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Transition from fossil fuels to renewable energy: Identifying the necessary dynamic capabilities for a transition among Norwegian oil and gas companies

Fanny Hermundsdottir | **Øyvind Bjørgum** | **Ann Elida Eide**

Department of Industrial Economics and Technology Management, Norwegian University of Science and Technology, Trondheim, Norway

Correspondence
Fanny Hermundsdottir, Department of Industrial Economics and Technology Management, Norwegian University of Science and Technology, Alfred Getz veg 1, 7034, Trondheim, Norway.
Email: fanny.hermundsdottir@ntnu.no

Abstract

The increasing awareness of the role of fossil fuels in global warming, fluctuating oil and gas prices, and governments' commitments to phase out fossil fuels are driving the Norwegian oil and gas industry to increasingly aim for a transition to more sustainable renewable energy. There are few studies investigating how highly emission-intensive oil and gas firms can transition into greener industries. In this multiple-case study, we investigate how these firms can develop green innovations and enter renewable industries by developing dynamic capabilities. We find several microfoundations of dynamic capabilities that are important for green innovation development. Expanding the search window and proactive behavior are key for identifying new opportunities, while developing market insight, cross-sector collaboration, and structural ambidexterity are crucial to seize and reconfigure opportunities. The findings also illuminate how firm strategy in the sensing stage impacts what opportunities firms seize. The study is one of few studies that explore the microfoundations of dynamic capabilities necessary for entering new and unfamiliar markets, and it contributes to the understanding of the dynamics of the underlying microfoundations and the impact of green innovation type on these dynamics.

KEYWORDS
ambidexterity, green innovations, microfoundations, multiple case study, sustainability

1 | INTRODUCTION

Oil and gas have traditionally been two of the most important resources for supplying the globally growing demand for energy. However, the high pollution and non-renewable sources of energy from the oil and gas industry cause significant negative effects on the environment, both for local and global ecosystems, by increasing temperatures due to the emission of greenhouse gases (Ahmad et al., 2017; George et al., 2016). Due to the international awareness of climate challenge (IPCC, 2022), the European Union's strategy to phase out fossil fuels by 2050 (European Commission, 2022), and the volatile prices of oil and gas (e.g., Rogoff, 2022), firms in the oil and gas industry are pushed to refocus their operations toward alternative areas such as the renewable energy industry to remain competitive in the future (Ahmad et al., 2017).

One way the firms in this industry can be proactive in their transition towards sustainable development is by developing green innovations in new markets such as the renewable energy industry.

Abbreviations: CEO, chief executive officer; HVDC, High-Voltage Direct Current.

Green innovation is defined as new processes, products, or organizational procedures aimed at reducing negative impacts on the environment and improving the environmental and financial performances of the firm (Arfi et al., 2018). Recent studies show that oil and gas firms have entered renewable energy sectors such as solar (e.g., Pinkse & Van den Buuse, 2012) and offshore wind (e.g., Mäkitie, 2020) by developing green innovations. However, this transition from a fossil fuel-based industry to a more sustainability-oriented industry is not and will not be straightforward, as many existing capabilities related to oil and gas are challenged or will become obsolete and require constant adjustments to be successful (Eikelenboom & de Jong, 2019). Moreover, green innovation is complex and dynamic, requiring reconfiguration and renewal of capabilities, resources, and assets (Da Giau et al., 2020; Mousavi & Bossink, 2017). To succeed in the sustainability transition, oil and gas firms must develop new capabilities and strategies for green innovations while building competitive advantage. Dynamic capabilities are crucial for this purpose (Kortus & Gutmann, 2023).

Dynamic capabilities are critical in times of change and for the development of green innovations (Kortus & Gutmann, 2023; Mousavi et al., 2018; Reyes-Santiago et al., 2019). Dynamic capability is the ability of a firm to create or reconfigure resources in order to address rapid changes in the environment (Eikelenboom & de Jong, 2019; Eisenhardt & Martin, 2000; Teece et al., 1997). However, research on dynamic capabilities in a sustainable context is still scarce (Amui et al., 2017; Da Giau et al., 2020; Elf et al., 2022; Inigo & Albareda, 2019). In their systematic literature review of dynamic capabilities and sustainability, Amui et al. (2017) urged researchers to use dynamic capabilities as a main theoretical framework in future sustainability-related studies, as such research is lacking. Researchers also call for studies investigating the dynamic capabilities that should be developed and how these can be used to meet sustainability challenges (Amui et al., 2017; Mousavi et al., 2018). Finally, the literature calls for qualitative studies examining how dynamic capabilities can lead to sustainability implementation (Khan et al., 2021) and for case studies of sustainability integration, including the key processes involved (George et al., 2016).

Another challenge firms meet when they diversify their operations in new industries is that exploitation of existing resources become insufficient to develop a competitive advantage in the new industry. Therefore, diversifying firms must simultaneously develop or acquire new resources suitable for the new industry (Mäkitie, 2020; Pisano, 2017). This simultaneous exploitation and exploration in firms is called ambidexterity and is an important dynamic capability for firms (Pertheban et al., 2023) wanting to enter new industries. Diversifying into new industries is a difficult strategic operation for managers, and the literature provides little insight into the creation of new capabilities when entering new markets and how this may be easier in some contexts than in others (Pisano, 2017).

Hence, in this study, we aim to answer the following research question: *How do firms in emission-intensive industries use dynamic capabilities to develop green innovations for renewable energy industries?* Central questions are thus how existing resources and capabilities can be leveraged and which ones must be developed to successfully enter a new industry. Dynamic capabilities are considered the specific capabilities needed for oil and gas firms to develop green innovations in new industries. We focus our study on the supplier and service firms in the Norwegian oil and gas industry that have diversified into more sustainability-oriented industries by the development of green innovations. The study makes several contributions. First, it uncovers important microfoundations of dynamic capabilities necessary for firms and industries to perform the green transitioning process—a transition that has received too little attention. Second, it contributes to understanding more of the dynamics between the different stages of sensing, seizing and reconfiguring, and how the type of innovation can impact the underlying microfoundations. Finally, the study is one of few studies that investigate in detail how oil and gas firms can be better equipped to transition to a sustainability-oriented future and use its extensive competence in a more sustainable manner for a greener future. Mobilizing this industry in the transition will ultimately make the world closer to reaching the goals of the Paris agreement in 2030.

2 | THEORY

2.1 | Dynamic capabilities

The theoretical foundation of this study is based on dynamic capabilities (Teece, 2007), a concept emphasizing how firms can innovate by resource reconfiguration in order to adapt to rapid changes in the environment (Amui et al., 2017; Mousavi & Bossink, 2017). In this study, we define resources as "asset or input to production (tangible or intangible) that an organization owns, controls, or has access to on a semi-permanent basis" (Helfat & Peteraf, 2003, p.999). Capabilities, however, is here understood as "the ability of an organization to perform a coordinated set of tasks, utilizing organizational resources, for the purpose of achieving a particular end result" (Helfat & Peteraf, 2003, p.999). Thus, capabilities are needed to utilize the resources the firm have (McDougall et al., 2022; Tollin & Christensen, 2019). Capabilities are often divided into ordinary and dynamic capabilities (Neri et al., 2023; Teece, 2018). The ordinary capabilities is what makes the firm able to execute the basic daily activities and survive in the short term, while the dynamic capabilities is about developing, modifying, and integrating the ordinary capabilities to innovate and respond to changes in the environment (Jiang et al., 2018; Knoppen & Knight, 2022; Winter, 2003). Essid and Berland (2018) tie dynamic capabilities, ordinary capabilities, and resources together and argue "Dynamic capabilities are seen as second-order capabilities that act on ordinary capabilities to transform them or create new capabilities that make internal reconfiguration of processes and resources possible" (Essid & Berland, 2018, p. 233). Therefore, as capabilities enable firms to utilize their resources, we view resources and capabilities as interdependent and, therefore, propose that dynamic capabilities ultimately are about the management of resources and capabilities.

Dynamic capabilities' focus on resources and capabilities comes from its origin in the resource-based view (Hällerstrand et al., 2023; Mousavi & Bossink, 2017). Here it is argued that the competitiveness of firms lies in the heterogeneity of resources—that is, firms that have resources that are valuable, rare, imperfectly imitable, and non-substitutable will gain a competitive advantage (Barney, 1991; Eisenhardt & Martin, 2000; Song & Choi, 2018). However, since markets, demands, and the general business environments constantly change, existing resources become insufficient to remain competitive (Kumar et al., 2018). Therefore, in order to innovate, firms must develop dynamic capabilities to cope with the changing environment and renew their sources of competitiveness (Gelhard & Von Delft, 2016; Ruiz-Ortega et al., 2023). This implies that a firm's competitiveness lies in its ability to modify its resources and capabilities over time to address the changing environment (Knoppen & Knight, 2022; Ruiz-Ortega et al., 2023). Thus, dynamic capabilities enable the firms able to develop, integrate, or release the resources and align them with the changing environment to remain competitive (Eisenhardt & Martin, 2000; Strauss et al., 2017). In relation to the resource-based view, we therefore understand dynamic capabilities as processes that enable firms to reconfigure their resource base (Eisenhardt & Martin, 2000; Strauss et al., 2017). Dynamic capabilities are therefore a way of both reducing risk and increasing firm competitiveness (Bag et al., 2020).

