (Norwegian Ministry of Trade, Industry and Fisheries, 2024b).

Norway’s climate and industrial policy include a weaker climate legislative framework than its Nordic neighbors. It is non-binding and without institutional mechanisms like an independent climate council, to back up its new target of 70-75% emission reduction from 1990 levels by 2035 (Kjørstad, 2024; Prop. 129 L (2024–2025), n.d., p. 35; Ulvin, 2025). Emission reductions are often pursued abroad through quota trading rather than through domestic industrial measures. This arrangement reduces innovation-momentum and industrial attention to climate solutions in Norway while failing to redirect resources from the fossil industries (T. Hansen et al., 2024; Kjørstad, 2024). Well-endowed with natural resources, Norway is a net energy exporter with a significant share of hydropower in its domestic energy mix and heavy economic reliance on hydrocarbon exports (IEA, n.d.).

Its industrial policy reflects a tension between maintaining fossil fuel activities and pursuing green energy technologies. There is currently no governmental plan to phase out oil and gas, and public subsidies to the petroleum sector remain in place (Norwegian Ministry of Climate and Environment, 2025b, p. 113). Nonetheless, in 2022, the Norwegian government launched a broad “Roadmap” strategy (*Veikart – Grønt Industriløft*) to accelerate industrial decarbonization across key sectors aligned with the NZIA like offshore wind, hydrogen and CCS (Norwegian Ministry of Trade, Industry and Fisheries, 2024a). The initiative outlines high-level ambitions to build globally competitive green value chains. It is indirectly supported by a series of sectoral strategies and roadmaps, that reflect a growing alignment with EU decarbonization objectives despite Norway's status as a non-member state.

Offshore wind and CCS are Norwegian priorities. Export revenues for wind-technology suppliers amounted to EUR 1.9 billion in 2023 (Kanestrøm et al., 2024, p. 45). CCS is one of the few green industrial sectors governed through a stable and mature public-private partnership. The sector is anchored by the state-led Longship project, involving seven public actors, including the Ministry of Energy, supervisory agencies and administrative bodies within the offshore and environmental areas (Gassnova, 2022, p. 13). Through Gassnova, a Norwegian state enterprise for CCS, the Norwegian government has taken on a de-risking role by covering a significant share of the investment and operational costs, while also facilitating coordination between industrial emitters and the transport-storage consortium. Evaluations report this "project integrator role" as central to "coordinate and facilitate" the CCS value chain, manage interdisciplinary challenges and differing corporate expectations regarding work processes, deliverables and resource use. Secondly, "state aid agreements were needed" for CCS in absence of commercial incentives, triggering a need for close involvement of the state (Gassnova, 2022, p. 6). Longship is the historically largest climate investment in Norway which in June 2025 became Europe's first complete CCS value chain (Norwegian Ministry of Energy, 2025b). Public–private collaboration in Norway's green industry governance is predominantly arranged around project-based commercial partnerships.

Manifestations of turbulence in Norway's green industrial governance

Shifting parameters

Turbulence in the Norwegian green industries has emerged in the context of Norway's distinct governance characteristics: a market-oriented regulatory culture, reactive renewable energy policy, and relatively limited administrative anticipation of EU Green Deal dynamics (Leiren & Farstad, 2024; Ursin, 2025b). This has left Norway vulnerable to shifting parameters like external macroeconomic shocks and contested public legitimacy.

Recent years have seen a tightening of budgetary conditions and increased scrutiny over the use of public funds in large-scale industrial ventures, particularly following rising inflation and interest rates. A shift in renewable technology support is observed among key Norwegian politicians and in its central energy companies (Rustad, 2025a, 2025b). Citing profitability concerns and broader market volatility, Equinor retreats from its renewable ambitions as it ramps up oil and gas production (Røise et al., 2025), and Statkraft halts new hydrogen and offshore wind projects, returning its focus to hydropower (Bøe, 2025). The cancellation of a planned hydrogen pipeline for its blue hydrogen exports to Germany (Office of the Norwegian Prime Minister, 2023) is another example. As Europe's largest gas producer with an almost fully renewable electricity system and hydropower abundance, Norway is well positioned to produce both blue and green hydrogen (Ursin, 2025a). However, in 2024, commercial partners Equinor and Shell cancelled the project, citing a lack of regulatory support and non-profitable market conditions, and the hydrogen value chain between Norway and Germany was cancelled (Brenna, 2024).

