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Revival of wind-powered shipping: Comparing the early-stage innovation process of an incumbent and a newcomer firm

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Abstract

Despite the urgency of decarbonising, the shipping sector has demonstrated a slow-paced response to climate change challenges. Some frontrunner firms are engaged in sustainability-oriented innovation processes. However, there is limited knowledge of how such processes emerge and contribute to societal sustainability transitions and what the role of technology is in companies' (re)orientation towards sustainable business models. This study contributes to filling these gaps through a comparative case study of the ongoing innovation process within an incumbent and a newcomer firm developing wind-powered energy solutions for deep-sea transportation. The study's findings bear implications for theory and practice. This paper's combination of a dynamic capabilities approach and a multi-level perspective from sustainability transitions research is a conceptual novelty, enabling an understanding of the activities involved in the (re)orientation process towards sustainable business from a company's perspective, as well as broader societal and sustainability needs.

KEYWORDS

dynamic capabilities, incumbents, innovation process, multi-level perspective, newcomers, shipping

1 | INTRODUCTION

The shipping sector faces the challenge of decarbonising its operations by at least 50% by 2050, compared with 2008, and ultimately achieving fossil-free operations (IMO, 2018). This requires not only a shift to low or zero-carbon energy solutions but also profound changes in the shipping regime composed of established technologies, infrastructure, institutions, markets and consumer preferences (Geels, 2002; Sharmina et al., 2020). Although a transition to alternative energy solutions in the risk-averse, competitive and cost-sensitive shipping sector (van Leeuwen & van Koppen, 2016) is underpinned by deep uncertainty, some firms and key stakeholders are starting to experiment with renewable energy solutions, such as wind power (Ovcina, 2020).

The potential of wind propulsion is gaining traction in the literature on low-carbon energy transitions (Balcombe et al., 2019; Chou et al., 2021; Traut et al., 2014), including its use in commercial shipping (Gilbert et al., 2014; Mander, 2017; Rehmatulla et al., 2017; Rojon & Dieperink, 2014). Previous research suggests that wind power has potential to provide propulsive power for slow-steaming vessels (Traut et al., 2014) and can be a valuable complement to alternative fuels (Chou et al., 2021). However, a lack of full-scale demonstration, along with safety and reliability concerns, limits the upscaling of wind-based technologies (Gilbert et al., 2014). Existing studies seldom address how the opportunities for wind-energy solutions emerge or what the underlying processes of such sustainability-oriented business models are (Chou et al., 2021).

A business model describes 'the design or architecture of the value creation, delivery and capture mechanisms employed' of products or services offered by firms (Teece, 2010, p. 191). In contrast to conventional business models, sustainable business models integrate sustainability in all core elements (value proposition, value network and value capture) (Geissdoerfer et al., 2018), where economic value must be ensured in concert with environmental and/or social value (Boons & Lüdeke-Freund, 2013). Sustainable business models can also be vehicles and mediators for commercialising technological innovations (Evans et al., 2017) that bring benefits beyond the core firm (cf. Schaltegger, Hansen, & Ludeke-Freund, 2016). Despite interest in sustainable business models, relatively little is known about the activities underpinning the organisational (re)orientation towards sustainable business models among different types of firms (Geissdoerfer et al., 2018) and strategic processes leading to innovation uptake in shipping (Acciaro & Sys, 2020). Consequently, there is a need to analyse the processes underpinning relationships between sustainable innovations, sustainable business cases and models (Lüdeke-Freund, 2020), technology (Preghenella & Battistella, 2021) and how they may impede or enhance sustainability transitions (Köhler et al., 2019). A comparative analysis of the ongoing sustainability-oriented innovation process in two firms—one established and one newcomer—that are bringing wind-based vessel-design concepts into the roll-on/roll-off (Ro-Ro) vehicle-carrier shipping business segment can help address these research gaps by (1) nuancing key decisions and activities behind frontrunner firms' (re)orientation towards renewable energy with embedded sustainable value propositions, value networks and value capturing; and (2) clarifying the roles of established firms (incumbents) and newcomers in the context of early-stage maritime energy transitions—a nascent research topic in the field of sustainability transition studies (Stalmokaitė, 2021).

Harnessing wind energy for the main propulsion of ocean-going cargo vessels is at the early stage of development and represents 'a niche situation' in low-carbon transitions (Mander, 2017). Niche situations begin with pioneering actors (Smith, 2007) who 'are prepared to work with specific functionalities, accept such teething problems as higher costs, and are willing to invest in improvements of new technology and the development of new markets' (Hoogma et al., 2002, p. 4). The question of who the pioneering actors in such niche development activities are has been studied through 'big versus small' or 'incumbent versus newcomer' dichotomies. However, such perspectives are criticised for underestimating the differential roles of incumbents and newcomers in sustainability transitions and simplifying the processes of sustainable value creation (Bergek et al., 2013; Schaltegger, Ludeke-Freund, & Hansen, 2016). Acknowledging the need for further research to capture the activities of various firms orientation towards sustainability transitions (Schaltegger et al., 2020; Turnheim & Sovacool, 2020), this study contributes empirical examples from the shipping sector.

The primary aim of this paper is to compare an incumbent's and a newcomer's engagement in sustainability-oriented innovation processes leading to the adoption of low-emission technologies in shipping. The further aim is to demonstrate that, by combining a dynamic capabilities approach (Teece et al., 1997) from the strategic management literature and a multi-level perspective (MLP) framework (Geels, 2002) from the sustainability transitions field, a deeper conceptual understanding of firms' roles in sustainability transitions can be obtained. The dynamic capabilities approach, with its business perspective, helps to explain similarities and differences in how firms identify new business opportunities (sensing) and how sensed opportunities are implemented in practice (seizing and transforming) (Teece, 2007). The MLP framework, with its concepts of landscapes, regimes and niches, approaches transformation from the perspective of society and a sociotechnical context in which firms' (re)orientation towards sustainable business models is situated. Against this background, the following research questions are set: (1) What are the underlying sensing components and activities helping incumbents and newcomers to detect a sustainable niche technology, and how are they turned into seizing and transforming? (2) How can identified similarities and differences between sensing, seizing and transforming explain variation in established-regime and emergent-niche interactions and how they contribute to sustainability transitions?

2 | THEORETICAL UNDERPINNINGS

2.1 | The multi-level perspective

The MLP is one of the most used frameworks in sustainability transitions research (Köhler et al., 2019). Taking persistent environmental problems as the point of departure, MLP scholars analyse dynamics of change (i.e. emergence and diffusion of radical innovations) and stability (i.e. lock-in and path dependency) in sociotechnical systems (transport, energy, agri-food, etc.). A change towards sustainability is not straightforward because multiple elements (i.e. technologies, infrastructures, markets and institutions) and various actors (i.e. policymakers, firms, users and scientists) are locked in by various organisational routines and institutional, economic and technological interdependencies (Klitkou et al., 2015). Accordingly, transitions are conceptualised as co-evolutionary processes between three MLP levels: protected spaces where radical innovations emerge (niches), a semi-coherent set of rules and dominant practices (the regime) and the wider societal context (the landscape) (Geels, 2002).

Focusing on sustainability-oriented innovation processes requires a holistic lens to assess the sociotechnical context in which firms are embedded and to differentiate between external influences at societal (landscape) and sectorial (regime and niche) levels—which are important to firms' innovation activities (Bolton & Hannon, 2016; Hörisch, 2015). Although sustainability transitions are known to be enacted by multi-actor processes (Köhler et al., 2019), the role of frontrunners is essential (Farla et al., 2012): they can (1) raise awareness and provide legitimacy to new technology (Jacobsson & Johnson, 2000); and (2) enable learning and facilitate stakeholder engagement (Bocken et al., 2018). Furthermore, the frontrunners' role is pronounced when firms' engagement in sustainability-oriented innovation process comprises co-creation of environmental value propositions in relation to the broader range of stakeholders (cf. Freudenreich et al., 2020). It thus passes firms' boundaries and requires the consideration of interactions across multiple levels and with a broad value network of partners, suppliers and other engaged stakeholders (Johnson & Schaltegger, 2019).

