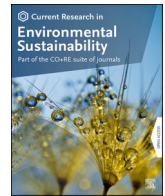




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Green bonds and sustainable business models in Nordic energy companies

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ABSTRACT

As green bonds continue their dynamic growth trajectory to finance the transition to a more sustainable future, a gap in the literature remains on how companies have overcome internal barriers to successful green bond issuance. This case-based study analyzes how five Nordic energy companies have successfully surmounted internal barriers to issuing green bonds by leveraging their sustainable business models. The findings show a number of antecedental features of sustainable business models prior to green bond issuance including: a focus on environmental betterment as part of the mission and strategy; investments into assets that provide an environmental benefit and a divestiture of those that do not; the active pursuit to reduce CO₂ emissions through R&D; and, strong governance mechanisms. Throughout the process of issuing green bonds, companies introduce changes to their sustainable business models, most notably, green finance frameworks and additional governance practices. As a result of the green bond issuance, reinforcing choices and consequences emerge to create virtuous cycles. In turn, the virtuous cycles support environmental objectives and foster more economic and environmental value for the company, investors, and society. Our study offers a process-based theoretical outline of how sustainable financing can make a business model more sustainable by removing internal barriers and strengthening company strategy, asset choices, and governance.

1. Introduction

Green bonds have grown to US\$2 trillion, representing 2.4% of the global bond market (Climate Bonds Initiative (CBI), 2023a, 2023b). Researchers have investigated green bonds in terms of pricing and the “greenium” (i.e., a lower yield relative to conventional bonds) (Ehlers and Packer, 2017; Hachenberg and Schiereck, 2018; Karpf and Mandel, 2018; Zerbib, 2018; Agliardi and Agliardi, 2019; Larcker and Watts, 2020; MacAskill et al., 2021; Dorfleitner et al., 2022), the impact to the issuer's financial and environmental performance (Flammer, 2020, 2021; Fatica and Panzica, 2021), and the overall development of the green bond market including external barriers for continued growth (Organisation for Economic Co-operation and Development (OECD), 2015; Ehlers and Packer, 2017; Park, 2018; European Union, 2019; Tolliver et al., 2020; Deschryver and De Mariz, 2020; Bhutta et al., 2022; Aneja et al., 2023, European Commission, 2023).

Motives to issue green bonds vary. Glavas and Bancel (2018, 2020, 2022) found agency motives and state ownership as key determinants while emphasizing green bonds' dual role of being both debt and a Corporate Social Responsibility (CSR) policy instrument. Maltais and

Nykvist (2020) categorized motives for green bond issuance into three main pillars: financial, business, and legitimacy. Other researchers acknowledge that strong governance conditions provide a breeding ground for green bond issuance (García et al., 2023).

While many internal barriers have been reported in the literature – the lack of eligible green projects, concerns over greenwashing, additional costs, labor-intensive reporting, insufficient involvement in the market, and the lack of awareness (European Union, 2019; Deschryver and De Mariz, 2020; Sangiorgi and Schopohl, 2021; Khan et al., 2022) – there seems to be a gap in the literature on how companies overcome the barriers to successful green bond issuance. At a broader level, there is a paucity in the literature that links sustainable financing to sustainable business models. While this linkage may seem obvious, in reality, little is known about the complex, dynamic processes at play between sustainable business models and green bonds.

Two research questions emerged to address the gap:

1. How can companies overcome internal barriers to issuing a green bond through their sustainable business model?

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2. How does the sustainable business model change (if at all) during or after the company issues a green bond?

We draw from prior research to explore the notion of sustainable business models, applying choices of policies, assets, and governance, and the consequences of those choices (Casadesus-Masanell and Ricart, 2010, 2011; Schneider and Clauss, 2020).

Our contribution is a process-based theoretical outline delineating how sustainable finance contributes to the sustainable transformation of companies. This is an important contribution, theoretically and empirically, as business and societies grapple with climate change. Proposing a deeper understanding of sustainable business models, we reveal the features that help overcome internal barriers to green bond issuance. Issuing a green bond is inextricably tied to the business model since the firm's policies, assets, and governance choices are affected in different ways than from conventional bonds. It is a choice that necessitates a green finance framework: a set of criteria that guides how the company manages the funding from green bonds. The green bond carries a set of conditions that commit the firm to invest in specific assets and establish governance processes that hold the firm accountable for meeting environmental improvements. Thus, our study also contributes to sustainable business model research by introducing sustainable financing as a key choice, allowing organizations to accelerate the transition to lower emissions and create sustainable value for the firm, customers, investors, and other stakeholders.

The study investigates five Nordic energy firms that have issued green bonds since 2017. Employing a case-based methodology incorporating qualitative interviews and secondary published materials enabled a thorough, detailed understanding of the internal conditions, processes, rationale, management viewpoints, and logic (Creswell, 2014; Yin, 2014) between business models, sustainability, and firm financing.

2. Literature review

2.1. Sustainable business models

Scholars have built on business model research to create what has become known as “Sustainable Business Models.” Initially, research focused on integrating “sustainable” practices into the business model along environmental and social dimensions while considering financial and economic viability (Stubbs and Cocklin, 2008; Wells, 2013). In looking at sustainable innovations, Boons and Lüdeke-Freund (2013) developed normative requirements for sustainable business models where ecological or social elements are integrated into the value proposition, supply chain, customer interface, and the resulting costs and benefits. Bocken et al. (2014, p. 50) detailed eight sustainable business archetypes under technological, social, and organizational categories; the archetype of “substitute with renewables and natural processes” is applicable to many renewable energy companies. Evans et al. (2017) incorporated economic, social, and environmental benefits into the notion of value and clarified that sustainable business models should have value flows among multiple stakeholders including the natural environment and society while boosting business performance. As such, sustainable business models are increasingly considered a source of competitive advantage (Nidumolu et al., 2009; Porter and Kramer, 2011; Morioka et al., 2017; Geissdoerfer et al., 2018; Nosratabadi et al., 2019).

Sustainable business models link back to earlier foundational business model research such as Osterwalder et al.'s (Osterwalder et al., 2005, p. 4) description of the business model as a “blueprint of a how a company does business” and Teece's (Teece, 2010, p. 172) idea of how the “enterprise delivers value to customers, entices customers to pay for value and converts those payments to profit.” In the same vein, Zott et al. (2011) underscored the importance of strategic issues within business model literature including value creation, competitive advantage, and

firm performance.

Casadesus-Masanell and Ricart (2010, p. 198) proposed that business models comprise concrete “choices” of how the firm operates and “consequences” of those choices. Under choices, they distinguish between three main types – policies, assets, and governance structures – where policy choices embody courses of action for the organization, asset choices constitute tangible resources, and governance choices involve decision rights on policies and assets. They set forth that the business model reflects the “realized strategy” of a firm since a firm's strategy might encompass different contingencies, such as changing the business model in reaction to a new industry entrant (Casadesus-Masanell and Ricart, 2010, p. 195). Casadesus-Masanell and Ricart (2010) concept of realized strategy is distinct from Mintzberg and Waters' (1985) notion that a firm's realized strategy often differs from the intended strategy.

Drawing from Casadesus-Masanell and Ricart's concept of choices and consequences, Schneider and Clauss (2020) found virtuous cycles in sustainable business models when firms made three fundamental choices: prioritization of environmental or social objectives; consistency in behavior and strong transparency; and, extensive collaboration through partnerships and the broader community.

Sustainable business model research has often been intertwined with corporate social responsibility (CSR) concepts, given its inherent push to “achieve a balance between economic, environmental, and social imperatives (Triple-Bottom-Line-Approach)” (United Nations Industrial Development Organization (UNIDO), “What is CSR?”, 2023). The European Union (EU) emphasized the importance of integrating social, environmental, ethical human rights, and consumer concerns into organizations' core strategies (European Union, 2011). For companies to embrace CSR, Latapí et al. (2021a, 2021b) proposed 19 main characteristics of a responsible energy company, including the top five of responsible decision-making, sustainability as a part of business strategy, a purpose-driven mission, a positive contribution to society, and the replacement of fossil fuels as an energy source. Raith and Siebold (2018) looked at the United Nations Sustainable Development Goals (SDGs) and encouraged companies to pursue SDGs and build an economically sustainable business model to create shared value (Porter and Kramer, 2011).

The inclusion of sustainability and CSR within business models has also become central to investors increasingly integrating ESG (Environmental, Social, and Governance) criteria and the Principles for Responsible Investment (PRI) in their investment decisions (United Nations, 2023). From a financing perspective, some researchers have found ESG disclosures result in a lower cost of debt by accessing financing at better rates (Raimo et al., 2021) despite other researchers expressing concerns over data quality in ESG measures where it lacked materiality, accuracy, reliability, and comparability (Jonsdottir et al., 2022).