The sustainability transition represents a "departure from the present" (Mousavi & Bossink, 2017, p.1263) that involves rapid changes in the environment such as new regulations and technology, and customer and stakeholder demands (Chevrollier et al., 2023). In order to implement sustainability, including green innovations, firms therefore need to be adaptable, flexible, and continuously improve and change according to the environment (Eikelenboom & de Jong, 2019). Because of this, dynamic capabilities are highly relevant when dealing with sustainability innovation, as sustainability innovation is complex, dynamic, and characterized by constant change that requires continuous adjustments (Eikelenboom & de Jong, 2019; Inigo & Albareda, 2019; Rodrigues and Rodrigues & Gohr, 2022). Dynamic capabilities in a sustainability context involve building and integrating resources and capabilities that integrate sustainability into new innovations, with the aim of meeting new market needs (Dangelico et al., 2017). In the development of green innovations, firms must use and enhance their existing capabilities or create new ones; as such, dynamic capabilities can be considered central tools in this innovation development (Dangelico et al., 2017; Mousavi et al., 2018; Rodrigues and Rodrigues & Gohr, 2022). As a result, a firm's dynamic capabilities can determine its ability to address sustainability challenges and increase its competitiveness (Hällerstrand et al., 2023; Mousavi et al., 2018).

2.2 | Microfoundations of dynamic capabilities

Dynamic capabilities may be difficult to fully grasp as they often are vaguely described as a higher-order construct (Eisenhardt & Martin, 2000; Fallon-Byrne & Harney, 2017; McDougall et al., 2022). Therefore, to fully understand the nature of dynamic capabilities and to make them more specific, the underlying microfoundations must be identified (Knoppen & Knight, 2022; Neri et al., 2023; O'Reilly & Tushman, 2008). Microfoundations are here understood as the distinct skills, processes, activities, and behaviors undergirding dynamic capabilities (Chevrollier et al., 2023; Fallon-Byrne & Harney, 2017; Teece, 2007) that help explain the micro–macro links connecting variables at a "lower" level to the construct of dynamic capabilities (Wilkens & Sprafke, 2019) (see Figure 1). Microfoundations can therefore be viewed as the processes, activities, etc. that help firms in renewing or creating new capabilities and resources (Teece, 2018). By this, microfoundations shape and help understand the mechanisms and development of dynamic capabilities (Bojesson & Fundin, 2021; Fallon-Byrne & Harney, 2017; Strauss et al., 2017) by "unpacking" or reducing resources and capabilities to specific components, thus contributing to a deeper understanding of firm behavior (Felin et al., 2012).

Dynamic capabilities are commonly divided into three clusters of activities: *sensing*, *seizing*, and *reconfiguring* (Teece, 2018). Here, sensing, seizing, and reconfiguring are viewed as higher-order dynamic capabilities (Chevrollier et al., 2023) that include several relating microfoundations. Sensing, seizing, and reconfiguring happen in a logical order, as each of the phases provide basis for the next phase (Maijanen & Virta, 2017). *Sensing* includes scanning the external and internal environments to identify new opportunities and make appropriate strategic decisions (Feiler & Teece, 2014; Mousavi & Bossink, 2017). This includes microfoundations such as observing market and industry trends, exploring new technological opportunities, evaluating markets, and gathering information about actors in the business environment (Feiler & Teece, 2014; Kortus & Gutmann, 2023). In this way, sensing may involve investments in R&D and related activities (Feiler & Teece, 2014; Khan et al., 2020).

Seizing includes preparing the business to address the identified opportunities (Feiler & Teece, 2014; McDougall et al., 2022). As not all identified opportunities are viewed as appropriate, seizing does not happen as often as sensing (McDougall et al., 2022). Seizing often consists of microfoundations such as developing new products, processes, or services and adjusting or redesigning the business model to capture new opportunities and create value. Therefore, seizing often requires investments in technology, development, and commercialization (Teece, 2007).

To stay relevant in fast-changing markets and during technological changes, *reconfiguring* involves doing the actual organizational changes necessary to capture the value from the identified opportunities (Feiler & Teece, 2014). Reconfiguring is the ability to reconfigure existing or new resources to execute the identified opportunity (Khan et al., 2021).

Earlier studies have identified several microfoundations of dynamic capabilities important for sustainability innovation development, such as proactive sustainability strategy (Mousavi & Bossink, 2017), adopting holistic perspectives (Santa-Maria et al., 2022), creation of know-how (Neri et al., 2023; Santa-Maria et al., 2022), business model redesign (Hällerstrand et al., 2023; Khan et al., 2020;

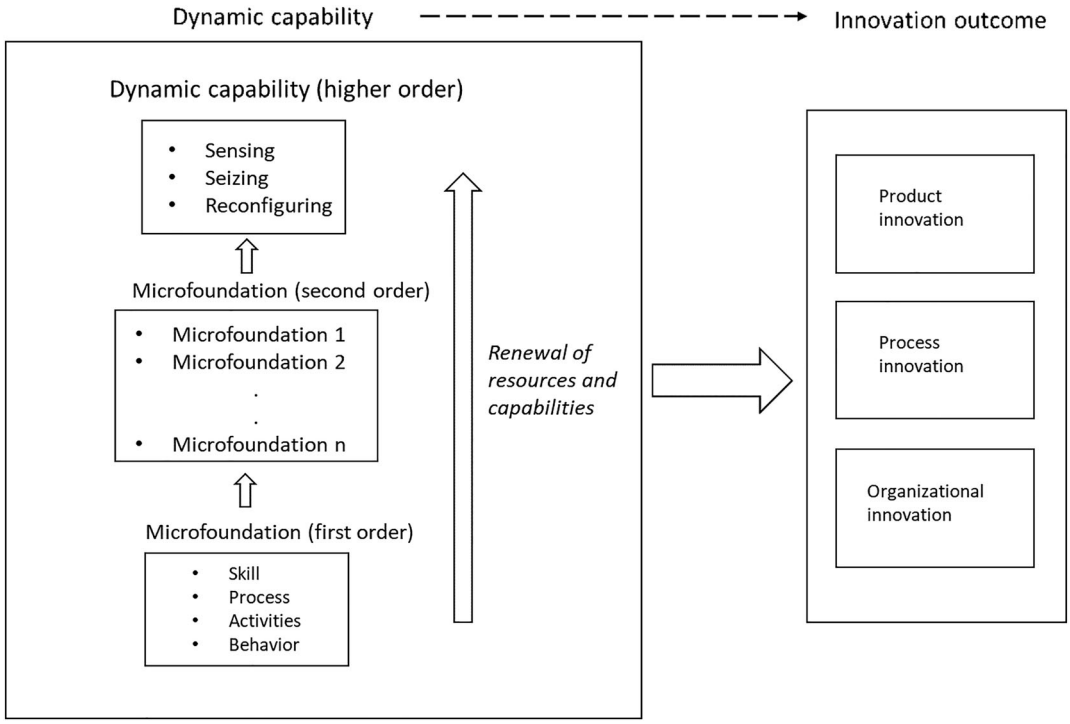

FIGURE 1 The relationship among microfoundations, dynamic capabilities, and innovation outcome (illustration inspired by Fallon-Byrne & Harney, 2017).

Mousavi & Bossink, 2017), collaboration (Chevrollier et al., 2023; Hällerstrand et al., 2023; Khan et al., 2020; Mousavi et al., 2018), human capital investment (Khan et al., 2020), and resource co-specialization (Mousavi & Bossink, 2017). However, there are few studies that look into the necessary microfoundations for green innovation development in the context of going into a new industry, more specifically, the context of going from being in an emission-intensive industry to going into a more future-oriented industry as the renewables. As the dynamic capabilities necessary for innovation development depends on the specific context (Eikelenboom & de Jong, 2019), we argue that there is a need for research studying this context.