A dominant perspective in transition studies is that incumbents are regime-level actors who oppose radical innovations, while newcomers and start-ups are responsible for niche development (Geels, 2011; Geels & Schot, 2007). However, recent contributions show that incumbents can strategically reorient towards radical niches (Bergek et al., 2013; Berggren et al., 2015; Bohnsack et al., 2020; Stalmokaitė & Hassler, 2020). Meanwhile, although newcomers are expected to operate primarily within niches, they can support sustainability transitions by influencing regime actors (Hörisch, 2015). Smith and Raven (2012) define niches as protective spaces for potential path-breaking innovations and refer to this process as niche shielding, nurturing and empowerment. They use two modes to describe niche–regime interactions: fit-and-conform and stretch-and-transform. In the former case, niche actors work to make niche innovations competitive within an existing regime's structures and norms, while the stretch-and-transform pattern necessitates changing mainstream practices and questioning established institutions and values.

Considering a call for a more symmetrical approach to niche–regime interactions, where the role of newcomers and incumbents is acknowledged in relation to niche development (Mylan et al., 2019; Turnheim & Geels, 2019) and earlier observations referring to the permeability of the three MLP levels (Hörisch, 2015), we embrace the dynamic capabilities approach to capture 'business-related mechanisms of niche-regime interactions' (Geels, 2010, p. 505). This makes it possible to explain the innovation process, including activities underpinning organisational (re)orientation towards sustainable business models as well as heterogeneity among firms (Teece, 2014a).

2.2 | The dynamic capabilities approach

Teece et al. (1997, p. 516) define dynamic capabilities as 'the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments' and classify them into three activities: sensing, seizing and transforming (or reconfiguring) (Teece, 2007, 2014a). Sensing is linked to scanning, learning and interpreting opportunities and threats in the business environment, such as customer demands, technology, regulations and competitors' moves. It involves sense-making, generating scenarios and testing hypotheses against different stakeholders. Seizing means responding to sensed opportunities and threats through the development of new strategies, business models, products or services. Transforming entails recombining assets and organisational routines. (Teece, 2018b)

The dynamic capabilities approach captures underlying processes through which a firm (1) 'innovate[s] outside its current routines' and engages in innovation processes (Lee & Kelley, 2008); and (2) designs and adjusts business models (Teece, 2018a). Even if there are differences in conceptualising dynamic capabilities (Ambrosini & Bowman, 2009), we follow Teece (2012) view on dynamic capabilities understood as strategic and entrepreneurial acts underpinned by managerial abilities to sense, seize and transform resources in new value-creating ways. Although value creation, delivery and capture are key concepts in the business-model literature (Teece, 2010), an increasing number of scholars focus on firms' contribution to sustainability (Bidmon & Knab, 2018; Lüdeke-Freund, 2020; Schaltegger et al., 2012; Wesseling et al., 2020). A core insight is that firms' engagement with sustainable business models goes beyond conventional approaches to value creation and requires the incorporation of social and ecological values in the innovation process in relation to multiple stakeholders, not just the customers (Schaltegger, Hansen, & Ludeke-Freund, 2016). Due to their focus on environmental or social value creation, the effects of sustainability-oriented innovations are therefore expected to exceed firms' boundaries (Lüdeke-Freund, 2020). Arguably, the dynamic capabilities perspective, with its elements of sensing, seizing and transforming, examines key activities that guide various firms in their (re)orientation towards sustainable business models. The early-stage sustainability-oriented innovation process represents one phase in the process of (re)orientation (cf. Geissdoerfer et al., 2018).

Both the dynamic capabilities and the MLP frameworks draw on evolutionary theories of economic change and a Schumpeterian perspective on innovation (Geels, 2019; Teece, 2007) that defines innovation as carrying out new ideas on the market through new combinations of existing resources or by using existing resources for new purposes (Schumpeter, 1934). Teece (1998) considers that firms can implement *seizing* through 'new combinations'. For example, experimentation often includes a mix of old and new technologies (Castellano et al., 2013). The innovation process might contain elements reinterpreted from the past, combined in a new way with recent or new elements of value propositions, value networks and value capture.

Consequently, learning is critical to an understanding of dynamic change and sustainable business models. Firms can use past experiences, knowledge and accumulated routines in combination with continuous learning and new knowledge creation to effectuate change (Teece, 2014b). Learning can involve many forms: 'learning-by-doing' or 'learning-before-doing' (Pisano, 1994; Teece et al., 1997). The former method is used when firms lack underlying knowledge and learn from trial and error; the latter when firms can rely on scientific and practical knowledge before action. Furthermore, firms can engage in exploitative and explorative learning (March, 1991), combine both strategies at the same time (ambidextrous organisation) (O'Reilly & Tushman, 2008) or employ one after the other through divergent (explorative) and convergent (exploitative) iterative phases (Van de Ven et al., 1999). Therefore, learning and knowledge accumulation are central activities and components in the development of sustainable-business-model elements, such as the value proposition, the value network and value capture.

2.3 | Analytical framework: Firms' roles in the context of niche development

Combining the dynamic capabilities approach with MLP makes it possible to incorporate more purposeful roles for strategic management in transition studies (Geels, 2020). Firms' engagement in sustainability-oriented innovation processes and (re)orientation to sustainable business models are context dependent and therefore are likely to vary across space and time (Gao & Li, 2020). Accordingly, both agency and system perspectives are needed to understand the roles of various firms in sustainability transitions. While the dynamic capabilities perspective helps explain what 'goes on inside firms' (Geels, 2014, p. 275) and how firms design and adjust (sustainable) business models (Teece, 2018a), the MLP framework makes it possible to account for a broader sociotechnical context in which firms' activities are embedded (cf. Schaltegger, Ludeke-Freund, & Hansen, 2016). The latter is especially important because regulatory, societal and market developments can either stimulate or hinder sustainability-oriented innovations.

An analytical framework based on the MLP and the dynamic capabilities approach is proposed here (Figure 1) that depicts the process of niche–regime dynamics by placing firms at the centre. The bidirectional arrow representing firms' sensing, seizing and transforming activities illustrates that deviation from dominant regime practices and novelty creation can be driven by different firms regardless of their type and position (newcomer/niche vs. incumbent/regime). Accordingly, an incumbent firm, just like a newcomer firm, can operate on a niche level (Hörisch, 2015). Sensing, seizing and transforming are key elements of the innovation processes underlying novelty creation (i.e. niches) that lead to new sustainable business models with value propositions to different stakeholders on the landscape (i.e. society) and regime levels (i.e. customers, partners and policymakers). A broader landscape and regime environment are thus important for firms' sensing, seizing and transforming because firms' commitment to niche innovations can be both stimulated and hindered by regime- (i.e. stricter regulations, subsidies and customers' demands) and landscape-level factors (i.e. increased societal awareness and changing norms). In contrast to Geels (2011), we assume that a strong structuration on the regime level versus the niche level does not automatically lead to a stronger constraining influence on regime-level actors' activities versus those of niche-level actors. Incumbents from the regime level, like newcomers from niches, can have unique combinations of resources and dynamic capabilities that can both enable and hinder engagement in sustainability-oriented innovation processes.

3 | METHODOLOGY

3.1 | Research design

The selection of firms was guided by *purposeful* sampling (Patton, 2002): information-rich cases were identified for an in-depth study of shipping firms' engagement with renewable energy solutions.