While sustainability in business models has increasingly become a core component, the role of firm financing in sustainable business models is still in the early stages of exploration. Discussions on business models have primarily focused on the profit and loss statement as well as the left side (i.e., assets) of the balance sheet (Teece, 2010). In contrast, firm financing has revolved mainly around the right side (i.e., liabilities and equity) (Myers, 2001; Kruk, 2021). This separation of the firm's strategy from financing ostensibly dates back to Modigliani and Miller (1958) seminal theorem asserting that a firm's financing and risk management choices would not affect firm value if cash flows were unaffected by the decision and if the company operated in perfect markets (Titman, 2002). Barton and Gordon (1987, p. 69) explained that critiques had been levelled at Modigliani and Miller's theorem for an “oversimplification of the assumptions about how the world works” and that, by in large, the financing of the firm had been left up to the finance function with the condition that it be consistent with the company's long-term strategy. Bridging finance and strategy, Barton and Gordon (1987) consider how strategic decisions, the financial context of the

firm, and management preferences could affect firm financing. In sum, sustainable business model research has not thoroughly delved into the connection with firm financing; in the next section, we discuss green bonds in terms of connecting the two themes, thereby enhancing our knowledge on the means toward sustainable transformation of companies.

2.2. Green bonds: motivations, barriers and outcomes

In studying motivations for issuing green bonds, [Maltas and Nykvist \(2020\)](#) grouped motivations into: financial reasons (better returns, reduced financial risk, investor incentives, lower cost of capital, and better capital access); business reasons (branding, operational efficiency, creating new markets, and reduced business risk); and, legitimacy (social license to operate, stakeholder accountability, and institutional pressures). Other researchers presented a signaling model and concluded that motivations were linked to managerial incentives and short-term gains in the stock price ([Daubanes et al., 2021](#)). [Glavas and Bancel \(2018\)](#) conducted a study of green and non-green bond issuers across 27 countries from 2013 to 2017 and purported that agency motives (i.e., incentivizing managers to act in the best interest of shareholders) and state-ownership were the two main drivers of green bond issuance.

Despite different possible motivations, companies have faced several internal barriers to issuing green bonds. In developing the European Union (EU) bond standard, the EU identified internal barriers as lack of eligible green projects and assets, issuer concerns over reputational risks and green definitions, unclear economic benefits for the issuer, complex and potentially costly external review procedures, labor-intensive reporting procedures, and uncertainty on the types of assets that could be financed ([European Union, 2019](#)). [Deschryver and De Mariz \(2020\)](#) found risks of greenwashing and the perception of higher issuing costs while [Sangiorgi and Schopohl \(2021\)](#) uncovered insufficient involvement in the market, lack of awareness, and suitable green projects. [Khan et al. \(2022\)](#) documented ten internal barriers: unclear ideas about the “green” concept, unsupportive organizational structure, lack of employee training and know-how, insufficient analytical capabilities, lack of internal policies and procedures creating risk, low return on investment for green innovations, inadequate technological structures, complexity in technology to support, lack of technical expertise, and poor communication with external shareholders.

Those internal barriers to issuing green bonds are addressed, according to [García et al. \(2023\)](#), in larger companies with strong governance, gender board diversity, a sustainability committee, higher environmental scores, and lower CO₂ emissions. Other studies found that an ownership strategy (i.e., a collaboration pact between owners that contains guidelines for long-term strategic focus) serves as a critical governance mechanism that lays the foundation for a focus on SDGs, ESG, and eventually, green bond issuance ([Jonsdottir et al., 2021](#); [Kavadis and Thomsen, 2023](#)).

When looking at any positive side effects of green bonds beyond financial or environmental measures, [Shishlov et al. \(2016\)](#) emphasized the importance of communicating the sustainability strategy and creating internal synergies between financial and sustainability departments. Additionally, [Zhang et al. \(2022\)](#) demonstrated that green bonds empowered companies to innovate with green technology by developing more green patents. In a single case study of an Icelandic energy firm, green bonds helped the functioning of the business model by acting as a two-way reinforcing mechanism between the green bond and the SDGs/ESG framework ([Jonsdottir et al., 2021](#)).

Overall, the literature provides clarity on the motivations and barriers for green bond issuance, but does not detail how companies overcome the barriers. Acting as both a financing tool and CSR policy instrument ([Glavas and Bancel, 2018](#)), green bonds allow researchers to further expound upon and contribute to our understanding of the link between sustainable financing and sustainable business models.

3. Methodology

To investigate the relationship between green bonds and sustainable business models, we adopted a constructivist approach. Given the complexity of business models, sustainability, and firm financing, we followed [Creswell \(2014, p. 8\)](#) in that the interviews would be “varied and multiple” and include a “complexity of views.” The critical dimensions to examine were not apparent at the outset given the open-ended nature of the research questions and our intention to induce theory from the field. As such, we employed a qualitative case study design at multiple companies ([Creswell, 2014](#); [Bansal and Corley, 2012](#)). By selecting this research design, the rationale, motivations, opinions, and logic of the people closest to the subject could be examined ([Yin, 2014](#)). The research process involved four main steps as shown in [Fig. 1](#).

3.1. Case selection and archival data

To select a purposeful sample of case companies ([Yin, 2014](#)), the focus was on organizations that had issued a green bond. From 2007 to June 2023, [Refinitiv Workspace \(2023\)](#) listed 8713 green bonds. To remove regional differences in green bond market development and regulatory regimes, the Nordic region was selected. Within the Nordic region, Green, Social, Sustainable, and Sustainability-Linked (GSS+) bonds grew 11.5% to €48.6 billion (US\$51.2 million) in 2022 and of this total, green bonds accounted for 88% ([Albuquerque, 2023](#)). While the Nordic region is not entirely homogenous, the Nordic countries have been collectively regarded as world leaders in sustainability and typically rank high on CSR and transparency rankings ([Aslani et al., 2013](#); [Latapi et al., 2021a](#)). Two countries within the Nordics – Sweden and Norway – are touted as pioneers in the green bond market ([Torvanger et al., 2021](#)).

We focused on the energy industry since energy companies are one of the leading sectors for green bond issuances and have a significant impact to society through power generation and distribution. Moreover, they are well positioned to make a direct contribution to CO₂ emission reductions since energy production has historically been carbon-intensive; over the last 20 years, some energy companies have looked to adapt their business models toward cleaner energy sources ([Leisen et al., 2019](#)). Interestingly, the Nordic region has seen long-term economic benefits from diversification into sustainable energy ([Ahmed et al., 2022](#)). Firms were subsequently evaluated on whether they exhibited [Bocken et al.'s \(Bocken et al., 2014, p. 50\)](#) archetypes of sustainable business models; all firms evinced the archetype of “substitute with renewables and natural processes.” Additionally, the companies met [Evans et al. \(2017\)](#) criteria of having value flows for multiple stakeholders, including the natural environment and society.

There are still CO₂ emissions within renewable energy portfolios, albeit on a significantly reduced level from fossil fuels. Two companies were in the process of phasing out fossil fuels, and all of the companies require ongoing financing and investments to improve environmental measures. The companies are partially or fully owned by municipal or national governments. Some of the selected firms pursued additional activities such as non-renewable district heating or broadband services. Finally, while market development varies in each of the five Nordic countries, all countries had active green bond markets over the last five-year period ([Climate Bonds Initiative \(CBI\), 2023a, 2023b](#)).

Based on this selection process, 18 Nordic energy green bond issuers were contacted through the authors' professional contacts or via cold call emails to senior executives. Interviews were requested with one individual from finance/treasury and another from strategy/sustainability closest to the first green bond issuance. Striving for representation across all types of energy businesses and sources, the number of granted interviews was limited by firms willing to engage in the study. One of the companies was only able to dedicate one resource for interviews and no Finnish companies participated. See [Table 1](#) for participating companies' key features.

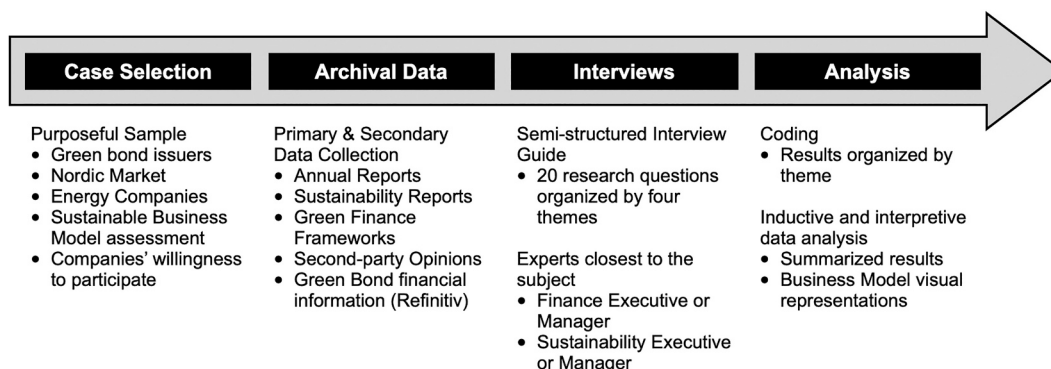


Fig. 1. Research Process. Source: Developed by the authors.

