Darshika Gohil

Sustainable Procurement Practices in the Wind Energy Sector: A Case Study of Vaasa's Manufacturing Industry

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Abstract

Author(s): Gohil Darshika

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Keywords:

The wind energy industry plays a significant role in sustainable development by encouraging clean energy and lowering carbon emissions. But achieving sustainability in this industry involves more than just producing energy; it involves using procurement procedures that guarantee social, economic, and environmental responsibility for the environment. In the wind energy sector, sustainable procurement entails choosing vendors, products, and procedures that reduce adverse environmental effects while promoting moral labour standards and long-term financial sustainability.

In the manufacturing sector of Vaasa, a region well-known for its strong presence in the renewable energy sector, this thesis investigates sustainable procurement procedures. The study's objectives are to evaluate the procurement practices currently used by wind energy producers, pinpoint major obstacles, and offer suggestions for improving supply chain sustainability. This study advances our knowledge of how sustainable procurement can promote innovation, cost effectiveness, and environmental responsibility in the production of wind energy by examining the industry's best practices, stakeholder viewpoints, and regulatory frameworks. Companies, legislators, and industry stakeholders looking to improve the sustainability of procurement practices in the renewable energy sector will find value in the findings.

Foreword

“Education is the most powerful weapon which you can use to change the world.” – Nelson Mandela

In this thesis, I examine sustainable procurement methods in the wind energy business using Vaasa's manufacturing sector as a case study. It stands for my dedication to expanding my understanding of sustainable development and ethical business practices in a quickly expanding industry.

I am extremely grateful to my supervisors, Tommi Kyllönen and Päivi Karhu, for their knowledgeable advice, helpful criticism, and constant encouragement during this study. Their assistance greatly influenced the direction of this work.

I also want to express my sincere thanks to all the interview subjects and industry experts who so kindly gave of their time and wisdom to enable this research. Lastly, I would want to sincerely thank my family for their constant encouragement and support. Their confidence in me has always given me courage. In addition to encouraging more study and useful developments in this important field, I hope that this thesis makes a significant contribution to the comprehension and use of sustainable procurement in the wind energy industry.

Sincerely,

Darshika

Darshika Gohil

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List of Symbols

ISO – International Organization for Standardization

EU – European Union

GPP – Green Public Procurement

ESG – Environmental, Social, and Governance

TBL – Triple Bottom Line

LCA – Life Cycle Assessment

RBV – Resource-Based View

EIA – Environmental Impact Assessment

FAO – Food and Agriculture Organization

GHG – Greenhouse Gas

CSR – Corporate Social Responsibility

SDGs – Sustainable Development Goals

SMEs – Small and Medium-Sized Enterprises

R&D – Research and Development

ROI – Return on Investment

CSDDD – Corporate Sustainability Due Diligence Directive

TCO – Total Cost of Ownership

1 Introduction

The urgent need to slow down climate change and reduce our dependence on fossil fuels is making the shift to renewable energy a top priority for the entire world. Wind energy, a vital component of the renewable energy industry, has grown significantly, raising the need for ethical and sustainable supply chain management techniques. A key factor in ensuring the long-term sustainability and ethical sourcing of materials in the production of wind energy is sustainable procurement, which includes environmental, social, and economic factors in purchasing decisions (Ogun Suji et al., 2024, p. 1412).

Procurement tactics are determined by cost-effectiveness, technology improvements, and regulatory compliance in the highly competitive and complicated wind energy sector. Manufacturers are moving toward sustainable procurement frameworks that encourage resource efficiency, the concepts of the circular economy, and responsible supplier engagement in response to these issues (Ogun Suji et al., 2024, p. 1418). By using such approaches, businesses improve corporate social responsibility, increase resilience against supply chain shocks, and lessen their environmental impact.

Procurement procedures in Vaasa's wind energy manufacturing sector are under a lot of pressure to change, considering the European Union's aggressive wind energy growth ambitions, which include achieving 500 GW by 2030 (up from 204 GW in 2022) (Widuto, 2024, p. 3). Because of the region's significant contribution to the wind energy sector, sustainable procurement is essential to achieving regional and EU sustainability targets. The EU's wind manufacturing industry, which presently provides 94% of offshore wind installations and 85% of onshore wind installations, emphasizes the value of local procurement tactics in lowering dependency on imports and advancing sustainability goals. Furthermore, it is anticipated that the wind industry will generate 68,000 new jobs by 2030, highlighting the necessity of local employment programs and workforce training (Widuto, 2024, p. 3).

Finland's energy hub, Vaasa, is home to a strong wind energy provider and manufacturer community. Nevertheless, a systematic method for integrating sustainability into procurement processes is still required, even given the region's strong commitment to renewable energy. The purpose of this thesis is to examine the current state of sustainable procurement in Vaasa's wind energy manufacturing industry, identify best practices and obstacles, and offer suggestions for improving procurement tactics in accordance with international sustainability norms.

Sustainable procurement in the wind energy sector is emerging as an essential component of long-term performance as enterprises around the world adopt greener solutions (council of European Union, 2024). By examining the function of procurement in achieving sustainability objectives and offering suggestions on how Vaasa manufacturers might deepen their dedication to ethical sourcing and manufacturing, this study adds to the current conversation.

As the global shift towards renewable energy, Sustainable procurement has come to be as a key component in guaranteeing the long-term sustainability of the wind energy industry. Manufacturers must implement sustainable sourcing practices because procurement decisions have a big impact on social responsibility, resource efficiency, and environmental impact. Sustainable procurement in the context of wind energy refers to the selection of suppliers, materials, and procedures that limit environmental harm while maintaining moral labour standards and viability from an economic standpoint (Council of European Union, 2024, p. 17).

Although sustainability is becoming more and more important, the wind energy industry still has several obstacles when it comes to implementing sustainable procurement methods. These include the complexity of the supply chain, financial limitations, compliance with regulations, and the requirement for increased supplier operations openness (Ogun Suji et al., 2024, p. 1411). A methodical approach that encourages stakeholder participation and coordinates procurement policies with international sustainability standards is needed to address these issues.

The goal of this thesis is to provide significant insights into optimizing sustainability in wind energy production in Vaasa, a city known for its strong presence in renewable energy innovation, by analyzing current procurement strategies, assessing industry best practices, and identifying areas for improvement. This study aims to investigate sustainable procurement practices in the wind energy manufacturing sector. To guarantee that procurement choices have a good impact on the environment and the economy, the study also looks at how businesses might strike a balance between cost-effectiveness and sustainability objectives (Victoria State Government, 2024).

This research emphasizes the vital role that procurement plays in creating a more environmentally conscious and responsible wind energy industry by adding to the conversation on sustainable procurement (Victoria State Government, 2024). The results are intended to help industry participants create more innovative supply chains, increase the resilience of the renewable energy sector, and promote sustainability.

This thesis aims to address the following questions:

Q1: What procurement procedures does Vaasa's wind energy manufacturing sector currently follow?

Q2: What are the main barriers to implementing sustainable procurement methods in Vaasa's wind energy sector?

Q3: How can Vaasa's wind energy industry improve its environmental performance and efficiency through sustainable procurement practices?

This thesis uses a constructive research strategy and a deductive approach to data analysis to examine procurement procedures in Vaasa's wind energy manufacturing industry to provide answers to these issues. The study starts with well-known ideas and concepts about sustainable procurement, like the Resource-Based View, Stakeholder Theory, and the Triple Bottom Line, and then uses them to examine industry procurement processes. The objective is to evaluate current procurement practices, pinpoint major obstacles to sustainable procurement, and suggest workable answers to enhance environmental effectiveness and performance. The deductive method enables the study to utilize known theoretical frameworks with empirical data and make inferences about how well actual practices fit or differ from these models.

A variety of qualitative research techniques were used to collect data. Experts from important procurement teams in Vaasa's wind energy manufacturing sector participated in semi-structured interviews, which gave researchers a thorough grasp of the processes in place today and the difficulties that professionals in the field confront. To learn more about the particular obstacles to sustainable procurement, these interviews were supplemented by workshops and conversations with industry stakeholders, such as suppliers, manufacturers, and policymakers.

The need for Vaasa's wind energy production industry to adjust to the growing demand for sustainable practices serves as the basis for this study. To promote innovation in the industry and enhance economic and environmental performance, it is essential to close the gap between theoretical understanding and practical applications. This study intends to improve environmental performance, simplify procurement procedures, and establish Vaasa's wind energy industry as a leader in sustainable manufacturing by addressing the obstacles to sustainable procurement.

To strengthen the region's competitive position, encourage innovation, and help in the growth of a more sustainable and flexible wind energy sector, this study eventually aims to contribute to a more sustainable and effective wind energy supply chain in Vaasa. The study will give manufacturers, legislators, and other stakeholders who are working to establish efficient sustainable procurement procedures in the sector important insights by identifying the main obstacles and potential solutions.

2 Sustainable Procurement

The global shift to carbon neutrality and renewable energy depends heavily on the wind energy industry. But sustainability in this sector goes beyond producing clean energy; it also requires the implementation of ethical and responsible supply chain procurement procedures. Sustainable procurement guarantees that the components, materials, and services used in the production of wind energy are purchased and managed in a way that promotes social justice, reduces environmental damage, and generates long-term economic benefit (OgunSuji et al., 2024, p. 1).

To guarantee long-term sustainability and moral supply chain management, the idea of sustainable procurement is constantly developing and incorporates economic, environmental, and social factors into purchasing decisions (ISO 20400, 2017). It goes beyond conventional cost-driven procurement strategies to address more general issues, including resource efficiency, social responsibility, and carbon footprint reduction (Walker & Brammer, 2012). Sustainable procurement procedures prioritize a lifecycle approach, considering the full product journey from the extraction of raw materials to disposal. This strategy guarantees that procurement choices promote economic viability, ethical labor standards, and environmental preservation, encouraging innovation and long-term resilience in sectors like wind energy (Banga, 2016, p. 2).

2.1 Definition of Sustainable Procurement

Sustainable procurement refers to the process of acquiring goods and services in a way that achieves value for money on a whole-life basis while generating benefits for society, the economy, and the environment. Sustainable procurement, according to the International Organization for Standardization (ISO), is "procurement that has the most beneficial effects on the environment, society, and economy throughout its whole life cycle"(ISO 20400, 2017). By strategically integrating sustainability into contract management, risk assessment, and supplier selection, it promotes ethical supply chain operations and resilience (Zimon et al., 2019).

Sustainable procurement considers more factors than traditional procurement, which mostly concentrates on price and quality (Kalubanga, 2016, p. 2).

- Lowering resource usage and carbon emissions.

- Ensuring moral labour standards are followed across the supply chain.
- Promoting creativity by utilizing eco-friendly products and technologies.
- Coordinating procurement methods with international agreements such as the EU Green Deal and the Paris Agreement on Climate Change (European Commission, 2024).

2.2 Evolution of Sustainable Procurement Practices

Over the past few decades, corporate sustainability initiatives, legal changes, and growing awareness of environmental deterioration have all contributed to the evolution of sustainable buying. Its development is demonstrated by the following milestones:

Period	**Key Developments**	**References**
1980s-1990s: Early Awareness	Initial discussions on environmental responsibility and green supply chain management.	Wilcox, n.d, p. 4
	The adoption of ISO 14001 (Environmental Management Systems) encouraged sustainable business practices.	
2000s: Regulatory Development and Corporate Engagement	Growth of corporate sustainability programs and adoption of Green Public Procurement (GPP) policies in the EU.	European Commission, 2008
2010s: Expansion of Circular Economy and Renewable Energy Policies	Introduction of ISO 20400:2017, a global standard for sustainable procurement.	ISO 20400, 2017
	Growing emphasis on circular economy strategies, promoting waste reduction and recycling.	
2020s-Present: Net-Zero and Climate Action Goals	Increasing focus on decarbonizing supply chains to align with net-zero carbon emission goals.	World Economic Forum,2021
	Integration of sustainable procurement in Environmental, Social, and Governance (ESG) reporting frameworks.	

Table 1: Evolution of Sustainable Procurement Practices

In the 1980s and 1990s, the concept of environmental responsibility gained traction as governments and businesses acknowledged the importance of minimizing environmental impacts (Development & Director, 1987,p. 29). Green supply chain management emerged as a critical area of focus. A significant milestone was the release of ISO 14001, which provided a systematic framework for managing environmental responsibilities. This standard motivated organizations to integrate sustainable practices into their operations. In the 2000s, companies started to prioritize sustainability as a strategic issue. To incentivize public sector organizations to purchase eco-friendly goods and services, the European Union implemented Green Public Procurement (GPP) legislation. This, in turn, pushed private sector suppliers to adopt more sustainable practices (European Commission, 2008).

The 2010s saw a growth in sustainability efforts, especially the use of circular economy tactics that prioritized recycling, material reuse, and waste reduction. To help firms connect their sourcing efforts with worldwide best practices, ISO 20400:2017 was released, which offered international criteria for integrating sustainability into procurement decisions. The goal of reaching net-zero carbon emissions became the focus in the 2020s. To meet global climate action targets, organizations gave decarbonization of their supply chains top priority. A wider cultural movement toward responsibility, openness, and moral business practices is shown in the integration of sustainable procurement into ESG reporting (World Economic Forum, 2021).

2.3 Importance of Sustainable Procurement in Wind Energy (particularly in Vaasa)

For the wind energy industry to deliver on its promise of generating clean, renewable energy while reducing adverse environmental and social effects, sustainable procurement is a strategic requirement (Ramos et al., 2023). For raw materials, components, and services, the sector relies on intricate, international supply chains, many of which present serious sustainability issues. For example, the procurement of composite materials for blades and rare earth components for turbine magnets often involves procedures that negatively impact worker welfare and the environment (Ramos et al., 2023). The wider environmental and social advantages of wind energy can be compromised by supply chain operations that are not properly managed, which can result in unethical labour practices, excessive carbon emissions, and unsustainable extraction of resources (Khatun, 2024, p.6).

In this regard, sustainable procurement guarantees that the wind energy sector is in line with commitments to social responsibility, environmental conservation, and economic stability. Beyond ethical responsibilities, it provides strategic benefits like increased competitiveness, innovation, and regulatory compliance. This is especially crucial in Vaasa, Finland, a major European center for producing renewable energy. Because they comply with the renewable energy rules of the European Union, Vaasa's wind energy producers are leading the way in the advancement of sustainable procurement methods (Widuto,2024). Environmental, social, and ethical factors must be incorporated into procurement decisions following regulations like the EU Renewable Energy Directive and Green Public Procurement (GPP) guidelines (European Commission, 2024).

Sustainability is not only a best practice but also a commercial need since compliance with these principles is required to keep access to EU markets and land government contracts (International Labour Organization, 2013, p. 13). Additionally, Vaasa's wind energy industry's competitive edge is strengthened globally via sustainable procurement. Social responsibility, environmental leadership, and ethical sourcing improve a brand's reputation and draw in sustainability-minded investors and stakeholders (WINDExchange, 2021). Furthermore, by generating employment, encouraging skill development, and establishing a strong industrial foundation, putting an emphasis on local sourcing promotes regional economic development (Khatun, 2024, p.7). This strategy is in accordance with the EU's focus on regional economic resilience as well as Finland's national sustainability goals.

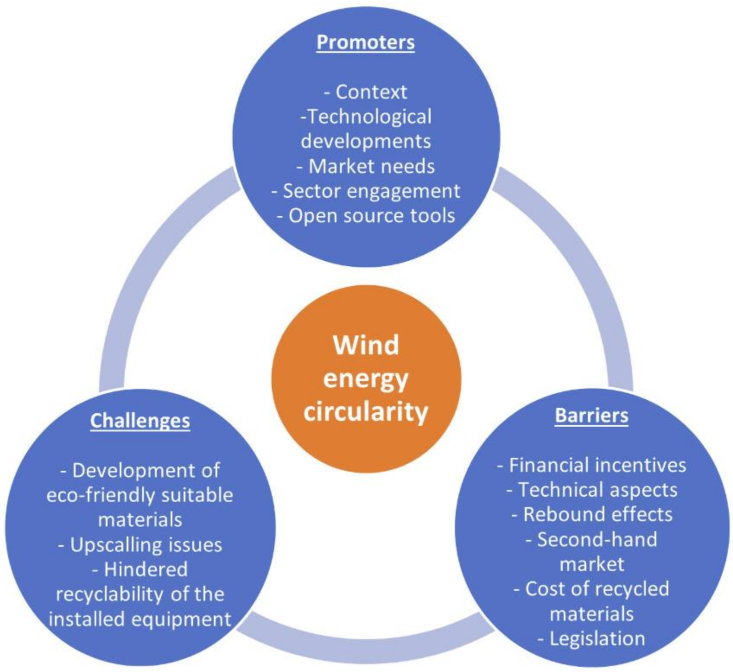

Figure 1: Wind energy sustainability in Europe—A review of knowledge gaps, opportunities and circular strategies.

By using eco-friendly materials and optimizing supply chain operations, sustainable procurement helps lower carbon emissions from an environmental standpoint. Sustainable raw materials lessen the environmental effects of mining and manufacturing processes, while locally sourced components cut down on transportation distances and related emissions (Ramos et al., 2023).
Another factor driving innovation in Vaasa's wind energy industry is sustainable procurement. Companies are spending money on circular economy solutions, like wind turbine blade recycling technology and the creation of recyclable or biodegradable materials (Valkokari et al., 2019). These programs decrease waste, extend the life of wind energy assets, and smooth the shift to a circular, zero-waste production model.