2.3 | Ambidexterity

A challenge when it comes to firms' transition into more sustainability-oriented industries is that they simultaneously must continue their daily operations in their current market to gain the necessary financial resources that can enable the sustainability transition (Alänge & Steiber, 2018). Thus, while existing capabilities and resources are used to compete in current environments, new or modified resources, processes, and skills are necessary to exploit new opportunities when the external environment changes (O'Reilly & Tushman, 2008) such as going into a new industry. Ambidexterity is used to describe this simultaneous exploitation and exploration in firms and is defined as "a firm's ability to exploit existing assets and positions in a profit producing way and simultaneously to explore new technologies and markets; to configure and reconfigure organizational resources to capture existing as well as new opportunities" (O'Reilly & Tushman, 2008, p. 189). An example of ambidexterity in the oil and gas industry could be a supplier firm that continues to improve the performance of their traditional service delivery in the oil and gas industry, for example, a subsea system, by streamlining and optimizing manufacturing and installation (exploitation). Simultaneously, the firm starts developing a new green innovation that targets a new renewables market, for example, a subsea facility that produces hydrogen by utilizing electricity from an offshore wind park (exploration). In this way, ambidexterity ensures current survival in existing markets by exploitation and future survival by adopting to new or emerging markets by exploration (March, 1991; O'Reilly & Tushman, 2008). It can be argued that to remain competitive over time, firms must be ambidextrous (Vahlne & Jonsson, 2017). Both exploitation and exploration are important in a firm, and the challenge lies in finding the right balance between the two in terms of investment and resource allocation and acknowledging that their expected outcomes vary in quantity and timing (March, 1991). While too much emphasis on exploitation can lead to missed opportunities, too much focus on exploration can lead to risks of bad investments (O'Reilly & Tushman, 2008). The right balance depends on how fast and what type of changes the firm experiences (O'Reilly & Tushman, 2008). Thus, ambidexterity involves a firm's capacity to address conflicting demands effectively and simultaneously in discontinuous environments (Birkinshaw et al., 2016).

There are few studies focusing on the connection between ambidexterity and dynamic capabilities (Jurksiene & Pundziene, 2016). However, ambidexterity is by some referred to as a type of dynamic capability necessary for adapting to fast-changing environments, as it

includes routines to balance exploration and exploitation, such as decentralization, differentiation, integration, and resource allocation (O'Reilly & Tushman, 2008, 2013; Pertheban et al., 2023; Popadiuk et al., 2018; Vahlne & Jonsson, 2017). For example, through structural ambidexterity, firms can reduce the tensions of doing both exploration and exploitation by separating the tasks in specific business units, project teams or among employees (Chevrollier et al., 2023; Popadiuk et al., 2018). Thus, as a dynamic capability, ambidexterity enables firms to reallocate and reconfigure resources and skills to exploit existing opportunities and simultaneously explore new ones (O'Reilly & Tushman, 2013; Weiss & Kanbach, 2022).

To summarize, this study uses dynamic capabilities, that is, the modification of resources and capabilities to address rapidly changing environments (Gelhard & Von Delft, 2016; Ruiz-Ortega et al., 2023) and to study how oil and gas firms develop green innovations and enter more sustainability-oriented industries like the renewables industry. In the context of this study, ambidexterity is an important dynamic capability, as it enables both exploitation of current resources and exploration of new resources in order to go into new industries. Finally, to better understand the firms' dynamic capabilities, we study the specific processes, activities, and behavior, that is, the microfoundations, of the firms.

3 | METHODS

This study is exploratory in nature and seeks to understand the role of dynamic capabilities in oil and gas firms' green transition, utilizing an embedded multiple case methodology (Eisenhardt, 1989; Yin, 2018). In selecting case companies, the study used purposive sampling, where cases were strategically identified on the basis of their relevance to the research question (Bryman, 2016). To be included as a case company, the company had to be a service firm in the oil and gas industry that had introduced or was developing a green innovation in a renewable energy industry. It was also important that the company had sustainability as a key focus area and that their engagement in renewables was a long-term strategy, meaning that the company had invested resources and time to develop the green innovation. In this way, it was more likely that the study could explore the development of dynamic capabilities. Further, we identified appropriate case companies on the basis of publicly available information. For example, we looked for case companies on different websites that concerned offshore wind, various green energy clusters or research council projects. Because of the inclusion criteria, not many companies stood out as appropriate. As there were only a few companies that fitted the inclusion criteria, all companies we identified were invited to participate even though they varied in firm size (see Table 1). In total, seven case companies were invited to participate in the study. One company did not want to contribute, and one company pointed us to another company they felt were more suitable. Therefore, in the end, six case companies were included in the study. All case companies were located in Norway, of which some had head offices in Norway, while others had international head offices. Norway is considered an appropriate context as the Norwegian oil and gas industry faces strict environmental regulations and external pressure from stakeholders to be more sustainability oriented, as the small country is Europe's second

TABLE 1 Case companies' descriptive and interview objects.

Case company[a]	Interview objects (*n*)	Number of interviews	Interview time	Number of employees	Role in oil and gas industry
Electrotech	Head of offshore wind. business developer (2)	2	56 min. & 52 min.	1500–5000 mainly in Norway, global presence	Deals with engineering, procurement, construction (EPC) contracts mainly as the main system integrator of products and systems from other suppliers
Engineeringtech	Head of sustainability. head of offshore wind (2)	2	51 min. and 58 min.	5000–15,000 mainly in Norway, global presence	A global supplier in the oil and gas sector whose main expertise is connecting together and managing large engineering projects
Membranetech	CEO (1)	1	84 min.	<250 in Norway	Has a long history in offering engineering, construction, and installation of oil and gas facilities
Nortech	CEO (1)	1	71 min.	500–1,500 mainly in Norway, global presence	A logistics supplier in the oil and gas sector
Subseatech	Project leader (1)	1	71 min.	500–1500 in Norway, 15,000–50,000 globally	A supplier company in the oil and gas industry, focusing on subsea
Yardtech	Business specialist. Assurance manager (2)	1	72 min.	500–1500 in Norway, 15,000–50,000 globally	Has a background as an EPCI (engineering, procurement, construction, and installation) contractor in the oil and gas industry

[a]Fictive names.

largest oil and gas producer[1] and one of the world's largest producers of natural gas.[2] Because of this, the Norwegian oil and gas sector is viewed as a big potential contributor to the sustainability transition by moving their operations into more renewable energy industries (Mäkitie, 2020; Mäkitie et al., 2019), such as offshore wind and hydrogen production.

Data for this study were collected from semi-structured interviews and secondary sources such as internal documents from the case companies, media webpages, webpages of industry clusters and networks the case companies were involved in, and from the case companies' own websites with information about them and their green innovations. The secondary sources were important in the preparation of interviews, understanding of analysis, and to triangulate and verify interview data after the interviews had been conducted. The interview guide was made on the basis of the authors' review of relevant literature on dynamic capabilities and consisted of questions related to the microfoundations of sensing, seizing, and reconfiguring (Mousavi et al., 2018; Teece, 2007). The aim of the interviews was to obtain detailed information about the case companies' green innovation drivers and implementation, and use of existing and new resources and capabilities in the innovation process. In addition, the interviewees were asked other relevant questions such as their work responsibilities, the challenges their companies were facing, and the company's positioning in the industry.

In total, nine people with positions ranging from business developer to chief executive officer (CEO) were interviewed (see Table 1). The interviews were conducted digitally from March 2021 to July 2021. All interviews were recorded and fully transcribed.

3.1 | Analysis

All interviews were coded using the NVivo software. First, the transcriptions were structured and categorized utilizing Teece's (2007) dynamic capabilities' framework, including microfoundations within sensing (e.g., internal and external drivers), seizing (e.g., new green innovation, new resources, and knowledge), reconfiguring (e.g., resource reconfiguration), and some additional categories (e.g., about the company and green innovations). The coding was done for each case company separately, and transcription blocks that were found relevant were coded (Bryman, 2016). To ensure validity, one of the authors coded all interviews, while the rest of the authors divided the coding of interviews between them. By this, all interviews were coded by two of the authors, and all authors were part of the coding process. After the initial coding, the authors compared and discussed the coding results before coming to a common agreement on the final codes.

After this initial coding step, the codes were further reduced to synthesize the main significance of each coded block of text. The next step was the examination of the systematic and reduced coding for all the case companies as a whole. On this basis, several first-order concepts within sensing, seizing, and reconfiguring emerged and were categorized within appropriate microfoundations (second-order concept). Hence, this was considered a thematic analysis, in which similar codes are categorized into bigger themes (Terry et al., 2017). There are several illustrative examples in Tables 3–5 that link quotes from interviews with first- and second-order concepts (microfoundations).