Table 1 Participating companies.

Company	Active Countries	Date Established	Energy Types	Energy Production and Retail Distribution - Terawatt hours (TWh)	Ownership	Employees (2022)
1 Eidsiva Energi	Norway	2000	Hydro and wind	Production: 6.3 TWh (partial ownership) Distribution: 23.4 TWh	City of Oslo +27 municipalities	1253
2 Landsvirkjun	Iceland	1965	Hydro and geothermal	Production: 14.8 TWh	Government of Iceland	285
3 Reykjavik Energy (Orkuveita Reykjavíkur)	Iceland	1909 1999 (current formation)	Hydro and geothermal	Production: 3.5 TWh Distribution: 1.2 TWh	City of Reykjavik +2 additional municipalities	496
4 Ørsted	Denmark, Netherlands, UK	1972 2017 (current formation)	Hydro, wind, coal, gas, solar, biomass	Production: 42.0 TWh	50.1% Government of Denmark, remaining institutional and retail investors (publicly traded)	8027
5 Vattenfall	Sweden, Germany, Netherlands, Denmark, Finland and UK	1909	Hydro, wind, nuclear, coal, gas, solar, biomass	Production: 123.5 TWh Distribution: 36.3 TWh (Retail customers)	Government of Sweden	19,638

Source: Developed by the authors based on company websites and Annual Reports. Energy production and distribution were based on electricity and other documented energy sources such as district heating.

The five companies issued 26 green bond series, including 43 different green bond tranches from 2017 to 2023. On average, the participating companies issued 5.2 green bond series and 8.6 tranches, ranging from 3 to 8 bond issuances throughout the period. The maturity ranged from two to 1000 years, with the mean average being 15 years when removing the 1000-year maturity (the average was 130 years when the 1000-year bonds were included). There were six currencies represented, including the EUR (33%), NOK (23%), GBP (19%), USD (12%), ISK (9%), and SEK (5%). The three main types were fixed rates (70%), resettable (19%), and floating (12%). All of the bonds followed the ICMA (International Capital Market Association) guidelines and were subject to second-party opinions from S&P Shades of Green (formerly CICERO) and Sustainalytics (S&P Global Shades of Green CICERO, 2023; Sustainalytics, 2023). See Appendix A for a summary of the participating companies' green bonds.

3.2. Interviews and analysis

An open-ended semi-structured interview guide was developed to understand the important dimensions within each interviewee's specific context and collect information not explained in publicly available data (Creswell, 2014; Cassell, 2015). Twenty main interview questions were developed to tease out observations along five main themes including: the motives for issuing green bonds, internal and external barriers, antecedents leading to the green bond issue, the process of issuing, and benefits after the bond issue. Throughout the data collection phase, published materials such as annual reports, sustainability reports, green finance frameworks, and second-party opinions were referenced.

Table 2 List of Interviewees.

	Interviewee(s)	Company	Length
1	Director of Finance*	Company 1	60 min
2	Treasury Manager*	Company 1	60 min
3	VP of Strategy (Former CFO)	Company 1	45 min
4	CFO	Company 2	60 min
5	Director for Climate and Green Solutions	Company 2	60 min
6	Treasury Manager	Company 3	60 min
7	Sr. Sustainable Finance Advisor	Company 4	30 min
8	Former CFO	Company 4	30 min
9	Director of Treasury	Company 5	60 min
10	Director of Sustainability	Company 5	60 min

Source: Developed by the authors.

Table 2 shows the interviewees.

Given the differences in geographic locations, videoconference communication tools allowed a low-cost method to communicate while still being able to build rapport, take visual cues, and gauge interest from the interviewees. All interviews were conducted in May and June 2023 in English. None of the interviews were recorded to build trust and ensure that interviewees could express "off the record" views if desired. The principal interviewer took comprehensive notes directly into Microsoft Word. The data was analyzed using a combination of Atlas.ti and Excel where quotes were coded under specific themes and structured in the software to allow for the comparison of results between each of the interviewees. Throughout the data analysis phase, we applied inductive reasoning to gain insight into the linkages between several

factors of green bonds, sustainable business models, CSR, SDGs, ESG, and firm financing overall. This included the development of high-level business model visual representations shown in the next section.

4. Results

For context, we begin by summarizing the main motives for issuing a green bond before explaining the barriers the firms faced. We then turn to how those barriers were overcome by summarizing the main features of the sustainable business model *before* the green bond issuance in terms of choices – noting the difference between policy, asset, and governance choices – and consequences, including a visual representation. Finally, we consider the business model *after* the green bond was issued noting virtuous cycles or other positive side effects with a second visual representation of the sustainable business model.

For quotes, interviewees are identified by using a letter (note: the assigned interviewee letter does not follow the order in [Table 2](#)). Appendix B shows expanded quotes by theme.

4.1. Motives for issuing a green bond

Nearly all interviewees mentioned the two top motives for issuing a green bond in tandem: formalizing the commitment to the overall CSR mission and accessing more capital. For the first, all interviewees highlighted the importance of the green bond in communicating and reinforcing the overall company mission of improving the environment as a key part of the business strategy. For the second, most of the issuers were trying to broaden their investor base either in local Nordic markets or internationally to reduce financial risk and ensure sufficient financing. For example, two companies were trying to attract new investors and one was striving to enter into a new bond market by appealing to US investors to raise funds in US dollars. Some of the companies also talked about wanting to improve their credit ratings, which was the main reason why they were trying to broaden their capital sources. Nearly all interviewees talked about the “greenium” (i. e., where the investor receives a lower yield than traditional bonds) but most did not issue conventional bonds in the same period to compare the pricing. While the interviewees knew that a greenium might be possible hence allowing them to lower their cost of capital, all of them said it was not the primary reason behind issuing a green bond. Finally, as the market matured, the motivations for continuing to issue green bonds has changed. All of the interviewees agreed green bonds had become the “standard” in their industry.

4.2. Sustainable business model prior to green bond issuance

The most resounding feature of all business models prior to the green bond issuance was the key policy choice to focus on environmental betterment as part of the companies' mission and strategy. The vision and mission statements of the participating companies include:

- Eidsiva: “We shall create value for all our stakeholders by offering new, smart, and sustainable solutions.”
- Landsvirkjun: “Landsvirkjun's vision is a sustainable world, powered by renewable energy.”
- Ørsted: “To create a world that runs entirely on green energy.”
- Reykjavik Energy: “To improve the quality of life and with social responsibility as a guiding light.”
- Vattenfall: “Our goal is to enable fossil-free living within one generation.”

Although the companies' journeys to embed CSR and adopt sustainability as a key part of the mission were distinct, three companies experienced a major transformative asset choice throughout their recent history that supported the move toward greater sustainability. For example, Reykjavik Energy emerged from near bankruptcy in 2010 after

selling off several diverse businesses, refocusing, and creating an ownership strategy in 2014 that placed environmental considerations on equal footing as profits. The ownership strategy guided major decisions at the company. Ørsted went through a major transformation after its predecessor, DONG (Danish Oil and Natural Gas) Energy, sold off its oil and natural gas portfolio in 2017 and committed to renewable energy, adopting a new name. Over time, Ørsted's goal was to convert its coal and natural gas plants to sustainable biomass. Vattenfall divested its lignite coal business in Germany in 2016, closed its last coal-fired plant in the Netherlands in 2019, and committed to phasing out coal from district heating by 2030, allowing it to focus largely on renewables with wind power and biomass.

At the core, the five participating companies all had one major element of their business model in common: the generation of electricity through renewable sources directly or via subsidiaries. For example, Eidsiva's largest business area was power distribution through the electricity grid with co-ownership in 74 hydroelectric power generation plants in Norway, along with additional businesses in district heating and broadband services. Somewhat similar was Reykjavik Energy, which operated electricity and district heating utility companies while producing electricity and hot water at two geothermal plants and one hydro facility, while additionally offering the fiber network and green tech start-up carbon storage subsidiary Carbfix ([Birgisdóttir, 2023](#)). Landsvirkjun's main business was hydropower generation, operating 15 plants throughout Iceland as well as operating three geothermal plants and one small-scale wind farm. Ørsted had international operations and was involved in a diverse set of power generation including wind power (105 onshore and offshore wind farms owned or built), bioenergy, solar, thermal power, distribution, and district heating. Similarly, Vattenfall was an international operation engaged in the production of electricity via 71 hydro plants, 35 wind farms, 16 biomass, 11 coal or gas, 10 solar parks, four nuclear facilities, and one industrial waste site.

All the companies formally demonstrated their commitment through governance choices by having dedicated resources to environmental issues and sought to be transparent by openly sharing metrics with stakeholders and the public. For example, the participating companies started to collect environmental data and publish it in environmental reports between 2008 and 2012, leading to publicly available documents that detailed environmental goals, measurements, and commitments for the future. Between 2012 and 2017, all of the companies expanded from environmental (“E”) reporting to incorporate social (“S”) and governance (“G”) measures. Furthermore, all companies voluntarily committed to the United Nations Global Compact (UNGC) and between 2015 and 2018 adopted some of the UN's SDGs as part of their corporate goals.