Notwithstanding these advantages, many barriers prevent sustainable procurement from being widely used. It is challenging to guarantee sustainability at every stage due to the complex nature of global supply chains, especially when procuring rare earth elements from politically unstable areas (Ramos et al., 2023). Long-distance transportation of massive turbine components raises carbon emissions and goes against climate aims. Legal and administrative complications are also introduced by regulatory compliance with frameworks like the EU's GPP. Cost is still a hurdle because sustainable options are frequently more expensive, forcing businesses to strike a compromise between their financial obligations and environmental objectives (Ibukun et al., 2024).

However, Vaasa's wind energy industry offers a lot of chances to promote sustainable buying. Reducing emissions, transportation expenses, and reliance on unstable markets can be achieved by localizing supply chains by obtaining materials and components from Finland or the EU. Recycling and reusing turbine materials are examples of circular economy activities that reduce waste and advance sustainability (Ramos et al., 2023). Additionally, supply chain traceability and transparency are improved by digitization using blockchain and AI, guaranteeing compliance to sustainability guidelines. Greener procurement methods are encouraged by policy support from the Finnish and EU governments, such as tax breaks and subsidies (Incentives for Sustainable Growth, 2023).

Innovation in energy-efficient production methods and sustainable material sourcing is promoted by cooperation between Vaasa's manufacturers, research institutions, and industry stakeholders. This collaboration advances the EU's renewable energy strategy and strengthens Vaasa's position as a leader in the wind energy industry (Ogunsuji et al., 2024).

sustainable procurement is essential to the wind energy sector's future success, especially in areas like Vaasa that are essential to the EU's renewable energy plan. Vaasa's wind energy producers may improve compliance, competitiveness, and innovation while promoting regional development and reducing environmental impacts by incorporating environmental, social, and economic sustainability into procurement decisions. Sustainable procurement is a strategic requirement for attaining a just, flexible, and low-carbon energy future, not only a moral decision.

2.4 Key Stakeholders in Sustainable Procurement for Wind Energy in Vaasa

Vaasa's strategic location, technological expertise, and dedication to sustainability have made it a center for Finland's renewable energy industry, especially in wind energy (European Cluster Collaboration Platform, 2022). A variety of manufacturers, suppliers, developers, energy producers, and clustered organizations can be found in the area, all of which support the expansion and prosperity of the wind energy sector.

Category	**Company Name**	**Description**
Manufacturers	Vestas	A leading global manufacturer of wind turbines, supplying and maintaining wind energy solutions, including in Finland (Vestas,2023).
	Hitachi Energy Finland Oy	Produces transformers essential for wind energy applications, including WindSTAR™ transformers designed for offshore wind turbines (Hitachi Energy,2024).
	Wärtsilä	Supplies energy storage and optimization solutions for wind power integration, improving grid stability and efficiency (Wärtsilä, n.d.).

	ABB	Provides electrical systems, automation, and grid integration solutions for wind energy projects, enhancing energy efficiency and reliability (ABB, 2023).
Suppliers	Peikko Finland Oy	Provides foundation solutions for wind turbines, supplying technology for various wind parks in the region (Peikko Finland Oy, 2025).
	Blomberg Stevedoring	Provides logistics, port handling, and transportation services for wind turbine components, ensuring efficient supply chain management (Hennanurmi, 2023).
Developers & Operators	Ilmatar Onshore	Specializes in offshore wind energy projects in Finland, including the development and operation of onshore wind farms (Ilmatar, 2025).
	EPV Windpower Ltd	Operates multiple wind farms in the region, contributing significantly to local wind energy production (EPV, 2024).
	Prokon Wind Energy Finland Oy	Develops and operates wind farms, with several projects in planning and construction phases across Finland (Prokon, 2024).
	OX2	Manages wind energy projects, including the Merkkikallio wind farm in the Vaasa region (OX2, 2024).
	Axpo Renewable Finland Oy	Developing the Lålax wind farm in Vörå, near Vaasa, contributing to local renewable energy initiatives (Axpo Finland, 2025).
Energy Producers	Vaasan Sähkö	One of Finland's largest wind power producers, generating renewable energy from local wind farms.
Cluster Organizations	EnergyVaasa	Represents over 180 energy technology companies in the region, fostering collaboration and innovation in the energy sector (*EnergyVaasa - the Nordic Energy Capital*, n.d.).

Table 2 : Key Stakeholders in the Vaasa Wind Energy Sector.

The active participation and cooperation of numerous supply chain stakeholders are crucial to the effective adoption of sustainable procurement methods in Vaasa's wind energy industry. By creating sustainability standards and incorporating responsible sourcing into their procurement strategy, manufacturers like Vestas, Wärtsilä, Hitachi, and ABB are taking the lead. By enforcing moral labour standards, cutting carbon emissions, and encouraging the use of eco-friendly products across their supply chains, these businesses set the standard for sustainability activities. Suppliers supply essential materials, parts, and infrastructure for wind turbines in Vaasa's wind energy industry; the turbines themselves are not manufactured. Peikko Finland Oy supports robust and effective turbine installations by providing technology and foundation solutions for several wind parks in the area (Peikko Finland Oy, 2016). Blomberg Stevedoring manages transportation, port operations, and logistics to guarantee the sustainable and efficient delivery of wind turbine parts (*Oy Blomberg Stevedoring Ab*, 2024). Collectively, these vendors are crucial to maintaining an effective and ecologically conscious supply chain for Vaasa's wind energy sector.

In Vaasa's wind energy industry, developers and operators are just as important as communities, non-governmental organizations, and certifying authorities. Although they do not manufacture their own components, companies like Ilmatar Onshore, EPV Windpower Ltd, Prokon Wind Energy Finland Oy, OX2, and Axpo Renewable Finland Oy create, run, and oversee wind farms. By requiring their suppliers to use ethical sourcing and ecologically conscious practices, these organizations promote the adoption of sustainable procurement. Local renewable energy generation and economic development are greatly aided by their projects, which range from offshore wind farms to regional initiatives like the Merkkikallio and Lålax wind farms. The Lålax wind farm in Vörå, close to Vaasa, is being developed by Axpo Renewable Finland Oy, helping Finland's transition to sustainable energy and the region's renewable energy projects (Axpo Group, 2024). These developers and operators ensure that wind energy projects follow sustainability objectives, which benefit the environment and nearby communities.

2.5 Key theories related to sustainable procurement

Analysing sustainable procurement processes in Vaasa's wind energy manufacturing sector requires a solid theoretical underpinning. Several theories shed light on how procurement strategies might incorporate sustainability. Three important ideas and pertinent conceptual models that can assist in framing your research are listed below.

2.5.1 Triple Bottom Line (TBL) Theory

Established by John Elkington in 1994, the Triple Bottom Line (TBL) is a comprehensive sustainability framework that assesses organizational performance across three key areas: People (Social), Planet (Environmental), and Profit (Economic).

People (Social): Emphasizes equitable and beneficial labour, community, and regional practices for an organization.

Planet (Environmental): Reducing adverse ecological effects by emphasizing sustainable environmental practices.

Profit (Economic): Refers to the economic value created by the organization, not only for shareholders but also for the wider economy.

The TBL approach encourages businesses to expand their focus beyond financial outcomes to include the social and environmental impacts of their operations (Biswas & John, 2022, p. 43) TBL plays a crucial role in procurement by ensuring that purchasing decisions not only drive economic growth but also contribute to long-term environmental sustainability and social equity. This balance is especially important in industries like wind energy, where the industry has a significant impact on the environment and local communities. Organizations can make decisions that promote sustainable development and benefit not only shareholders but also the larger community and ecosystem by taking economic, environmental, and social sustainability into account (International Labour Organization, 2013, p.23) TBL highlights how crucial it is to include these three pillars into procurement procedures to make sustainability a key factor in corporate plans, particularly in sectors like wind energy that have significant ecological and social effects.

The TBL framework includes three dimensions, as explained below.

Social Dimension

The Triple Bottom Line (TBL) framework's social dimension is the examination of social indicators that show the equity and well-being of people and communities impacted by organizational operations. Education, social capital, affordability, accessibility, acceptability, empowerment, health and well-being, and quality of life are some of these indicators (Biswas & John, 2022, p. 45). This factor highlights the significance of inclusive employment methods, worker safety, and ethical labour practices in procurement environments. The social aspect of sustainability is very important in the wind energy industry because of the direct and indirect effects the industry has on workers and communities. By encouraging businesses to choose suppliers who support diversity, respect human rights, and provide safe and equitable working conditions, sustainable procurement methods help achieve social goals. This involves emphasizing procurement practices that support workforce development, like training courses in renewable energy technology, and following health and safety regulations across the supply chain (Núñez Ferrer, 2020, p. 4). Businesses may support long-term job prospects, improve local worker capacities, and advance social fairness by including social concerns in procurement decisions. In addition to strengthening ties within the community, these behaviours support the larger objectives of sustainable development and ethical corporate operations.

Environmental Dimension

The Triple Bottom Line (TBL) framework's environmental dimension focuses on reducing ecological damage and protecting natural resources across the course of a good or service's whole life cycle. This involves assessing the effects on the environment, including waste production, pollution, emissions, and resource depletion (Biswas & John, 2022, p. 44). By choosing products and services that lessen adverse environmental effects and encourage responsible resource use, procurement can achieve environmental sustainability. Achieving environmental goals in the wind energy industry depends heavily on sustainable procurement. Increasingly, businesses base their procurement strategy on frameworks that give preference to environmentally friendly goods and services, such as the European Union's

Green Public Procurement (GPP) standards. This entails picking sustainable packaging options, energy-efficient parts, recyclable materials, and low-emission modes of transportation (A Review of Green Public Procurement in the EU, 2022, p. 126). Furthermore, the entire environmental impact of wind turbine components—from the extraction of raw materials to the disposal of end-of-life components—is assessed during the procurement process using life cycle assessment (LCA) techniques. Organizations may guarantee that all supply chain phases follow environmental regulations and support long-term sustainability objectives by incorporating life cycle assessment (LCA) into procurement procedures (Mishnaevsky, 2021). This aspect of sustainable buying also promotes the use of renewable energy in industrial processes, local sourcing, and energy-efficient shipping. When combined, these methods lessen wind energy operations' carbon footprint and aid in the larger shift to a low-carbon economy.

Economic Dimension

The Triple Bottom Line (TBL) framework's economic component focuses on the long-term economic value and financial sustainability produced by an organization's activities. This entails assessing the wider financial effects of purchasing decisions, including lifecycle costs, supply chain stability, and innovation-driven value creation, in addition to the immediate costs (Mishnaevsky, 2021). By incorporating the concepts of the circular economy, cutting waste, and increasing energy efficiency, sustainable procurement improves economic performance in the wind energy industry. Organizations can save money over time and lessen their reliance on resources by concentrating on the total cost of ownership, which considers maintenance, operational effectiveness, and end-of-life factors. The resilience of the supply chain is increased, and the risk of disruptions relating to regulatory compliance or reputational harm is reduced when suppliers with robust environmental, social, and governance (ESG) policies are chosen. Additionally, businesses can manage sustainability KPIs, optimize processes, and maintain their competitiveness in the global renewable energy market by utilizing digital procurement technologies and sustainable product creation (Alves Dias et al., 2020, p. 13). In addition to increasing profitability and efficiency, this economic focus on sustainable procurement helps firms adapt to changing market demands, legislative frameworks, and investment standards that place a higher priority on sustainability. It sets businesses up for success in a global energy economy that is becoming more and more concerned with sustainability.

Organizations in the wind energy industry are increasingly adopting a comprehensive approach that incorporates economic, environmental, and social factors, going beyond the conventional cost-focused procurement approach. This all-encompassing strategy improves supply chain accountability, transparency, and resilience in addition to being in line with international sustainability trends and legal mandates like the EU Green Deal (Núñez Ferrer, 2020, p.3). Long-term profitability is supported by practices like lifecycle assessments, supplier audits, and ESG-based procurement, which encourage ethical behaviour throughout the supply chain. Additionally, sustainable procurement promotes innovation in logistics, production techniques, and materials, giving businesses a competitive edge in the worldwide market for renewable energy.

2.5.2 Resource-Based View (RBV) Theory

According to Barney's (1991) Resource-Based View (RBV) theory, a company's distinct internal resources and competencies are the source of its long-term competitive advantage. RBV states that for a business to succeed in the long run, its resources must be rare, valuable, non-substitutable, and imperfectly imitable. When in line with RBV principles, sustainable procurement practices provide a competitive edge that goes beyond simple compliance with environmental laws. Manufacturers of wind energy in Vaasa can create distinctive capabilities that improve their market position by incorporating environmental, social, and governance (ESG) considerations into procurement decisions (Mailani et al., 2024, p. 3)

Valuable: By using low-carbon materials and circular economy efforts, sustainable procurement lowers operating costs, lowers regulatory risks, and improves supply chain resilience while encouraging long-term cost savings.

Rare: Businesses that emphasize ESG-compliant procurement stand out from rivals who depend on high-emission global supply chains by establishing enduring alliances with regional producers of low-carbon steel and aluminium.

Imperfectly Imitable: Competitors find it difficult to readily duplicate expertise in lifecycle assessments (LCA), workforce training, and sustainable supply chain management since it is built over time.

Non-Substitutable: Beyond conventional cost-driven approaches, advanced ESG-driven procurement methods offer a distinctive value proposition by securing government contracts, ensuring long-term compliance with EU legislation, and granting access to green funding.

The wind energy industry may successfully implement sustainable procurement using the Resource-Based View (RBV) framework. Businesses can obtain a competitive advantage and support long-term sustainability by concentrating on their internal resources and competencies. RBV and sustainable procurement, which incorporates environmental, social, and governance (ESG) factors, are compatible in several ways.

A strategic perspective for comprehending how sustainable procurement methods might give the wind energy industry an advantage over competitors is the Resource-Based View (RBV) framework. Businesses can set themselves apart in a market that is changing quickly by concentrating on their own resources and talents (Barney, 1991, p. 99). In this regard, RBV and sustainable procurement go hand in hand, especially when it comes to rare, valuable, non-replaceable, and imperfectly imitable resources (Mailani et al., 2024, p. 3). When sustainable procurement lowers expenses and risks, it is considered useful.

Businesses can drastically reduce operational costs and reduce the risk of non-compliance with changing environmental rules by giving priority to low-carbon materials and the circular economy. In addition to lowering transportation costs, the regional procurement of resources like low-carbon steel and aluminium makes the supply chain more resilient to shocks like flooding or political instability. (American Clean Power Association, 2024, p. 8).By lowering emissions and enhancing long-term sustainability, this emphasis on local sourcing further improves cost-efficiency. Businesses that implement environmental, social, and governance (ESG)-driven procurement methods set themselves apart from rivals that depend on conventional, highly polluting global supply chains.

These businesses establish long-lasting partnerships with local suppliers, giving them a distinct competitive edge that is hard for rivals to match. Additionally, businesses develop unique, difficult-to-replicate resources over time, like knowledge of sustainable supply chain management, workforce development, and Life Cycle Assessments (LCA) (American Clean Power Association, 2024, pp. 2–6). These skills are valuable yet difficult for rivals to copy because they take a lot of time and money to develop. Finally, standard cost-focused procurement techniques cannot readily replace the non-replaceable resources provided by ESG-driven procurement. This includes obtaining government contracts, making sure EU sustainability laws are followed, and obtaining green finance.

These benefits are essential for long-term success because they help the organization achieve wider sustainability goals, improve its reputation in the marketplace, and give it access to opportunities that are not available to companies that are only concerned with price. Therefore, Vaasa wind energy firms may improve their competitiveness and help ensure the long-term viability of the industry by combining RBV with sustainable procurement methods.

2.5.3 Stakeholder Theory

According to the Stakeholder Theory, which was first presented by Freeman and then expanded upon by Phillips and Freeman (2003, p. 3), businesses should consider the interests of all parties involved in their decision-making, not just shareholders. This idea emphasizes how crucial it is to take into account the requirements and expectations of many stakeholder groups, including workers, suppliers, consumers, local communities, regulatory agencies, and environmental campaigners, when it comes to sustainable procurement. In industries like wind energy, where a variety of players are involved along the supply chain and environmental and social implications are significant, effective stakeholder engagement is especially important. Aligning procurement procedures with the interests of these many stakeholders encourages moral behaviour, compliance with sustainability guidelines, and long-term corporate resilience (Laari and Lorentz ,2020, p. 19)

Decisions about procurement in the wind energy industry have a significant impact on the economy, society, and environment. By considering the interests of all pertinent parties—not only shareholders, but also workers, suppliers, consumers, communities, regulators, and environmental organizations—Stakeholder Theory provides a useful prism through which businesses can manage these consequences.

This approach encourages procurement professionals to adopt sustainable and ethical practices in addition to cost-centric decision-making. To lessen the harm to the environment and conform with industry standards and environmental legislation, businesses could, for instance, give priority to obtaining renewable or low-impact products. In the same way, companies encourage more responsible conduct throughout their value chains by collaborating closely with suppliers to establish common sustainability objectives, such as compliance with global labour standards or carbon reduction targets. Another essential component of stakeholder-oriented procurement is supply chain traceability and transparency. Organizations ensure upstream operations are morally and environmentally sound by implementing standards like ISO 14001, conducting supplier audits, and reporting on sustainability. In marketplaces that are competitive and driven by sustainability, this transparency strengthens stakeholder trust and improves the company's reputation, both of which are becoming more and more important.

Stakeholder theory also emphasizes how important it is to balance conflicting interests. While local communities and regulatory bodies may call for more robust environmental protections and long-term social benefits, investors may place a higher priority on profitability and immediate rewards. By interacting with stakeholders, establishing clear expectations, and making fair, morally sound judgments, sustainable procurement must resolve these conflicts (Ramponi, 2017, p. 70).