The significant decline in public legitimacy for and strong opposition to onshore wind is a relatively recent shifting parameter creating turbulence in the sector. Between 2018 and 2021, public support for onshore wind plummeted from 65% to 33%, driven by mounting opposition to perceived top-down planning. Norway used to have a centralized and agency-led wind power licensing model, but the perceived legitimacy concerns first led to a halt in onshore wind licensing from 2019 to 2022, and then to a new system where municipalities have veto-power. While some municipalities have since expressed interest in hosting wind projects, the prior controversy continues to shape perceptions and complicate coordination (Lind et al., 2025, pp. 19–25). These developments highlight how shifting parameters reduces both outcome effectiveness and perceived legitimacy of green industries.

Intercurrence

Intercurrence in Norway arises from institutional disconnects between key policy areas. A fundamental challenge for the Norwegian public administration, is the mismatch between the holistic EGD approach and the siloed structure of the relevant policy areas, as energy, industry and climate belong to different ministries. Even if Norway has several agreements with the EU on climate, the entanglement of policy areas challenges Norwegian public administration and gets stuck on controversial issues (Leiren & Farstad, 2024, pp. 4–5). The

Norwegian Foreign Minister explicitly highlights the cross-sectoral nature of the NZIA as an obstacle for interpretation and implementation (Norwegian Parliament, 2024). As sectoral ministries aim to solve its own problems, it creates new issues to succeed in cross-sectoral work (Szulecki et al., 2025), a clear indicator of intercurrence turbulence.

Some efforts to enhance cross-sectoral climate efforts post-EGD are identified in the Norwegian administrative system. The Roadmap strategy established a cross-ministerial group, consisting of state-secretaries. However, this group rarely meets, and continued sectoral borders in central administration limits its effect (Szulecki et al., 2025). The Roadmap also mentions "high level meetings" led by the prime minister (Norwegian Ministry of Trade, Industry and Fisheries, 2021, pp. 106–107, 2024a, p. 107), but as of July 2025, no further updates on this Council are available through open access. Furthermore, although the Roadmap introduces a Climate Partnership model, it has not yet been operationalized in the sectors studied in this thesis. In other words, Norway is in the developing stage of networked governance efforts in its industrial strategy, which remains largely consultative and reactive. The most promising initiative to manage intercurrence in Norwegian EGD governance is the "Green Book" (*Grønn bok*), aiming to involve almost all ministries in climate-related decisions impacting the national budget. Its effectiveness remains unknown, and notably it does not consider decisions without budgetary implications. New Norwegian coordination mechanisms initiated to better match the EGD, remain symbolic and procedural (Szulecki et al., 2025).

The EGD strategic shift also introduced a break with the market-and competition logic otherwise dominating the EU's development, creating turbulence for Norway through both shifting parameters and intercurrence. The EU's more interventionist industrial turn under the EGD contrasts with Norway's preference for market-oriented governance, and the basis that the EEA agreement was built on (Ministry of Climate and Environment, 2023, p. 99). Scholars note that Norwegian policy elites continue to frame industrial planning through the lens of theoretical market efficiency, without sufficiently considering how change can pass in practice, politically (Ursin, 2025c). The Norwegian industry voice their concerns of letting the Norwegian hydrogen success depend on market competition, while its competitors harvest the EGD industrial turn (Stensvold, 2023). This mismatch between EU logics and

Norwegian governance culture is a growing source of intercurrence in industrial policy, that is likely to increase the turbulence challenges for Norway (Leiren & Farstad, 2024, p. 4).