Table 2 shows that the case companies can be divided into two groups, incremental or radical innovation group, depending on their green innovation type. We categorize incremental innovations as innovations that predominantly builds on the firm's existing capabilities and are improvements on existing products and services, while radical innovations are new products and services that require new capabilities and knowledge from the firm (Mikalef et al., 2019; Sheng & Chien, 2016). The distinction between the incremental and radical innovation group is done as the analysis revealed that there were many similarities in terms of microfoundations and timelines among the case firms that had more similar type of innovations.

4 | RESULTS

Before presenting the microfoundations necessary for the green innovation development, it is important to understand why the sensing phase arose in the first place. The data clearly shows that the case companies were facing huge external pressures and changes in the environment that forced them to be more open to changes. First, the case companies' stakeholders, including the customers, policymakers, and society as a whole, were increasingly focused on sustainability challenges and especially on decreasing emissions. Second, the rapid and significant decline in the oil price in 2014 had a large impact on activity levels and profitability in the oil and gas industry, and many firms had to lay off employees. Such market volatilities in addition to less promising prospects for the industry because of climate considerations and national governments' commitment to phase out non-renewable energy sources. (e.g., the Paris Agreement) led to fewer opportunities within oil and gas. Thus, the case firms realized that to secure future survival, they would need a more diverse and resilient business, as it was too risky to be dependent solely on activities within the oil and gas industry as illustrated by Yardtech:

> *The business we have had historically will gradually diminish. We need to start looking for new business areas that have a market potential in the future, and at the same time, we have to continue to do what we always have done until it's no more left*. (Yardtech).

[1] https://www.statista.com/chart/29897/biggest-producers-of-oil-and-gas-in-europe-in-2021/.
[2] https://yearbook.enerdata.net/natural-gas/world-natural-gas-production-statistics.html.

TABLE 2 Case companies' green innovations, renewable energy markets, and commercial statuses.

Company	Green innovation	Type of innovation	Innovation level	Renewable energy market	Commercial status
Electrotech	In the offshore wind industry, it delivers total systems, mainly HVDC offshore platforms. It aims to be a system integrator for hydrogen production projects in the future.	Service	Incremental	Offshore wind Hydrogen	The firm delivers services to the offshore wind market Hydrogen projects are under development.
Engineeringtech	The firm builds jackets and undercarriage for wind turbines, manufactures subsea equipment, converter platforms, and floating foundations for the offshore wind industry. It also positions itself toward hydrogen production and CCS.	Service and product	Incremental	Offshore wind Floating offshore wind and hydrogen	Commercial activities within bottom-fixed offshore wind Floating offshore wind is in the pilot testing stage, and hydrogen projects are under development.
Nortech	Offers maintenance and installation of wind turbines and develops infrastructure and land areas for hydrogen production.	Service	Incremental	Offshore wind Hydrogen	Delivers services to the offshore wind market Plans to build a hydrogen pilot plant in 2024
Membranetech	Membrane technology for blue hydrogen production; that is, where hydrogen is created from natural gas, and the CO_2 is captured and stored (CCS).	Product	Radical	Hydrogen	First pilot customer in 2021
Subseatech	Offshore wind turbines with underwater storage of hydrogen.	Product	Radical	Offshore wind and hydrogen	Pilot testing in 2023
Yardtech	A floating system consisting of wind turbine, solar, and wave energy.	Product	Radical	Floating offshore wind	Pilot testing in 2023/2024

Going into renewables was therefore first and foremost a strategic choice to be more prepared for the future and increase their competitiveness.

4.1 | Sensing

There are various ways of how the case companies discovered new opportunities within renewables. The data analysis revealed two prominent microfoundations that were important in the sensing phase: expanding the search window and explorative initiatives (see Table 3).

4.1.1 | Expanding the search window

The external drivers made the case companies realize that to strengthen their future competitiveness, and potentially their long-term survival, they had to diversify their business portfolio. In other words, the case companies expanded their search windows and were not only looking for new opportunities within their own industry but also broadening their search and looking for opportunities across industries and markets. This included being more *open to new ideas*, which comprise both explicit initiatives to increase idea development and an increased openness towards investigating new ideas (as illustrated in Table 3). The recent growth in the renewable energy sectors such as offshore wind and hydrogen, which have a lot in common with the oil and gas industry, made these industries attractive to the case companies.

> *(…) it is simply what is happening in the world around us, which has made this [sustainability] an important topic internally in the firms as well. Because the financial industry has turned, because our customers have turned, everything has been happening in the last 3–4 years really*. (Subseatech)

However, such large changes to the business were not possible within the existing company goals and strategies, and the case companies also needed to develop *a new strategy* to be able to expand the search window. Nortech, for example, needed to allocate resources, making it possible to address the external drivers:

> *After the "green awakening", our owners have understood that sustainability is very important, made a firm strategy, and allocated $500 million to decarbonization*. (Nortech)

TABLE 3 Microfoundations of sensing.

Microfoundation sensing		Case firms	Illustrative quotes
Expanding the search window	Being open to new ideas	All	*"We have had some discussions with a creative manager in Lego. He has also visited us and presented how they work with creative processes. So, we definitely are trying to learn from others."* (Electrotech) *"The opportunity [within hydrogen] emerged because *a hydrogen company* needed to build a pilot plant."* (Nortech)
	Developing new strategy	All	*"No matter what kind of project or product we develop, it should contribute to a more sustainable future, and it is a fairly simple, short, and clear guide that the group provides. (…) You feel like that you have the legitimacy and alibi to, yes, spend innovation money on achieving something."* (Yardtech)
Explorative initiatives	Structured market scanning	Incremental innovation group	*"We have a business development group that scan for opportunities in new markets. (…) It consists of personnel from top management, marketing, engineering, and young employees to get diversity of opinions. (…) They have quarterly meetings on major topics."* (Electrotech)
	Proactively seeking out to learn about new markets	Incremental innovation group	*"We are focused on understanding the industry [offshore wind]. (…) In the oil and gas industry, we know who takes decisions, when projects are coming, what jobs that will be needed etc. (…) We need to understand this in offshore wind."* (Nortech) *"We have a team that is out talking to the customers. We try to learn what challenges they have, what projects they have in their pipeline, and how we can assist them in conducting these projects."* (Engineeringtech)
	Proactive behavior of single firm employees	Radical innovation group	*"I submitted a small proposal together with a couple of colleagues to an idea box. (…) We had an idealistic motivation of creating something new and contribute to solving the climate challenges."* (Subseatech) *"An engineer, temporarily laid off due to the decline in the [oil & gas] industry, had an idea. This was the beginning. He established his own company, which has given us exclusive user rights to the IP."* (Yardtech)

4.1.2 | Explorative initiatives

Interestingly, there are clear differences within the new strategies the case firms developed to explore initiatives. This is especially visible if we divide the firms into two groups based upon the innovation level (see Table 2) of their renewable energy technology. Overall, the firms in the incremental innovation group (Electrotech, Engineeringtech, and Nortech) conducted a *structured market scanning* and were *proactively seeking out to learn about new markets* in order to identify opportunities that fitted their competences. This can be illustrated by Electrotech that state that their involvement within offshore wind was a result of a structured market scanning looking for specific opportunities:

> *Going into offshore wind is a result of two things. First, an internal strategic process where we looked for new opportunities to build a more diverse business portfolio to reduce risk in the future. Second, an opportunity that arose. However, the opportunity arose because we had deliberately chosen to search after that kind of opportunities*. (Electrotech)

Engineeringtech had a similar approach:

> *When approaching the offshore wind market, I would say that we are completely shameless. We knock on all doors, we phone high and low, we are just going in. And so, we*

> *work much, much harder and much more proactively than we have ever done before*. (Engineeringtech)

In Nortech's case, the market team identified a suiting opportunity when they found out that one of Nortech's customers, a big oil and gas producer, wanted to build the world's first floating offshore wind park:

> *We decided long before any tender opportunities existed that we wanted to take part in this. We put resources into contacting them to discuss what services they needed in order to accomplish building the floating wind park (…)*. (Nortech)

These quotes illustrate that the explorative initiatives of the incremental innovation group followed a clear strategy where the companies were scanning markets for specific opportunities. Although they were open to new ideas, there were some central requirements to what made new opportunities interesting:

> *We let some opportunities pass as we did not have any prerequisite to succeed compared to competitors (…). Instead, we focused on the opportunity where we could build the type of fundament that were close to what we were doing, that fitted the organization, was big enough and there were few competitors. It was an adjacent opportunity*. (Electrotech).