In the end, a procurement strategy guided by stakeholders increases innovation, compliance, and resilience. It assists businesses in managing risks, obtaining their social license to operate, and advancing sustainable development objectives. In industries like wind energy, where supply chains are intricate, technologies are developing quickly, and public and regulatory scrutiny is intense, this strategy is especially important.

2.5.4 Sustainability Standards and Guidelines:

Businesses that produce wind energy in Vaasa are required to go by several national and international sustainability standards and guidelines that guarantee operational effectiveness, environmental responsibility, and regulatory compliance. From the production of turbine components to the general design and management of wind farms, these standards and guidelines influence how businesses approach the generation of wind energy. The following are important sustainability requirements and principles that Vaasa wind energy producers are required to follow:

ISO Standards :

A thorough framework for managing an organization's environmental responsibilities in a systematic way is provided by ISO 14001. By assisting businesses in determining and evaluating the environmental effects of their operations, goods, and services, the standard aims to improve environmental performance. It highlights how crucial legal compliance is, making sure businesses follow regional, national, and global environmental laws. Furthermore, ISO 14001 encourages effective resource management by pushing businesses to reduce waste and maximize energy and material utilization. Businesses can lessen their environmental impact, increase sustainability, and promote an ongoing environmental improvement culture in their operations by following these recommendations (ISO 14001, 2015).

This standard's primary goal is to assist companies in using energy more efficiently, which will lower their overall energy usage and environmental impact. ISO 50001 encourages businesses to set up clear energy policies and planning processes so that their energy goals are in line with their business strategy. The recommendation also emphasizes how crucial it is to track and report energy consumption to identify problem areas and guarantee advancement toward energy efficiency objectives. Since its most recent revision in 2018 (ISO 50001, 2018), the standard has been improved to consider the growing importance of carbon-neutral energy management techniques. Businesses may maximize energy performance, lower operating costs, and help create a more sustainable and carbon-neutral energy future by adhering to ISO 50001.

Organizations can show their dedication to maintaining high standards of customer satisfaction and product quality by following ISO 9001. Processes for continuous improvement, which assist companies in improving operations and resolving possible problems, are highly valued in the standard. Additionally, by guaranteeing that goods, such as wind turbines and their parts, satisfy both legal and consumer standards, ISO 9001 encourages regulatory compliance. The most recent iteration of ISO 9001, published in 2015 (ISO 9001, 2015), emphasizes the significance of digital transformation in quality management systems and uses advanced data analytics to enhance stakeholder management and process efficiency. In the end, ISO 9001 aids companies in the wind energy sector in improving product dependability, raising output, and cultivating closer bonds with stakeholders and clients.

EU Regulations and Directives :

Companies must match their activities with national and EU-wide renewable energy goals, as specified by the EU Renewable Energy Directive (RED II), which imposes legally obligatory renewable energy targets on EU member states. For Vaasa's wind energy producers, this entails making sure that their goods support Finland's renewable energy goals as well as the EU's overarching goal of consuming at least 42.5% renewable energy by 2030. Following these rules guarantees that wind energy products fulfill the necessary requirements to produce renewable energy while also advancing the green energy transition (Solt et al., 2024).

A foundation for defining specifications for the design of energy-related items, such as wind turbines and their parts, is provided by the EU Eco-design Directive (2009/125/EC). Manufacturers of wind energy are required to stick to eco-design standards, which emphasize energy efficiency and reducing environmental effects across a product's whole lifecycle. This entails cutting down on energy use, enhancing robustness, and making sure that goods are made to be easily recycled or disposed of. Businesses in Vaasa support sustainability and comply with EU laws that encourage environmentally friendly production methods by following these guidelines (European Environment Agency, 2025).

Finland's National Environmental Regulations :

For wind energy projects to develop sustainably, Finland's National Environmental Regulations are crucial. Manufacturers are required by the Environmental Protection Act (527/2014) to reduce their negative effects on the environment, with an emphasis on ecological preservation and pollution control (United Nations Environment Programme, 2025). The Water Act (587/2011) regulates water use, particularly in offshore wind farm projects, and mandates that manufacturers control effluent discharge and safeguard aquatic environments (Food and Agriculture Organization of the United Nations [FAO], 2011). By mandating manufacturers to perform Environmental Impact Assessments (EIA) to prevent disturbances to nearby communities and natural landscapes, the Land Use and Building Act (132/1999) guarantees that wind turbines are constructed in environmentally appropriate areas. These rules encourage the wind energy industry to adopt sustainable practices (*Land Use and Building Act*, n.d.).

Circular Economy Guidelines :

The Finnish Circular Economy Roadmap (2020) describes the country's plan to move toward a circular economy and encourages businesses, such as Vaasa's wind energy producers, to concentrate on cutting waste and making the best use of available resources (Sitra, 2016, p. 12). The significance of recycling, reusing materials (such as metals from wind turbine components), and designing items for disassembly is emphasized in this plan. Manufacturers of wind turbines are urged to use tactics that support these objectives, such as lessening the environmental impact of their manufacturing procedures. Because wind turbine blades are composed of composite materials that are difficult to recycle, end-of-life management is extremely important (Mishnaevsky, 2021). Vaasa manufacturers must embrace the circular economy by looking for environmentally friendly ways to recycle and dispose of turbine parts, guaranteeing that there is as little trash sent to landfills as possible.

Sustainable Procurement Standards :

To guarantee that wind energy projects in Vaasa meet environmental and regulatory requirements, sustainable procurement criteria are essential. For many public sector initiatives in Finland, especially those that receive government support, Green Public Procurement (GPP) is a crucial need. GPP requirements, which place a strong emphasis on the use of sustainable materials, energy-efficient production methods, and respect for stringent environmental standards, must be met by suppliers working on these projects (A Review of Green Public Procurement in the EU, 2022). Furthermore, Vaasa's wind turbine manufacturers and component suppliers must incorporate sustainability into their procurement procedures to meet the EU Green Deal and GPP criteria. This entails giving priority to renewable resources, cutting carbon emissions, and making sure that goods are made to be recyclable (European Commission, 2016, pp. 4–6). Businesses can improve their competitiveness in the market and support the larger environmental aims by following these requirements.

Carbon Footprint and Emission Reduction Standards :

Vaasa wind energy producers' sustainability initiatives primarily depend on Carbon Footprint and Emission Reduction Standards. Using standardized carbon accounting techniques, several businesses actively analyze their carbon footprint to evaluate and reduce emissions at every stage of the wind turbine lifecycle, including installation, transportation, and manufacturing. Manufacturers can greatly reduce their environmental impact by putting in place energy-efficient procedures, using renewable energy sources in production, and improving logistics. The revised Climate Change Act (July 2022), which formally requires reaching carbon neutrality by 2035, strengthens Finland's commitment to carbon neutrality. The Act establishes aggressive, legally binding goals to cut greenhouse gas (GHG) emissions by 60% by 2030, 80% by 2040, and 90–95% by 2050, excluding land use, land-use change, and forestry (LULUCF) (*Energy Policy Review Finland 2023*, n.d.).To reduce waste and pollution, these goals force Vaasa wind energy producers to use cleaner production techniques, improve material efficiency, and apply the concepts of the circular economy. By complying with such strong national laws, the wind energy sector in Vaasa is positioned as a major actor in the shift to a low-carbon economy and is in line with Finland's long-term climate plan as well as the larger goals of the EU Green Deal.

Offshore Wind Regulations (For Offshore Wind Farm Development) :

The Act on Offshore Wind Power in the Exclusive Economic Zone (EEZ), which will go into force on January 1, 2025, will help Finland develop its offshore wind energy industry. By creating a systematic regulatory framework for offshore wind farm development, this law makes sure that projects follow all applicable environmental and permitting regulations. The Environmental Impact Assessment (EIA), a crucial part of the Act, requires developers to assess and reduce possible environmental risks before project approval. The Act also specifies a transparent permitting procedure that speeds up the required permits to enable efficient project implementation. The law minimizes disturbances to marine biodiversity during the building and operating stages by enforcing ecological protection measures to safeguard maritime ecosystems. The Finnish government has demonstrated its commitment to increasing the nation's capacity for renewable energy by announcing plans to hold the first offshore wind offers by the end of 2025 (Finnish Government, 2025). The 2024 amendments to the regulations are expected to simplify the permitting process and enhance biodiversity protection, further driving the rapid development of offshore wind energy in Finland. By putting this Act into effect, Finland hopes to draw in investment, quicken its clean energy transition, and support international efforts to achieve carbon neutrality, solidifying its position as a leader in the development of sustainable wind energy.

Stakeholder Engagement and Social Responsibility :

Wind energy manufacturers in Vaasa play a crucial role in ensuring that wind farm projects are developed in a socially responsible manner. Gaining the public's trust, resolving issues, and cultivating sustainable support for renewable energy projects all depend on interacting with stakeholders, local communities, and environmental organizations. To address possible issues like noise pollution, landscape damage, and biodiversity protection, manufacturers and developers are required to hold open and honest consultations with local authorities and citizens. Companies actively engage in community development activities, which include job creation, infrastructural improvements, and educational campaigns to raise knowledge of renewable energy sources, in addition to minimizing adverse consequences. Corporate social responsibility (CSR) programs are used by many wind energy companies to make sure that their projects complement local objectives for social and economic advancement. These initiatives show a dedication to moral corporate conduct, guaranteeing that the growth of renewable energy benefits local communities as well as the sector. To preserve ecosystems and reduce disturbances to wildlife and natural habitats, businesses must conform to environmental impact assessment (EIA) regulations and implement mitigation techniques.

To improve their corporate responsibility and sustainability performance, Vaasa's wind energy producers match their operations with the Sustainable Development Goals (SDGs) of the UN. The SDGs listed below are especially relevant to the production of wind energy:

SDG 7: Affordable and Clean Energy: By facilitating greater access to clean and renewable energy sources, wind energy producers assist Finland, and the EU meet their carbon neutrality goals. The manufacturing of wind turbines and their parts facilitates the move away from fossil fuels, fostering increased sustainability and energy security (United Nations, 2015).

SDG 12: Responsible Consumption and Production: By using eco-friendly materials, increasing production efficiency, and reducing waste output, wind energy companies put a high priority on sustainable supply chain management. By designing turbines and components to be recyclable and reusable, many manufacturers follow to the concepts of the circular economy, minimizing their impact on the environment over the course of the product's lifecycle (United Nations, 2015).

SDG 13: Climate Action: By producing low-carbon electricity, wind energy production directly contributes to efforts to mitigate climate change. Businesses in Vaasa are actively attempting to lower greenhouse gas (GHG) emissions related to the manufacture, shipping, and installation of turbines. Their dedication to combating global climate change is further strengthened by their commitment to carbon footprint reduction initiatives like Finland's Climate Change Act and the EU Green Deal (United Nations, 2015).

To sum up, businesses that produce wind energy in Vaasa must comply by a wide range of sustainability guidelines and criteria to guarantee that they support Finland's renewable energy objectives. To encourage sustainable practices in the wind energy industry and guarantee that manufacturers fulfill their social and environmental obligations, these standards—which include ISO certifications, EU directives, national environmental rules, and circular economy guidelines—are essential. While guaranteeing that Finland continues to be a leader in the development of renewable energy, these standards also help businesses to satisfy the demands of their stakeholders, such as investors, regulators, and the public.

2.6 Barriers to Implementing Sustainable Procurement in the Wind Energy Sector

Driven by both commercial pressures and environmental concerns, the wind energy industry in Vaasa, Finland, is leading the way in the shift to sustainable procurement practices. Even so, there are still several barriers that Vaasa's industries must overcome to completely incorporate sustainable procurement techniques into their daily operations. These challenges include all of which are discussed in more detail below.

- High Upfront Costs
- the scarcity of suppliers that satisfy sustainability standards,
- the complexity and variability of rules,
- internal opposition to change,
- a lack of knowledge or instruction regarding sustainable procurement methods.

To take full advantage of sustainable procurement in the wind energy industry, these challenges represent difficulties that need to be overcome. To successfully incorporate sustainable practices into their operations, Vaasa's industries have to understand and overcome these challenges. Each of these challenges is examined in greater detail in the sections that follow.

2.6.1 High Upfront Costs in Sustainable Procurement

In Vaasa's wind energy industry, sustainable procurement creates serious financial challenges, especially for SMEs. Despite the long-term advantages, the adoption of eco-friendly materials, such as recyclable metals and carbon-neutral polymers (Osman et al., 2022). While SMEs frequently lack the financial resources to invest in greener solutions without outside investment, large manufacturers like Vestas's struggle to strike a compromise between sustainability and cost-competitiveness (Vestas, 2023, p. 18). Cost pressures are increased by sustainable supply chains and logistics. For example, making renewable fuels more accessible to the shipping industry is a financial problem for Wärtsilä. Now, renewable fuels are more costly than conventional fossil fuels. Because these fuels are expensive and limited, ship owners are hesitant to invest in them. However, due to the lack of demand, fuel producers are unwilling to boost production (Säätöenergia, 2023). The cost of switching to electric trucks, low-emission ships, and sustainable fuels is considerable for businesses like Blomberg Stevedoring. The adoption of sustainable practices is delayed because these upfront expenditures are difficult to justify in the absence of government subsidies or regulatory incentives.

The financial burden is further increased by regulatory compliance. Businesses like Wärtsilä are required to spend on environmental certifications like ISO 14001 and Life Cycle Assessments (LCAs), which call for expensive software and professional assessments (Wärtsilä annual report 2023, n.d., p. 47). Although necessary for regulatory compliance and competitiveness, these expenses disproportionately affect smaller businesses, making the adoption of sustainability more difficult. Furthermore, green technology R&D expenditures are expensive but essential. Companies such as ABB and Peikko Finland Oy make significant investments in energy storage systems and recyclable steel foundations (*Yleistä*, 2025). These high development costs, however, frequently pose a challenge for SMEs, restricting their capacity for innovation and postponing industry-wide sustainability initiatives. In Vaasa's wind energy industry, the shift to greener procurement is still progressing slowly in the absence of funding.

2.6.2 Limited Supplier Availability

Finding materials that satisfy severe sustainability standards is a major difficulty for several of Vaasa's wind energy companies, including Vestas and Peikko Finland Oy. Companies are forced to purchase products from foreign vendors due to a shortage of local suppliers who are certified in ISO 14001 or who comply with EU legislation such as REACH and Eco-design directives (Durrani et al., 2024, p. 5). Small and medium-sized enterprises (SMEs) face financial challenges and lose their competitive edge in the wind energy industry because of this reliance on outside suppliers, which slows down the supply chain, makes logistics more complicated, and increases transportation costs.

Furthermore, certain technological elements like energy storage systems, recyclable materials, and low-carbon production methods are needed in the wind energy industry (*Zero-Waste vestas*, n.d.). Advanced components are required by companies such as Hitachi Energy Finland Oy and Vestas, but local suppliers might not have the technological know-how to make these parts sustainably. Due to their limited capacity for research and development (R&D), many local vendors are unable to update their production techniques to satisfy changing sustainability criteria (Ogunsuji et al., 2024, p. 1411). Businesses are forced to rely on foreign suppliers with advanced technology as a result, which raises costs and makes quality control, consistency, and lead times more difficult.

There are frequently significant operational and financial challenges when moving from non-sustainable to more sustainable suppliers. The broad adoption of green techniques in many companies is slowed down by their opposition to change. It is challenging for businesses like Blomberg Stevedoring and EPV Windpower Ltd. to confirm that their suppliers adhere to sustainability criteria. This process is made more difficult by the complexity of global supply networks and the absence of generally recognized sustainability certifications. These companies find it more difficult to verify that their suppliers are following sustainability standards in the absence of clear and consistent criteria, which may cause the adoption of sustainable practices to be further delayed (Durrani et al., 2024, p. 11).

2.6.3 Regulatory Complexity

For businesses in Vaasa, the complexity and uncertainty of regulations about procurement and sustainability in the wind energy industry pose serious difficulties. These difficulties result from the ever-changing national and international regulatory environment, the necessity for businesses to comply with a wide variety of environmental regulations, and the uneven evaluation of sustainability in various countries. All EU member states are required to meet the broad, general goals outlined in the EU Renewable Energy Directive (RED II). Its primary objective is to make sure that the EU as a whole works toward becoming carbon neutral by 2050 and reaches targets for renewable energy consumption, such as 40% by 2030 (European Parliament & Council, 2023). On the contrary, Finland's Local Rules are more precise and comprehensive. For instance, Finland is creating specific local rules for offshore wind energy, focusing on sustainability and environmental protection (Finnish Government, 2025). This affects manufacturing companies that they must have to conform to Finland's stricter environmental laws (such as the sourcing of materials like rare earth metals). and Local suppliers working with wind energy companies may need to meet higher environmental and sustainability standards. Now, if they want to supply turbines for an offshore wind project, they must meet both the EU’s broad renewable energy goals and Finland’s stricter material sourcing and environmental impact rules. If Finland adds stricter sustainability standards, this might increase costs or require design changes for the turbines.

Finland's wind energy projects have been significantly impacted by delays in regulatory approval. Long environmental studies and land-use permit procedures have presented difficulties for businesses like OX2. Due to revised assumptions about permitting delays and regulatory requirements, OX2 noted in its Quater 1 2024 Interim Report that it had reduced the number of projects it had undertaken, especially onshore wind projects in Finland and Sweden (OX2, 2024, p. 5).

Due to regional variations in renewable energy rules, large companies such as Vestas, ABB, and Hitachi face difficulties when expanding into new markets. Countries like the U.S. and those in Asia have various regulations, which makes operations more complicated and expensive, even if the EU has common aims for renewable energy.