Another critical policy choice was an active pursuit of research and development (R&D) to reduce CO₂ emissions, often with a combination of in-house efforts and partnerships with research institutes, universities and suppliers, albeit at varying levels of scale. For example, prior to Eidsiva's first green bond, the company had collaborated with research institutes to invest in R&D at district heating and hydro plants, leading to more efficient delivery of hot water and electricity ([Sevault et al., 2018](#)). Before its first green bond, Vattenfall had 120 people in a dedicated R&D department along with other staff in business units and external collaborations to actively reduce the environmental impacts through a number of projects such as using artificial intelligence (AI) to monitor hydro plants, applying optimization models to reduce nitrogen oxide (NO_x) at district heating plants, combining wind and solar plants to prevent grid imbalances, and an overall effort to work with major partners to electrify the manufacturing of steel, cement, and biofuel to reduce CO₂ emissions in Sweden by 30% ([Vattenfall, 2016-2022](#)). Ørsted actively solicited R&D and technology development projects from suppliers (including an open invitation on its website) and worked with research institutes and universities around the world; some examples of its R&D included the development of a new foundation for offshore wind projects and digital analytics software for offshore wind

turbine monitoring (Ørsted, 2017). Landsvirkjun had a dedicated R&D department (that originally housed the environmental group before being spun out as a separate division in 2018) that worked with research institutes, universities, and suppliers to improve CO₂ emissions and sequestration on hydro and geothermal projects (Landsvirkjun, 2017). Similarly, Reykjavik Energy had participated in a major R&D project dating back to 2007 with scientists at leading universities around the world to develop Carbfix, a novel way of permanently storing CO₂ in basalt rock, among other initiatives to improve monitoring and energy loss at hydro and geothermal plants (OR, 2023; Mitchell et al., 2021, 2022; Jonsdottir et al., 2023).

The last major choice on governance was in regards to how the owners, board of directors, and management related with one another. As previously mentioned, the ownership strategy in addition to the shareholder's agreement provided a stable guide to Reykjavik Energy amidst changes to the elected officials at the municipal governments (i. e., the owners of the company). Eidsiva had a similar ownership structure (albeit with 28 municipal government owners) but did not have a separate ownership strategy from the binding shareholder's agreement. As for national governmental ownership, Landsvirkjun and Vattenfall, were both governed by standardized shareholder agreements that oversaw respective nationally-owned companies. Ørsted was different than the other four companies in that it was owned 50.1% by the Danish state and the remainder by institutional investors in Denmark (19%), North America (10%), UK (10%), and others (11%).

When analyzing the collective choices from all five companies, one of the main consequences was a strong corporate culture oriented toward long-term energy transformation. While each of the business models is unique, Fig. 2 shows a high-level business model representation to visualize the common choices and consequences noted across the five companies.

4.3. Barriers and challenges to issuing green bonds

The presence of sustainable business models in the participating companies removed many of the barriers that other organizations need

to confront such as the lack of eligible green projects, unclear economic benefits, and uncertainty on the types of assets that could be financed. All companies had already committed to key policy, asset, and governance choices to drive performance improvements and were clear about the investments that would drive dual environmental and economic benefits. Furthermore, the key strategic choice to focus on environmental improvement largely removed other internal barriers mentioned in the literature review section, such as being unclear about the “green” concept or having unsupportive organizational structures. While the sustainable business model was seen as being key in pre-empting many of the “typical” barriers, all interviewees still mentioned some external and internal barriers to issuing green bonds.

Two main challenges were mentioned on external market factors. The first was the lack of market readiness caused by the “newness” and lack of standardized practices for green bonds. The second was market timing; while most interviewees felt they did not have a challenge with their first green bond issuances (issued between 2017 and 2019), a complicated geopolitical situation led to tumultuous markets in 2022 and 2023.

From the standpoint of internal barriers, interviewees mentioned: selecting the correct measurements, setting up internal policies and reporting procedures, increasing know-how, and explaining the business model to second-party opinion providers and investors. Interviewee A highlighted:

“The green bond is not that ‘plug and play’ like a conventional bond where you have a credit rating, investors that buy it, and a standardized process. We could do a conventional bond in five days. With a green bond, you need a lot more planning. It requires more due diligence, procedures, written principles, and the investors go much more into our business model.”

Interviewee G talked about the barriers their company faced with the first green bond:

“It was a massive headache to get the first green bond issue through; the team came to me several times and asked ‘Can we scrap it?’ They were getting frustrated because not all external consultancies were used to handling large hydro projects. There were preconceptions of what a large hydro project would mean, and we had to educate them on how our projects worked.

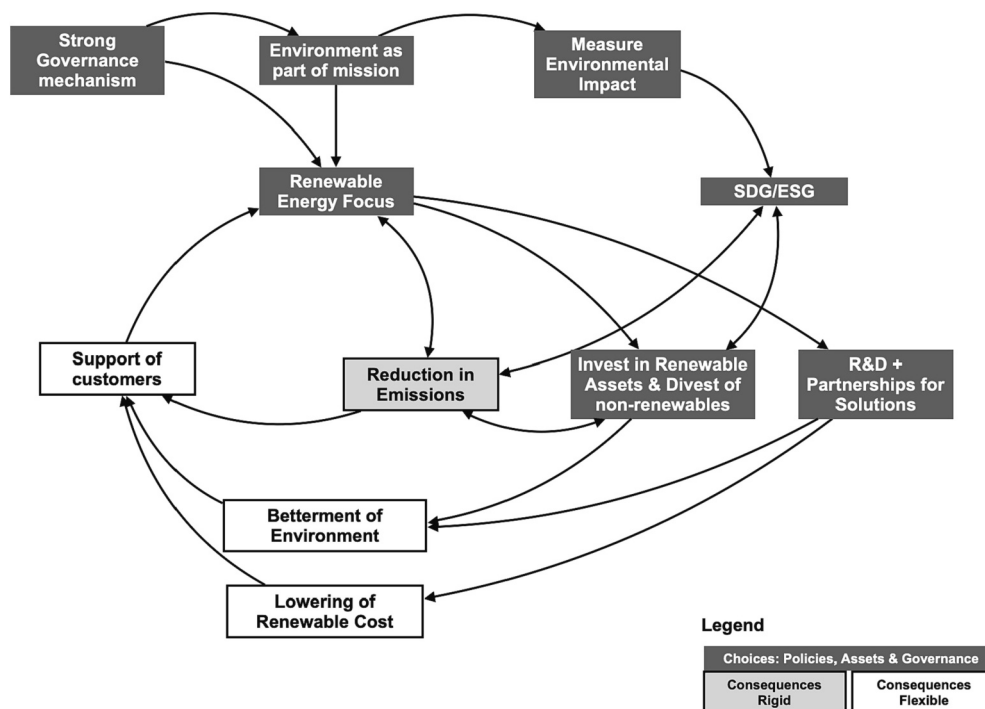


Fig. 2. Generalized High-Level Business Model Representation prior to Green Bond. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Source: Developed by the authors.

Relative to alternative financing, green bonds were purely driven by our need to show who we were; if it was based on cost only, we would not have done it.”

Interviewee H talked about the situation at their company: “The green finance framework was a lot of work and we had to have many interviews to determine what types of projects should be included.”

4.4. Overcoming barriers – throughout or after green bond issuance

In most cases, the idea to issue a green bond caused the company to develop a green finance framework first. The green finance framework acts as a policy choice and governance tool. The participating companies' green finance frameworks followed ICMA's green bond guidelines by documenting the use of proceeds, project evaluation and selection, management of proceeds, and reporting (ICMA, 2021). Some companies included information on their strategy, sustainability initiatives, alignment to SDGs, and additional governance features. The companies all developed the green finance framework with the intention of issuing a green bond. Interviewee J talked about the introduction of the green finance framework at their company:

“The green finance framework is a very good way of motivating change – let's burn down the old way, and the virtue of pain is that it makes you want to change. I think, in this case, the stick is more effective than a carrot. The green financing framework is considered a regulatory thing – managers are afraid of being in breach of regulation. The formalization of a green bond framework creates a perceived notion of this to be mandatory and part of the status quo, so it forces people to do it even though some of it might be optional.”

Interviewee H explained how the green finance framework was a consequential change within their company: “The green finance framework created much more conversation between departments. When we were issuing brown bonds, no one cared; we just issued the brown bonds, and it financed everything. Now, pretty much everyone knows about the green bond.”