Thus, being able to utilize already existing resources and capabilities was central for Electrotech when scanning the offshore wind industry. In addition, it was also important to look for opportunities that had high potential for value creation and few competitors. Engineeringtech has a similar viewpoint:

> *How close is this from what we are already doing? (…) Is there a big potential for this opportunity? Who else is working on this in the market? Do we have something that they don't have? Can we take it further in a different way?* (Engineeringtech)

Thus, for the case companies with more incremental innovations, attractive opportunities were markets where they could utilize existing technological resources and capabilities, and markets with few actors so they could differentiate themselves from competition. In other words, they scanned for attractive opportunities in markets where existing resources and capabilities developed within their oil and gas business could be exploited and further developed to increase their competitiveness.

While the incremental innovation group developed structured strategies with clear targets for how the opportunities should fit the firm, the radical innovation group (Yardtech, Membranetech and Subseatech) had far less structured approaches to finding new opportunities. They did not do structured market scans nor they had a predefined target of what type of resources that could be utilized when looking for new opportunities. Instead, the green innovation initiatives rather happened because of the *proactive behavior of single firm employees*. Thus, these companies were not actively scanning for opportunities but were, due to the drivers mentioned above, becoming more open to new ideas and opportunities, for example, through new ideas developed by employees. In Subseatech's case, its American owners did initially have no intention of starting new projects outside oil and gas, because their strategy was to only focus on core business. Their green innovation instead started as a sole initiative by a few employees and was kept under the radar for quite some time.

> *The first two years, the project had to keep a low profile to avoid attention from the management in the US. (…) We were working undercover with the project (…). Recently, we have received internal support, and now it's recognized as an important and strategic project by the management*. (Subseatech)

Thus, it took some time before the company's management accepted and legitimated the employees' initiative of going into renewables. Later, with increased sustainability focus and good progress in the project, it became one that the top management often promoted in international conferences and external communication to showcase how they could contribute to the sustainability transition.

Membranetech wanted to develop a technology with lower emissions as their customers' demands had changed towards cleaner energy. Therefore, they proactively searched for new business opportunities, initially within their current business environment and later by expanding their search window. However, compared to the case firms with more incremental innovations, their search was less open and structured and focused on solving one problem:

> *First, we were interested in carbon-capture and tried to get a role within a big carbon-capture project but that failed. (…) Later, two of our directors went to *a big research institution* to see if they had potential technologies that we could use for carbon-capture, and then we got to know about the membrane technology*. (Membranetech)

However, after buying the patent for membrane technology, Membranetech later discovered that it also could be used to produce hydrogen and chose to change from focusing on carbon capture to instead focus on hydrogen production. This sudden change was possible due to a relatively open innovation strategy and primarily driven by the belief in future demand for green energy solutions. Thus, Membranetech entered the renewables industry despite not having any specific resources or capabilities related to hydrogen production, and without having done a structured scanning of the hydrogen market.

4.2 | Seizing

After having identified new opportunities in the renewable energy industry, the case firms came to the stage where choosing opportunities to invest in was necessary. Thus, they had to seize the identified opportunities by performing microfoundations that included new business activities, assessing new knowledge and resources, and establishing new collaborations (see Table 4).

4.2.1 | New business activities

All case firms entered the renewable energy industry with a *new product or service* compared with their offerings in the oil and gas sector. The radical innovation group entered emerging industries such as floating offshore wind and hydrogen production with a radical and novel offering that would need many years to develop into a commercial activity. By contrast, the incremental innovation group

TABLE 4 Microfoundations of seizing.

Microfoundations seizing		Case firms	Illustrative quotes
New business activities	New green product	Radical innovation group	*"The floating offshore wind concept is a completely new technology."* (Yardtech)
	Modified green service	Incremental innovation group	*"Compared to the oil and gas industry where we built a new product for every project, there is more standardization when we build an offshore wind substation."* (Electrotech) *"Strategic question of whether we should build our product based on others' technology or our own technology."* (Engineeringtech)
	New or modified business models	All	*"Some projects we can run the old-fashioned way, while other projects we need to look at completely different. So, we have an open dialogue with our partner that on some projects we may create joint ventures or consortiums and share the responsibility."* (Electrotech)
Accessing new knowledge and resources	Developing new technological knowledge	Radical innovation group	*"We have had to learn a lot about hydrogen, electrolyzers and fuel cell technologies. Our partner [a research institution] has a lot of the hydrogen expertise we need."* (Subseatech)
		Incremental innovation group	*"We are constantly developing and doing fine adjustments to the components we already have to fit the renewables industry."* (Engineeringtech)
	Developing new market insights	Radical innovation group	*"It's not the technology that is hard; it is partnerships, business practices, and the market side."* (Subseatech)
		Incremental innovation group	*"Working for other customers and having other contract forms have been new for us"* (Electrotech).
	Acquiring technology	Membranetech and Yardtech	*"We have an agreement on exclusive user rights for the patent. In return for this, we take care of the financing of the technology development."* (Yardtech)
	Accessing external funding	Radical innovation group and Nortech (hydrogen)	*"We are, together with a hydrogen company, establishing a company for hydrogen production and carbon capture and storage. We have received 77 million [NOK] in public funding for that. And this would never have happened without it [the public funding]."* (Nortech)
Establishing new collaborations	University and cluster collaboration	Radical innovation group	*"Through the collaboration with the university we get access to knowledge and software (…). We also have a Phd-candidate who will work on hydrodynamic analysis and design connected to the technology."* (Yardtech)
	Cross-sector collaborations	All	*"If you are going into a new area where you do not have the competence, you must find the right partners who can complement the competence you have. With the partnerships, we also share risk, and we can join more new areas than just one."* (Nortech)

was actively searching for opportunities where they could utilize existing resources and capabilities, and entered renewables with services and technologies that were very similar to their offerings in oil and gas. These opportunities arose as a result of being directly contacted by renewable energy firms or existing oil and gas customers that planned to enter renewables, which had knowledge about the incremental innovation group's resources and capabilities. For example, Electrotech entered the offshore wind industry through a partnership with a big actor that needed the specialized services that Electrotech could offer to build a HVDC platform, while Nortech's initial entry into renewables happened because an existing customer from oil and gas needed Nortech to do a study for them on the development of an offshore wind park.

However, the incremental innovation group's initial entry into renewables was only related to one specific project, and the firms, learning from their first involvement, over time realized that if they wanted to really establish themselves in renewables and offer more services, they had to *modify their business model*, as illustrated by the CEO of Nortech:

> *It's not the complexity that you have in oil and gas. (…) It's not technically difficult, necessarily. (…) But to enter the market and find the right business model, that has been demanding.* (Nortech)

This quote also illustrates a view shared by many of the case companies; that market related issues could be more challenging than technological ones. This is because these new business landscapes comprise new customers and suppliers, different type of tenders, and different pricing models among others. These market specific challenges were not necessarily identified by the case companies before entering renewables, which meant that new knowledge and resources were required after the entry. Changed business models was also a challenge for the radical innovation group as explained by Subseatech:

> *We cannot just take with us the same business model from oil and gas over to renewables. (…) We work very hard to find what our right position in the new market is.* (Subseatech)

4.2.2 | Accessing new knowledge and resources

Thus, to be able to modify their business models, the firms in the incremental innovation group quickly realized that they were forced to *develop new market insights*. Nortech described the challenge of understanding who the decision-makers in offshore wind are, when new projects are coming, and what types of tasks are needed. For Electrotech, a big change was the close cooperation with sub-suppliers in both the development and execution of projects compared to oil and gas. Also, the offshore wind suppliers typically are bigger than Electrotech's suppliers in oil and gas, making negotiations more demanding:

> *It's a tougher world in offshore wind, with international customers running fixed-price contracts according to other contract formats than we are used to. (…) It has been a very different method of implementing projects.* (Electrotech)

Additionally, access to *new technological knowledge* was necessary to develop the case companies' green innovations, especially when developing the more radical innovations since these demanded specific knowledge related to offshore wind or hydrogen. For example, Yardtech needed technical competence in turbine technology and hydrodynamics, while Membranetech lacked knowledge of chemistry, technical safety of hydrogen, and other processes unusual for the oil and gas industry. The radicalness of these innovations makes it hard to know beforehand what specific technological knowledge that is needed for the commercialization process. For Membranetech, where the specific technology was new to the firm, the process of developing and commercializing such radical technology from scratch was a completely new challenge for them:

> *We have learned what we shouldn't do and what doesn't work. We have tried a lot of things with the membrane technology and done a lot of different testing. Everything that could go wrong has gone wrong.* (Membranetech)

Yardtech also emphasized the move away from typically delivering projects to delivering new products, which requires series production and represented a new business logic for the organization. Both examples show that it was difficult for the radical innovation group to assess what knowledge and capabilities they would need to commercialize these innovations when the decision to enter renewables was made. These uncertainties increased the length and cost of the development process. To be able to develop such novel and radical innovations, the findings show that the case companies needed *access to external funding* as they were typically only willing, or able, to fund a minor part of the development themselves because of the high financial need, as illustrated by Yardtech:

> *If you are going to build an offshore wind farm, we are talking about billions, not a billion, but billions [of NOK] (…) It took around a year to have initial funding in place, in a combination between different public funding programs.* (Yardtech)

Combining this high financial need with uncertainties related to technology, markets, and regulative frameworks, the innovations were not possible to fund either by internal or external private capital. Instead, funding through public organizations such as Innovation Norway, Research Council of Norway, and Enova was crucial:

> *There is not a lot of funding available. The public funds have really been crucial (…) We have almost always applied for [public] funding first and then asked for funding internally afterwards. And that has worked very well.* (Subseatech)

4.2.3 | Establishing new collaborations

New and emerging technological domains such as (floating) offshore wind and various hydrogen solutions need knowledge and resources from different industries in their development stages. The findings show that the case companies lacked capabilities and resources related to both technologies and markets. To address these limitations, they initiated new partnerships with organizations that in many cases were both new to the case companies and also from different industries. These cross-sector collaborations were crucial for the case firms to access resources and knowledge that did not exist in the oil and gas industry but was central for developing their innovations. However, the findings show that the case companies' oil and gas experience made them attractive collaborators for firms in the renewables. For example, Electrotech's entry into the hydrogen industry happened partly because a renewables company needed a complementary partner to deliver the construction, building, and design for hydrogen production:

> *We didn't take the first step, but *a hydrogen company* that has been in the hydrogen market for many years did. (…) They saw that their deliveries of electrolysis plants had increased so much that they needed someone to lead and operate their projects and to help them change the way they worked (…).* (Electrotech)

However, differences between the oil and gas and the renewables industry, such as, for example, the contract formats and business models, made it challenging to initiate and develop these cross-collaborations. Still, these hurdles were necessary to access crucial knowledge and resources and valuable insight into the renewables sector. In some cases, such cross-sector partnerships could also give the case firms new perspectives, as illustrated by Subseatech:

> *It is most interesting to work with those [companies] that are purely renewable. They work in a different way, which we learn a lot from. We learn how they work, which is valuable to bring back to already existing customers.* (Subseatech)

4.3 | Reconfiguring

To make their firms more able to conduct green innovation developments, our findings show how the case companies redeployed existing knowledge and resources and established new organizational forms.

4.3.1 | Redeploying existing knowledge and resources

The findings show how the case companies were able to utilize a range of existing knowledge and resources from oil and gas in the development of green innovations (see Table 5). For all case companies, their *engineering knowledge* of their employees was an important and highly transferable resource. For example, the employees' knowledge in engineering disciplines such as chemistry, electronics, materials, hydrodynamics, and safety were directly transferable to the green innovation development. Furthermore, all case companies utilized their experiences as service providers in big projects in the oil and gas industry:

> *We use competence and experiences from the oil and gas sector directly in the renewables sector. […] We use our competence to sew things together in regard to hydrogen or biogas or whatever it may be.* (Engineeringtech)

The ability to use existing resources and capabilities was a central motivation for the case companies when entering renewables, and this was especially true for the incremental innovation group. The findings also show that for this group, the engineering competence was especially transferable as illustrated by Electrotech:

> *If you blindfolded an engineer and asked him if he was working on an oil and gas project or an offshore wind project, he wouldn't have understood the question because he does the same things.[…] for the most part, things are very similar, and therefore, it's so important to us that we can use the competence and abilities we already have in a new setting.* (Electrotech)

Furthermore, the case firms' competence in building and construction, in addition to their working methods and procedures, were important skills that were directly transferable to the renewable energy sector regardless of the radicalness of the innovation:

> *[…] Whether it is building a sub-station for a new offshore wind facility or building a module for oil and gas, there are many similarities—it needs to be in the ocean, it is heavy and large, it includes procurement, engineering, electro, steel and structure—many of the elements will be the same."* (Yardtech)

Moreover, the case companies' *physical assets* (e.g., shipyards, laboratories or docks) were also transferable to the renewables industry. For Nortech, their location with existing facilities were very attractive for a Norwegian hydrogen company, and they ended up collaborating on developing a pilot plant for hydrogen production in Nortech's facilities.

The last important transferable resource highlighted by the case companies was their *financial resources*, which are acquired through

TABLE 5 Microfoundations of reconfiguring.

Microfoundations reconfiguration		Case firms	Illustrative quotes
Redeploying existing knowledge and resources	Integrating existing engineering knowledge	All	*"We have made implementation models, and our tools, procedures, and everything is the same. […] We have a tool system that fits everything, whether it is a wind project, oil and gas project, or hydrogen project."* (Electrotech) *Apart from the membrane, all other components are known technology—they are just assembled differently*. (Membranetech)
	Redeploying physical assets for new usage	All	*"(…) We have shipyards, we have sites around the world that can solve these big problems. And a renewable company cannot just snap its fingers and then suddenly have 1,500 men and operators, automation engineers, sheet metal workers and know how to run a logistics project."* (Engineeringtech)
	Utilizing financial resources	All	*"Fortunately, during the technology development, we have been able to operate in the traditional oil and gas sector and had an income there the whole time."* (Membranetech)
Establishing new organizational forms	Establishing new firms	Membranetech, Subseatech, Nortech (hydrogen) and Engineeringtech (hydrogen and floating offshore wind)	*"(…) We don't think we would have survived if we were only a part of the core business. When this was just a project, it was very easy to get sucked into the core business. (…) You get the money you need to carry out that particular project, but you have limited freedom and flexibility to create new opportunities and to do what you think is important."* (Subseatech)
	New internal divisions	Yardtech and Electrotech	*"First, we created a separate business unit for wind. Then, we saw that it became too small and was not appropriate. So, it was organized into two business units, one is doing the framework contracts, maintenance and modifications, the other the new construction."* (Electrotech)
	Acquiring companies	Nortech and Engineeringtech	*"We acquired a company in Denmark to deliver services to the offshore wind market."* (Nortech)

their core activities in the oil and gas industry. The financial resources gave them freedom, opportunities, and room to explore new solutions without pressure to see immediate profits. This is especially true for the green innovations with less demanding technology development and shorter time-to-market, as illustrated by Nortech's CEO when commenting on their need for capital when they first entered the offshore wind market:

> *Public support? No, this we have established and executed on our own because we have the financial weight to do it without it* [public funding]. (Nortech)

4.3.2 | Establishing new organizational forms

The development of green innovations for the renewable sector made the case companies conduct different organizational changes to better fit the organization to the discovered opportunities. For example, Membranetech and Subseatech *created a subsidiary company* for the green technology where further technology development was facilitated. For Membranetech, the main reason for this was financial:

> *[…] We had to acquire capital; it was so demanding, and we have used a lot of money on the technology development, so we had to create our own company to acquire capital*. (Membranetech)

By establishing a new company, it was easier for Membranetech to separate the green innovation from the existing business and highlight its value proposition to attract external investors. For Subseatech, which is a part of a large international company, the main motivation for establishing a subsidiary was a bit different. For them, the subsidiary obtained the necessary freedom to continue the technology development without having to continuously compete with other internal projects for money and people. And at the same time, this extra space away from the rest of the organization gave them the possibility to build new competence, culture, and a team around the new technology.

Furthermore, after entering the offshore wind industry, Engineeringtech and Nortech decided to *establish new firms*. Engineeringtech started independent companies into both wind and hydrogen where many employees were transferred from the mother firm. They observed a large market that needed focus and considered the formation of new companies as an appropriate solution. This organizational structure provides clear delineations between the activities provided by the mother firm and the activities provided by the new firms, and for Engineeringtech, this was important since the spin-off company could focus on developing floating offshore wind technology while the mother firm still could be a supplier for competing offshore wind companies.

In contrast, Yardtech and Electrotech chose to maintain their green innovation within the firm by *creating new divisions*. Yardtech organized technology development under their business development department, while Electrotech started two *new internal divisions* within offshore wind as a result of going into that industry. However, offshore wind projects concerning construction were still organized together with oil and gas projects because many tasks in offshore wind were almost the same:

> *The handling and implantation of projects is really similar. A project leader's tasks are more or less the same, but he has to learn a new industry and new contract formats. The discipline work, however, is really similar.* (Electrotech)

In addition, Engineeringtech and Nortech decided *to acquire companies* within offshore wind. Nortech acquired two such companies, which quickly gave them a stronger position in the wind market, by gaining increased specialization and coming physically closer to the wind market in Europe. Engineeringtech acquired a startup company in the emerging floating offshore wind industry to learn more about the technologies and industry.