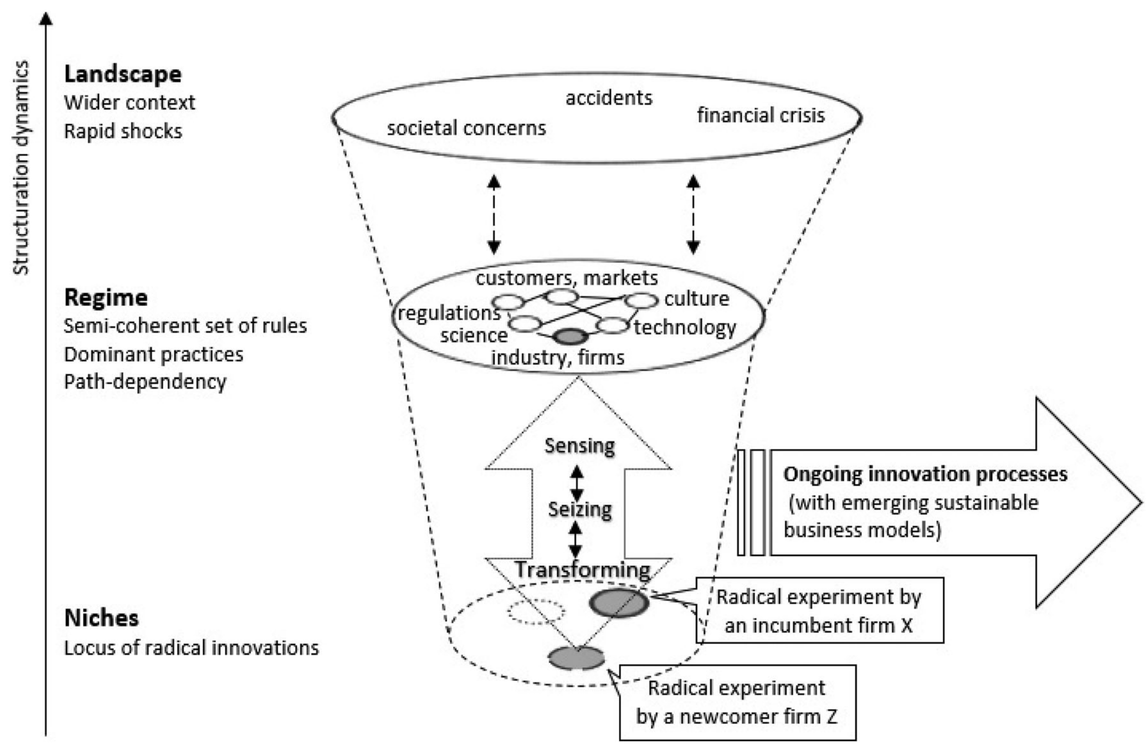

FIGURE 1 Analytical framework: incumbent and newcomer firms and their roles in the context of niche development. Authors' own representation based on Geels (2004) and Teece (2018a)

Wind power is an interesting niche solution, since it does not compete with the energy options applicable in other sectors (e.g. biofuels) and can contribute to decarbonisation (Gilbert et al., 2014). Accordingly, two firms engaged in wind-based niche technologies were selected: (1) newcomer firm Neoline and (2) established firm Wallenius Marine. Both firms operate in the roll-on/roll-off (Ro-Ro) shipping segment, which constitutes approximately 7.7% of the global fleet (Zis et al., 2020). Ro-Ro vessels are designed for the transportation of wheeled cargo: vehicles or loading units (e.g. trailers) are driven on board at the port of departure using ships' own ramps and driven off at the destination. Besides vehicles, Ro-Ro vessels carry valuable palletised cargo on trailers and heavy plant equipment on flat tracks. The benefit for the cargo owner is speed: loading is efficient to minimise time spent at port (MarineInsight, 2021). Ro-Ro vessels run fixed schedules between ports. Fuel consumption and thus fuel costs and emissions produced by these vessels are often high, explaining the interest in low/zero-emission energy sources.

Both shipping companies are pioneering ocean-going-vessel-design concepts based on sailing technologies. Different wind-assistance technologies such as kites, soft and hard sails and Flettner rotors are emerging (WASP, 2020). However, sailing technology for main vessel propulsion is at the early stage and exceeds existing greenhouse gas (GHG) regulations in shipping. In contrast to companies pioneering wind-assist technologies, the selected firms are early movers in harnessing wind power for the main propulsion in deep-sea shipping, which enables considerable reduction of CO_2 emissions.

We follow a comparative case-study design (Yin, 2018) and two ongoing innovation processes (i.e. units of analysis) between two frontrunners. Both firms represent an extreme case (Flyvbjerg, 2006) because their experimentation with wind power for the main vessel propulsion is atypical in the Ro-Ro shipping segment. Since both firms deviate from conventional energy choices, they are relevant cases for generating an in-depth understanding of how incumbents and newcomers engage in sustainability-oriented innovations and thereby contribute to emergent energy transitions in shipping.

3.2 | Data and analysis

Our analyses draw on a mix of real-time and retrospective data. Multiple sources of evidence including interviews, observations, companies' reports, presentations, press releases and news articles were collected. Data collection started with observations and semi-structured interviews. In total, 11 interviews were collected, eight being conducted between 2017 and 2020 and three being obtained from open-source online portals (Table 1). An interview guide was developed for each individual interview and included questions about firms' engagement in the innovation process: technology choices, business environment, stakeholders, resources and related challenges (see Supporting Information). All interviews lasted 60 min on average and were transcribed verbatim and posted to interviewees for additional comments. Follow-up emails, informal conversations, firms' reports, press releases and seminar presentations where the studied firms introduced their projects added a broader context and were used for data triangulation (Yin, 2018).

Analyses of the acquired material followed the thematic content analysis method (Kuckartz, 2014). We used software (NVivo) to compile, code and analyse data. We began by developing a coding scheme. The first author managed the coding procedure, while the co-authors read and commented on coded text units during the process (Saldana, 2009). Firstly, we established and operationalised concepts of sensing, seizing and transforming by assigning text passages to these categories. We kept the MLP concepts (landscapes, regimes, niches) open-ended in the first coding stage. Instead, we searched for these components in text passages assigned to sensing, seizing and transforming categories, which were further classified into sub-categories. Subcategories, determined inductively through an iterative process of reading data material, included technology, environmental considerations, partners, customers, regulations, challenges, opportunities, resources and decision making. This enabled us to identify how niche, regime and landscape attributes are manifested in each subcategory referring to firms' innovation processes, regardless of firm type and position (newcomer/niche vs. incumbent/regime). Lastly, categories and subcategories were compared across the database and

TABLE 1 Overview of interviews

Organisation	Interviewee position	Interview date	Format
Neoline	Manager/founder	2020-01-15	Online
	Sales manager	2020-02-21	Online
	Manager/founder	2020-05-14	Online
	Chairman of the supervisory board	2019-06-24	Open-source
Wallenius Marine	Head of sustainability	2017-10-31	Face-to-face
	Project manager	2017-11-30	Face-to-face
	Project manager	2020-02-15	Face-to-face
	Chief operating officer	2020-05-05	Open-source
	Chief operating officer	2020-10-01	Open-source
DNV-GL	Expert on regulatory affairs	2020-04-02	Online
Swedish Transport Administration	Manager	2020-05-05	Face-to-face

interpreted using the analytical framework. To enhance the overall quality and accuracy of the study, we shared the draft report with interviewees from both firms, who provided complementary comments and concurred with our findings.