Accompanying the green finance framework, additional governance mechanisms were already in place or emerged. For example, in one company, a sustainability committee had previously been formed and led by the CFO. The committee included representation from the sustainability department, which in tandem with an external consultancy and banking advisory, developed the first green finance framework and had decision rights over subsequent versions. Another company created a specific Green Bond Committee, including representation from finance, sustainability, strategy, and investor relations. Participating companies mentioned that the sustainability department became a co-owner of the green finance framework along with finance and senior management. All the companies had issued two to three subsequent versions of the green finance framework after the first. Committees and constant communication between individuals across finance, sustainability, strategy, and operations, were deemed essential to overcome the challenges in developing the first green finance framework and determining how the environmental improvements would be measured. Some interviewees highlighted the involvement of external banks and consultancies playing a pivotal role in helping to develop the green finance framework and work through the “newness” of the market.

To facilitate the reporting, some companies had previously determined specific procedures for measuring environmental metrics while others needed to introduce new procedures. Over time, some companies made the decision to have certain metrics certified or verified by external parties. Interviewee B explained the impact of new reporting requirements:

“Green bond investors are looking at two issues: They want a confirmation about proceeds in the framework and are concerned about the environmental impact from all the proceeds. We had to start doing green bond reporting. If you handle green financing in the proper way, it modernizes your entire organization.”

Interviewee J shared their perspective on reporting in the early stages: “Initially, the reporting was tedious as it was too much hands-on

work. It has taken some time to get the reporting set-up, and now it is done alongside the financial reporting.” Some companies made their major changes to reporting routines prior to issuing green bonds; Interviewee I explained: “We had started to professionalize the reporting in 2014 and 2015, so we were advanced and had good quality data prior to the green bond.” Even still, at that company, after the green bond issuance, sustainability reporting was placed under the finance function to support ESG and environmental reporting.

For tracking the use of proceeds, one company made changes to the accounting system to mark whether the asset was under the green finance framework, allowing it to be assigned to a specific bond series. Other companies talked about tracking the eligible projects independently from a specific bond series taking into account the net total proceeds of the bond on one side and applying it to eligible projects on the other.

4.5. Financial benefits

Most of the companies emphasized the benefits as broadening the investor base and opening up additional sources of financing. Nearly all interviewees also mentioned some level of greenium, but most admitted it was difficult to measure. Others were divided on whether it disappeared after the first or second green bond or whether it strengthened over time. However, other interviewees said the greenium had been constant throughout the bond issuances. Finally, some interviewees talked about how the green bond helped improve the image in the investor community of the company overall.

The financial results improved for all companies from 2017 to 2022. Additionally, some saw their credit ratings improve. The interviewees underscored that executing the company strategy – the realized strategy in the form of the sustainable business model – effectively led to economic performance improvements (i.e., the green bonds themselves were not directly attributed to economic performance). See Appendix C for a financial summary.

4.6. Non-financial benefits

All interviewees highlighted environmental benefits and the continued improvement of key performance measures, such as reductions in CO₂ emissions, which originated from the sustainable business model. The issuance of green bonds cultivated other reinforcing internal benefits, including: organizational learning on becoming more sustainable, encouraging others in the company to become more sustainable, considering new projects that were not previously planned, refining the focus on sustainable projects, increasing the amount of external certification on environmental measures, and improving communications between departments resulting in a greater shared purpose. Interviewee C summed up the effect as: “Green bonds have sped up our learning and consciousness of the importance of sustainability in general. They have been part of the motivation to become more sustainable.” Interviewee D talked about how green bonds created a common purpose:

“Nearly everyone agrees that climate change is human-induced and very real, and we have to act on it. However, while some people are driven by reducing emissions and respecting nature, others are truly driven by other forces whether that be acknowledgement, finance, risk, etc. With green finance, we're getting to a common 'why' – it connects all of the reasons why the company should behave well. It's not exclusively because of nature, but it also offers acknowledgment, financial reasons, and a reduction in risk.”

4.7. Business model representation after green bond issuance

Tying together the many themes, linkages were found between new choices. For illustrative purposes, three distinct choices are shown: the green finance framework, decision rights on the green finance framework, and the decision in some companies to certify measures. Flowing from these choices are positive “consequences,” whereby the benefits

strengthened key elements of the business model and produced virtuous cycles. Fig. 3 shows this representation:

4.8. Potential drawbacks and future concerns

The main drawback that some of the issuers mentioned was the additional cost of securing the second-party opinion and increased reporting procedures. In one company, the perceived greenium outweighed these costs. However, other interviewees surmised that green bonds might have been more costly as the greenium became smaller after the first and second issuance.

Additional concerns emerged on greenwashing, the EU's taxonomy, and the difficulty driving future environmental benefit. Interviewees indicated that awareness of potential greenwashing pushed them to ensure the pursuit of sound projects with real and measurable environmental benefits. However, a couple of interviewees talked about how applying voluntary green bond rules in different industry contexts opened up the possibility of greenwashing. While other interviewees welcomed improved clarity, some cautioned that reporting under the EU's Taxonomy was perhaps moving away from the strategic intent. Finally, as many of the companies had already reduced large amounts of CO₂ emissions, some interviewees highlighted the difficulty in harnessing further reductions.

5. Discussion

The aim of this paper was to answer two main questions: How can

companies overcome internal barriers to issuing a green bond through their sustainable business model? How does the sustainable business model change (if at all) during or after the company issues a green bond?

The main internal barriers were not as broad as in Sangiorgi and Schopohl (2021) or Khan et al. (2022) studies; however, our empirical context was focused on an industry in which awareness is already high for environmental issues and in a geographic area that is a global pioneer in green financing. As such, our empirical context has enabled a more stringent exploration of the processes through which companies can overcome internal barriers to green bond issuance, as well as subsequent changes in their sustainable business model. Importantly, participating companies already had sustainable business models in place, allowing them to remove barriers that other types of companies might face, such as having eligible projects or being unclear about the "green" concept. The main internal barriers were: selecting the correct measurements, setting up internal policies and reporting procedures, increasing know-how, and explaining the business model to other stakeholders. The external barriers of market readiness and consistency of green bond standards were aligned with early studies (Ehlers and Packer, 2017; Park, 2018; Tolliver et al., 2020; Deschryver and De Mariz, 2020; Bhutta et al., 2022).

In observing the antecedents of the companies' business models through interviews and published materials, Evans et al. (2017) concept of value and performance improvements encompassing economic, social, and environmental benefits was observed. Schneider and Clausen (2020) three conditions of prioritization of environmental or social objectives, consistency in behavior and strong transparency, and extensive

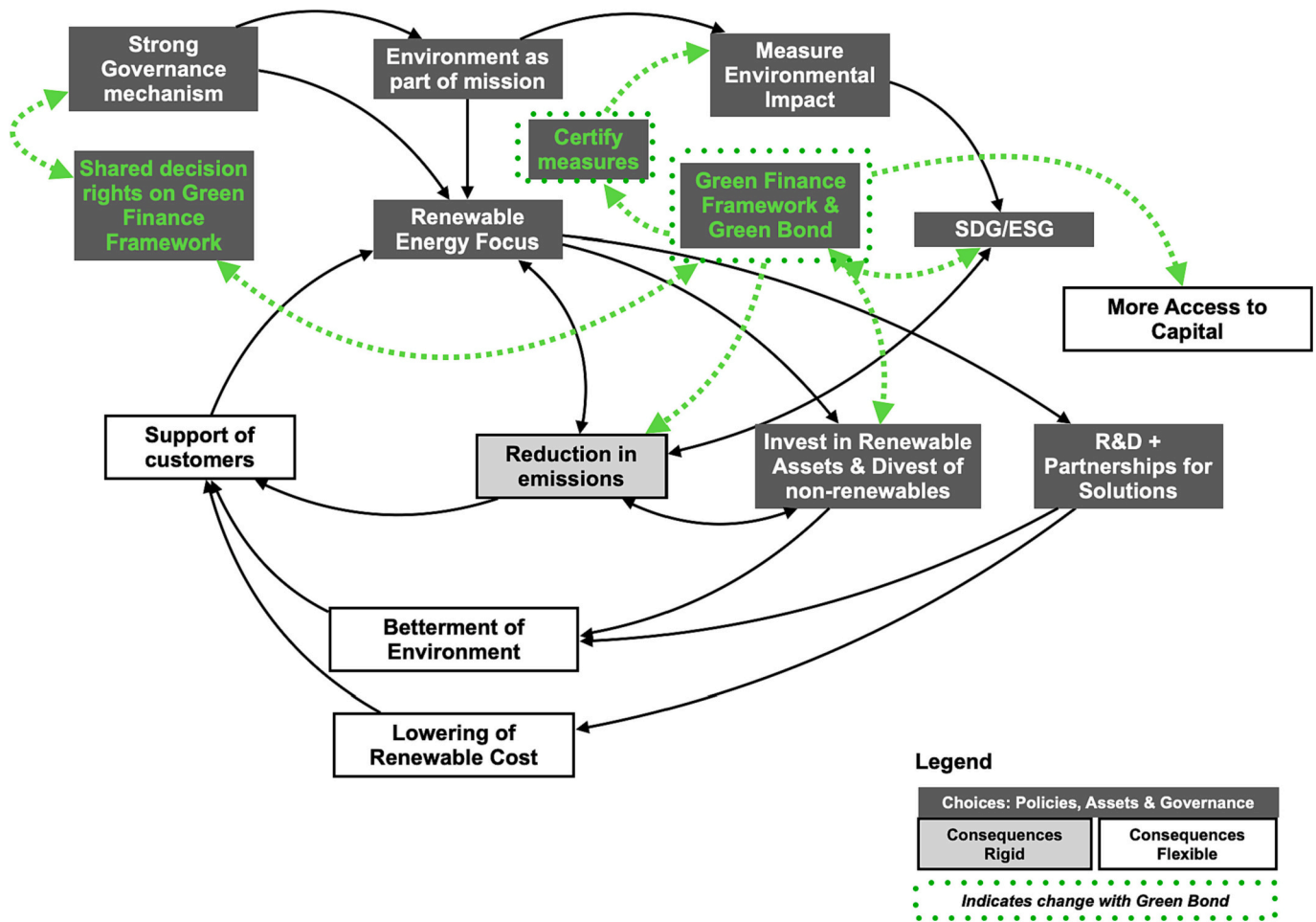


Fig. 3. Generalized High-Level Business Model Representation after Green Bond. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Source: Developed by the authors