5 | DISCUSSION AND IMPLICATIONS

5.1 | Microfoundations of sensing, seizing, and reconfiguring

In order to implement new sustainability innovations, dynamic capabilities are necessary (Elf et al., 2022; Kortus & Gutmann, 2023). Therefore, research studying how dynamic capabilities and their underpinning microfoundations enable firms to innovate for sustainability and create competitiveness has been called for (Amui et al., 2017; Khan et al., 2020; Mousavi & Bossink, 2017; van Lieshout et al., 2021). However, what microfoundations that are necessary for innovation development will vary depending on whether the firms enter familiar or new markets as this influences the potential to utilize the current resource base (Altintas et al., 2022). This study therefore contributes to the existing literature by shedding light on the microfoundations necessary for a transition towards a more sustainability-oriented business in new markets.

5.1.1 | Different ways of sensing opportunities

Our findings contribute to the sustainability-oriented dynamic capabilities literature by showing how companies, depending on their green innovation, sense opportunities differently. Owing to several external drivers, going into greener industries was not perceived as a deliberate choice by the case companies but as essential to secure future competitiveness and survival. Thus, sensing was an important first step for all the case companies, which involved scanning the external environment and searching for opportunities and threats (Elf et al., 2022; Leemann & Kanbach, 2022). Common for all case companies was that the extraordinary pressure they experienced made them more explorative by *expanding their search window*. That is, the firms started to look for opportunities outside their core businesses and instead in new markets and industries. When firms search for new business opportunities, they often do this in technological domains where they have knowledge and experience of related technologies (Leten et al., 2016). Thus, the case firms identified many business opportunities within the growing renewable energy sector, where they believed their existing resources and capabilities gave them an advantage.

Furthermore, the case companies conducted several *explorative initiatives* to identify new opportunities. Depending on the radicalness of the green innovation, the case companies identified the opportunities differently. For example, finding new opportunities within sustainability requires understanding of customer demands, regulations, future trends, and environmental changes (Demirel & Kesidou, 2019; Inigo & Albareda, 2019). Thus, for the incremental innovation group, there was a high focus on structured market scanning and proactively seeking out to learn about new markets within the renewables. Going into the renewables became a deliberate strategy. For this group, other firms were important for discovering opportunities within the renewables, and the case companies saw an opportunity to contribute with complementary services. This is in line with Perrons (2014) that found suppliers and customers to be the main knowledge sources in oil and gas companies' innovation activities. However, for the radical innovation group, the search for new opportunities in the renewables sector was much less structured. Instead, the initial ideas of their new green innovations originated from employees highly eager to improve the environmental performance of their firm. These individuals, ranging from normal employees to CEOs, showed extraordinary dedication to be change agents, and in some cases, the ideas were pursued with little or no knowledge and support from management in the initial phases. Thus, this group knew they wanted to be more environmentally friendly, but the discovered opportunities were not a result of structured scanning in the same way. Instead, it was an opportunity that emerged and evolved with time because of eager individuals.

Nevertheless, common for all case companies is that they identified new opportunities because of their proactive behavior, in which they deliberately searched, were open for, and were capable of identifying new business opportunities within sustainability that could ultimately create a competitive advantage (Aragón-Correa et al., 2008; Coppola et al., 2023). Thus, firms with a proactive sustainability strategy are better able to sense potential business opportunities, as they are continuously searching for new ways of improving their environmental performance (Mousavi & Bossink, 2017).

5.1.2 | Linking sensing with seizing

A firm typically does not seize all opportunities (McDougall et al., 2022), and a firm must assess and take strategic choices of what opportunities to go further with (Altintas et al., 2022). This study finds that the firms' sensing phase has implications for what type of opportunities they seize. From our findings, we see that the incremental innovation firms had a deliberate firm strategy of going into the renewables. This involved actively scanning markets to search for opportunities in areas with limited competition and where they could utilize current resources and capabilities. As a result, they could enter the renewables with incremental innovations that were minor modifications of their existing services. The firms that entered with more radical innovations, however, had a much less deliberate company strategy. These firms did not structurally scan markets for opportunities, instead their green innovations had a more serendipitous path via various firm employees before being seized and invested in by the firms. This finding is an important link between sensing and seizing and suggests that a more structured sensing process within clear frameworks has implications for the seizing phase as it limits the openness and incentives to choose more radical projects, in line with earlier studies such as Katila and Ahuja (2002).

5.1.3 | Seizing

The findings show that while *new business activities* in the radical innovation group entail developing new technology, the incremental group only slightly modifies their service. However, for all case companies the new green innovations lead to a change in the business model to a varying degree.

In the development of sustainability innovations, new skills and knowledge are necessary (Michelino et al., 2019). Hence, even though the case companies had many resources and knowledge from the oil and gas sector that were transferrable to renewables, they also had shortcomings on certain aspects and therefore needed to *access new knowledge and resources*. In the sensing phase, the case companies typically looked for opportunities where they primarily could utilize existing technological capabilities and resources, with limited focus on market-related capabilities. However, the findings show that the need for understanding market actors and market dynamics quickly arose after entering the renewables industry. This is similar to earlier studies that have found market insight to be significant for the development of sustainability innovations (Demirel & Kesidou, 2019). As green innovations come with inherent risks, understanding the market is crucial to gain a competitive advantage and get returns of the investment (Bhupendra & Sangle, 2015).

As the case companies needed to access new knowledge and resources, *establishing new collaborations* became crucial for most case companies (Khan et al., 2021; Mousavi & Bossink, 2017; Song & Choi, 2018). In fact, what characterizes the development of green innovations is that they entail new knowledge and information, making external sources more important than in traditional innovations (Khan et al., 2020; Prieto-Sandoval et al., 2019). Earlier studies have found that collaborating with other firms have a positive influence on innovation capacity (Klewitz & Hansen, 2014) and can increase the speed of innovation development (Inigo & Albareda, 2019). This study also shows how important cross-sector collaborations are for green innovations in new or emerging domains such as floating offshore wind or "zero-emission" hydrogen.

5.1.4 | Reconfiguring

Our findings show that the case companies can, to a large extent, *redeploy existing knowledge and resources* from their experience in the oil and gas into the new green innovation development. These general-purpose capabilities (Pisano, 2017) were typically engineering knowledge, such as execution of big projects, working methods, and technology development. In fact, this was one reason why the case companies chose the specific new green innovations: there were many opportunities for resource deployment (Mäkitie, 2020).

New organizing, including establishing new firms and creating new internal divisions, supported the case firms' strategic change (Chevrollier et al., 2023; van Lieshout et al., 2021). More specifically, the new organizing allowed the firms to be ambidextrous by opening up for both exploration and exploitation (Chevrollier et al., 2023; Leemann & Kanbach, 2022). Hence, the tension between doing exploitation in the present market by improving existing products and conducting exploration by experimenting with new green innovations to capture opportunities in new markets was mitigated through structural ambidexterity (Altintas et al., 2021; Chevrollier et al., 2023; O'Reilly & Tushman, 2008). The new organizing allowed the case companies to better meet current challenges and ensuring viability in the present business, while meeting future opportunities and demands and ensuring competitive advantage in the future (Altintas et al., 2021; Maijanen & Virta, 2017). This simultaneous balance of exploitation and exploration is found to be beneficial, as it allows firms to avoid short-term traps associated with exploitation and reduce the high risks associated with exploration (Michelino et al., 2019). However, what is interesting is that the case companies managed to balance exploration and exploitation activities in the sensing and seizing phases without structural ambidexterity. It was only later in the innovation process they saw the need to change their organizational structure to better balance the tensions. This shows that opportunities can

be sensed and seized without an initial structured management of ambidexterity. Nevertheless, our findings show the necessity of simultaneous exploitation and exploration in the sustainability transition for oil and gas firms. Thus, our findings contribute to the literature by showing how dynamic capabilities and ambidexterity are closely related (Altintas et al., 2021; Leemann & Kanbach, 2022; Popadiuk et al., 2018) in the green innovation process for oil and gas firms.

5.2 | Type of green innovation and dynamic capabilities

We further contribute to the literature by showing how the radicalness of green innovations lead to different innovation journeys in terms of the order the microfoundations of sensing, seizing, and reconfiguring are conducted. Few studies have made a distinction on this. Inigo et al. (2017) find that the sensing, seizing, and reconfiguring phases are different for firms with incremental versus radical business model innovations. In contrast, this study shows that the same seizing and reconfiguring microfoundations are more or less present for all the case companies, regardless of the radicalness of innovation. What is interesting, however, is the order in which the microfoundations are conducted among the two groups. The findings therefore support that dynamic capabilities are important for the development of both incremental and radical innovations (Mikalef et al., 2019); however, the innovation journey will vary depending on the type of innovation.