This is directly observable in Norwegian hesitation to adopt the NZIA. While Norwegian firms and public strategies aim to harvest the opportunities arising from the NZIA and green industrial push in EU markets, the government has not yet decided whether to adopt the regulation. A central explanation is the implications that would follow for Norway's hydrocarbon sector, which could be obligated to provide CO^2 injection capacity in line with the polluter-pays principle (Offshore Norge, 2024). Simultaneously, Norway is working around EU market issues by engaging in select strategic partnerships with the bloc, as outlined in the EU-Norway Green Alliance (European Commission, 2023a). Norway has entered Memorandums of Understanding with several EU countries enabling cross-border CO^2 transportation (Finansavisen, 2024). However, if Norway does not adopt the NZIA, it risks becoming a "third country" site outside of the EU CO^2-market that would not satisfy the NZIA obligations. This could entail serious consequences for the appeal of the Norwegian CCS industry (NTB, 2024; Ursin, 2024).

Temporal complexity

Relevant to all turbulence parameters, Norway sees a significant delay in transposition of EU legislation into national law. While official numbers are not published, there are estimated to be over 600 acts in line for EEA integration (Ursin, 2025b). Particularly contested are acts relating to the climate or energy policy areas. Until January 2025, only the 2009 edition of the EU Renewable Energy Directive (2009/28/EC) was implemented in Norway. After a coalition breakdown between the Norwegian Labour and Agricultural Party government where the latter exited government (Milne, 2025), the 2018 revision was accepted into EEA legislation, but the most recent 2023 revision remains "unaddressed" by the Norwegian administration (Norwegian Ministry of Energy, 2025a), together with the NZIA. These delays manifest temporal complexity, and the institutional mismatch that leads to this delay fits intercurrence.

Norwegian stakeholders are concerned with the negative impact of delayed transposition of EU legislation on the competitiveness of Norwegian industries (Leiren & Farstad, 2024, p. 5). Central to robustness is also the perceived legitimacy of involved actors. The temporal lag reduces the window for public deliberation and stakeholder adaptation, undermining both democratic legitimacy and industry readiness. This turbulence is visible in the Norwegian public discourse surrounding EGD, NZIA and its green industry policy. Norway struggles to keep up with the speed of EU policymaking in the area, and the result is a lack of analysis, influence on outcomes, and a democratic public discussion (Leiren & Farstad, 2024; Rieker, 2025).

5. Navigating turbulence in green industries: comparative reflections on governance robustness in Denmark and Norway

This chapter synthesizes findings from the Denmark and Norway case studies, to compare how turbulence manifests, and assess whether and how network governance and EU affiliation enable governments to govern robustly in the turbulence condition. To do so, it draws on the literature on turbulence, robust governance, network governance, and multi-level governance. Turbulence is present in both Denmark and Norway, varying across the three dimensions defined by Ansell & Trondal (2018): shifting parameters, intercurrence, and temporal complexity.

The analytical framework was developed to explore whether network governance practices and EU affiliation shape these variations. Robust governance, is not defined by the absence of turbulence but by the ability of governance systems to sustain effectiveness, legitimacy, and directional stability despite it (Ansell et al., 2024). The following analysis considers whether Denmark and Norway display such robustness in their green industrial development, and what role network governance and EU affiliation play in how disruption is absorbed, recalibrated or left unresolved.

Shifting parameters

The literature expects that shifting parameters, sudden changes in political, financial, or technological environments, destabilize governance by undermining existing plans and investments but can be buffered by institutionalized networks and coherent strategies. Both countries faced turbulence from rising interest rates, supply chain volatility, and the EU's industrial policy turn, to differing degrees. Importantly, the EGD industrial turn caused less turbulence in Denmark, which as a proactive EU-member co-created this policy shift. Denmark's EU-embedded anticipatory stance provided initial stability to shifting parameters, but turbulence has emerged through external financial and technological shocks, visible even in mature and networked sectors like the failed 2024 North Sea wind auction. Simultaneously, it exemplifies rapid recalibration triggered by disruption, and how the Danish corporatist traditions underpinned by the Climate Act and institutionalized public-private network platforms provided a rapid solution to relaunch the auction and mobilize subsidies. This supports the claim that robustness requires flexibility embedded in stable frameworks (Ansell et al., 2024).