The government of South Korea has been conducting auctions to encourage wind energy, with a particular emphasis on floating offshore wind technologies. However, South Korea has very strong winds, which create challenges for developing traditional, fixed wind turbines. Companies like Vestas, ABB, and Hitachi must adjust their designs or employ other technologies, such as floating turbines, to make sure they function well in South Korea's environment in response to these severe winds (Kirkland & Ellis LLP, 2024). Companies that use renewable energy in the US must comply with a complex set of laws that differ at the federal, state, and local levels. As a result, businesses must conform to various regulations in many countries, which increases the cost and duration of obtaining permissions and maintaining compliance (*Wind Energy Technologies Office*, 2017). When entering new markets, this can be a comparable issue for Vaasa firms like Vestas, Hitachi, or ABB. Their activities may be made more difficult by the fact that they are subject to different regulations in several nations or areas.

2.6.4 Internal opposition to change

Adopting new techniques can be severely restricted by internal opposition to change within Vaasa wind energy enterprises, especially when integrating cutting-edge technologies or moving towards more sustainable solutions. Organizational culture, a fear of the unknown, and worries about extra expenses or interruptions are some of the common causes of this resistance.

Vestas, a well-known wind turbine manufacturer, has encountered opposition to adopting new sustainable methods. The company has had to address concerns from employees who were used to traditional manufacturing processes. For example, implementing more energy-efficient technologies or switching to greener materials for turbine blades frequently necessitates alterations to production lines and employee training. Concerned about the possible interruptions to their routine and productivity, employees may push back against these changes internally because they can cause workflow disruptions and demand a large upfront investment (Vestas, 2024, p. 50).

One of the biggest obstacles to adopting sustainable practices for businesses like Hitachi Energy Finland Oy is internal resistance, particularly considering the rapidly developing technologies in the wind energy industry. For instance, a complex re-engineering of current products and systems is necessary to introduce WindSTARTM transformers for offshore wind turbines (Hitachi

Energy, 2024). Due to a lack of experience with the new technology and worries about possible production delays or job insecurity when previous systems are phased out, employees may oppose this change. The monetary consequences of these developments increase this unwillingness. Investing in renewable energy sources or energy-efficient technologies are examples of sustainable initiatives that frequently come with high upfront expenditures. Employees and managers at Hitachi Energy may oppose the company's move to these cutting-edge energy storage and optimization technologies because they are worried about the short-term financial effects and the unpredictability of the ROI. If the long-term advantages are not immediately evident, the business might have trouble getting its employees to support sustainability objectives, which could delay the adoption of essential technology improvements (Schleich & Article, n.d., p. 88).

Businesses in the Vaasa region may worry that putting more of an emphasis on sustainability may make them less competitive when compared to businesses that are free from environmental regulations or do not place as much emphasis on sustainability. Businesses in other regions, for instance, could not be subject to strict regulations aimed at minimizing their environmental effect, which could provide them with financial and flexible advantages. Employee resistance may result from their fear that these changes will make it more difficult for their business to remain competitive and expand in the market (Dechezleprêtre & Sato, 2014).

2.6.5 Lack of knowledge or Guidance

The lack of knowledge among staff members about sustainable procurement methods is a major problem for Vaasa businesses. Decision-makers may lack the skills to evaluate suppliers according to resource efficiency, ethical standards, or environmental factors since many companies lack dedicated sustainability officers or skilled procurement specialists (Hery Suliantoro & Fitriani, 2022). Employees may find it difficult to appreciate the long-term advantages of sustainable investments without the right training and knowledge, which makes it challenging to successfully incorporate these practices into procurement procedures. A major barrier for Vaasa-based businesses in the wind energy industry is their ignorance about sustainable procurement. Many workers and decision-makers lack the necessary skills to choose ethical and ecologically sustainable providers (Veers et al., 2023). Additionally, companies struggle to find staff with deep knowledge of sustainable procurement, making it harder to implement green practices.

Many businesses in the Vaasa region, particularly SMEs, can lack the funding necessary to recruit specialized staff to lead sustainable procurement activities or to provide thorough sustainability training. These businesses can also encounter other industry-specific difficulties associated with the wind energy sector. For instance, local suppliers who satisfy the strict sustainability requirements needed by the wind energy industry are frequently hard to find. In these situations, Vaasa businesses might find it challenging to adopt sustainable procurement without growing their network of suppliers, which could be expensive and logistically challenging.

2.6.6 Maintaining a balance between cost efficiency and sustainability

Finding a balance between sustainability and cost effectiveness is one of the main issues facing Vaasa, Finland's wind energy producers. Significant financial barriers exist due to the high costs of eco-friendly materials, energy-efficient manufacturing processes, and strict regulatory compliance, even though the industry is facing growing pressure to use greener and more sustainable procurement methods. Since many sustainable alternatives, such as low-carbon or recycled materials, are more expensive, it can be challenging for businesses to maintain economic competitiveness while still meeting environmental regulations. Financial resources are increased by supply chain delays, changing raw material prices, and the requirement for constant technical developments. Businesses also need to make investments in sustainable sourcing practices and lifecycle evaluations, which call for more resources and knowledge (Nettlenbusch et al., 2025, p. 6) Because of this, Vaasa's wind energy producers always struggle to balance their financial aims with long-term sustainability objectives, which poses an important barrier to the industry's expansion and innovation.

Because of its location, industry expertise, and cultural mentality, Vaasa, Finland, has challenges when it comes to implementing sustainable procurement procedures. First, its remote position makes it more difficult to establish environmentally friendly supply chains by raising transportation costs and carbon emissions. Second, Vaasa is well-known for its manufacturing and energy sectors, which frequently consume large amounts of energy and non-renewable resources, posing sustainability problems. Lastly, it can be challenging to put long-term sustainability goals above immediate cost savings because Finnish businesses, especially those in Vaasa, tend to place a strong emphasis on cost-effectiveness. These regional challenges show why Vaasa businesses require customized approaches to strike a balance between cost and sustainability.

2.7 Theoretical Framework and Conceptual Overview

The primary theories and ideas that underlie this investigation are presented in this chapter. It gives a summary of how these concepts apply to understanding sustainable procurement methods in the wind energy industry, specifically in Vaasa. The theoretical framework and its relationship to the study goals are covered in the section that follows.

2.7.1 Theoretical Framework and Research Relevance

This study explores sustainable procurement practices in the wind energy sector in Vaasa through the examination of several established theories. These consist of Stakeholder Theory, Resource-Based View (RBV), and Triple Bottom Line (TBL). Each of these frameworks offers an individual perspective that will help readers better understand how to make procurement choices in the wind energy sector more ethical, efficient, and sustainable.

Analysing the wider effects of procurement choices in Vaasa's wind energy industry requires the application of the Triple Bottom Line (TBL) theory. By adding social, environmental, and economic factors, TBL expands the scope of traditional procurement and makes sure that businesses in the industry take these factors into account when making decisions. TBL will evaluate results in sustainable procurement that go beyond cost, emphasizing effects like lowering carbon footprints, utilizing renewable resources, enhancing working conditions, and generating employment locally. This study will investigate how Vaasa's wind energy firms incorporate these objectives into their procurement strategy using TBL. TBL will also assist in assessing trade-offs between sustainability objectives, providing insight into how businesses strike a balance between the "People, Planet, and Profit" pillars while purchasing goods, services, and technology (Biswas & John, 2022, p. 2)

Utilizing a company's internal resources and skills to gain a competitive edge is the main goal of the Resource-Based View (RBV) hypothesis. RBV will investigate how businesses in Vaasa's wind energy industry use internal resources, like supply chain management experience, Life Cycle Assessment (LCA) knowledge, and specialist procurement skills, to advance sustainability (Barney, 1991, p.106). RBV emphasizes how procurement procedures can be improved by both material assets and intangible knowledge. For instance, a business might source parts from vendors who follow stringent environmental regulations by utilizing its knowledge of sustainable supply chains. To help Vaasa's wind energy producers minimize their environmental impact, maximize their profits, and guarantee long-term sustainability, this theory highlights the strategic significance of these resources in promoting sustainable procurement.

Understanding the connections and relationships between different stakeholders in sustainable procurement within Vaasa's wind energy sector will be made easier with the help of stakeholder theory. Suppliers, manufacturers, local communities, authorities, environmental groups, and customers are some of these stakeholders (Mitchell, Agle, & Wood, 1997, p.858) The investigation of how wind energy businesses interact with these groups to match procurement choices with their interests will be guided by the theory. For example, local populations may place a higher priority on issues like noise pollution or job generation, while authorities may concentrate on environmental compliance. To ensure long-term good effects in the industry, wind energy producers may need to collaborate with suppliers who satisfy sustainability criteria or local governments that support green efforts (Reynolds, 2024). This is where Stakeholder Theory will come in useful.

The Triple Bottom Line (TBL), Resource-Based View (RBV), and Stakeholder Theory theories offer a thorough foundation for understanding sustainable procurement processes in Vaasa's wind energy industry within the framework of this study. These theories are interconnected and complement each other, collectively guiding how businesses can balance economic, social, and environmental objectives while optimizing procurement strategies in the wind energy industry (Halonen, 2018, p.19)

The foundation for this is provided by the Triple Bottom Line (TBL) theory, which presents a comprehensive view of sustainability. By framing procurement methods in terms of social and environmental considerations in addition to cost, it aids in directing the research. TBL highlights the need for companies operating in Vaasa's wind energy sector to have a balanced approach to procurement, making sure that the acquisition of goods, services, and technologies benefits people, the environment, and financial gain (Biswas & John, 2022, p. 46). This theory is related to the Resource-Based View (RBV), which emphasizes how businesses can successfully apply TBL by utilizing their own resources and competencies, such as knowledge of sustainable supply chain management. Businesses in Vaasa's wind energy industry may utilize their distinct assets, such as local expertise, existing connections, and technological expertise, to develop sustainable procurement plans that promote environmental objectives, cut expenses, and improve long-term commercial viability (Barney, 1991, p. 105)

In addition, by emphasizing the relationships between the different players involved in sustainable procurement, Stakeholder Theory enhances TBL and RBV. This approach emphasizes how crucial it is to comprehend the various interests of stakeholders, including local people, suppliers, regulators, and environmental organizations. To make sure that procurement choices in Vaasa meet their requirements and expectations, the wind energy sector must involve these stakeholders. Therefore, by analyzing how businesses resolve disputes and work together with many stakeholders to attain sustainability, stakeholder theory fills the gap between the real-world implementation of TBL and RBV.

By offering an organized method for examining the complex structure of sustainable procurement in the wind energy industry, these theories work together to help frame and direct the research. By developing a framework that incorporates both internal capabilities and external connections, they enable the research to examine how procurement decisions in Vaasa might be improved for social and environmental benefits in addition to cost-efficiency. By bringing these theories together, the study will investigate how sustainable procurement methods in Vaasa's wind energy sector may support sustainability while also guaranteeing the industry's sustainability and resilience.

2.7.2 Bridging Theory to Practice

TBL theory encourages companies to think beyond cost and efficiency when making buying decisions in Vaasa. TBL can be used by Vaasa wind energy firms to evaluate suppliers according to financial, social, and environmental standards (Biswas & John, 2022, p. 46). Important elements include financial performance like cost competitiveness, social impact like fair labour practices, and environmental policies like carbon reduction. By incorporating renewable energy technologies that lower carbon footprints and encourage local job creation and community engagement, TBL makes sure procurement decisions demonstrate a commitment to sustainability (International Labour Organization, 2013, pp. 23-27). This method helps procurement officers select suppliers who share sustainability objectives, which eventually leads to more sustainable wind energy projects that benefit Vaasa's economy, society, and environment.

RBV places a strong emphasis on using internal assets and skills to obtain a competitive advantage, particularly in procurement procedures (Barney, 1991, p. 107). Businesses in the wind energy industry in Vaasa can develop distinctive procurement strategies that promote long-term sustainability by utilizing their own experience in sustainable supply chain management, Life Cycle Assessments (LCA), and local knowledge. For example, Vaasa's wind energy producers can use internal resources to choose suppliers who share their commitment to sustainability or reduce waste by managing resources effectively. Vaasa's businesses can reduce expenses while maintaining sustainable procurement practices by utilizing RBV resources, such as technical advancements, connections with stakeholders, and knowledge of environmental regulations (Jezierski et al., 2021). This idea assists Vaasa procurement teams in concentrating on enhancing internal capabilities to improve sourcing choices and lessen environmental effects.

Stakeholder Theory is essential in real-world procurement because it highlights the importance of considering the interests of all parties involved in the procurement process. This includes a wide range of stakeholders in the wind energy industry in Vaasa, including suppliers, local communities, regulators, environmental organizations, and consumers (Ramponi, 2017, p.1995) Stakeholder theory can be used by Vaasa businesses to interact with these groups in ways that benefit all parties. Companies must, for instance, manage legal responsibilities, respond to community concerns, and work with environmental organizations to guarantee sustainability standards while procuring materials for wind turbines or installing renewable technologies (Wüstenhagen et al., 2007). The study of how Vaasa companies handle these relationships is guided by stakeholder theory, which makes sure that procurement choices benefit all parties involved and encourage cooperation to promote positive change, such as lowering environmental impacts, preserving local jobs, and following to environmental regulations.

The theories offer useful insights into how procurement choices would affect various stakeholders in Vaasa's wind energy industry. For instance:

The social outcomes of TBL procurement decisions, such as the creation of jobs, better local infrastructure, and community development programs connected to wind energy projects, may be advantageous to local communities (International Labour Organization, 2013, p. 33)

To supply the goods or services required for wind turbine projects in Vaasa, suppliers may be required to conform to stricter sustainability standards as outlined by RBV (Ogunsuji et al., 2024, p.1410). Innovating and bringing their activities into compliance with environmental regulations may be encouraged by this.

To make sure that procurement choices comply with national and international sustainability standards, regulators are essential. Stakeholder theory emphasizes how important it is for Vaasa businesses to stay in constant contact with authorities to guarantee adherence to environmental regulations.

The social and environmental aspects of TBL, where businesses are more concerned with minimizing their environmental impact and obtaining sustainability certifications, may influence buying decisions for environmental organizations.

Each of these theories will help in addressing the study's goals and research questions by directing the examination of how sustainability objectives influence Vaasa's procurement processes and pointing out obstacles to their adoption.

Research questions are

Q1: What procurement procedures does Vaasa's wind energy manufacturing sector currently follow?

Q2: What are the main barriers to implementing sustainable procurement methods in Vaasa's wind energy sector?

Q3: How can Vaasa's wind energy industry improve its environmental performance and efficiency through sustainable procurement practices?

The study of procurement procedures in Vaasa's wind energy industry will be guided by the Triple Bottom Line (TBL) Theory, which examines how businesses strike a balance between social, economic, and environmental factors. TBL will assist in determining whether Vaasa's wind energy firms presently take sustainability elements into account when making procurement decisions, going beyond cost concerns, such as social effect (e.g., job creation) and environmental consequences (e.g., carbon reduction), to answer Research Question 1. TBL will evaluate how businesses might use sustainable procurement strategies to enhance their environmental performance and efficiency in response to Research Question 3. The theory will investigate methods for obtaining renewable resources, cutting carbon emissions, and encouraging long-term sustainability, ultimately assisting Vaasa's wind energy industry in meeting its financial and ecological objectives.

Understanding the internal difficulties and capacities of Vaasa's wind energy industry regarding sustainable procurement will be made possible by the Resource-Based View (RBV) Theory (Barney, 1991). RBV will assist in identifying internal barriers that could prevent the adoption of sustainable procurement practices, such as knowledge, skill, or resource shortages, in relation to Research Question 2. The study will identify the problems that businesses face by looking at how they use internal skills like supply chain management knowledge and technological advancements. For Research Question 3, RBV will investigate how businesses can use their internal resources—such as an understanding of Life Cycle Assessments (LCA) and solid supplier relationships—to improve environmental performance and procurement practices' efficiency

By analyzing the impact of different stakeholders on procurement procedures in Vaasa's wind energy industry, Stakeholder Theory will direct the study in answering all three research objectives. For Research Question 1, The theory will evaluate whether the interests of suppliers, regulators, local communities, and environmental organizations are balanced in the sourcing of materials and technology, as well as how these interests influence procurement decisions. For Research Question 2, Stakeholder theory will be used to identify outside factors that could prevent the implementation of sustainable procurement techniques, such as complex regulations or disputes among stakeholders. Lastly, in response to Research Question 3, the theory will emphasize how cooperation and relationship-building amongst stakeholders—including governments, suppliers, and local communities—can promote sustainable procurement methods and enhance environmental performance in Vaasa's wind energy industry.

2.7.3 Theoretical Gap

The study's theoretical gap is the lack of studies that have explicitly used sustainable procurement methods in the context of Vaasa's wind energy industry. Although research on sustainable procurement has been conducted in several industries, few have looked at how it functions in the wind energy sector, especially in a regional context like Vaasa, Finland, which is well-known for its large wind energy industry. By using well-known theories—Triple Bottom Line (TBL), Resource-Based View (RBV), and Stakeholder Theory—this study closes this knowledge gap by examining how Vaasa's wind energy firms incorporate sustainability into their procurement procedures.

Despite extensive discussion in the literature, TBL, RBV, and Stakeholder Theory have not yet found widespread use in the wind energy industry, particularly at a regional level such as Vaasa. Without going into the distinctive features of regional sectors, a great number of research on sustainable procurement concentrate on broad industries or extensive global patterns. With its expanding wind energy industry, Vaasa offers a unique example of how local dynamics, stakeholders, and procurement procedures may differ greatly from those found in bigger, global contexts (Aslani et al., 2013). By applying these theories to investigate how procurement procedures in Vaasa's wind energy industry may be made both economically effective and sustainable, this study aims to fill that gap.