For the incremental innovation group, the initial seizing and reconfiguring phases were less comprehensive compared to the radical innovation group (see Figure 2). The reason for this is that firms in this group deliberately searched for opportunities more adjacent to their existing business. While the radical innovation group developed a new technology, the incremental group only slightly modified their service to fit the renewables industry. Thus, the incremental group was able to enter the renewables industry fast. This illustrates that, in some instances, minor changes to the resource base is enough to utilize identified opportunities (Khan et al., 2021). For the incremental group, the entry into the renewable industry was a result of working closely together with other actors in the new industry, bringing complementary innovations to the market, a term called co-specialization (Mousavi & Bossink, 2017; Teece, 2007). Collaboration provided the case companies important access to market knowledge and other important complementary resources (Klewitz & Hansen, 2014), which made the entry into the new market possible. However, after a fast entry into renewables, the incremental innovation group saw that if they wanted to increase market shares and win more tenders, they had to *acquire new knowledge and resources* including both technological and market knowledge. In addition, they realized the need to *establish new organizational forms* to be better able to focus their new services. Thus, after initially going into the renewables with their modified green service, the incremental innovation group returned to the seizing and reconfiguring phases in order to enhance their offering and capture more value in the renewable markets. In other words, the firms needed to do a more comprehensive renewal of their resources to better capture the identified opportunities (Khan et al., 2021). This supports the notion that change does not necessarily happen linearly in the real world (Leemann & Kanbach, 2022). Instead, firms may seize opportunities before they have fully sensed and scanned for different opportunities, or start reconfiguring for change before they have fully seized the necessary resources (Leemann & Kanbach, 2022, p. 498). Compared to the radical innovation group, the incremental innovation group therefore did the microfoundations in a nonlinear path by returning to the seizing and reconfiguring phase after going into the renewables industry. This illustrates that dynamic capabilities for sustainability, including sensing, seizing, and reconfiguring, are not necessarily an isolated step-by-step process, but instead different microfoundations interact and are undertaken simultaneously (Elf et al., 2022; Khan et al., 2020; Pieroni et al., 2019). Innovating for sustainability may require moving back and forth between the different sensing, seizing, and reconfiguring phases to optimize the value creation and competitiveness. Firms learn along the way during the innovation process and may need to take a step back to do adjustments and acquire the new necessary resources before going further ahead. Thus, dynamic capabilities for

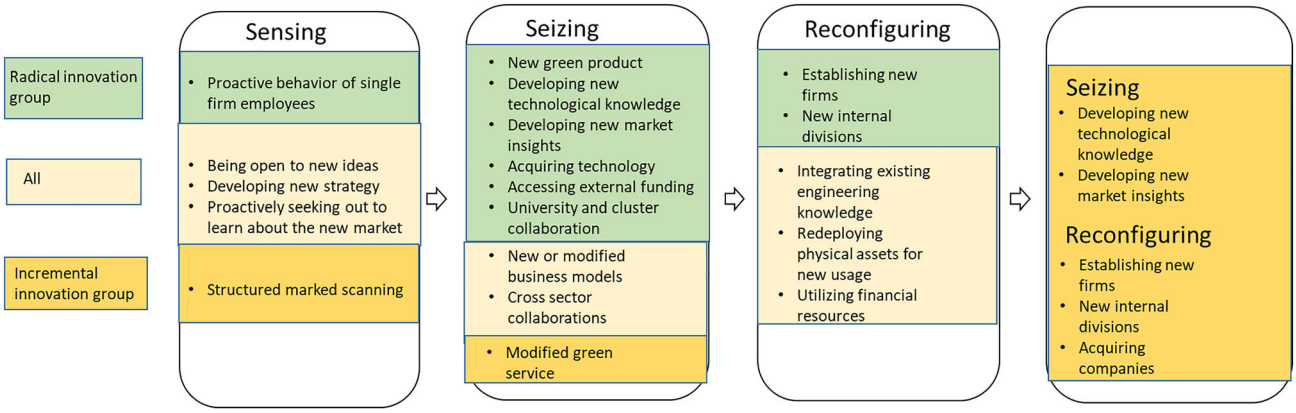

FIGURE 2 *Innovation journey of case companies.*

sustainability innovations require constantly assessing the environment and stakeholder requirements, and making the necessary recalibrations to take advantage of new opportunities (Kortus & Gutmann, 2023).

5.3 | Contributions – microfoundations in a unique context

Even though there are several studies investigating the microfoundations of dynamic capabilities necessary for sustainability implementation (Kortus & Gutmann, 2023), there are, to our knowledge, few studies that explore this in the context of going into new and unfamiliar markets. Thus, this study responds to calls to investigate microfoundations for sustainability in different types of contexts (Inigo & Albareda, 2019; Khan et al., 2020). In this study, we discover the microfoundations of dynamic capabilities necessary for green innovation development that enable firms to transition from being solely petroleum-based to being more future oriented by going into the renewable energy markets. Thus, one of the key contributions of this study is the unique context the microfoundations for green innovation development is studied. This context is unique as it is planned to gradually phase out this industry, due to the damage it causes on the environment (George et al., 2016; Silvestre & Gimenes, 2017). At the same time, the industry is significant for the world's current and future energy infrastructure and supply and has accumulated valuable experience related to advanced technology and innovations over many years. Consequently, this research has important contributions to theory and practice, showing how an industry that traditionally have been highly emission-intensive can be an important contributor to the green transition of the energy sector by developing green innovations. Not only will the green innovation development contribute to a lower environmental impact among the firms, but it will also contribute to secure their future survival and competitiveness in a more sustainability-focused future.

6 | CONCLUSION

In this case study, we examined dynamic capabilities in a unique context. We study how dynamic capabilities enable firms in the oil and gas industry to develop green innovations to adapt to the external changes in the environment with increased focus on sustainability. We find several microfoundations related to sensing, seizing, and reconfiguring important for the green transition. Through dynamic capabilities, we find that the case companies can use their resources to explore new sustainable avenues of operation and, in this way, increase their competitiveness and chances of surviving in the future (Kabongo & Boiral, 2017). The findings also show how, depending on the radicalness of innovation, the firms' innovation journey in terms of when the different microfoundations are undertaken varies. This illustrates that microfoundations of sensing, seizing, and reconfiguring are interdependent and do not necessarily follow a linear path.

Our study also has several practical implications. First, we show that the development of dynamic capabilities can help firms in non-renewable industries to develop green innovations that make the firms more prepared for the increased sustainability-oriented future. In this way, by adjusting the resource base according to the changing environment, firms can create a competitive advantage (Leemann & Kanbach, 2022; Mikalef et al., 2019; Qiu et al., 2020). Thus, it is therefore not the dynamic capabilities themselves that create a competitive advantage, instead it is changes in the resource configuration they lead to, as, for example, changed operations and the way of competing (Mikalef et al., 2019; Van de Wetering, 2019). Second, we find important microfoundations of dynamic capabilities that can encourage firms in their own journeys towards increased sustainability. Specifically, we show how expanding the search window and proactively searching and being open for new opportunities is crucial for finding new business opportunities within sustainability. We also found that gaining new knowledge and resources—especially new market knowledge—is important for utilizing the new opportunities, and that collaboration with other firms can accelerate the green transition. We show that oil and gas firms can, to a large extent, use their existing resources and knowledge when going into renewable energy markets; however, they must develop certain market-specific capabilities and knowledge to succeed with the innovation development (Pisano, 2017). Finally, new organization is important to capture value from the opportunities. Specifically, new organization enable firms to be ambidextrous by exploring new green solutions in new future-oriented markets (exploration), while they still operate in their traditional markets to ensure viability (exploitation). We believe that these findings are applicable to other industries as well, as many industries have relevant resources and capabilities that can be used in more sustainability-oriented new markets.

Despite its important contributions, this study also has some limitations. This study only investigates firms in the Norwegian oil and gas sector, and to what extent the findings are applicable to other industries and settings is unclear. We also only interviewed a few firms, and additional interviews could have provided us with more insight into the problem statement. Hence, we urge future studies to further study what microfoundations are necessary for sustainable development and how firms in traditional environmentally degrading industries can become greener and lower their emissions by developing dynamic capabilities. As technological and market breakthroughs in green innovation development often take more time than expected, we also call for more longitudinal case studies that can follow firms in their innovation development over time. In this way, one can observe how dynamic capabilities develop with time. In addition, further research could study how oil and gas firms balance their exploration towards greener solutions with simultaneous operation in their present market, which is currently, at least in the short term, experiencing more demand than ever.

ORCID

Fanny Hermundsdottir https://orcid.org/0000-0002-7995-6958
Øyvind Bjørgum https://orcid.org/0000-0002-2185-9020

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