By contrast, shifting parameters in Norway resulted in project termination rather than recalibration. The cancellation of the blue hydrogen pipeline to Germany reflects volatility under market-led governance. CCS through the Longship project remains the exception, progressing as the state assumed a de-risking and coordinating role. These observations align with literature suggesting that institutionalized governance networks and coherent industrial policy frameworks can buffer against shocks and shifting parameters, while market-based governance arrangements expose sectors to greater volatility. The Norwegian market-logic is also challenged by the more interventionist industrial shift within the EU, which contrasts the EEA framework. With its pre-existing network structure, Denmark can absorb this change more rapidly, leveraging the opportunities of this shifting parameter to gain competitive footing, access funding and mobilize actors across borders. In Norway, this development instead creates intercurrence-like turbulence for Norwegian green industries that risk having to navigate different regulatory markets, and competitive disadvantages as European competitors can access state aid and operate within the NZIA.

The literature on industrial policy also emphasizes the importance of a national vision to structure industrial development. Denmark clearly positions green industries as its growth engine, whereas Norway sustains fossil expansion alongside green ambitions. This duality makes fossil stability a seemingly easier refuge in turbulent conditions than recalibrating green sectors, exemplified by Equinor, previously tasked with greening the energy industry, returning to its fossil roots as markets shift. Close integration to fossil value-chains and logics, possibly contributes to the prioritization of CCS among NZIA-technologies. The Norwegian state's dual role as petroleum enabler and green investor adds an additional layer of complexity and strategic ambiguity that is largely absent in Denmark.

Furthermore, green industries in Norway face more turbulence than its Danish counterparts stemming from public legitimacy concerns. This turbulence is typically rooted in native rights disputes, lacking local consultation and concerns for privatization of common national resources, with onshore wind as a striking example leading to a full stop in development (Lee, 2021; Reuters, 2023). Beyond specific projects, green industries are frequently described as illegitimate and undemocratic derived from “Brussels” as Norway does not have

EU decision-making powers through the EEA (Rieker, 2025), clearly hampering robust multi-level advancement of green industries in Norway. Ultimately, it is found that Denmark's corporatist networks and EU embeddedness buffered external shocks, while Norway's market-led model with unresolved EU-issues amplified them.

Intercurrence

Intercurrence arises when overlapping mandates or policy domains produce governance frictions (Dobbs et al., 2021, p. 317). Robustness literature suggests structured, role-clarified public-private networks can mitigate such turbulence (Ansell et al., 2024, p. 54). The case comparison supports this claim. In Denmark, climate, energy, and industrial portfolios are integrated within one ministry, reducing fragmentation and enabling coherent strategy that aligns with the holistic EGD. In Norway, by contrast, ministerial siloing is a persistent source of intercurrence. Climate, energy, and industrial portfolios are institutionally separate, and attempts to improve coordination have been largely procedural and symbolic, with limited operational impact (Szulecki et al., 2025).

The Danish Climate Partnerships, Commercial Beacons, and mission-driven partnerships provide forums for information sharing, co-production of policy and implementation strategies. These are complemented by ad hoc taskforces like the PtX Taskforce and NEKST, addressing specific coordination challenges while organized along existing institutions. Overlapping but complimentary networks create strategic redundancy, enabling adaptive capacity for rapid mobilization of problem-solving coalitions in line with robust ideals. Simultaneously, evaluations of specific Danish networks illustrate limitations noted in the literature. When administrative follow-up lags due to overload, even well-designed networks risk producing turbulence by raising unrealistic expectations, as it can undermine the trust necessary to network govern in green industries (Bragadóttir, 2024). Danish networks are more successful when involving clear role allocation, monitoring mechanisms, and time-limited taskforces.