Although there has been considerable research on sustainable procurement in the worldwide wind energy business, there are hardly any studies that concentrate on Vaasa. Due to Vaasa's distinct economic, regulatory, and environmental circumstances, the opportunities, challenges, and approaches pertaining to sustainable procurement are probably not the same as those in other areas (Aslani et al., 2013). By concentrating on Vaasa, this study not only advances theoretical understanding but also offers useful information for regional stakeholders, including businesses and government. It will draw attention to regional issues that affect sustainable procurement choices in Vaasa's wind energy industry, such as regional laws, stakeholder dynamics, and market circumstances.

Overall, by filling in these gaps, the study advances the theoretical knowledge of sustainable procurement in the wind energy industry, especially in local contexts like Vaasa. Additionally, it is practically relevant, providing policymakers and local wind energy companies with useful information to enhance procurement methods that strike a balance between social, economic, and environmental goals.

3 Research Methodology

3.1 Research Philosophy

The constructivist research philosophy, which is the foundation of this study, holds that knowledge is co-constructed by human interactions, experiences, and the social context (Klotz & Lynch, 2007, p. 15). This method highlights how crucial it is to comprehend the viewpoints of various stakeholders, including manufacturers, suppliers, legislators, and local communities, to shape procurement procedures in the context of Vaasa's wind energy manufacturing industry. It assumes that social, economic, and contextual factors—in addition to data—have an impact on procurement decisions (Klotz & Lynch, 2007, p. 16).

A mixed-approaches strategy is used in the study, combining quantitative and qualitative research methods. Because it enables the examination of both contextual insights and empirical data pertaining to sustainable procurement procedures in the wind energy industry, this technique is appropriate for the study's goals (Hesse-Biber & Johnson, 2015, p. 21).

The analytical framework employs a deductive logic, utilizing pre-established themes from the Triple Bottom Line (TBL), Resource-Based View (RBV), and Stakeholder Theory to direct the coding and interpretation of qualitative data, despite the interpretivist nature of the whole research. This maintains openness to fresh perspectives while guaranteeing conformity with the theoretical foundation.

Overall, the study's objective of bridging the gap between the theoretical foundations of sustainable procurement and their real-world implementation within the framework of Vaasa's wind energy industry is supported by the mixed-methods methodology. It provides a more thorough and useful set of findings by allowing a more thorough understanding of the contextual elements that affect procurement decisions, as well as the empirical proof of their efficacy.

3.2 Research Design:

The present study used a mixed exploratory and descriptive research approach to successfully address the research goals of sustainable procurement in the wind energy manufacturing industry in Vaasa. Since procurement methods in this regional and industrial context have received little scholarly attention, the exploratory component is essential for revealing fresh perspectives and highlighting obstacles to long-term adoption (Creswell & Creswell, 2018, p. 304).

The study can examine stakeholder opinions, perceptions, and contextual dynamics related to procurement practices thanks to the exploratory design. This makes it easier to uncover hidden motives and difficulties that might not be evident from just looking at quantitative data. By evaluating policy papers, performance indicators, and business practices, the descriptive design, on the other hand, enables an organized account of present procurement methods and aligns them with sustainability goals.

When combined, these complementary methods enable the study to use survey data and document analysis to explain established practices and to investigate new themes through interviews. A thorough grasp of how procurement decisions are made, what sustainability components are being included, and where improvements may be made is made possible by this dual focus (Creswell & Creswell, 2018, p. 304). The study's overall objective of connecting theoretical frameworks with practical applications of sustainable procurement is ultimately supported by the research approach.

3.3 Research Strategy

With an emphasis on Vaasa's manufacturing sector, this thesis employs a scientific research methodology to investigate sustainable procurement procedures in the wind energy business. This study attempts to offer trustworthy and significant insights into procurement procedures (Neuman, 2013) while preserving objectivity and repeatability by utilizing qualitative methodologies, such as a small-scale survey and expert interviews (Adams et al., 2014, p. 5).

A cross-sectional design is used in this study to take a momentary picture of sustainable procurement methods. This method enables a thorough examination of present procedures, emphasizing opportunities, problems, and industry best practices. The study obtains a comprehensive grasp of procurement practices and their sustainability implications in the wind energy sector by utilizing both qualitative interviews and secondary data.

To identify patterns in procurement decision-making, the study employs a positivist technique, emphasizing the objective gathering and analysis of data. Although positivism places a strong emphasis on objectivity and empirical inquiry, the study also takes interpretivist findings into account, recognizing the impact of human interaction on research findings. This combination guarantees that the study provides accurate, trustworthy, and morally sound information into the wind energy industry's sustainable procurement procedures (Adams et al., 2014, p. 97).

3.4 Data Collection Methods

Semi-structured interviews and an online survey were the two main techniques used in this study to gather data. In keeping with the study's mixed-methods approach, these techniques were chosen to capture both detailed stakeholder perspectives and more general sector-wide patterns. Sustainable procurement methods in Vaasa's wind energy manufacturing sector were the focus of the data collecting.

Semi-structured Interviews:

Semi-structured interviews with important procurement players, including as procurement managers, supply chain specialists, and sustainability officers from Vaasa-based businesses, were used to collect qualitative data. The purpose of the interview guide was to investigate participants' perspectives, methods of decision-making, difficulties, and approaches concerning sustainable procurement. With participant consent, all interviews were performed online or in person, audio recorded and then transcribed. A deductive coding scheme based on the Triple Bottom Line (TBL), Resource-Based View (RBV), and Stakeholder Theory served as the basis for thematic analysis of the data. By using these theories as the foundation for pre-established categories, the study was able to evaluate how actual procurement procedures match theoretical models while keeping an open mind to the possibility of context-specific revelations (Lancaster, 2005, p. 134).

Surveys:

Professionals in procurement positions in Vaasa's wind energy industry were given access to an online survey to supplement the results of the interviews and offer measurable proof. Both closed-ended and open-ended questions about supplier selection criteria, sustainable practices, procurement priorities, implementation challenges, and future trend expectations were included in the survey. Frequencies and percentages were among the descriptive statistical techniques used to examine the survey data (Creswell & Creswell, 2018, p. 207). To guarantee data triangulation and enhance comprehension of sector-wide patterns and difficulties, these findings were compared and linked to the themes that emerged from the interviews.

The study used a sequential exploratory approach, and the survey instrument was developed based on themes found in the interviews. This made it possible to focus on important areas of interest and guarantee that the qualitative and quantitative elements were in line. Through the integration of quantitative survey patterns and thematic insights from interviews, the study offers a thorough understanding of procurement procedures in Vaasa's wind energy sector. Through the application of the selected theories (TBL, RBV, and Stakeholder Theory), both datasets were analysed, enabling the study to connect empirical results with accepted theoretical frameworks.

3.5 Sampling Strategy

A systematic sampling technique will be used for this study to choose individuals with relevant experience in sustainable procurement in the wind energy manufacturing industry in Vaasa. This approach guarantees that the people selected can offer comprehensive insights on procurement procedures and how they relate to sustainability (Creswell & Creswell, 2018, p. 212).

Key stakeholders, including supply chain experts, procurement managers, and sustainability officers, will participate in semi-structured interviews as part of the qualitative component. Supply chain experts will share their perspectives on how the procurement process incorporates sustainable practices. Procurement managers, who oversee monitoring procurement policies, will provide insightful opinions on how decisions are made and what influences procurement tactics. Sustainability officers will offer a more thorough comprehension of the difficulties involved in integrating sustainability objectives with procurement choices. To comprehend the larger context, including laws and policies that affect procurement processes, industry professionals and legislators will also be questioned.

A survey aimed at wind energy suppliers and manufacturers in Vaasa's wind energy industry will be used for the quantitative component. These participants, who work directly in the procurement process, will provide insights regarding the industry's application and perception of sustainable procurement methods. To supplement the qualitative information obtained from interviews, the survey will concentrate on collecting information on the existing procurement practices and their effects on the environment, society, and economy.

By choosing individuals with relevant experience and skills, the planned sampling strategy supports the goals of the study. To answer the study questions about sustainability and procurement processes in Vaasa's wind energy industry, this will guarantee the collection of extensive, context-specific data. A comprehensive understanding of the procedures, difficulties, and possibilities in sustainable procurement will be possible thanks to the mix of qualitative interviews and quantitative surveys. This approach enables the study to provide a thorough understanding of procurement methods in Vaasa's wind energy sector by capturing both the complex, individualized experiences of stakeholders and the larger patterns across the industry.

3.6 Data Analysis Methods

Both descriptive statistical analysis and thematic analysis were used to evaluate the data in accordance with the study's mixed-methods methodology.

A thematic analysis of the interview transcripts was done for the qualitative data. Following a logical approach, the analysis's themes were predetermined using the theoretical framework, particularly components from the Resource-Based View (RBV), Stakeholder Theory, and Triple

Bottom Line (TBL). These ideas functioned as analytical frameworks for classifying and interpreting participant answers. While allowing for new information to enhance the interpretation when appropriate, this method made sure the study stayed theoretically based (Adams et al., 2014, p. 158).

Descriptive statistics, such as frequencies and percentages, were used to examine the quantitative data from the survey replies. This aided in determining shared procurement procedures, perceived challenges, and sustainability sentiments among various stakeholder groups. The descriptive results offered important support and validation for the themes found in the qualitative analysis, despite the sample size restricting advanced statistical testing. The study was able to connect theory and practice by integrating descriptive statistics and deductive theme analysis, which brought empirical data into line with the theoretical models and research goals.

The study may examine both the subjective viewpoints of stakeholders and the objective, quantifiable results of procurement methods, thanks to the combination of thematic analysis and descriptive statistics. This strategy is consistent with the mixed-methods methodology, which enables a comprehensive analysis of sustainable procurement in the wind energy industry in Vaasa. The research will offer a thorough grasp of the complexity and dynamics of procurement strategies in this environment by combining qualitative and quantitative data.

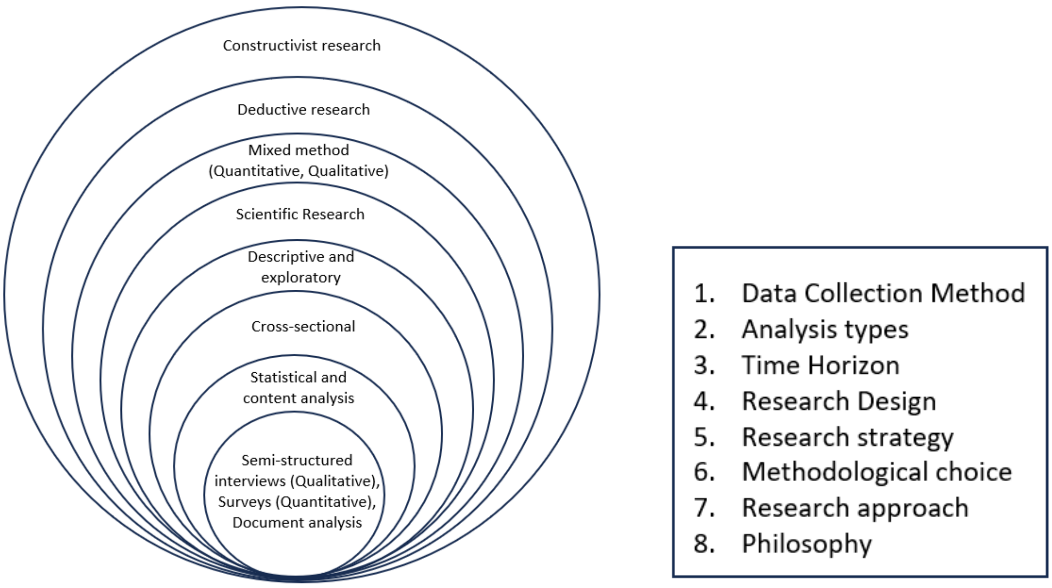

Figure 2 : Research Methodology.

3.7 Ethical Considerations

To ensure credibility, ethical integrity, and dependable results, trustworthiness is crucial in both research and procurement (Shenton, 2004, p. 64). It guarantees ethical sourcing, improves transparency, and develops solid connections with suppliers in the buying process. Trustworthiness in research guarantees that results are unbiased, accurate, and significantly advance our understanding. To establish the credibility of my thesis:

> *Credibility*: The study collects information from a variety of sources, such as sustainability reports, survey results, and interviews with procurement specialists. A well-rounded and balanced analysis is ensured by using a variety of sources (Shenton, 2004, pp. 64–69).
>
> *Dependability*: A well-defined and methodical research procedure is used, guaranteeing methodological consistency and enabling the study to be repeated with results that are comparable (Shenton, 2004, p. 71).
>
> *Confirmability:* Rather than depending on subjective beliefs, the conclusions are supported by actual data and facts. Peer review and open documentation are two practices that lessen biases and increase objectivity (Shenton, 2004, p. 72).
>
> *Transferability*: Other companies aiming to enhance sustainable procurement procedures can also benefit from the knowledge gained from this study, which is not just restricted to Vaasa's wind energy sector (Shenton, 2004, p. 70).
>
> *Reliability*: Consistency in responses was guaranteed by the survey instrument employed in this investigation. To find any ambiguities, the questions were examined in an initial stage and were straightforward and well-structured. This guarantees that the survey would provide comparable findings under the same circumstances if it were conducted again (Squires & Brady, 2006, p. 238).
>
> *Validity*: To guarantee content validity, the survey questions were precisely in line with the study's goals. Furthermore, to guarantee construct validity and improve the precision and applicability of the results, the findings were cross-checked with interview insights and secondary data (such as sustainability reports) (Squires & Brady, 2006, p. 238).

By adhering to these guidelines, our study guarantees accurate and significant results. Both academic research and real-world business applications gain from the study's credibility, which is enhanced by a robust methodology, ethical approach, and open reporting.

4 Empirical Research

This thesis's empirical portion examines procurement practices in the wind energy manufacturing industry in Vaasa, with a focus on sustainability. To offer useful insights into the potential and difficulties related to sustainable procurement, this part presents the research findings based on data gathered by [data gathering method: surveys, interviews, industrial report, etc.]. The results will be examined considering the previously developed theoretical framework, which examines sustainable supply chain management, industry best practices, and procurement principles.

The following important research topics are intended to be addressed by this empirical study:

> **Q1:** What procurement procedures does Vaasa's wind energy manufacturing sector currently follow?
>
> **Q2:** What are the main barriers to implementing sustainable procurement methods in Vaasa's wind energy sector?
>
> **Q3:** How can Vaasa's wind energy industry improve its environmental performance and efficiency through sustainable procurement practices?

The empirical study explores current procurement strategies in Vaasa's wind energy sector, looking at both established and new sustainable practices to provide answers to these issues. The study also looks at the operational, legal, and financial barriers that businesses must overcome to switch to more ecologically friendly buying practices.

The theoretical framework, which serves as the basis for comprehending sustainability concepts and procurement methods, has a close connection to the empirical component. The results will be interpreted using theoretical ideas like supplier collaboration, circular economy principles, and green supply chain management. To provide suggestions for improving sustainability and efficiency in procurement procedures, this study will compare established theories with actual procurement practices in Vaasa's wind energy sector.

This study uses a mixed-method approach, collecting quantitative data on sustainability indicators and procurement metrics using a structured survey and qualitative data from semi-structured interviews with procurement managers. When assessing sustainable procurement strategies, this dual approach enables both breadth and depth of understanding (Creswell & Creswell, 2018, p. 297). Semi-structured interviews with procurement managers, supply chain specialists, and sustainability officials from Vaasa-based wind energy manufacturing companies made up the qualitative component. The interviews centered on sustainability practices, obstacles, and procurement strategies. With the participants' permission, recordings were made during each session, which lasted roughly thirty to forty-five minutes.

Semi-structured interviews were used to collect primary data. Business papers, trade journals, and policy documents pertaining to Vaasa's wind energy sector were the sources of secondary data.

Five participants provided comprehensive insights into sustainable procurement techniques and procurement practices in the wind energy industry for the qualitative component:

<table>
<tr><th>Interviewee</th><th>Position</th><th>Duration</th><th>Channel</th></tr>
<tr><td>A</td><td>Global Sourcing Sustainability Manager</td><td rowspan="2">28 minutes 09 seconds</td><td rowspan="2">Combine Interview on Teams</td></tr>
<tr><td>B</td><td>Engine Powerplant Sourcing Expert</td></tr>
<tr><td>C</td><td>Development Manager, Sustainability and Future Fuel Concept</td><td>18 minutes 33 seconds</td><td>Interview on Teams</td></tr>
<tr><td>D</td><td>Supply Quality Engineer</td><td rowspan="2">24 minutes 58 seconds</td><td rowspan="2">Combine Interview on Teams</td></tr>
<tr><td>E</td><td>Supply Manager</td></tr>
</table>

Table 3 : Overview of Interviewees – Positions, Duration, and Channels

Participant A, who oversees the sustainability of global sourcing, offered thoughts on how to include sustainable practices into international procurement plans.

Participant B, who oversees engine powerplant sourcing, talked about the difficulties in finding energy solutions in the wind energy industry.

Participant C, shares intentions for integrating sustainable procurement into operational strategies while working on future fuel plant development and sustainability activities.

Participant D, who works in supply quality engineering, provided information about quality control and procurement procedures.

Participant E oversees supply management and has shared information about procurement procedures, supplier relations, and associated difficulties in the wind energy industry.

Through semi-structured interviews, the study's qualitative component provides a great deal of flexibility, enabling the investigation of unforeseen topics that might come up during the discussion. This adaptability is essential for revealing fresh viewpoints on procurement procedures, the obstacles to environmentally friendly procurement, and the difficulties faced by businesses in Vaasa's wind energy industry. Furthermore, the comprehensive character of qualitative data makes it possible to investigate complex topics that are frequently hard to convey through numerical data alone, such as the incorporation of sustainable practices, industrial difficulties, and obstacles to successful implementation.