collaboration through partnerships and the broader community were present in all participating companies. Many conditions also aligned with Latapí et al.'s (Latapí et al., 2021a; Latapí et al., 2021b) study on energy companies' characteristics after adopting CSR, such as a purpose-driven mission, sustainability integrated into the business strategy, positive contribution to society, and replacing fossil fuels as an energy source.

A few additional pre-issuance features of sustainable business models emerged. First, most companies had a catalyst that produced the choice to invest in assets for environmental benefit and divest non-renewable assets. Second, all companies had some level of research and development (R&D) either as a separate department in the case of larger companies or embedded within the business in smaller companies. The R&D focused the company on specifically improving environmental measures. Third, companies all had set-up procedures for collecting and measuring environmental data, while formalizing reporting through an ESG framework. Finally, strong governance supported the overall sustainability strategy, even though the manifestation of the governance mechanism was distinct, such as shareholder agreements or non-binding ownership strategies. The last observation was consistent with García et al. (2023) observation of strong governance being a key factor for firms to issue green bonds.

The vital importance of developing the green finance framework as a key policy choice and the subsequent governance choice for shared decision rights on the green finance framework were the two main changes noted in nearly all of the companies. On one hand, this may seem like an obvious observation. However, in talking with the interviewees, they emphasized that the green finance framework signaled a substantial policy, governance, and mindset change toward financing at the company. At the same time, it is clear that those changes may be accompanied by the increasing weight of new rules and procedures, and subsequently by increasing chances of organizational conflict and politics around them, as well as resistance to change from some organizational actors. In short, sustainability and the important changes it may bring are not immune to interests and agency. This may be an important avenue for future research to examine, as shedding light on the human factor and its role may help alleviate challenges in transitioning to greater sustainability (Kavadis et al., 2024).

The financial benefits that flowed from the green bond issuance were consistent with the literature in that nearly all the firms noted greater access to capital (Shishlov et al., 2016; Maltais and Nykvist, 2020). The knowledge of having a broader funding pool was necessary for several firms as it strengthened the environmental focus. Most firms acknowledged some greenium (Ehlers and Packer, 2017; Hachenberg and Schiereck, 2018; Zerbib, 2018; Agliardi and Agliardi, 2019; MacAskill et al., 2021) even though some said that it started to dissipate after the first few green bond issuances (Karpf and Mandel, 2018). During the period analyzed (2017–2022), all of the companies experienced improved economic performance, driven by their realized strategy – i.e., the sustainable business model.

As for the non-financial benefits, this study expanded on Shishlov et al. (2016) earlier observations of communicating the sustainability strategy and greater communication between the finance and sustainability departments. The benefits were broader since some companies talked about green bonds accelerating the organization's overall learning on sustainability and encouraging others in the organization to integrate sustainability into their operations. The importance of the “compliance-like” mechanism also emerged, in line with Shishlov et al. (2016) comparing it to ISO certification and Glavas and Bancel (2018) classifying green bonds as a CSR policy instrument. Additionally, companies were more open to projects that might not have been funded before green bonds and used the opportunity for project-focus refinement.

While debates still circulate as to the mixing of corporate financing and company strategy, green bonds connect the two because of the dual purpose of being a financing tool and CSR policy instrument (Glavas and

Bancel, 2018). Some of Barton and Gordon (1987) propositions were observed, namely management's risk appetite, company goals, and the financial context of the firm, all affecting the decision to take on debt in the form of a green bond.

6. Conclusions

This study adds to the discussion on how organizations can overcome internal barriers to financing the transition to a more sustainable future. The importance lies in prioritizing environmental measures in the strategy (policy choice) and securing it in place through a governance mechanism such as shareholder agreement, ownership strategy, or board of directors' alignment (governance choice). It may follow logically that a sustainable business model should have sustainable financing; our study revealed *how* sustainable financing helps companies become more sustainable.

Our study proposes some additional features to be considered as part of sustainable business model research: investing in assets that provide an environmental benefit and divesting of those that do not (asset choice), embedding R&D formally or informally to reduce the environmental impact (policy choice), collecting and measuring environmental data (policy choice), adopting a formal ESG reporting method (governance choice), and introducing a green finance framework (policy and governance choice). The features can be applied in different industries, albeit with different levels of scope and application.

We additionally found several other benefits for companies, including corroborating many of the oft-studied financial benefits of increasing capital sources and achieving a lower cost of capital through a greenium. On non-financial benefits, we observed greater organizational learning on becoming more sustainable, encouraging others in the company to embrace sustainability, considering new projects that were not previously contemplated, refining the focus on sustainable projects, and improving communications between departments, resulting in a greater shared purpose.

This study has some limitations. First, a qualitative design was chosen in a specific industry and geography. While this enabled us to explore our research questions in a more stringent empirical context, as the selected companies might be predisposed to acting for the public good, the very same conditions or characteristics may not be present at other companies in other contexts. In particular, within the energy industry and the Nordic region, there is a high awareness of environmental issues and a general acceptance of the need to reduce harmful environmental practices. All of the companies had renewable energy as a key part of their strategy for several years, which demonstrated the amount of value they were putting on environmental betterment. In addition, of the selected companies, all had some government ownership either at the national or municipal level.

During the interviews, the business model was discussed at a higher-level, making it challenging in some cases to comprehensively document all of the features of the companies' business models. Furthermore, long-term insights were sought, which required the interviewees to trace steps and activities back to 2017 and before. The collective experiences of the five companies were induced into one business model representation. As such, it does not emphasize nuanced, firm-level specificities and discussion of how each specific company competes in their respective markets. Nevertheless, our objective was to draw from relevant prior research and propose a process-based theoretical outline about how companies could create sustainable value through their business model and financing. This offers a starting point for future research to build on our outline and potentially develop testable hypotheses.

In order to encourage further development of green projects and grow the amount of green financing, it is crucial for companies, financial institutions, investors, and researchers to consider the interplay between sustainable financing and sustainable business models. Future studies could investigate other industries and geographic contexts where the

business model changes as a result of pursuing sustainable finance. Different sustainable finance instruments such as social, sustainable, sustainability-linked, and transition bonds and loans could also be studied to understand how those distinct instruments may affect the sustainable business model. Additionally, researchers could seek to understand the role sustainable finance plays in helping companies that do not have sustainable business models transition toward greater sustainability over time. Investigating the relationship between sustainable business models and sustainable finance will help ensure companies are well-prepared to accelerate the transition to lower emissions and create

more economic and environmental value for the firm, customers, investors, and society at large.

Declaration of Competing Interest

There are no conflicts of interest to declare.

Data availability

Data will be made available on request.