The Longship CCS project illustrates the potential for robust governance through structured partnerships in Norway. Longship combines clear role allocation, public co-funding, and cross-sector coordination between the Ministry of Energy, industrial actors, and state enterprise Gassnova have enabled a level of robustness rarely found elsewhere in Norway's green industrial governance. Longship demonstrates how trust-based collaboration, backed by institutional resources, can stabilize project trajectories even under turbulent market and political conditions. Otherwise, the Norwegian industrial policy approach is described as too passive to enable dynamism and change in line with green transitional ambitions (Algers & Kattel, 2021, p. 5).

Comparing the hydrogen pipeline efforts illustrates differences in the two countries industrial logic and how active industrial policy is facilitated by network arrangements. Denmark systemically embedded its hydrogen pipeline development within a broader subsidized PtX strategy, EU initiatives and energy island industrial planning from the start. Norway, in contrast, approached the hydrogen pipeline as a standalone corporate project without long-term public commitment or dynamic national strategy, making it more exposed to market volatility and regulatory uncertainty. This comparison indicates that Denmark's governance approach actively addresses market failures by coordinating public and private efforts. While this thesis does not claim direct causality, these patterns illustrate how governance structures and network integration can shape green industrial development.

Temporal complexity

Temporal complexity**,** challenges both countries, but is more pronounced in Norway. Denmark faces permitting delays and infrastructure bottlenecks, alleviated somewhat by network mechanisms, targeted fast-track procedures and EU-level coordination. Denmark combines strategic stability through legally anchored climate commitments and long-term roadmaps, with organizational flexibility via institutionalized governance networks. The 2020 Climate Act institutionalizes strategic foresight through legally binding targets and annual progress plans, monitored by the DCCC that acts as an early-warning system, allowing the state to adapt its implementation pace without undermining long-term objectives, a key trait of robustness (Dobbs et al., 2021, p. 320).

Denmark thus posits a legal anchoring for is green ambitions that Norway does not. Norway's delayed EU directive transposition compounds project-level lags, narrowing the window for stakeholder adaptation and investor certainty. The slow uptake of the 2018 Renewable Energy Directive and a backlog of over 600 acts awaiting EEA integration illustrate how institutional processes exacerbate misalignment, reducing both effectiveness and legitimacy. As a non-member, Norway cannot shape EU timelines upstream and must transpose legislation reactively, often with delay or controversy (Leiren & Farstad, 2024; Rieker, 2025). This confirms the literature's view that anticipatory and scale capacity depend on multi-level governance configurations. Domestic dualism between fossil and green industries further exacerbates temporal misalignment, producing strategic ambiguity rather than coherent sequencing.

Robust governance through networks and EU affiliation?

Across all three turbulence dimensions, robustness appears as an ideal type rather than a settled achievement. Denmark demonstrates that turbulence can catalyze recalibration and innovation when embedded in corporatist networks and supported by EU membership. Policy coherence with the EU and stakeholder participation has driven green progress (Amangku, 2025, pp. 57–59), but successful network governance depends on significant administrative capacity and risks overload if follow-up lags. Norway illustrates the opposite tendency. Turbulence often reinforces standstill and fragmentation, but structured networks such as Longship reveal that robust outcomes are possible when the state assumes a clear, well-resourced role. While Norway articulates strong ambitions through strategies such as the "Roadmap", the architecture in place to govern these transformations lacks the coherence and anticipatory capacity typically associated with robust governance (Ansell et al., 2024).

In line with scholarly expectations, Denmark's EU affiliation not only conditions its anticipatory capacity, but also enhances its scale capacity. Denmark's membership embeds it in EU rulemaking and funding, enhancing ability to align timelines and mobilize resources. Norway's EEA status produces compliance without coordination, generating systemic lag that compromises anticipatory capacity. While bound to implement many EU rules, Norway lacks influence in shaping them and often faces delays in transposition. This introduces legal and strategic uncertainty manifesting as intercurrence, when EU policies intersect unpredictably with national competencies, and temporal complexity, as domestic adaptation processes struggle to keep pace. Importantly, it is a salient source for public controversy and legitimacy concerns. Even Norwegian authorities often face ambiguity about what rules will apply, when they will take effect, and how they will interact with domestic priorities, exemplified by ongoing uncertainty surrounding NZIA alignment (Norwegian Government, 2024). Norway's peripheral positioning complicates attempts of robust response to EU-driven turbulence.