The quantitative component includes surveys aimed at acquiring structured information from a broader set of industry professionals. Since the survey consists of multiple-choice questions, the data obtained is quantitative, allowing for statistical analysis to detect patterns and trends in procurement habits. The survey enhances the qualitative findings by providing a numerical viewpoint on sustainability initiatives and procurement problems, guaranteeing a fair and comprehensive study (Creswell & Creswell, 2018, p. 207). Both primary and secondary data form the basis of the study.

19 survey responses were gathered from a larger group of industry professionals working in sustainability or procurement in the wind energy sector, in addition to the interviews. Respondents included professionals from leading manufacturing firms based in the Vaasa region. The multiple-choice questions in the survey provided quantitative information that supports the qualitative understandings gained from the interviews.

This study's survey component provides structured data from a larger sample of wind energy industry professionals, which enhances the qualitative insights gained from the interviews. The survey's multiple-choice questions produce quantifiable data that may be statistically examined to find trends, patterns, and connections between various aspects of sustainability initiatives and procurement practices. Beyond the insights gained from a limited number of interviews, the comments gathered from industry specialists at leading organizations in the Vaasa region provide broader representation and support the generalization of the findings. Trends including the use of sustainable procurement practices, difficulties encountered, and the general condition of industry procurement procedures can all be found using this quantitative technique.

The procurement procedures in Vaasa's wind energy manufacturing industry are the main topic of this case study, which also looks at businesses that produce and develop renewable energy solutions. The main businesses in this case study are key industrial actors, all of which are essential to the production and advancement of technologies for the wind energy industry. In addition to making contributions to the global energy market, these businesses prioritize sustainable practices in their procurement procedures, which is a key component of the study.

4.1 Qualitative analysis

This section's analysis was driven by a theory-based thematic approach. The Triple Bottom Line, Resource-Based View, and Stakeholder Theory are just a few of the well-known sustainability theories that served as the foundation for the pre-developed themes. The interview and survey questions were better organized according to these predetermined themes. The study was able to concentrate on how participant data confirms or denies these theoretical concepts by employing this deductive approach. This method makes sure that the study remains theoretically grounded and makes it possible to compare the results with what is already known about sustainable procurement.

This section presents the key themes that were utilized to examine the qualitative interviews with experts in wind energy procurement. The data collection approach was organized around these themes, which were derived from well-established sustainability ideas. The results are arranged in the following categories (see Appendix 2, p. 2).:

1. Supplier Evaluation
2. Sustainability in the buying process
3. Operational and regulatory obstacles
4. Possibilities for enhancement
5. Technology in Procurement
6. Material Sourcing operational emissions

Direct statements from the interviewees are used to examine each theme, which is then interpreted using the theoretical frameworks—the Triple Bottom Line, Resource-Based View (RBV), and Stakeholder Theory—introduced in the literature study. When combined, these theories offer a strong basis for understanding environmentally friendly procurement procedures in the wind energy industry.

4.1.1 Supplier Evaluation

Supplier evaluation, or how businesses evaluate and manage supplier relationships with an increasing emphasis on sustainability, is one of the major issues that came out of the interviews. Organizations are progressively incorporating sustainability standards into their procurement procedures in the context of Vaasa's wind energy industry through cooperative benchmarking, transparent procedures, and structured assessment tools. The Supplier Evaluation Process and Transparency, and Collaboration are two sub-themes that fall under this main theme.

Supplier Evaluation	Supplier Assessment Process	Sustainability Assessments	*"Every time we onboard a new supplier, they must complete specific assessments, including a sustainability assessment with dozens of questions." participant D.*	
		EcoVadis Ratings	*"We have started using a tool called EcoVadis... This tool rates suppliers based on their sustainability performance." participant E.*	
		Risk Evaluation		"We follow a supplier evaluation program where we first collect information by sending out surveys to suppliers... We also have automated systems in place that flag potential risks."participant B.
		Sustainability Criteria		"Currently, we do not have a specific scoring system for sustainability, but incorporating one in the future would be beneficial."participant B.
	Transparency and Collaboration	Supplier Audits	*"If a supplier's score on the sustainability assessment is too low, we are required to conduct an on-site audit to evaluate their sustainability practices." participant D.*	
		Group-Level Strategy	*"We need a group-level approach for setting and enforcing sustainability requirements, but this is still missing at the moment." participant D.*	
		Supplier Transparency		"We request information about their Scope 1 and Scope 2 emissions... Currently, our focus is on Tier 1 suppliers, but in the future, we plan to extend this transparency requirement to Tier 2 and Tier 3 suppliers."participant A.
		Industry Collaboration		"We focus on benchmarking—learning from others and collaborating with industry leaders to improve our sustainability efforts."participant A.

Figure 3 : Example of the coding and thematic analysis process for the theme "Supplier Evaluation"

Supplier Evaluation Process:

The importance of sustainability in the supplier onboarding process was underlined by the participants. Participant D claims that their company integrates sustainability by requiring thorough evaluations from all new suppliers.

> *"Every time we onboard a new supplier, they must complete specific assessments, including a sustainability assessment with dozens of questions." - participant D.*

This suggests that sustainability is a formal and structured aspect of supplier selection rather than simply an afterthought.

Participant E further supported this by mentioning the use of sustainability rating tools.

> *"We have started using a tool called EcoVadis... This tool rates suppliers based on their sustainability performance."- participant E.*

This is indicative of a growing movement in supplier management toward the standardization and digitization of sustainability assessment. This methodical assessment guarantees that sustainability will continue to be a crucial factor in the selection and oversight of suppliers.

According to Participant B, their organization assesses suppliers and controls risks using a mix of automated tools and surveys. They acknowledge the significance of sustainability for the future even though they do not currently have a formal scoring system in place.

> *"We follow a supplier evaluation program where we first collect information by sending out surveys to suppliers... We also have automated systems in place that flag potential risks. Currently, we do not have a specific scoring system for sustainability, but incorporating one in the future would be beneficial. We focus on benchmarking—learning from others and collaborating with industry leaders to improve our sustainability efforts." - participant B.*

Even in the absence of a formal grading system, this method demonstrates a progressive approach that depends on industry cooperation and learning from best practices to enhance sustainability performance.

Both acknowledge the significance of supplier evaluation in promoting sustainability, despite the differences in their methods. By forcing suppliers to conduct thorough sustainability studies and employing EcoVadis for direct performance ratings, one takes a more systematic and efficient approach. Second, on the other hand, employs a developing approach, depending on surveys, data collection, and benchmarking to gradually improve sustainability. Notwithstanding these variations, sustainability is emphasized by both businesses as a crucial component of long-term collaborations and supplier selection.

Transparency and Collaboration:

In managing supplier sustainability, participants underlined the need for openness and cooperation. Despite having different methods, both participants emphasized ways to increase supply chain accountability.

> *"If a supplier's score on the sustainability assessment is too low, we are required to conduct an on-site audit to evaluate their sustainability practices."- participant D.*

> *"We request information about their Scope 1 and Scope 2 emissions... Currently, our focus is on Tier 1 suppliers, but in the future, we plan to extend this transparency requirement to Tier 2 and Tier 3 suppliers."- participant A.*

Although they adopt distinct strategies, both place a strong emphasis on transparency in supplier sustainability practices. However, one uses audits to enforce sustainability requirements. In contrast, the second concentrates on monitoring the Scope 1 and 2 emissions of suppliers and hopes to eventually expand transparency to Scope 3. Both businesses understand that their supply networks require more stringent sustainability supervision.

Emissions in the production of wind energy components fall into three categories. Fuel used in manufacturing machinery or corporate vehicles is an example of scope 1 emissions that originate directly from a business's operations. Indirect emissions from purchased electricity or energy needed to run offices and companies are referred to as scope 2 emissions. Emissions from suppliers, transportation, and the product's post-purchase lifetime are all included in scope 3 emissions. The second company intends to broaden its efforts to incorporate Scope 3 for increased sustainability and transparency in procurement, but it already concentrates on monitoring Scope 1 and 2 emissions.

Supplier Readiness :

According to the participants, their organizations are just beginning to incorporate sustainability into their supplier agreements. Though not yet organized or completely defined, discussions about sustainable materials and methods are still going on.

> *"We are not yet at a stage where we always discuss the sustainability level of materials with suppliers. We are still very early in this process." – participant C.*
>
> *"The biggest challenge arises when we buy finished products from suppliers... The difficulty lies in ensuring that suppliers follow the correct guidelines and requirements regarding what materials they procure." - participant B.*
>
> *"At the moment, we do have sustainability targets for suppliers, but they are still quite high-level... The exact expectations are not always clearly defined."- participant E.*

Both companies are just beginning to incorporate sustainability into their supply chain operations. One finds it difficult to make sure suppliers follow the proper regulations and to regularly review the sustainability of materials with them, particularly when buying completed goods. In the same way, Second has set sustainability goals for its suppliers, however, these goals are broad and lack specific demands. Although both businesses acknowledge the value of sustainability, they are still in the process of establishing and enforcing precise guidelines with suppliers.

In line with Stakeholder Theory, the results of the Supplier Evaluation Process, Transparency and Collaboration, and Supplier Readiness themes highlight how crucial it is to manage supplier relationships to meet sustainability objectives. Sustainability integration into supplier selection shows proactive management of these connections, while EcoVadis and other methods guarantee that suppliers behave responsibly as important stakeholders in supplier assessments. Transparency measures that acknowledge suppliers as important stakeholders impacting sustainability performance include exchanging emissions data and carrying out audits. The Supplier Readiness topic emphasizes the necessity for ongoing interaction and the difficulties in matching supplier skills with sustainability goals. These revelations immediately connect the findings to the fundamental ideas of Stakeholder Theory in the context of sustainable procurement, highlighting the need to strengthen supplier relationships for long-term value development.

4.1.2 Sustainability in the buying process:

During the interviews, sustainability in the purchasing process surfaced as a crucial subject, emphasizing the ongoing conflict between budgetary constraints and environmental responsibility. Businesses in the wind energy sector in Vaasa are working harder and harder to include sustainable practices in their purchasing choices. These efforts are frequently complicated, though, by issues including pricing pressure, price sensitivity of customers, and material performance constraints. As they transition to more environmentally friendly options, businesses must carefully evaluate trade-offs between sustainability, cost effectiveness, and quality assurance. Cost vs. Sustainability and Quality and Sustainability are the two primary sub-themes that fall under this theme.

Cost vs. Sustainability:

The participants highlighted the continuous conflict between implementing sustainable practices and preserving cost-effectiveness. For businesses looking to fulfil both financial and environmental goals, striking a balance between the two continues to be a significant problem.

> *"One of our key challenges is finding the right balance between cost and sustainability."- participant D.*
>
> *"One of the challenges is that our customers are not yet willing to pay extra for sustainable raw materials, such as green steel or eco-friendly sheet metals." - participant E.*

one must strike a balance between sustainability and cost. They must handle both without sacrificing one for the other, as participant D. According to participant E, a significant problem is that consumers are unwilling to pay more for environmentally friendly products like sustainable metals or green steel. This makes it more difficult for the business to completely embrace greener choices while maintaining pricing competitiveness.

The complex relationship between cost, procurement efficiency, and sustainability was often brought up by participants. One of the industry's biggest challenges is still finding a balance between these aspects.

> *"There is always a cost pressure when discussing sustainability. It becomes a balancing act between sustainability, cost, and procurement efficiency." – participant B.*

> *"Balancing cost and sustainability is very difficult... We are not yet at a stage where we always discuss the sustainability level of materials with suppliers. We ensure that maintenance does not become a significant cost over time. This means we incorporate life cycle thinking into how we design our solutions."- participant C.*

> *"When you calculate the total cost, including potential fines for using conventional methods, the price difference between gray fuel and green fuel becomes minimal." – participant A.*

one is under pressure to strike a compromise between costs and sustainability. Finding the ideal balance between cost, efficiency, and sustainability is difficult, according to participant B. According to participant C, they are not yet at a stage where they regularly talk to suppliers about the sustainability of materials, but they concentrate on lowering long-term maintenance costs by considering the full life cycle of products. participant A adds that the cost difference between conventional and green fuel is significantly less when possible, and fines for employing conventional methods are considered.

Both have trouble striking a balance between cost and sustainability. Customers' unwillingness to pay more for sustainable products presents a problem for one, making it more difficult to completely implement green practices. Similar difficulties are faced by the second in making sure suppliers comply with sustainability guidelines, particularly for final goods. However, by considering the full life cycle of items, they concentrate on long-term savings. Both businesses understand that sustainability is crucial, but they also need to figure out how to control expenses and stay competitive.

Quality and Sustainability:

Participants underlined that although sustainability is becoming more and more important, product quality and safety must not suffer as a result. It is encouraged to incorporate sustainable resources, including recycled plastics, but only within parameters that guarantee great performance and safety.

> *"If we increase the amount of recycled plastic too much, it could affect the performance and safety of the product... There are limits to how much recycled plastic we can currently use."- participant E.*

> "Sustainability is crucial, but if a product is sustainable yet compromises safety, then it’s not worth it... Quality cannot be compromised." Participant A.

Both businesses stress how crucial it is to strike a balance between product performance, safety, and sustainability. One emphasizes that although recycled plastic is good for the environment, there are restrictions on how much can be utilized without compromising the functionality and security of the device. Like this, the second emphasizes the importance of sustainability, but a sustainable product is not regarded as a good choice if it compromises quality or safety. Both businesses place a great priority on maintaining strict safety and quality standards in addition to their environmental objectives.

Because it stresses striking a balance between three important pillars—people (social impact), planet (environmental sustainability), and profit (economic viability)—the Triple Bottom Line (TBL) theory is relevant to the conversation. The economic aspect of TBL, where businesses must maintain financial stability while implementing sustainable practices, is shown in participants D and B's worries about striking a balance between cost and sustainability. Participant C's emphasis on lifecycle thinking, which considers decisions' long-term effects on the environment, is consistent with the ecological part. Furthermore, as mentioned by participants A and E, the focus on maintaining product quality and safety draws attention to the social component of TBL and guarantees that sustainability does not compromise user welfare. These issues are linked by TBL theory, which highlights how crucial it is to consider all three aspects while making decisions to achieve long-term success.

4.1.3 Operational and regulatory obstacles

As they work toward sustainability, wind energy companies face more and more operational and regulatory challenges. International compliance standards, complicated documentation requirements, and changing laws all make the procurement process more challenging. Businesses frequently suffer uncertainty because of delayed policy implementation and the rigorous nature of compliance procedures, despite their commitment to complying with environmental and material-sourcing rules. The industry's battle to preserve operational efficiency while staying in line with changing regulatory environments is reflected in this theme.

Regulatory Compliance:

Both businesses stress how crucial it is to comply with changing laws about material procurement and sustainability.

> *"Legislators are continuously introducing new regulations... For example, the Corporate Sustainability Due Diligence Directive (CSDDD) has been postponed by up to two years."- participant A.*

> *"We need to carefully track and verify the origin of our materials... We do not simply rely on supplier declarations—we conduct inspections and verify material certificates to ensure compliance."- participant B.*

> *"The basic idea is that we must report to the European Union how much emissions are generated in the production of the parts we purchase from outside Europe."- participant D.*

Through inspections and certificate verification, one takes the initiative to confirm the origin of materials and guarantee compliance. New rules, such as the Corporate Sustainability Due Diligence Directive (CSDDD), are continually being postponed, which presents difficulties for them as well. Second, on the other hand, emphasizes the necessity of tracking and complying with international reporting standards, highlighting the need to report emissions created from materials obtained outside of Europe. Although both businesses are committed to complying with rules, they struggle to keep up with the times.

A fundamental component of understanding the significance of internal resources for regulatory compliance is the Resource-Based View (RBV) theory. The necessity of strong inspection procedures and compliance systems to monitor material origins and comply to changing rules is emphasized by the participants. Participant A emphasizes how difficult it is to adjust to delayed directives like the CSDDD, highlighting the necessity for businesses to make use of their networks and expertise. participant D's emphasis on emissions reporting emphasizes the importance of internal resources, such as systems and technology. RBV demonstrates how organizational resources are essential for preserving compliance and competitive advantage in a regulatory environment that is always developing.

4.1.4 Possibilities for enhancement

Businesses in the wind energy industry are actively looking for methods to improve their environmental and social performance as sustainability standards continue to climb. This involves setting aggressive decarbonization targets, establishing responsible supplier relationships, and getting ready for upcoming regulatory changes. Although there has been progress in areas such as supplier audits, material innovation, and emissions tracking, a more united and strategic approach is still required. Businesses are actively attempting to integrate these ideals into their supply chains and operations because they understand how important sustainability's social and environmental components are.

Future Preparedness:

Both are actively establishing challenging sustainability targets. By investigating alternative sustainable materials

> *"We anticipate that sustainability requirements will increase in the future, so our current strategy is to be prepared and to explore alternative options for sustainable materials." - participant E.*

> *"We have set a target to be carbon neutral in our operations by 2030, which primarily focuses on Scope 1 and Scope 2 emissions. Our goal is to contribute to system-level and societal-level decarbonization. This requires increasing the share of renewables, such as wind energy, in the energy mix. Our goal is to contribute to system-level and societal-level decarbonization. This requires increasing the share of renewables, such as wind energy, in the energy mix."- participant C.*

> *"Our goal is to reduce Scope 1 and Scope 2 emissions by 25% by 2030... Varsila aims to achieve carbon neutrality in its operations by 2030." – participant A.*

one is highlighting their forward-thinking attitude and becoming ready for future, stricter sustainability regulations. In contrast, the second wants to achieve carbon neutrality by 2030, emphasizing the use of renewable energy sources and lowering Scope 1 and Scope 2 emissions. Both businesses are dedicated to drastically reducing their environmental impact in line with international decarbonization objectives.