4 | FIRM CHARACTERISTICS

Neoline is a newcomer shipping firm in the Ro-Ro shipping segment based in France (Table 2). The founders of Neoline are closely tied to the established regime: they are merchant marine officers, naval architects, captains of Ro-Ro ships and shipowners of sailing cruise vessels, as well as entrepreneurs and experts in finance. They have experience from an earlier start-up shipping firm engaged in transporting goods on conventional sailing vessels. They founded the Neoline Association in 2011 to initiate the development of a new vessel-design concept and transportation service based on sailing vessels and established the Neoline company in 2015 (Figure 2). Neoline plans two pilot 136-m-long sailing vessels for transporting rolling and out-of-gauge freight for transatlantic routes powered by sails (the main propulsion) and diesel engines for manoeuvring in ports and reaching windy locations in the ocean. The long-term ambition is to launch a 210-m-long zero-emission vessel by 2030.

In contrast, Wallenius Marine (hereafter: Wallenius) is an established firm specialising in ship management, design and newbuilding. Wallenius is described in earlier studies (e.g. Sjögren et al., 2012) and internally (Wallenius, 2020e) as a frontrunner because of its proactive approach to environmental issues and innovative culture (Wallenius, 2020e). Although Wallenius was officially founded in 2002 (as an in-house company), it has been part of Soya Group's shipping business (a Swedish family-owned company) since the 1930s (Figure 3). Wallenius was an internal supplier to vessels

TABLE 2 Summary of firms' characteristics

	Wallenius Marine	Neoline
Founded	1934 (a separate in-house company since 2002, an open supplier on the market since 2017)	2015
Origins	Subsidiary of an established family-owned firm, Soya Group, based in Sweden	New privately held firm based in France
Business area	Ship management, newbuilding and design in the Ro-Ro shipping segment	Shipping firm in the Ro-Ro shipping segment
Number of employees	Approx. 800 (including the crew) Approx. 1100 employees in Soya Group (parent company) across Europe, the United States and Asia	6
Fleet size	n/a Wallenius Marines owner is a shareholder of Ro-Ro shipping firms with a total fleet capacity of approx. 140 vessels	Planning the construction of two pilot 136-m-long sailing vessels
Shipping routes	Transatlantic route—For Oceanbird vessel Global—For vessels managed by Wallenius Marine	Transatlantic: West of France, East Coast of Canada and East Coast of the United States

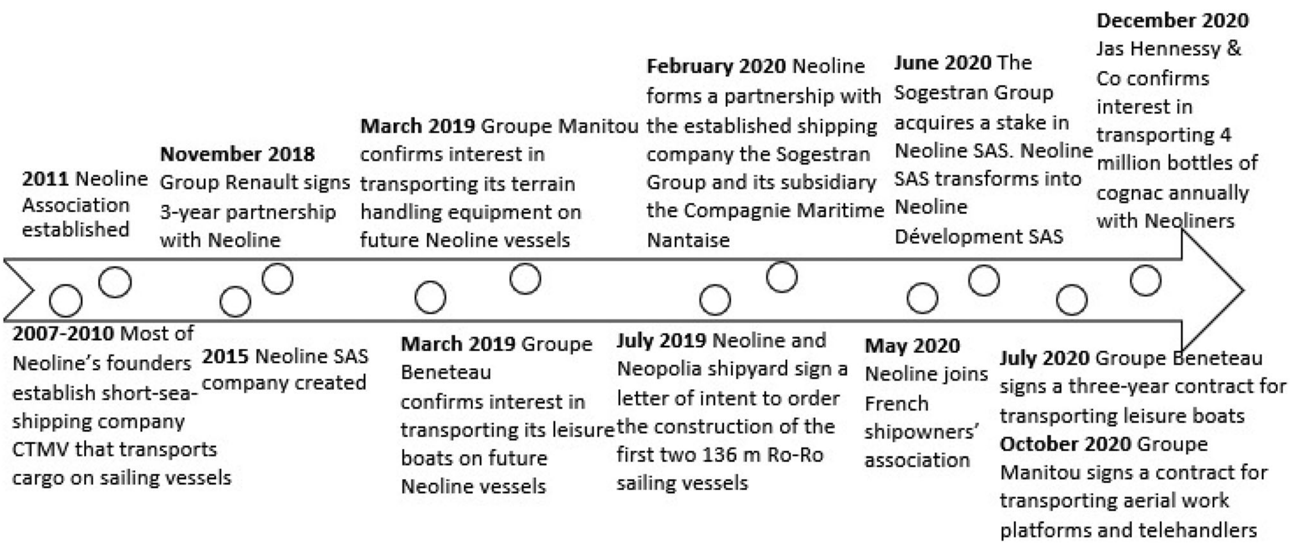

FIGURE 2 Timeline of Neoline's key events

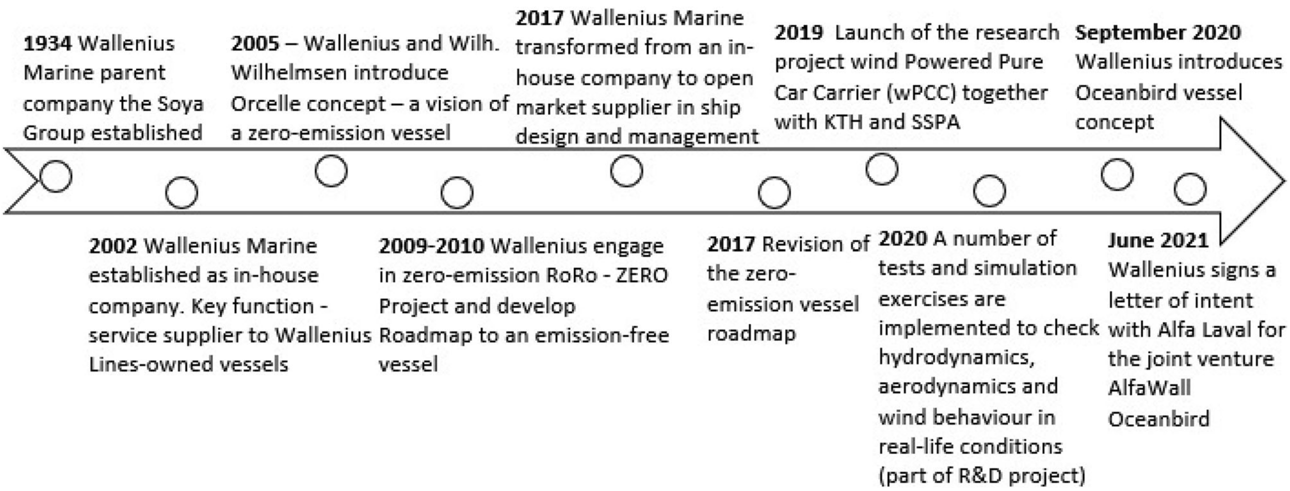

FIGURE 3 Timeline of Wallenius' key events

owned by its sister company Wallenius Lines until, in April 2017, Wallenius Lines sold all assets, including vessels, to Wallenius Wilhelmsen Logistics (WWL)—a company mutually owned by the Wallenius parent company and Norwegian shipping firm Wilh. Wilhelmsen. Wallenius became a global service supplier in the shipping market (Wallenius, 2017b), bringing opportunities to compete for the management of larger shares of WWL vessels and work with external customers. In 2019, Wallenius received a grant from the Swedish Maritime Administration to implement a research and development (R&D) project to design a wind-Powered Car Carrier (wPCC), Oceanbird (Trafikverket, 2020). Construction of the first sailing vessel for transatlantic trade by 2025 is planned (Wallenius, 2021c). Oceanbird will be powered by fixed-wing sails (the main propulsion), with engines installed for safety and manoeuvring in ports.