Appendix A Green Bond Issuances from Participating Companies: 2017 to 2023

Issue Date	Maturity Date	Term (years)	Amount (millions)	Currency	Type	Coupon Frequency	Coupon	Second-Party Opinion
Eidsiva								
05-Oct-2017	05-Oct-2023	6	750	NOK	Floating*	Quarterly	1.64%	S&P (CICERO)
22-Oct-2019	22-Oct-2029	10	1000	NOK	Fixed	Annually	2.54%	S&P (CICERO)
22-Oct-2019	22-Oct-2026	7	500	NOK	Fixed	AnnFREfuually	2.40%	S&P (CICERO)
02-Oct-2020	02-Oct-2025	5	900	NOK	Floating*	Quarterly	0.95%	S&P (CICERO)
02-Oct-2020	02-Oct-2030	10	1000	NOK	Fixed	Annually	1.82%	S&P (CICERO)
26-May-2021	26-May-2028	7	600	NOK	Floating*	Quarterly	0.87%	S&P (CICERO)
26-May-2021	26-May-2031	10	600	NOK	Fixed	Annually	2.375%	S&P (CICERO)
20-Jan-2022	20-Apr-2026	4	500	NOK	Fixed	Annually	2.347%	S&P (CICERO)
20-Jan-2022	20-Apr-2026	4	500	NOK	Floating*	Quarterly	1.560%	S&P (CICERO)
20-Jan-2022	20-Jan-2032	10	1000	NOK	Fixed	Annually	2.750%	S&P (CICERO)
Landsvirkjun								
09-Mar-2018	09-Mar-2023	5	85	USD	Fixed	Semi-Annually	4.12%	Sustainalytics
09-Mar-2018	09-Mar-2025	7	30	USD	Fixed	Semi-Annually	4.30%	Sustainalytics
09-Mar-2018	09-Mar-2028	10	20	USD	Fixed	Semi-Annually	4.41%	Sustainalytics
18-Nov-2020	18-Nov-2029	9	50	USD	Fixed	Semi-Annually	2.79%	Sustainalytics
08-Feb-2021	08-Feb-2030	9	100	USD	Fixed	Semi-Annually	2.84%	Sustainalytics
Reykjavik Energy (Orkuveita Reykjavíkur)								
18-Feb-2019	18-Feb-2055	36	2140	ISK	Fixed	Semi-Annually	2.60%	S&P (CICERO)
02-Sep-2019	02-Sep-2034	15	2700	ISK	Fixed	Semi-Annually	1.70%	S&P (CICERO)
23-Oct-2020	02-Oct-2023	2	3000	ISK	Fixed	Quarterly	2.80%	S&P (CICERO)
15-Apr-2021	18-Feb-2042	20	2197.5	ISK	Fixed	Semi-Annually	4.50%	S&P (CICERO)
Ørsted								
24-Nov-2017	26-Nov-2029	12	750	EUR	Fixed	Annually	1.500%	S&P (CICERO)
24-Nov-2017	24-Nov-3017	1000	500	EUR	Resettable	Annually	2.250%	S&P (CICERO)
16-May-2019	17-May-2027	8	350	GBP	Fixed	Annually	2.125%	S&P (CICERO)
16-May-2019	16-May-2033	14	300	GBP	Fixed	Annually	2.500%	S&P (CICERO)
16-May-2019	16-May-2034	15	250	GBP	Fixed	Semi-Annually	0.375%	S&P (CICERO)
09-Dec-2019	09-Dec-3019	1000	600	EUR	Resettable	Annually	1.750%	S&P (CICERO)
18-Feb-2021	18-Feb-3021	1000	500	EUR	Resettable	Annually	1.500%	S&P (CICERO)
18-Feb-2021	18-Feb-3021	1000	425	GBP	Resettable	Annually	2.500%	S&P (CICERO)
14-Jun-2022	14-Jun-2028	6	600	EUR	Fixed	Annually	2.250%	S&P (CICERO)
14-Jun-2022	14-Jun-2033	11	750	EUR	Fixed	Annually	2.875%	S&P (CICERO)
13-Sep-2022	13-Sep-2031	9	900	EUR	Fixed	Annually	3.250%	S&P (CICERO)
13-Sep-2022	13-Sep-2034	12	375	GBP	Fixed	Annually	5.125%	S&P (CICERO)
13-Sep-2022	13-Sep-2042	20	575	GBP	Fixed	Annually	5.375%	S&P (CICERO)
08-Dec-2022	08-Dec-3022	1000	500	EUR	Resettable	Annually	5.250%	S&P (CICERO)
01-Mar-2023	01-Mar-2026	3	700	EUR	Fixed	Annually	3.625%	S&P (CICERO)
01-Mar-2023	01-Mar-2030	7	600	EUR	Fixed	Annually	3.750%	S&P (CICERO)
01-Mar-2023	01-Mar-2035	12	700	EUR	Fixed	Annually	4.125%	S&P (CICERO)
Vattenfall								
24-Jun-2019	24-Jun-2026	7	500	EUR	Fixed	Annually	0.500%	S&P (CICERO)
12-Mar-2020	15-Oct-2025	5	500	EUR	Fixed	Annually	0.500%	S&P (CICERO)
12-Feb-2021	12-Feb-2029	8	500	EUR	Fixed	Annually	0.125%	S&P (CICERO)
26-May-2021	26-May-2083	62	500	SEK	Resettable	Annually	2.400%	S&P (CICERO)
26-May-2021	26-May-2083	62	3000	SEK	Floating	Quarterly	5.459%	S&P (CICERO)
29-Jun-2021	29-Jun-2083	62	250	GBP	Resettable	Annually	2.500%	S&P (CICERO)
17-May-2023	17-Aug-2083	60	250	GBP	Resettable	Annually	6.875%	S&P (CICERO)

Source: Green bond information from Refinitiv Workspace, Summary table developed by authors.

Note: *Eidsiva's floating rates are on top of NIBOR (Norwegian Inter-Bank Offer Rate) 3-month rate.

Appendix B interviewee quotes by theme

A.1. Motives for issuing a green bond (from Section 4.1)

Theme	Quote
Reinforcing Overall Company Mission and Strategy	G: "I saw there was a new way to advocate what the company stands for"
	D: "The green bond was a platform to show our environmental commitment in a financial manner."
	I: "It was signaling everything we were doing was related to sustainability."
	J: "We wanted to go green and issuing the green bond was a manifestation of what we wanted to achieve; by connecting to the financial markets, the investors could understand it as it was consistent with our business focus on wind energy."
Broaden Investor Base	A: "The main motive is to show that most of our investments are green and have high standards and a green bond is a way of communicating ambitions and strategies."
	G: "We're denominated in USD and USD in Europe is a difficult and fickle market, which pushed us to get in to the US bond market. If you meet their standards, you get repeat business from a lot of investors."
Green Bonds becoming the standard for their companies	B: "We had difficulties as we did not have the credit rating that we have today and we wanted to have greater access to capital sources."
	B: "If we started issuing ordinary bonds again, I would have severe problems"
	H: "If we were to issue a brown bond, people would wonder why."

A.2. Barriers and Challenges to Issuing Green Bonds (from Section 4.3)

Theme	Quote
External Barrier: Lack of Market Readiness	J: "Initially, there were some uncertainties regarding the formats as the markets established itself since green bonds were fairly new at the time." G: "Some of the US investors saw 'green bond' on the cover, and they later told me that it piqued their interest as the green bond market was not quite as developed at that stage."
External Barrier: Market Timing	H: "[When doing a green bond issuance], you of course always have to look at the market as a whole; there's been a crisis in the market in 2022 and 2023, different from the first time we issued green bonds."
Internal Barriers	Included in Section 4.3
	B: "The green bond is not that 'plug and play' like a conventional bond where you have a credit rating, investors that buy it, and a standardized process. We could do a conventional bond in five days. With a green bond, you need a lot more planning. It requires more due diligence, procedures, written principles, and the investors go much more into our business model."
	G: "It was a massive headache to get the first green bond issue through; the team came to me several times and asked 'Can we scrap it?' They were getting frustrated because not all external consultancies were used to handling large hydro projects. There were preconceptions of what a large hydro project would mean, and we had to educate them on how our projects worked. Relative to alternative financing, green bonds were purely driven by our need to show who we were; if it was based on cost only, we would not have done it."
	H: "The green finance framework was a lot of work and we had to have many interviews to determine what types of projects should be included."

A.3. Overcoming Barriers – Throughout or After Green Bond Issuance (from Section 4.4)

Theme	Quote
Green Finance Framework	Included in Section 4.4
	J: "The green finance framework is a very good way of motivating change – let's burn down the old way, and the virtue of pain is that it makes you want to change. I think, in this case, the stick is more effective than a carrot. The green financing framework is considered a regulatory thing – managers are afraid of being in breach of regulation. The formalization of a green bond framework creates a perceived notion of this to be mandatory and part of the status quo, so it forces people to do it even though some of it might be optional."
New reporting routines	H: "The green finance framework created much more conversation between departments. When we were issuing brown bonds, no one cared; we just issued the brown bonds, and it financed everything. Now, pretty much everyone knows about the green bond."
	Included in Section 4.4
	B: "Green bond investors are looking at two issues: They want a confirmation about proceeds in the framework and are concerned about the environmental impact from all the proceeds. We had to start doing green bond reporting. If you handle green financing in the proper way, it modernizes your entire organization."
Governance committees	J: "Initially, the reporting was tedious as it was too much hands-on work. It has taken some time to get the reporting set-up, and now it is done alongside the financial reporting."
	I: "We had started to professionalize the reporting in 2014 and 2015, so we were advanced and had good quality data prior to the green bond."
	J: "The committee was a handful of green finance enthusiasts within the company, and we looked after several items including gathering the specific metrics and creating the first reporting structure."
	B: "If you only do ordinary bonds and provide cash, you do not need to have any contact with others in the company. When you start to issue green bonds, we all get more dependent on each other. We in finance need to understand what we are investing in. Is it a category that is eligible? Why? In finance we need to understand what we're using the proceeds for and the environmental and operations people helped us to understand this."