Supplier Development and Sustainability Initiatives:

Enhancing supply chain sustainability is a top priority for both businesses. In addition to conducting thorough supplier evaluations, which include audits and quality inspections

> *"In supplier development, we conduct supplier assessment audits, quality process audits, and quality assurance inspections."- Participant B.*

> *"We are implementing a supplier CO2 emissions tracking platform... Starting in 2024, we will collect baseline emissions data from our direct and indirect suppliers. We are actively working to eliminate single-use plastics... Over the past few years, we have successfully reduced single-use plastic in packaging by 80%."- Participant A.*

> *"We conducted a Life Cycle Assessment (LCA) of a power plant about 1.5 to 2 years ago... Procurement accounted for only 0.5% of the total emissions. We have sustainable codes... They cover areas like human rights, labour practices, and ensuring no child labour is used. These are more related to social impacts." - Participant C.*

> *"We need a group-level approach for setting and enforcing sustainability requirements, but this is still missing at the moment. - Participant D.*

One is attempting to lower the usage of single-use plastics and monitor CO2 emissions. They also preserve social sustainability by enforcing labour and human rights standards. They do admit, though, that a coordinated, group-level strategy for implementing sustainability is still required. Second, on the other hand, is still working on creating such a method, despite acknowledging the significance of defining precise sustainability requirements. Although both businesses have a significant commitment to sustainability, a more organized and cohesive framework might yet be improved.

The Stakeholder Theory is relevant to this conversation because it highlights how crucial it is to manage relationships with different stakeholders to accomplish sustainability objectives. Both businesses are dedicated to enhancing their social and environmental performance, which is consistent with the theory's emphasis on satisfying stakeholders' demands, including those of suppliers, consumers, and government agencies. Both Participant C's objective of becoming carbon neutral by 2030 and Participant E's emphasis on investigating alternate sustainable materials demonstrate attempts to satisfy outside sustainability demands. The significance of including stakeholders, such as suppliers, in sustainable practices is also demonstrated by Participant A's supplier emissions tracking and Participant B's quality and sustainability audits. The importance of Stakeholder Theory is further supported by the fact that both businesses understand the necessity of a coordinated approach to guarantee thorough stakeholder participation.

4.1.5 Technology in Procurement

Digitalization is becoming more and more important in today's procurement procedures. Businesses are incorporating cutting-edge solutions to improve sustainable performance, transparency, and decision-making. These technical developments reflect the wind energy industry's increasing focus on data-driven and innovative procurement methods.

Incorporating Digital Tools:

Digital tools play an increasingly important role in enhancing procurement evaluation and sustainability efforts.

> *"We use various digital tools for procurement evaluation... Some digital tools also incorporate bonus-malus systems, where suppliers can receive extra points for meeting specific sustainability targets. We have a Total Cost of Ownership (TCO) calculation system that helps us determine the best supplier based on multiple criteria." – Participant A.*

> *"We have discussed the need to start studying how AI could be integrated into our daily operations. It's definitely a big topic... We need to explore how AI could be applied in procurement and sustainability." - participant D.*

One assesses suppliers using a variety of digital techniques. A bonus-malus system is one of these instruments, where suppliers receive extra points for achieving sustainability targets. To select the best supplier based on several criteria, they also employ a Total Cost of Ownership (TCO) approach. Second is starting to investigate the potential applications of AI in their day-to-day operations. They wish to learn more about the potential applications of AI in sustainability and procurement since they believe it to be a significant topic.

This topic is significant to the Resource-Based View (RBV) the theory since it highlights how crucial it is to use special internal resources and skills to obtain a competitive edge. The RBV's emphasis on leveraging resources, like cutting-edge technology, to generate value is in line with both businesses' use of digital technologies to improve sustainability performance and procurement procedures. Participant A's use of digital tools, such as the bonus-malus method and Total Cost of Ownership (TCO) system, demonstrates how businesses engage in cutting-edge resources to enhance sustainability and supplier selection. Similarly, an attempt to build new skills to remain competitive is seen in Participant D's investigation of AI for sustainability and procurement. A fundamental principle of the, these digital innovations show how utilizing cutting-edge resources can improve decision-making and sustainability outcomes.

4.1.6 Material Sourcing operational emissions:

Decarbonizing combustion processes and procuring materials sustainably are two major obstacles to reaching environmental targets. Businesses are attempting to decrease the usage of single-use plastics in packaging and use sustainable alternatives like green steel. However, attempts are being made to switch to sustainable fuels, which reflects a dedication to cleaner energy and lessening the impact on the environment, even if combustion is still a significant source of emissions. These initiatives show the challenges and advancements in building a more sustainable future.

Sustainable Materials:

Using sustainable resources is still a crucial but difficult part of supply chain management. One member draws attention to the challenges of implementing supply chain-wide preferences for eco-friendly products, such green steel.

> *"We encourage the use of green steel, but enforcing such preferences can be challenging, "- participant B.*

The gap between sustainability objectives and the reality of supplier compliance is shown by this comment. On the other hand, another person expresses a more positive conclusion regarding packaging innovations as a means of lowering environmental effects. With an 80% decrease in recent years, they declare notable progress in reducing the usage of single-use plastics:

> *"We are actively working to eliminate single-use plastics... Over the past few years, we have successfully reduced single-use plastic in packaging by 80%."- Participant A.*

While combined, these viewpoints highlight the difficulties businesses encounter while promoting the use of sustainable materials as well as the observable achievements they have made in environmental sustainability areas.

Focus on Combustion and Decarbonization:

Carbon emissions are still mostly caused by combustion, especially when fossil fuels are used. One participant highlights the basic difficulty of combustion processes by pointing out that carbon dioxide emissions are an inevitable byproduct of any fuel containing carbon*:*

> "When it comes to combustion, it is one of the main processes where emissions are always generated. If the fuel contains carbon, such as fossil fuels, it will produce carbon dioxide emissions." - participant C.

The business is working toward a forward-looking strategy centered on decarbonization in despite this barrier. They demonstrate their dedication to cleaner energy solutions by giving top priority to the development of engines built to run on sustainable fuels in the future:

> "Our primary focus is on enabling our engines to run on sustainable fuels in the future." - participant C.

This shows a dedication to switching to cleaner energy sources and a strong understanding of the effects on the environment today. When taken as a whole, these observations demonstrate the harm that modern combustion methods cause to the environment as well as the proactive measures being taken to switch to sustainable alternatives.

The Triple Bottom Line (TBL) theory, which highlights the harmony between social, economic, and environmental sustainability, is pertinent to this conversation. Businesses must balance economic and environmental trade-offs when coordinating supplier practices with sustainability goals, as demonstrated by Participant B's difficulties integrating sustainable materials like green steel. Participant A's accomplishments in cutting back on single-use plastics are consistent with TBL's environmental component and demonstrate advancements in sustainable material sourcing. Participant C's emphasis on switching to renewable fuels and decarbonizing combustion processes demonstrates how committed enterprises are to the environment. By highlighting the significance of striking a balance between operational effectiveness, cost considerations, and environmental impact, TBL links these initiatives.

The primary study topic on sustainable procurement in Vaasa's wind energy industry is addressed via the qualitative themes of supplier evaluation, cost vs. sustainability, regulatory compliance, and the impact of technology. The results show that although sustainability is valued, businesses struggle to strike a balance between cost constraints and legal obligations. To overcome these obstacles, the Resource-Based View (RBV) hypothesis highlights the necessity of utilizing internal resources. The Triple Bottom Line (TBL) hypothesis highlights the balance between environmental, social, and economic concerns in decision-making. In the meantime, Stakeholder Theory emphasizes how crucial it is to involve suppliers and other stakeholders to promote sustainability. When taken as a whole, these observations offer a solid grasp of the industry's sustainable procurement procedures.

4.2 Exploring Quantitative Results through Thematic Frameworks

An online survey was used to get opinions from experts in the wind energy industry in Vaasa. Multiple-choice questions on procurement strategies, Likert scale items to assess attitudes toward sustainability in procurement, and demographic and role-based questions to categorize respondents were all included in the survey. Procurement managers, sustainability officials, and other relevant specialists from major wind energy corporations provided a total of 19 responses.

These people are crucial to their organizations' buying decisions and the implementation of sustainable practices.

To compare how the numerical data confirmed or disproved the ideas from the qualitative responses, the quantitative analysis was structured around the same themes that emerged from the qualitative findings. This integrated analysis provides a comprehensive view of current procurement practices in the wind energy sector.

4.2.1 Supplier Evaluation

Cost-effectiveness is the most important factor when choosing a supplier, according to survey results from businesses in Vaasa's wind energy sector, with 18 (95%) of respondents placing a high priority on it. Key considerations also include sustainability and environmental standards 14 respondents (74%), dependability and prior performance 15 respondents (79%), and regulatory compliance 15 respondents (79%) (see Appendix 4, p. 9). Another comment emphasized the significance of commitment and availability, highlighting the necessity of a thorough supplier selection process that strikes a balance between sustainability, cost effectiveness, and regulatory compliance. In line with the objectives of long-term environmental and economic responsibility, these findings are crucial for improving sustainable procurement processes throughout the industry.

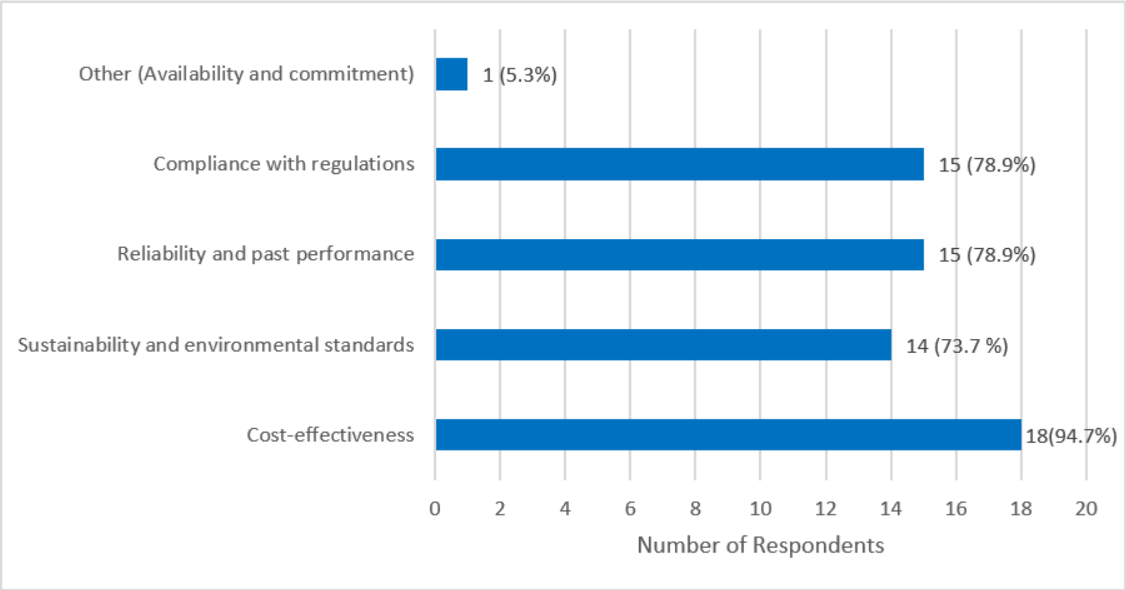

Figure 4 : Important Criteria for Supplier Selection (n=19)

4.2.2 Sustainability in the Buying Process

According to survey participants, the use of eco-friendly or recycled materials 5 respondents (29%), energy-efficient production and transportation 3 respondents (18%), and ethical and fair-trade procedures 9 respondents (52%) are important components of sustainability in procurement (see Appendix 4, p. 9). These elements are vital in determining the purchasing choices made by businesses in Vaasa's wind energy industry, emphasizing the significance of incorporating social and environmental responsibility into corporate operations to guarantee sustainability over the long run.

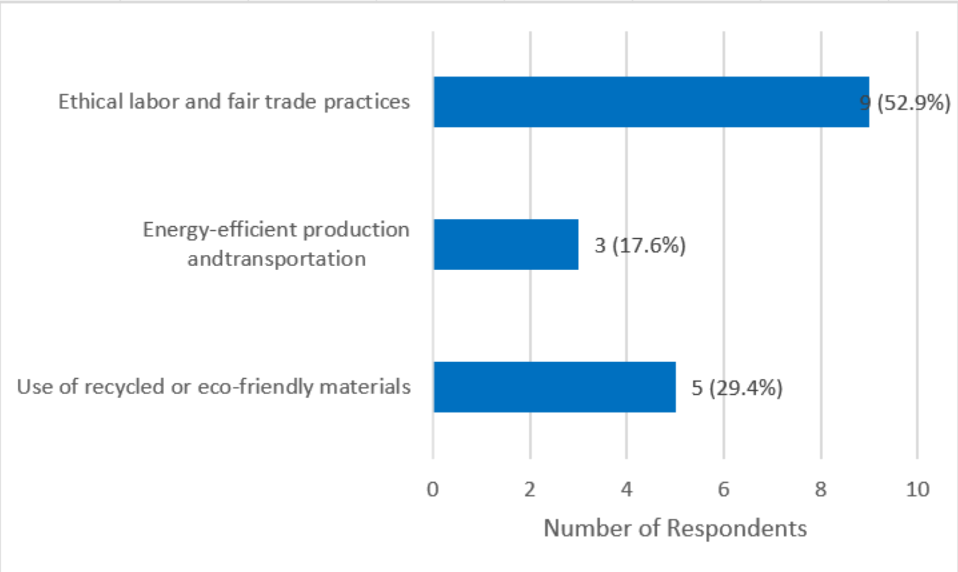

Figure 5 : Key elements of sustainability policy. (n=19)

None of the companies surveyed had a dedicated sustainability department, but the majority said they had sustainability policies in place. Additionally, 17 out of 19 respondents (90%) reported experiencing supply chain disruptions (see Appendix 4, p. 9), highlighting the difficulties faced even in the presence of sustainable rules. It also means that even while sustainability techniques are being incorporated, supply chain issues may still arise before they are completely optimized.

To investigate the connection between having a specialized procurement department and the probability of experiencing supply chain interruptions, a cross-tabulation was carried out (refer to Table 4). 7 (37%) of the 19 businesses surveyed said they had a procurement department, while 12 (63%) said they didn't. 17 (90%) of those with a procurement team experienced disruptions, compared to 12(63%) of those without such a department. (see Appendix 5, Table A, p. 12). These results suggest that the presence of a procurement department may not have played a major role in supply chain interruptions within this sample. Therefore, other elements like supplier networks, global conditions, or digital tools may be more important in determining resilience, even though specialized procurement teams may aid in managing interruptions.

4.2.3 Operational and Regulatory Obstacles

According to the survey's findings, most businesses in Vaasa's wind energy industry consider sustainability to be very important when making procurement decisions, giving it a high ranking (3 to 5) in their process (see Appendix 4, p. 9). But maintaining sustainability comes with several difficulties. According to 13 (72%) of respondents, the major challenge is the high price of sustainable materials. The scarcity of green suppliers is another problem that 8 respondents (44%) of businesses encounter, and 11 respondents (61%) point to the absence of clear rules and guidelines as an important challenge (see Appendix 4, p. 10). These obstacles highlight the need for transparent policies and more affordable, environmentally friendly alternatives to enhance procurement procedures and bring them into line with sustainability objectives.

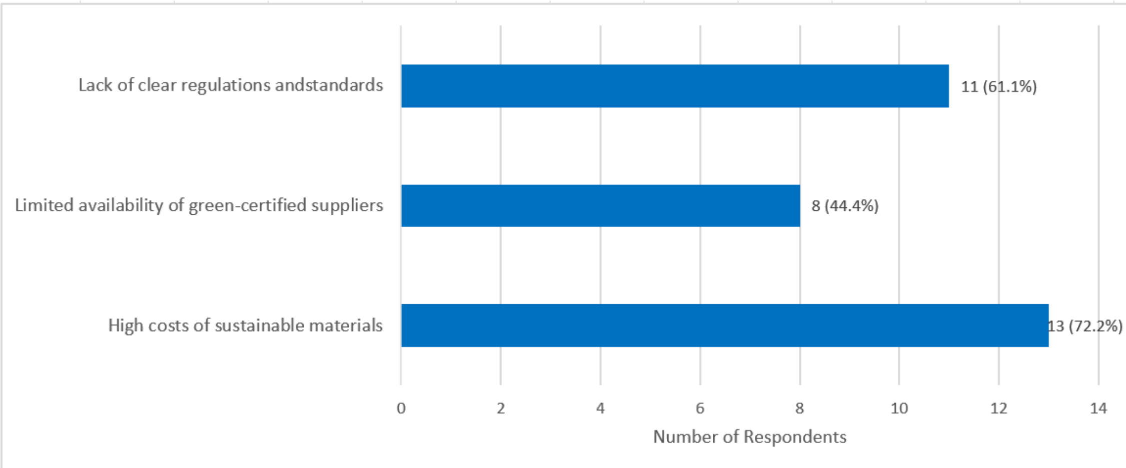

Figure 6 : Challenges in sourcing sustainable materials for wind energy. (n=19)

As was already said, 17 respondent (90%) of those surveyed said that their procurement procedures encounter supply chain interruptions. According to 11 respondents (65%) of the companies, the lack of raw materials is the main reason for these interruptions. Geographical risks and regulatory obstacles 10 respondents (59%), logistics and transportation problems 10 respondents (59%), and supplier capacity constraints 7 respondents (41%) are further significant factors (see Appendix 4, p. 10). These results underline the difficulties of running a sustainable supply chain in Vaasa's wind energy industry, highlighting the necessity of better logistics management, increased supplier dependability, and risk-reduction measures for raw material procurement and legal compliance.