5 | FINDINGS

5.1 | Sensing: Wind power - a sustainable business opportunity

5.1.1 | Neoline

Several key elements were found in how Neoline's founders identified business opportunities based on wind-powered energy: (1) past experiences, learning and knowledge; and (2) expectations and social commitment. The former were critical for initiating the innovation process and enabled Neoline's managers to reflect upon technological and commercial barriers and opportunities. The idea of transporting cargo by sailing ships came from a former shipping firm (Compagnie de Transport Maritime à la Voile, CTMV) established by Neoline's entrepreneurs in 2007 that specialised in providing wine transportation in the intra-European short-sea-shipping segment, chartering sailing ships to transport high-value cargo (Interview_3, 2020). CTMV created value for customers and society with emission-free (albeit slower and costlier) transportation over sea. CTMV closed in 2010, following the 2008 recession, but learnings gained were integrated into a new firm. In 2011, most of the CTMV founders created the Neoline Association to initiate the development of a sustainable business model for transporting cargo on sailing ships—now in the Ro-Ro shipping segment:

> We started a reflection thanks to this first failure [...] we realised that if we wanted to make competitive transports by sail, we had to highly reduce fuel consumption, and the easiest way was to lengthen the crossing. We believed it was necessary to make transatlantic routes, [...] to go to reach the wind where it is. (Interview_3)

Neoline sensed that sailing technology was a suitable solution for building a profitable business in the Ro-Ro shipping segment. Learning-by-doing experience with CTMV showed that vertical handling of goods was inconvenient with the masts and rigging on a sailing ship. Therefore, Ro-Ro vessels were identified as more suitable for the development of new vessel hybrid design concept based on renewable energy — wind. Soft-sail technology was chosen as a readily available solution (Neoline, 2019). Unlike previous attempts, Neoline's objective with the new company was to lead development at an industry level (Neoline, 2020b). Modern techniques and knowledge were considered to be important for bringing sailing back into commercial shipping (Interview_11, 2019).

Expectations and social commitment were other important sensing components. Neoline's commitment to low-carbon niche technology started to match increasing landscape and regime pressures such as societal awareness of climate change, environmental regulations and stakeholder interests. Neoline's managers found these developments positive because they challenge established industry practices and call for new sustainable business models (Neoline, 2020e). According to Neoline's founders:

> We really need to make big actions against climate change. Now [...] everybody understands it. It was not the same thing 12 years ago. (Interview_3)

Furthermore, Neoline's entrepreneurs expected that stronger regime pressures — stricter sulphur emission requirements (in effect since January 2020) — would raise the prices of conventional fuels. Since fuel constitutes approximately 40% of a vessel's operational costs, reducing dependency on fuel-price fluctuations and ensuring stable freight rates was sensed to be important in Neoline's value proposition to potential customers. As sailing technology reduces fuel consumption by 80%–90%, Neoline could design a competitive and stable freight rate offer without a bunker adjustment factor (BAF) (Interview_3, 2020). A BAF is the additional fee shipping companies charge its clients to compensate for fluctuations in fuel prices. Besides economic considerations, Neoline's managers sensed that their potential customers had begun appreciating ecological values linked to vessels' performance:

> The first question 2 years ago was, 'How much is it?', and today, 'How much can you cut carbon emissions?' (Interview_5)

Neoline sensed that the total transportation time should be part of the value proposition to customers. Focusing on smaller ports allowed Neoline to avoid direct competition with major shipping companies and to target cargo owners whose manufacturing plants are located near secondary ports:

> The idea was to find customers in the area and to find the balance between pre-carriage, pre-haulage transport from their plants to the ports, and then the maritime transit time [...] from a carbon-emission point of view it is also better ... they have 5 days less on the road. (Interview_5)

5.1.2 | Wallenius

For Wallenius, (1) competitive intelligence and learning and (2) expectations and social commitment, including a proactive owner's position towards environmental issues, were underlying sensing components. As early as 2004, they developed a concept of a zero-emission vessel — E/S Orcelle which inspired work towards low or zero-emission vessels (Interview_4, 2020; Interview_9, 2020). Wallenius adopted a structured approach, developed trend analysis and actively participated in R&D projects providing opportunities for organisational learning, including gathering information on industry-level developments (Wallenius, 2020h). An assessment in 2009, aimed to inventory new technology and R&D activities, evaluate operational constraints and to develop a roadmap on progressing to low and then zero-emission vessels in stages over time (Fagergren, 2010; Wallenius, 2020h). The roadmap enabled scenario development and yielded a portfolio of alternative energy solutions. It also concluded that a zero-emission vessel was realistic and sails were a feasible primary propulsor for Wallenius' future fleet: 'Sails or wings are therefore considered as a quite feasible emission-free alternative for our future ships' (Fagergren, 2010, p. 6).

The roadmap enabled Wallenius to identify key aspects for realising the zero-emission vessel concept, including increased energy efficiency, speed reduction, flexible routing adapted to weather conditions and combining wind energy with zero-carbon fuels (Fagergren, 2010). Wallenius also sensed that regime-level pressures such as changes in regulations and freight markets would be important for overcoming economic constraints and making alternative energy solutions feasible in the shipping market, particularly in customers' willingness to pay for slower transport (Wallenius, 2017a). Since 2017, Wallenius observes increasing stakeholders' support (Wallenius, 2019b, 2020h):

> Our vision is to lead the way towards truly sustainable shipping, and we are working on it in a structured way [...] Sometimes, the industry goes against us, but at the moment we are experiencing increasing [sustainability] demands from the industry, consumers and others. (Interview_10)

One example of 'others' in the quote above was the cooperation with an environmental research organisation in order to co-create a new value proposition linked to the reduction of noise pollution from shipping, which is harmful to marine mammals (Wallenius, 2021b). In 2017, Wallenius initiated a follow-up activity and updated the roadmap to show a number of technological advancements:

> So much has changed with technology since we last looked at sail power for propulsion [...] Automation, sensors, material technologies, route planning, weather forecasts, all of this together makes it possible to look at wind propulsion in a totally new light. (DNV-GL, 2021)

Besides taking stock of technological advancements, the review showed that environmental awareness had increased substantially since 2009, thanks to more stringent environmental regulations and the Paris Climate Agreement (Interview_2, 2017). This assessment enabled Wallenius to identify increasing landscape and regime pressures and to move from the vision to a concrete action:

> We had this [zero-emission roadmap] in the background and three years ago we decided that now the time is right to start to actually realise this. At that time, not many around us — our customers or our customers' customers — were very interested in this technology [...]. Now we feel this is about to change. (Interview_4)

Expectations about regulatory development, especially related to carbon-emissions, were also important to Wallenius:

> IMO [the UN International Maritime Organisation] has, so far, no real rules driving us in this direction […] But they have a goal of reducing the GHG. It is 50% to 2050 compared to 2008 levels. So, there is a goal […] but there are still no real regulatory rules driving this, except maybe partly this EEDI [Energy Efficiency Design Index]. But there will be! (Interview_4)

EEDI, as referred to above, is the first global mandatory technical instrument adopted by the IMO in 2011 to strengthen incentives for improved energy efficiency (less pollution) of vessels' equipment and engines.

The firm conducted studies showing that, if conventional marine fuel prices rise to a certain level or have considerable fluctuations, sailing vessels will be able to compete with conventional Ro-Ro vessels due to large fuel savings from sailing technology (Interview_4, 2020). Furthermore, forward-looking leadership and the owner's commitment to expend time and resources on engagement with the wind-powered vessel project were critical: 'Without the owner's willingness to spend significant resources on it, we would not have taken this journey so far' (Wallenius, 2020b).