Key findings include that the explanatory variables vary in salience across turbulence dimensions, even if the dimensions overlap and the effects of isolated initiatives are difficult to trace directly. Network governance mattered most for buffering shifting parameters and mitigating intercurrence in Denmark. The weak institutionalization of network governance in Norway makes equivalent effects harder to measure. The mixed effects of network governance on intercurrence, warrants further research into specific network configurations, and nuanced revision of the strong promotion of public-private arrangements seen among EU institutions and business communities. EU affiliation proved most relevant to Denmark's anticipatory capacity to shifting parameters and temporal complexity. The same is true for Norway, but with opposite patterns, reducing its anticipatory and scale capacity. The cases also diverged in which turbulence dimension was strongest. For Denmark, turbulence was most acute under shifting parameters. Global market shocks destabilized even mature industries, but networks enabled some recalibration. For Norway, turbulence was most severe under temporal complexity, closely followed by intercurrence from sectoral siloing.

6. Conclusion

This thesis set out to understand how governments navigate the turbulence of scaling green industries under the European Green Deal. By comparing Denmark, an EU member with extensive corporatist network traditions, and Norway, a non-member with more fragmented governance structures and petroleum dependence, the study examined how governance turbulence manifests and whether network governance and EU affiliation shape governments capacity to govern robustly *with* turbulence.

Findings show that turbulence under the EGD is present in both countries, but manifests unevenly across the three turbulence dimensions of shifting parameters, intercurrence, and temporal complexity. Denmark's institutionalized governance networks and EU embeddedness enabled recalibration and adaptation, whereas Norway's market-oriented and siloed arrangements amplified turbulence, with robustness emerging mainly in the state-led Longship. Across the examined sectors, Denmark appears most robust, but risks of administrative overload and uneven follow-up threaten legitimacy within its dense governance networks. The mere existence of networks does not enable robustness. Governments should also pursue central positioning in networks, which is a demanding administrative task, even for Denmark with strong network traditions.

This thesis contributes theoretically by showing that governance turbulence is not uniform but dimension specific. The comparison further highlights how EU membership can enhance anticipatory and scale capacity, whereas hybrid affiliation through the EEA can generate turbulence through multi-level regulatory uncertainty, transposition delays and legitimacy concerns. Robustness emerges as an imperfect practice, that not only depends on effectiveness in recalibrating policy, but also the perceived legitimacy of green industrial governance. Notably, the findings highlight the important role of the state in successful green industrial scaling.

Analytically, the thesis has shown the utility of combining turbulence theory with insights from network governance and MLG to capture manifestations of turbulence and mechanisms for robustness, though explanatory power varied by turbulence dimension. Moreover, in merging scholarships, the framework opened for a wide analytical scope which helps nuance the understanding of turbulence but also calls for further refinement of how different explanatory lenses apply across turbulence dimensions. The chosen research design relied primarily on open-source document analysis, limiting direct causal insights and access to unpolished accounts. Future work could employ qualitative interviews and process tracing to uncover detailed network dynamics and industrial path-dependences, further disaggregate effects of different measures, or broaden the comparison to additional EU and non-EU cases to test generalizability. Longitudinal studies could capture evolving turbulence dynamics and explore the intersection between social equity and de-risking critiques. These avenues would deepen understanding of how governments navigate turbulence as Europe aims to scale its green industries.

In conclusion, this thesis confirms turbulence as a defining feature of contemporary green industrial governance, with a dual potential to generate disruption and new opportunities under the EGD. The examination of Denmark and Norway illustrates how similar countries diverge in their capacity to govern robustly depending on their governance architectures and EU affiliation, welcoming a nuanced understanding of how governments can pursue industrial transformation in times of accelerating change.