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Theme	Quote
	D: <i>"In the early stages, the question from finance was 'We need some KPIs. Do you have some?' However, as green finance has evolved, the importance of actually selecting appropriate KPIs that made sense from both an environmental and financial standpoint. Luckily, we had the measures, but we have had to develop how our KPIs are presented to follow the ongoing involvement of green finance."</i>
External Advisors	B: <i>"The information was in the organization somewhere, but we needed to collect it, process it, do quality assurance, and then report on it. In a way, the information was not new, but it was not shared before, and it was used very differently in the past."</i> J: <i>"We were fortunate to have strong banking advisory, and that helped formalize the bond issuance – it would be much harder for smaller issuers that might not have access to a big banking advisory."</i>

A.4. Financial Benefits (from Section 4.5)

Theme	Quote
Broadening the investor base	C: <i>"The green bond opened up more financing options and reduced the financial risk. It is important for an energy company to have access to funding."</i>
Greenium	G: <i>"Green bonds allowed us to get funding from completely new sources in the US in USD that we did not have previously."</i> H: <i>"The first green bond was a better yield, but now after the third one, it is pretty much the same."</i> B: <i>"Most of the greenium is on the first or second issue and now, all of our new bonds are green so it is difficult to compare to regular bonds."</i> E: <i>"Internally, we tend to say it is about 10 bps, which over time makes a big difference for the amount we are issuing."</i> B: <i>"We were told it was about 15 bps by the banks, and we later participated in a study with several Nordic issuers and they found 5 bps on average."</i>
Improving the image with the investor community	J: <i>"Other things are more important than the yield. The additional basis points cannot really be tracked to any one thing as it has to do with market sentiment, and market sentiment might even be what an investor ate for lunch that day."</i> E: <i>"A green bond changes the narrative with investors and internal areas pursuing projects. In the investor's mind, there is less risk of the money financing a stranded asset. The green bond makes the story clear of how we are raising money and where we are spending it."</i>

A.5. Non-Financial Benefits (from Section 4.6)

Theme	Quotes
Lower emissions	D: <i>"We are almost at carbon neutral, and we've already shown a large reduction in CO₂."</i>
Greater organizational learning on sustainability	C: <i>"Green bonds have sped up our learning and consciousness of the importance of sustainability in general. They have been part of the motivation to become more sustainable."</i> G: <i>"When we issued the first green bond, we posted information on the internal website. We got much interest from all employees. They asked how it worked and what it meant for the company. It gave everyone more knowledge about green finance and a sense that we're doing good."</i>
Encouraging others in the company to become more sustainable	J: <i>"Green bonds are more effective as a facilitator for change as they create a conversation internally."</i> G: <i>"It pushed the lever up in the company. For example, the procurement department asked, 'if finance can do it, why can't we?' They started to ask suppliers for environmental measures and greener products. It was a motivation for others to look for ways in their departments to do something toward the vision."</i>
Considering projects that might not have been funded previously	J: <i>"If you want to drive change, if you can piggyback on external verifications or making something institutional, it certainly helps. Any institutional push facilitates change."</i> C: <i>"There are certain projects that are marginally profitable with a net present value (NPV) of zero. In the past, we would have said, 'do you have any other projects?' Now, even if a project is just marginally beneficial from a financial standpoint but strong from a sustainability perspective, we will support it. That wouldn't have happened without the green bond and green finance framework."</i>
Refining the project focus	E: <i>"The framework is very clear that the funding can only be used in certain projects and that means if you're not part of one of those projects, you have to look elsewhere for the money. It really limits and focuses the pool of money of what we fund."</i>
Improving communications between departments resulting in a greater shared purpose	B: <i>"One of the things that isn't spoken about that much is the internal effects on the organization. If you only do ordinary bonds and provide cash, you have no need to have any contact with others in the company. When you start to issue green bonds, you get much more dependent on each other."</i> G: <i>"The green bond made the finance function talk to the sustainability area. Other than maybe going for lunch together, the two areas had no business reasons to talk."</i> J: <i>"One thing the green finance framework and green bond did is open the communication channel between the financial and sustainability areas. We're sitting in the same meetings with banks and investors and we understand a lot more about each other's worlds now."</i> D: <i>"Nearly everyone agrees that climate change is human-induced and very real, and we have to act on it. However, while some people are driven by reducing emissions and respecting nature, others are truly driven by other forces whether that be acknowledgement, finance, risk, etc. With green finance, we're getting to a common 'why' – it connects all of the reasons why the</i>

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Theme	Quotes
	company should behave well. It's not exclusively because of nature, but it also offers acknowledgment, financial reasons, and a reduction in risk."

A.6. Potential Drawbacks and Future Concerns (from Section 4.8)

Theme	Quote
Greenwashing	E: "In the beginning, I believe companies were issuing green bonds more for green purposes. However, I feel greenwashing has grown. If you take companies doing a small-scale energy efficient building versus the scale of an energy producer building a wind farm, which one will be more impactful relative to your dollars spent? Obviously, the wind farm. Going forward, for the market to be used more strategically, that greenwashing element needs to be addressed by showing greater granularity so investors can easily identify the difference between the scale of the environmental impact."
EU Taxonomy	J: "I worry that the EU Taxonomy reporting requirements might be narrowing the focus too much on certain reporting aspects instead of the overall idea of investing in green assets." H: "With the EU Taxonomy, we have to split out the project into two categories where we have always tracked it as one category in the past. The regulation is not getting any simpler."
Harnessing further reductions	G: "Investors want to see continuous environmental improvement. It is a problem for us, because the CO2 emission numbers are already so low, to get better and show improvement becomes very challenging."

Appendix C Participating Companies Financial Results: 2017 and 2022

		Reported Financials				Converted to USD	
		2017	2022	CAGR % or ppt	FX	2017	2022
Eidsiva	millions	NOK	NOK			USD	USD
						0.1210	0.1045
	Revenues	3956	11,118	23.0%		479	1161
	EBITDA	1434	4344	24.8%		174	454
	EBITDA/Sales	36.2%	39.1%	2.8%		36.2%	39.1%
	Total Assets	18,895	50,832	21.9%		2287	5310
	Total Debt	8992	16,309	12.6%		1088	1704
	Debt/Assets	47.6%	32.1%	-15.5%		47.6%	32.1%
	Credit Rating (Scope)	BBB-	BBB+			BBB-	BBB+
Landsvirkjun	millions	USD	USD	Inc/(Dec) %		USD	USD
						1.0000	1.0000
	Revenues	491	709	7.6%		491	709
	EBITDA	346	455	5.7%		346	455
	EBITDA/Sales	70.4%	64.2%	-6.2%		70.4%	64.2%
	Total Assets	4506	3873	-3.0%		4506	3873
	Total Debt	2043	844	-16.2%		2043	844
	Debt/Assets	45.3%	21.8%	-23.5%		45.3%	21.8%
	Credit Rating (S&P)	BBB	BBB+			BBB	BBB+
Ørsted	millions	DKK	DKK	Inc/(Dec) %		USD	USD
						0.1518	0.1417
	Revenues	59,709	132,277	17.2%		9063	18,744
	EBITDA	16,158	23,925	8.2%		2453	3390
	EBITDA/Sales	27.1%	18.1%	-9.0%		27.1%	18.1%
	Total Assets	146,521	314,142	16.5%		22,241	44,514
	Total Debt	29,636	71,547	19.3%		4499	10,138
	Debt/Assets	20.2%	22.8%	2.5%		20.2%	22.8%
	Credit Rating (S&P)	BBB+	BBB+			BBB+	BBB+
Reykjavik Energy	millions	ISK	ISK	Inc/(Dec) %		USD	USD
						0.0094	0.0074
	Revenues	44,000	56,965	5.3%		413	422
	EBITDA	26,717	35,745	6.0%		251	265
	EBITDA/Sales	60.7%	62.7%	2.0%		60.7%	62.7%
	Total Assets	311,258	450,870	7.7%		2921	3342
	Total Debt	144,479	170,806	3.4%		1356	1266
	Debt/Assets	46.4%	37.9%	-8.5%		46.4%	37.9%
	Credit Rating (Fitch)	BB+	BBB-			BB+	BBB-

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	Reported Financials			Converted to USD	
	2017	2022	Inc/(Dec) %	2017	2022
Vattenfall					
<i>millions</i>	SEK	SEK		USD	USD
Revenues	135,114	239,644	12.1%	0.1172	0.0993
EBITDA	36,279	56,683	9.3%	15,834	23,787
EBITDA/Sales	26.9%	23.7%	-3.2%	4252	5626
Total Assets	409,132	792,327	14.1%	26.9%	23.7%
Total Debt	87,154	176,765	15.2%	47,947	78,647
Debt/Assets	21.3%	22.3%	1.0%	10,214	17,546
Credit Rating (S&P)	BBB+	BBB+		21.3%	22.3%
				BBB+	BBB+

Source: Developed by authors based on information in companies' annual reports and Refinitiv Workspace.

Note: Lansdevirkiun sold a material asset, the transmission system operator (TSO) Landsnet in 2022.

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