5.2 | Seizing: Activating the vision of sailing vessels

5.2.1 | Neoline

Technical and operational aspects — and stakeholder engagement — proved important in Neoline's seizing. Neoline mobilised internal and external competences for the vessel-design concept development. Neoline's strategy was to adapt readily available technologies, and soft-sail technology from the yachting industry was incorporated into the sailing-vessel design (Figure 4). Special attention was given to the main propulsion, including sails' resistance, durability and cost (Interview_8, 2020). As noted by Neoline's founder, the sailing-vessel concept and sustainable-business-model elements were designed progressively:

> The first design was 95 metres […] and it appeared we could not be competitive with a 95-metre ship. We increased the size to 120 metres […] and we finally designed a 136-metre ship, which had a better cargo capacity/vessel price ratio for our market. (Interview_3)

The Neoliner	**Wind-Powered Car Carrier - Oceanbird**

Displacement: 11 000 t	Displacement: 32 000 t
Length: 136 m Width: 24.2 m	Length: 200 m Width: 40 m
Sail type: soft sails	Sail type: 5 rigid wing sails (turn 360°)
Total sail surface: 4200 m²	Height incl. wings over water line: 105 m
Air draft: reducible to 41.5 m	Air draft: reducible to 45 m
Estimated reduction of CO_2: up to 90%	Estimated reduction of CO_2: up to 90%
Power: wind and engines (diesel-elec. 4000 kW)	Power: wind and engines
Average commercial speed: 11 knots	Average commercial speed: 10 knots
Cargo capacity: 1500 linear metres or 500 cars	Cargo capacity: 7000 cars
Estimated travel time: 12 days across the Atlantic	Estimated travel time: 12 days across the Atlantic
Estimated delivery of the first pilot vessel: 2024	Estimated delivery of the vessel: 2025

FIGURE 4 Technical characteristics of wind-powered vessel design concepts. *Source*: Neoline and Wallenius Marine websites. Illustrations: Mauric (Neoline) and Wallenius Marine (Oceanbird) [Colour figure can be viewed at wileyonlinelibrary.com]

Neoline utilised internal competences to develop the initial vessel design, and the external competences of an established naval architecture firm to validate and improve it (Interview_3, 2020). Moreover, Neoline had to develop new knowledge on operational aspects of sailing vessels. Meteorological routing and transatlantic simulations were undertaken to estimate the vessel's speed and fuel-consumption savings. According to Neoline's manager, it was a major development because existing weather-routing tools are unsuitable for hybrid propulsion with engine and sails (Interview_3, 2020). Neoline cooperated with an external partner and utilised historical meteorological data to prepare a weather-routing tool. Meanwhile, transatlantic simulations confirmed that vessels could reduce fuel consumption by 84% on average compared with competitors' vessels running at 15 knots and by 71% on average compared with conventional vessels at 11 knots (Neoline, 2019).

Other key seizing activities included early stakeholder engagement. From the early stage of the innovation process, Neoline's founders proactively connected with shipping regime actors — potential customers and finance institutions — and formed partnerships with technology providers, naval architects, shipyards, classification societies and established maritime companies. These activities aided preparation for the first vessel's construction, secured public funding (10%–15% of the total project costs) and provided opportunities to accommodate stakeholder demands. Neoline's founders hired a sales manager in 2017 to explore the Ro-Ro shipping market and sign contracts with potential customers (Interview_5, 2020). Partnerships with customers were important for securing the commercial credibility and feasibility of a new transportation service (Interview_3, 2020). Three partnerships were formed with customers in established markets: car manufacturer Groupe Renault, leisure-boat manufacturer Groupe Beneteau and rough-terrain equipment manufacturer Manitou Group. In late 2020, a major French cognac producer, Jas Hennessy & Co., committed as a future customer (Neoline, 2020c). All customers are engaged in transatlantic exports and find Neoline's value proposition timely considering the service's location, possibility of optimising pre-routing, reliable transit times and environmental performance (GroupeBeneteau, 2020; GroupeRenault, 2018; ManitouGroup, 2020). Moreover, technical aspects, such as vessels' ramp capacity, were designed in close consultation with customers, delivering additional value.

For a newcomer, a partnership with an established shipping company is another important seizing element:

> The key we do not have is being a current recognised shipowner [...], corporate credibility is paramount when you start negotiating with customers, financial banks or shipyards because they need strong confidence and warranties. (Interview_5)

In 2020, Neoline formed a partnership with the Sogestran Group and its subsidiary Compagnie Maritime Nantaise. Both firms are established French shipowners specialising in river and sea transport, vessel design, management and freight forwarding. The partnership benefits both parties (Neoline, 2020b). It brings Neoline financial resources, legal expertise and ship management competences while giving the partner an opportunity to test innovative vessel-design concepts and support the energy transition in shipping (Neoline, 2020d).

Furthermore, Neoline engaged with other stakeholders from the established shipping regime and niche market: standard-setting agencies such as classification societies and industry associations. Considering the lack of standards for vessels with main sailing propulsion, Neoline plans to utilise the existing standards for wind-assisted propulsion systems:

> It is very important for us to be legally considered as wind-assisted ships, because there is no regulation about main propulsion by sails. We have to fit in the existing frame. (Interview_8)

Since Neoline vessels' safety will be ensured by the engines, Neoline did not consider it necessary to have a new standard for main sailing propulsion in place (Interview_8, 2020). An additional challenge is that some regime pressures linked to the regulatory environment do not support wind-based energy. An expert on regulatory affairs from a ship classification society commented: 'If you look into energy efficiency requirements made in 2013, wind does not get a lot of reward' (Interview_7, 2020). The formula used for calculating vessels' EEDI is based on a worldwide aggregated wind matrix, neglecting wind power that can be delivered to vessels on particular routes (WASP, 2020). To create a favourable institutional environment for wind-based solutions, Neoline formed alliances with other businesses as one of the founders of the local windship association and joined the International Windship Association and the French shipowners' association (Neoline, 2020a).

5.2.2 | Wallenius

Partnerships, technology and operational considerations, along with external funding, form the basis of Wallenius' seizing. After sensing that wind power was the strongest candidate among energy solutions, Wallenius realised that rigid-wing technology featured unexplored opportunities in the commercial shipping market, which could be seized by further development of (1) wings and (2) the sailing-vessel-design concept:

> Although the hull and the cargo hold will be very similar to a standard vessel, the total concept is quite affected because of the sailing. (Interview_4)

To advance knowledge on the operational and technology characteristics of the sailing-vessel design, Wallenius utilised internal resources, searched for external competences and launched a joint R&D project (2019–2022). The Centre for Naval Architecture at the Royal Institute of Technology in Sweden (KTH) and the maritime knowledge company SSPA Sweden joined Wallenius to develop the wPCC Oceanbird. The project consists of two parts: R&D (co-funded by the government) and market entry (actual construction of the Oceanbird vessel) (Interview_4, 2020; Trafikverket, 2020). The results of the R&D project will be used to validate the vessel's design concept and construct the first vessel, with the anticipated delivery in 2025 (Wallenius, 2021c). The goal of the project is:

> … to pave the way for a paradigm shift in global shipping by demonstrating a sustainable transport concept, where it is not necessary to wait until 2050 to reach IMO's target of a 50% reduction of GHG. (Wallenius, 2018)

Wallenius combines established and new knowledge from the sailing, aeronautic and shipbuilding industries to develop a robust sailing-vessel design (Wallenius, 2020c, 2020k). In-house naval architecture and vessel-design competences were found to be important for seizing. Furthermore, external competences and partnerships were key for knowledge development. For example, SSPA implemented computer simulations and physical experiments to test the hydrodynamic performance of the vessel's hull (Wallenius, 2020i); KTH researchers measured wind speed and direction on board the vessel on transatlantic routes (Wallenius, 2020d) and constructed a 7-m vessel model to learn about the sailing characteristics and to develop algorithms for wing-sail control (Wallenius, 2020b, 2020j). R&D activity was found to be essential in Wallenius' seizing, helping 'to build up knowledge in a radically new area' (Interview_6, 2020) while training 'the next generation of engineers' (Wallenius, 2020k).