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Appendix 1 – Document overview

This appendix provides an overview of the most central documents making up the primary data analyzed to identify turbulence in the case-chapter. This includes documents that did not make it to direct citations across the thesis chapters, to enhance transparency and replicability of the research process.

Empirical material and deep case knowledge were gathered through document analysis of publicly available policy strategies, government reports, evaluation documents, consultation records, industry publications, and industry news media from Denmark and Norway. Primary sources include national industrial strategies, agency reports and news articles. These were supplemented by EU-level reports and relevant academic literature. This approach was chosen to capture how turbulence is articulated and addressed across sectors and administrative levels, and to trace the presence of collaborative governance mechanisms. Documents were selected to reflect the temporal scope of the post-EGD period, from 2019 to 2025. Materials were analyzed in their original languages, Norwegian, Danish, and English. Given the centrality of public-private coordination to the research focus, particular attention was paid to sources that document how actors interact (or do not) in green industrial governance.

The aforementioned sources are organized into three tables, one for each country case and the third including additional background research of particular relevance. The document title, year of publication, publishing organization or institution, document type and document language are listed.

Document overview – Denmark case

Document	Year of publication	Publisher	Type	Language	Link
Denmark: Quantifying Industrial Strategy	2021	OECD	Industrial policy report	EN	OECD report
"Thematic evaluation: The Commercial Beacons"	2025	The Danish Business Agency	Public evaluation	DK	Rapportskabelon
Status for PtX working groups	2024	The Danish Business Agency	Public evaluation	DK	Myndighedsarbejdsgruppe og interessentforum for PtX
Klimaaftale for energi og indsutri	2020	The Danish Government	Parliamentary agreement	DK	Publikation
State of Green Climate partnerships	2021	State of Green	Information document	EN	Climate Partnerships 2030
Power-to-X strategy	2021	Danish Ministry of Climate, Energy and Utilities	Government strategy, national level	EN	Strategi for Power-to-X
Climate action plan for CCS	2023	Danish Ministry of Climate, Energy and Utilities	Government strategy, national level	DK	Klimahandling - I mål med fangst og lagring af CO2
Denmark's climate action strategy	2025	The European Parliamentary Research Service	European Parliament briefing	EN	Denmark's climate action strategy
Agreement on the implementation of a Green Denmark	2024	The Danish Government	Parliamentary agreement	DK	aftale-om-implementering-af-et-groent-danmark.pdf
The Danish Climate Council – Status Report 2025	2025	The Danish Climate Council	Institutional report	DK	Klimaraadet_statusrapport25_FINAL_ONLINE.pdf
Analysis of barriers for increased financing and	2025	The Climate Partnership for the	Industry analysis	DK	klimapartnerskabet_baggrundsrapport_2025.pdf

investments in the green transition		Finance Sector/COWI			
State aid: Commission approves €400 million Danish aid scheme to support production of electricity from renewable energy sources	2021	The European Commission	Press release	EN	State aid: €400 million Danish aid scheme renewable energy
Innomissions – Mission-driven green partnerships	2021	Innovation Fund Denmark	Information page		Innomissions - Mission-driven green partnerships | Innovationsfonden
Status for the PtX taskforce working groups	2024	The Danish Energy Agency	Evaluation and status report	DK	Myndighedsarbejdsgruppe og interessentforum for PtX
Barriers for PtX development in Denmark, 2024	2025	The Danish Energy Agency	Evaluation and analysis	DK	Barrierer for udviklingen af PtX i Danmark 2024.pdf
Overview of NEKST efforts	2025	The Danish Ministry of Climate, Energy and Utilities	Implementation plan	DK	Notat

Document overview – Norway case

Document	Year of publication	Publisher	Type	Language	Link
Roadmap – The Green Industrial Initiative	2022	Norwegian Ministry of Trade, Industries and Fisheries & the Office of the Norwegian Prime Minister	Government strategy, national level	EN	Roadmap – The green industrial initiative - regjeringen.no
Roadmap 2.0 – The Green Industrial Initiative	2023	Norwegian Ministry of Trade, Industries and Fisheries	Government strategy, national level	EN	Roadmap 2.0: The green industrial initiative - regjeringen.no
Regulatory lessons learned from Longship	2022	Gassnova	Evaluation report	EN	Regulatory-lessons-learned-from-Longship-FINAL-WEB-1.pdf
Meld. St. 16 (2024-2025) The Norwegian industry – competitiveness for a new time	2025	Norwegian Ministry of Trade, Industries and Fisheries	Government white paper to the Parliament, national level	NO	Meld. St. 16 (2024–2025) - regjeringen.no
NOU 2023: 3 More of everything - faster	2023	The Energy-commission, with the Norwegian Ministry of Energy as recipient	Public commission report	NO	NOU 2023: 3
The Norwegian Government's position on the NZIA	2023	The Norwegian Government	Governmental position	EN	2023-07-11-nzia-norwegian-position.pdf
Meld. St. 25 (2024-2025) Climate report 2025 heading towards the low-carbon society	2025	The Norwegian Ministry of Climate and Environment	Government white paper to the Parliament, national level	NO	Meld. St. 25 (2024–2025)

EUs Net-Zero Industry Act: Offshore Norge's response	2024	Offshore Norge	Interest organization position paper	EN	net-zero-industry-act---english-version-of-offshore-norge-response-28-oct-2024.pdf
EEA database on the NZIA	2024	The Norwegian Government	Legislative process	NO	Net-zero Industry Act - Forordning om produksjon av nullutslippsteknologi (NZIA) - regjeringen.no
The EEA Agreement on climate and environment	2025	The Norwegian Ministry of Climate and Environment	Information page	NO	EØS-avtalen om klima og miljø - regjeringen.no
Minutes of meeting, European Consultative Committee	2024	The Norwegian Parliament	Meeting transcript	NO	Møte i Europautvalget onsdag den 18. september 2024 - stortinget.no
Prop. 129L (2024-2025) "Changes in the climate legislation"	2025	The Norwegian Government	Legal proposition	NO	Prop. 129 L (2024–2025)

Other central background source documents

Document	Year of publication	Publisher	Type	Language	Link
Investment needs and gaps for the sustainability transition in Europe	2024	European Environment Agency	Industrial policy analysis	EN	Investment-needs-and-gaps-for-the-sustainability-transition-in-Europe-Rethinking-the-European-Green-Deal-as-an-EU-industrial-strategy.pdf
European clean tech tracker	2025	Bruegel	Industry analysis	EN	European clean tech tracker
Offshore wind subsidies in the EU, Norway and the US	2023	Menon Economics	Industry analysis	EN	menon---offshore-wind-subsidy-regimes.pdf
Public consultation feedback, NZIA	n.d.	The European Commission	Public consultation archive	EN	Net-Zero Industry Act – list of net-zero technology final products and their main specific components (implementing act)
Joint Statement on establishing an appropriate European framework for cross-border CO2 transport infrastructure	2024	Governments of Denmark, France, Germany, the Netherlands, Sweden, Finland	Joint statement	EN	JOINT STATEMENT.pdf
Investing in Europe's green future: Green investment needs, outlook and obstacles to funding the gap	2025	European Central Bank	Research Report	EN	Investing in Europe's green future: Green investment needs, outlook and obstacles to funding the gap
Engaging the private sector in climate change mitigation: Comparison of different approaches in the Nordic region	2024	Nordic Ministerial Council	Research Report	EN	Engaging the private sector in climate change mitigation : Comparison of different approaches in the Nordic region

The Draghi report on EU competitiveness	2021	European Commission	Policy report	EN	The Draghi report on EU competitiveness
Social acceptance as a prerequisite for the green transition	2025	Nordic Council of Ministers	Research report	EN	Social acceptance as a prerequisite for the green transition