Wallenius engaged in dialogue with various stakeholders, including shipowners, cargo owners, equipment manufacturers, class societies, regulatory authorities and the public (DNV-GL, 2021).

> In 2019, the prospect of transforming Oceanbird from a vision into reality grew further when more and more important stakeholders, both within and outside Wallenius Marine, endorsed the project. (Wallenius, 2020f, p. 10)

Considerations about the market response and the ownership of the first vessel are also emerging. Wallenius' partner, established shipowner Wallenius Wilhelmsen, has already noted interest (Wallenius, 2019a, p. 16). According to Wallenius,

> Going forward, by partnering with Wallenius Wilhelmsen, we hope to be able to collaborate with one or several major auto manufacturers in order to take market expectations and demands into account. (Wallenius, 2019a, p. 15)

The role of car manufacturers is important in introducing sailing vessels into the Ro-Ro market (Wallenius, 2020g): 'We have been approached by cargo owners who are eager to be the first to have their vehicles delivered by a wind-powered ship' (DNV-GL, 2021). Reliable transit times are considered more important to cargo owners than speed (Interview_10, 2020). Therefore, a speed of 10 knots and a radical reduction of emissions are important value propositions to Wallenius' partners and customers. Nevertheless, considering Wallenius' long-lasting cooperation with established shipowners, introducing sailing vessels into the established fleet, route network and schedule frequency is challenging. According to Wallenius' manager,

> The traditional network of car-carriers is based on having a lot of vessels, so bringing one or two vessels that are not operating in the same way is a little bit of a challenge. So probably, it is going to be a complementary transportation in the first phase. (Interview_9)

Engagement with other stakeholders — classification societies — is an additional seizing element in the innovation process, making it possible to overcome regime-level barriers such as the lack of standards. According to an expert from a shipping-class society: 'This is a full-on sailing ship, rather than wind-assisted, and no modern cargo ship has been built for pure sail power' (DNV-GL, 2021). To this end, Wallenius is obtaining 'Approval in Principle' and has undertaken a study to identify potential hazards in the wind-powered-vessel-design concept. As noted by the project manager, 'The lack of standards, of course, makes things more difficult — but, on the other hand, we have more freedom and the opportunity to set the future standards' (Wallenius, 2020a).

5.3 | Transforming: Organisational change

5.3.1 | Neoline

Initial work of a newcomer firm on sailing-vessel design was undertaken in the framework of the Neoline Association (2011–2015). When technical and commercial sustainable-business-model elements were perceived to be feasible, Neoline's founders established Neoline SAS (2015–2020). Its new legal status enabled Neoline to utilise external competences that were important for project maturation: resolving technical challenges in main sailing propulsion and initiating stakeholder-engagement processes. The latest organisational change occurred when Neoline formed a partnership with the Sogestran Group, transforming Neoline SAS into Neoline Dévelopment SAS. It was decided that all management work in the construction and operation of the first pilot vessel would be coordinated by a new company, Neoline Armateur, in cooperation with the Sogestran Group.

5.3.2 | Wallenius

Wallenius underwent structural change when its parent company and Wilh. Wilhelmsen redefined the ownership structure of the mutually owned company WWL. In 2017, Wallenius was transformed from an internal supplier of ship management and design services to an external market supplier. As noted by the Wallenius project manager, this reorganisation brought an opportunity to work with external customers and enabled Wallenius to sell ship design and management services to other shipowners (Interview_4, 2020). Although organisational restructuring was driven by desire for a stronger market position in Ro-Ro shipping (Interview_1, 2017), we can interpret it as proactive restructuring, which enabled Wallenius to (1) sense and seize business opportunities, (2) make use of existing internal resources, and (3) engage in new knowledge development with external partners. Current developments linked to the Oceanbird project illustrate Wallenius aims to create a market for wind-based transport and plans to introduce its vessel-design concept to other shipping segments as well (Wallenius, 2020c). Although organisational restructuring brought additional challenges, such as maintaining direct dialogue with shippers, it enables Wallenius to monitor end-users' demands via long-lasting cooperation with established shipowners (Interview_4, 2020). The latest organisational change occurred in 2021, in the form of a joint venture with Alfa Laval (a former partner and supplier of shipping technology) to form AlfaWall Oceanbird and support the commercialisation of Oceanbird (Wallenius, 2021a, 2021d).

6 | DISCUSSION

Our cases of the early-stage innovation process with wind-based energy solutions and emerging sustainable business models indicate that firms' engagement in sustainability-oriented innovation processes exceeds firms' boundaries. Furthermore, it is not limited to a particular type of firm (incumbent vs. newcomer) but is conditioned by firms' capabilities to operate across niche and regime boundaries with the support of sensing, seizing and transforming.

The analysis of underlying sensing components and activities reveals similarities and differences between firms' engagement in niche development (Figure 5). The incumbent's and newcomer's engagement in the innovation process of wind-powered vessel development was found to be driven by seemingly similar expectations and

FIGURE 5 Similarities and differences between ongoing innovation processes. Authors' own representation based on results

social commitments connected to landscape- and regime-level developments. Both firms share similar observations about increased landscape pressures, namely, societal awareness and a need to drastically reduce the environmental impacts of shipping. Both are guided by proactive leadership and similar regime pressures: they anticipate more stringent environmental regulations to reduce GHG emissions. Furthermore, activities for building credibility and determining environmental value propositions of wind-powered-vessel business models were found to be important. For example, framing wind-powered vessels as clean alternatives to vessels powered by conventional energy sources (i.e. crude oil or diesel) and highlighting wind energy as the once-dominant energy regime in shipping indicates a blending strategy integrating niche- and (former) regime-level features into new value propositions to potential customers on a regime level and in society more broadly (i.e. on a landscape level).

Besides these similarities, another key sensing activity — learning — indicates substantial differences. The incumbent's learning was underpinned by 'learning-before-doing' (Pisano, 1994) or explorative learning (March, 1991) through systematic assessments and competitive intelligence activities that resulted in a roadmap with a portfolio of alternative energy solutions (i.e. divergent explorative learning). Assessing the feasibility of wind power thus began from competitive intelligence activities on a regime level, followed by engagement in the innovation process on a niche level at a later stage. In contrast, the newcomer's learning was informed by 'learning-by-doing' (Pisano, 1994) or exploitative learning (March, 1991), which emerged from an earlier start-up firm (i.e. niche level). The newcomer's prior experiences from conventional sailing and engagement with regime-level suppliers and customers were key sensing components (i.e. convergent exploitative learning).

These findings complement previous research on internal organisational learning in niche development and aggregation (Borghei & Magnusson, 2018) by demonstrating that knowledge accumulation can take different forms. Furthermore, some forms of learning, such as learning-from-experience, are not particular qualities of incumbents (cf. Zahra et al., 2006) but can also guide a newcomer's engagement in sustainability-oriented innovation processes. Finally, both studied firms were found to use a 'learning-by-doing' approach to turn sensed opportunities into seizing and transforming, albeit in distinct ways. For example, the newcomer's choice to use readily available soft-sail technology from the adjacent regime-level yachting sector differs from the incumbent's decision to develop commercially unavailable fixed-wing technology via R&D (i.e. niche-level activity). These findings indicate that business opportunities, innovation processes and sustainable-business-model elements (e.g. value propositions) do not simply emerge on either regime or niche levels circumscribed by the presence of incumbent or newcomer firms. Instead, they are actively designed through firms' sensing, seizing and transforming activities with the support of different types of learning processes taking place within and across niche- and regime-level boundaries in connection to broader stakeholders and sociotechnical context. These findings nuance earlier observations suggesting that firms' capabilities to connect across different levels are essential in the development and upscaling of sustainability-oriented products and services (Hörisch, 2015). The latter is key in understanding how incumbent and newcomer firms' contributions to sustainability transitions can be realised in practice.

Identified similarities and differences between the incumbent's and the newcomer's sensing, seizing and transforming activities demonstrate that the studied innovation processes carry features of fit-and-conform and stretch-and-transform niche-empowerment strategies (cf. Smith & Raven, 2012). A combination of fit and transform strategies was found to be utilised by both studied firms in their respective sensing, seizing and transforming activities. For example, sensing and seizing, underpinned by different types of learning, enabled both firms to design new value propositions for wind-powered vessel designs that required going beyond the companies' boundaries and engaging with stakeholders on landscape and regime levels. The use of wind energy to power the vessels with distinct shipping characteristics (e.g. slower speeds), while enabling substantial reductions of carbon emissions, stretch-and-transforms the norms and values of the established shipping regime. Unlike earlier studies suggesting that incumbents may be better positioned to invest in new value propositions due to their large resource base (Wesseling et al., 2020), our findings show that both incumbents and newcomers can and do invest in *new* value propositions. However, our findings also demonstrate that immediate access to established networks of partners (value network), a strong resource base and capabilities to connect with adjacent sectors can lead to *broader* value propositions (cf. Wesseling et al., 2020) beyond potential customers to facilitate additional stakeholder commitments. For example, the incumbent's engagement in wind-powered-vessel niche development via R&D provided opportunities to design broader value propositions within and beyond the shipping regime (i.e. natural environment and aeronautic industry). Along with integrating a strong environmental focus (reduction of underwater noise and carbon emissions) into new value propositions to potential customers, partners and society (i.e. regime and landscape levels), the innovation process itself contributed to new knowledge development (i.e. value proposition and value capture).

Finally, intended market-introduction activities suggest a combination of fit-and-conform and stretch-and-transform niche-empowerment strategies (cf. Huijben et al., 2016; Mylan et al., 2019). Considering the non-existent market for Ro-Ro vessels with wind as main propulsion, the newcomer designed an environmental and economic value proposition to potential customers bypassing major port hubs on transatlantic routes (niche market). Meanwhile, the incumbent utilised established partnerships with shipping companies (value network) for planning the introduction of its vessel as complementary transportation in the existing shipping network managed by an established shipowner (fit-and-conform strategy). However, considering the broader sociotechnical context such as regulations and standards, the incumbent's seizing contains stretch-and-transform elements (i.e. niche- to regime-level pressure): it develops new vessel-design standards and informs regulatory authorities and societal stakeholders what emission-reduction measures are possible.

Furthermore, a new joint venture with a former partner supplying maritime technology (value network) can be interpreted as a stretch-and-transform strategy whereby wing technology is planned to be adapted for other shipping segments as well (value capture). In contrast, the newcomer's strategy focusing on a niche market segment represents a fit-and-conform pattern (i.e. regime- to niche-level pressure), while its engagement with various stakeholders including the design of alternative value propositions and the development of new industry structures (i.e. local Windship association) corresponds to stretch-and-transform strategy (i.e. niche- to regime-level pressure). Although the abilities of single companies to trigger industry-wide transitions are limited (Hockerts & Wüstenhagen, 2010; Loorbach et al., 2010), frontrunner firms' engagement in sustainability-oriented innovation processes can inform reconfiguration of existing regimes by challenging existing norms, established business models and industry standards.

7 | CONCLUSION

Situated at the intersection of the maritime transport, sustainability transitions and strategic management fields of research, this study analysed and compared an incumbent's and a newcomer's engagement in the development of renewable energy solutions based on wind power for deep-sea transportation and how their leading roles in respective innovation processes can be relevant for broader sustainability transitions. Responding to calls for a more integrated research agenda for management and transition studies (Markard, 2017; Schaltegger et al., 2020), we operationalised the dynamic capabilities perspective in the context of MLP, which made it possible to demonstrate (1) the relevance of sensing, seizing and transforming concepts for nuancing the underlying processes of differently sized companies' engagement in niche innovations with emerging sustainable-business-model design elements; and (2) the importance of broader sociotechnical context in firms' engagement in innovation processes and their potential contributions to regime changes. In contrast to earlier observations suggesting that new entrants play active roles in the early stage of industry transformation, while incumbents engage in the later stage (cf. Hockerts & Wüstenhagen, 2010), our results demonstrate that both incumbents and newcomers can initiate sustainability-oriented innovations in the early stage and contribute to niche–regime interactions. An analysis of underlying sensing, seizing and transforming activities, together with MLP, elucidated how such processes are enacted and demonstrated that boundaries between what are conceived to be regime- and niche-level actors and their respective roles are not clear-cut. Firms strategically move back and forth from regime to niche environments and vice versa. Furthermore, the findings of this study show that the regime environment can serve as an important starting point for the incumbent's engagement in the sustainability-oriented innovation process on a niche level. From a broader perspective, the comparative case-study approach demonstrated that going beyond the newcomer/niche versus incumbent/regime dichotomy provides more productive ways to assess different firms' roles in transitions.

This study has several limitations that can be used to guide future research on incumbent and newcomer firms' roles in transitions. First, considering the focus on still-ongoing innovation processes and the fact that energy transitions in shipping are in the early stage, the findings of this study are too recent to provide encompassing conclusions for a broader sector-level impact. The potential of harnessing wind power for the main propulsion in other deep-sea shipping segments should also be explored further, since this study focused on two Ro-Ro firms planning to deploy wind-powered vessels for transatlantic trade. Accordingly, when interpreting the results of this study, readers should keep geographical and sectorial characteristics in mind. Second, the selection of frontrunner firms from a specific shipping segment only captured proactive perspectives. Accordingly, in-depth studies comparing an incumbent's and a newcomer's engagement with different technologies in other shipping segments and sectors are needed. Finally, the initial attempt to merge organisational- and system-level theories for clarifying niche–regime interactions from a business perspective with the support of sensing, seizing and transforming can be taken forward. For example, exploring how the dynamic capabilities approach can be linked to other concepts such as niche shielding and nurturing (Smith & Raven, 2012) or the notion of creative accumulation (Bergek et al., 2013), supplying valuable insights on the role of incumbents and newcomers in niche development, provides a compelling avenue for future research.

The findings of this paper bear practical implications. For policymakers, they reveal gaps between a slow-moving regulatory environment and fast-moving companies. Although few firms have taken practical steps towards wind power, the existing regulatory environment, exemplified by existing EEDI regulations and the lack of class rules for wind-powered vessels (wind as main propulsion), does not support fast-moving companies. These observations indicate the importance of building alliances with committed stakeholders to create or transform institutional infrastructures in a very early phase of the innovation process (cf. Van de Ven et al., 1999). Accordingly, considering the characteristics of slow-moving sectors like shipping, it is essential that policymakers, both at the sector and societal levels (i.e. regime and landscape), are made aware as early as possible of ongoing sensing activities among companies on the niche and regime levels. Capturing sensing activities oriented towards radical innovations and sustainable value propositions for the sector and society, together with collective pressure and legitimacy from a collective of broad stakeholders, can trigger regulators to examine regulatory hindrance. Activating this process allows a more favourable institutional transformation to form. Here, we observed different strategies from the newcomer (fit-and-conform) and the incumbent (stretch-and-transform) in relation to policymakers and standards. Both strategies have potential to trigger sense-making in regulatory organisations, but it is too early to assess which one will be more successful in seizing and transforming institutional barriers in the shipping sector.

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