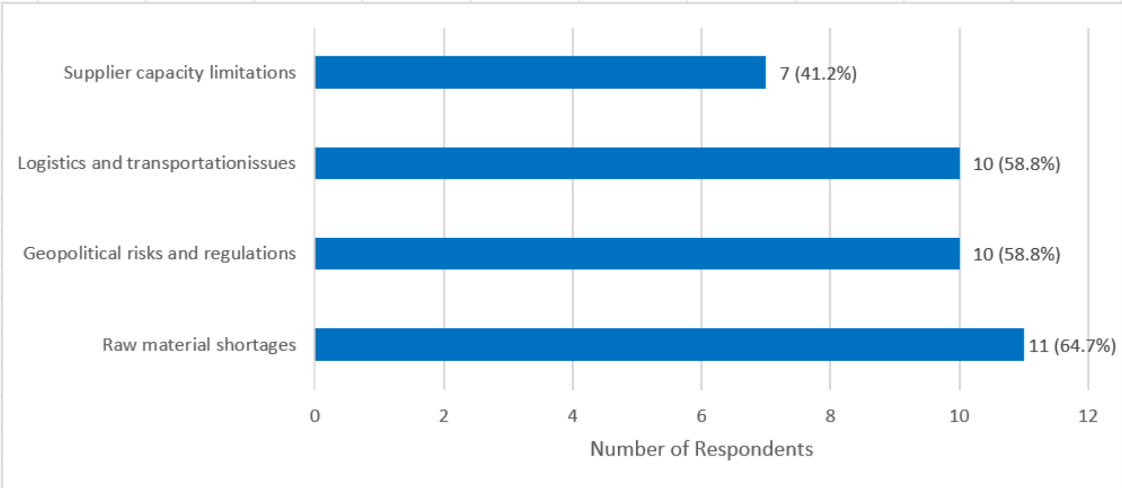

Figure 7 : The main cause of disruption. (n=19)

4.2.4 Possibilities for Enhancement

According to the respondents, businesses in Vaasa's wind energy sector look to acquire components from various suppliers to reduce procurement risks, 12 respondents (71%). Furthermore, according to 4 (24%) respondents, they enter into long-term agreements with suppliers (see Appendix 4, p. 10). As highlighted in the thesis, these tactics contribute to a more stable and dependable supply chain by lessening the effects of possible interruptions and building stronger supplier relationships.

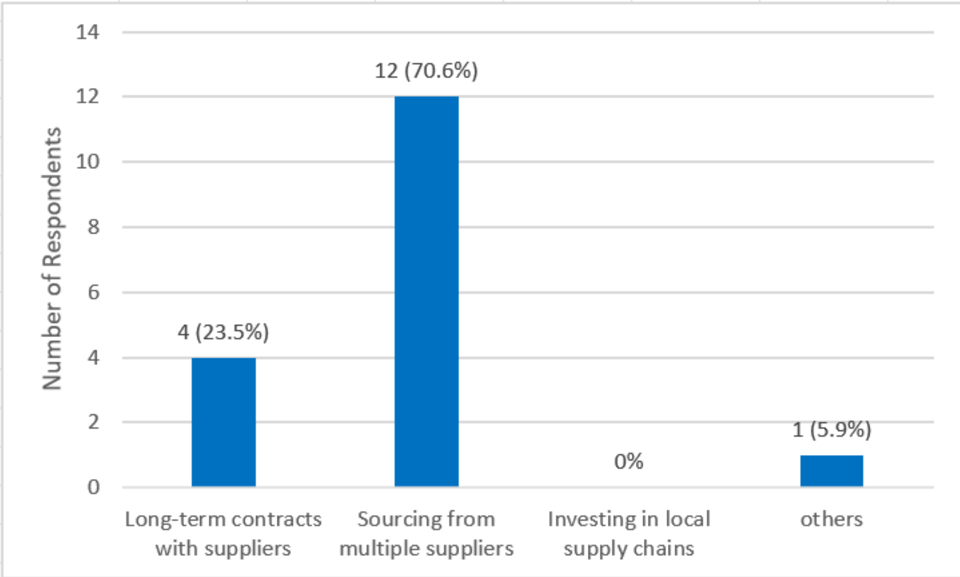

Figure 8 : Strategy for mitigating procurement risk. (n=19)

Companies emphasize specific strategies to save procurement costs. According to the results, increasing logistics efficiency is emphasized as the main strategy by 8 (44%) of respondents. At the same time, 5 (28%) of respondents said that investing in digital procurement tools and choosing green-certified suppliers was equally important (see Appendix 4, p. 10). This implies that although logistical optimization is still the primary goal for cutting costs, businesses also see the benefits of digital transformation and sustainable sourcing for improving procurement efficiency.

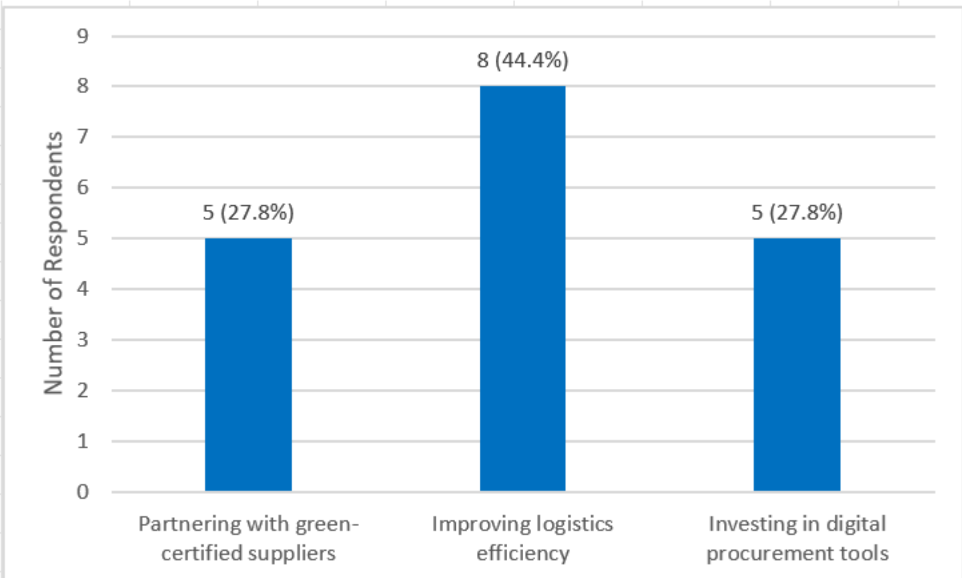

Figure 9 : The strategy adopted by companies to mitigate procurement cost. (n=19)

Respondents' opinions on upcoming procurement patterns differed in several important areas. A stronger focus on supplier sustainability audits, 6 respondents (32%) was the most notable trend found, indicating a rising dedication to ethical sourcing methods. Furthermore, 5 (26%) of participants expected a greater dependence on artificial intelligence and automation, highlighting the function of technology in optimizing procurement procedures. A move toward supply chain resilience and regulatory compliance is seen in the 3 (16%) of respondents who cited shorter supply chains, more local sourcing, and stricter government laws and regulations. 2 (11%) of respondents, on the other hand, emphasized the circular economy's increasing significance and its emphasis on sustainable resource use (see Appendix 4, p. 11). These findings imply that procurement tactics will keep changing, with digitization, sustainability, and regulatory compliance all having a significant influence on how decisions are made in the future.

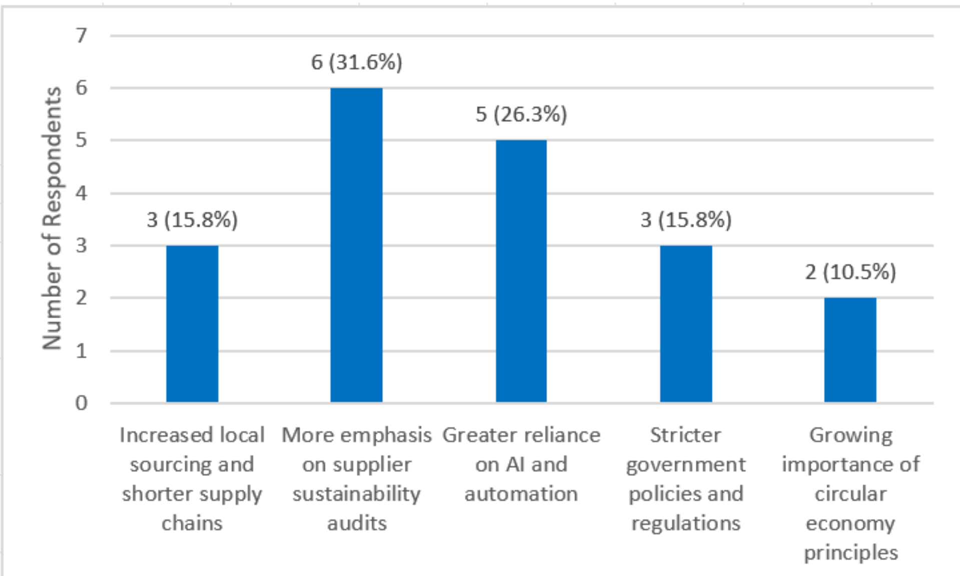

Figure 10 : Procurement trends in the next 5-10 years in Wind energy. (n=19)

4.2.5 Technology in Procurement

There were differing opinions about the application of AI in procurement. While 2 (20%) of respondents agreed that AI plays a role in automating procurement choices, forecasting demand, and improving inventory management, 5 (33%) of respondents said that AI is not employed in procurement. Furthermore, 4 (27%) of respondents emphasized how AI may improve risk assessment and supplier evaluation (see Appendix 4, p. 10). These results show that although the use of AI in procurement is still developing, businesses who use it see its potential to enhance productivity, risk management, and decision-making. Nonetheless, a sizable percentage of companies can still be integrating AI in its early stages or encounter acceptance difficulties.

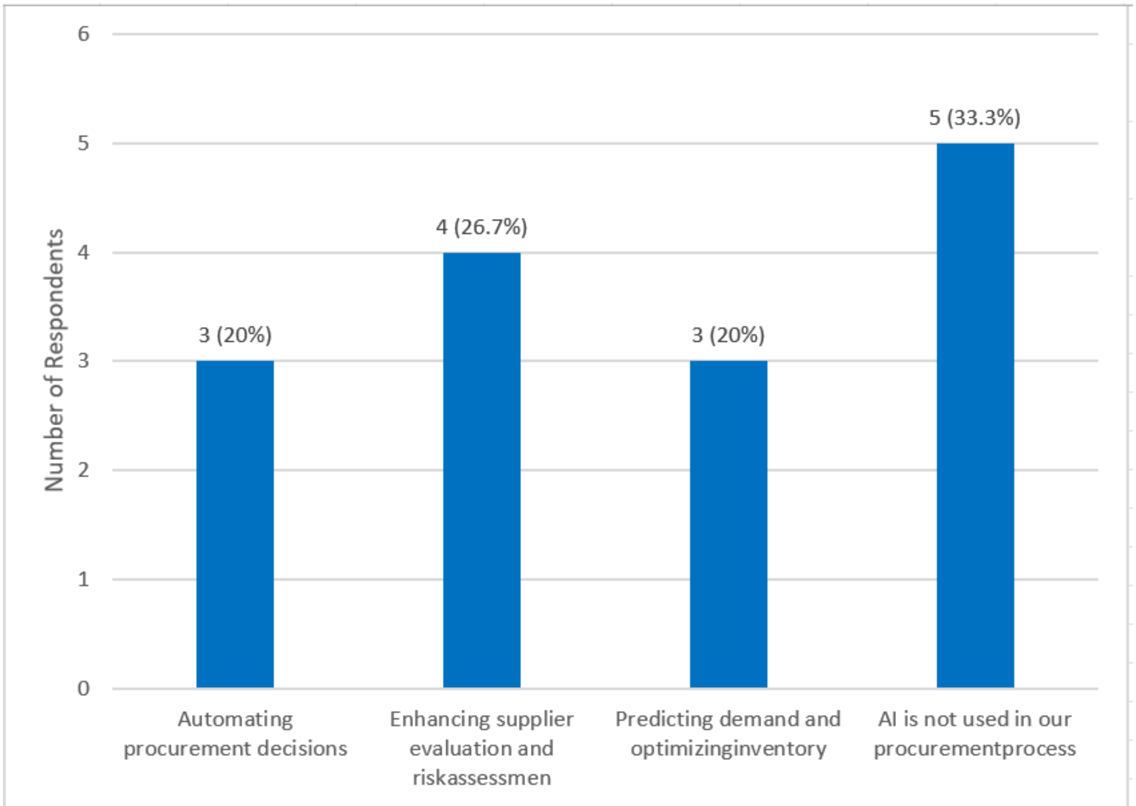

Figure 11 : Survey report on the role of AI in Wind energy procurement. (n=19)

Respondents' opinions on upcoming procurement patterns differed in several important areas. A stronger focus on supplier sustainability audits, 6 respondents (32%) was the most notable trend found, indicating a rising dedication to ethical sourcing methods. Furthermore, 5 (26%) of participants expected a greater dependence on artificial intelligence and automation, highlighting the function of technology in optimizing procurement procedures. A move toward supply chain resilience and regulatory compliance is seen in the 3 (16%) of respondents who cited shorter supply chains, more local sourcing, and stricter government laws and regulations. 2 (11%) of respondents, on the other hand, emphasized the circular economy's increasing significance and its emphasis on sustainable resource use (see Appendix 4, p. 11). These findings imply that procurement tactics will keep changing, with digitization, sustainability, and regulatory compliance all having a significant influence on how decisions are made in the future.

Respondents identified some important barriers in their answers to the open-ended question, "What are the primary barriers preventing the widespread implementation of sustainable procurement in wind energy?" Since many respondents brought up the high upfront costs and pricing pressure from wind turbine manufacturers, the most often cited barrier is the high cost of sustainable procurement. The difficulty of controlling supply chain transparency and the availability of materials were both mentioned as challenges. The restricted availability of sustainable materials, lack of awareness, and opposition to change were also highlighted by a few respondents. In general, supply chain complexity, price-driven competition, and cost effectiveness were found to be the primary barriers preventing the broad implementation of sustainable procurement in the wind energy industry (see Appendix 4, p. 11).

Respondents offered some solutions in answer to the open-ended question, "What improvements would you advise for making procurement in wind energy more effective and sustainable?" Implementing straightforward regulations, lowering reliance on Chinese components, and forging strategic partnerships with nations that share similar political views were among the main proposals. Additional recommendations included automating procedures, putting sustainability above cost reductions with specific goals, and region-based buying. Additionally, respondents emphasized the value of adopting certified sustainable products, investing in sustainable sourcing, and supporting local supply chains. To support sustainable procurement methods, they also suggested improving labour training, encouraging recyclable products, and putting in place financial incentives and green finance (see Appendix 4, p. 11).

In summary, the results of the research of procurement professionals in the wind energy sector of Vaasa highlight how important sustainability is in determining procurement methods. Cost-effectiveness is still a major consideration when choosing a supplier, but reliability, sustainability, and regulatory compliance are also crucial. Major challenges that businesses must overcome to match procurement procedures with sustainability objectives were identified by the survey, including the high price of sustainable materials, a lack of green suppliers, and supply chain interruptions. AI and other technology developments are also becoming more popular as businesses realize how they can improve risk management, decision-making, and procurement efficiency in general.

Despite these developments, problems including ineffective logistics and a lack of raw materials still present challenges. The future of procurement in the wind energy industry will likely be further shaped by the growing emphasis on digital transformation, ethical sourcing, and regulatory compliance as procurement tactics change. These observations provide insightful advice for strengthening sustainability, lowering industry risks, and optimizing procurement procedures.

5 Conclusion

Using a mixed-methods approach that combined survey data and interviews with procurement specialists, this empirical study investigated sustainable procurement procedures in Vaasa's wind energy manufacturing sector. The results provide important light on present sustainable practices, significant obstacles, and potential areas for future development.

The findings show that although cost-effectiveness continues to be the primary determinant of supplier selection, sustainability is becoming more and more valued across procurement functions. Progress toward organized sustainability evaluations is demonstrated by the incorporation of technologies such as EcoVadis and Total Cost of Ownership computations. Many businesses are still in the early phases of incorporating sustainability objectives into their daily procurement processes, though, especially when it comes to topics like emissions monitoring and supplier material talks.

High prices, a shortage of green materials, and unclear regulations are significant barriers to adopting sustainable buying strategies. Even while laws like the CSDDD are pushing businesses to be more transparent, their delays breed uncertainty, therefore, businesses must be proactive and make investments in supplier auditing and compliance systems. The conflict between price, quality, and sustainability was highlighted by the participants. Customers' unwillingness to pay for sustainable alternatives hinders many businesses' capacity to make more environmentally friendly decisions. Nonetheless, life-cycle thinking and long-term cost reductions through eco-efficiency and maintenance minimization are becoming more widely accepted. Adoption of technology has become a key factor in facilitating sustainable procurement. Although many people are still in the experimental stages of using AI and digital technologies, they have the potential to enhance risk management, sustainability tracking, and supplier evaluation.

The study's overall findings indicate that while businesses in Vaasa's wind energy industry acknowledge the value of sustainable procurement, its use varies and is not uniform. Achieving long-term sustainability goals will require strategic alignment, digitalization, supplier engagement, and clear regulations. The following discussion chapter, which examines the results considering current literature and theoretical frameworks and synthesizes the answers to the research questions, is now well-founded on these empirical findings.

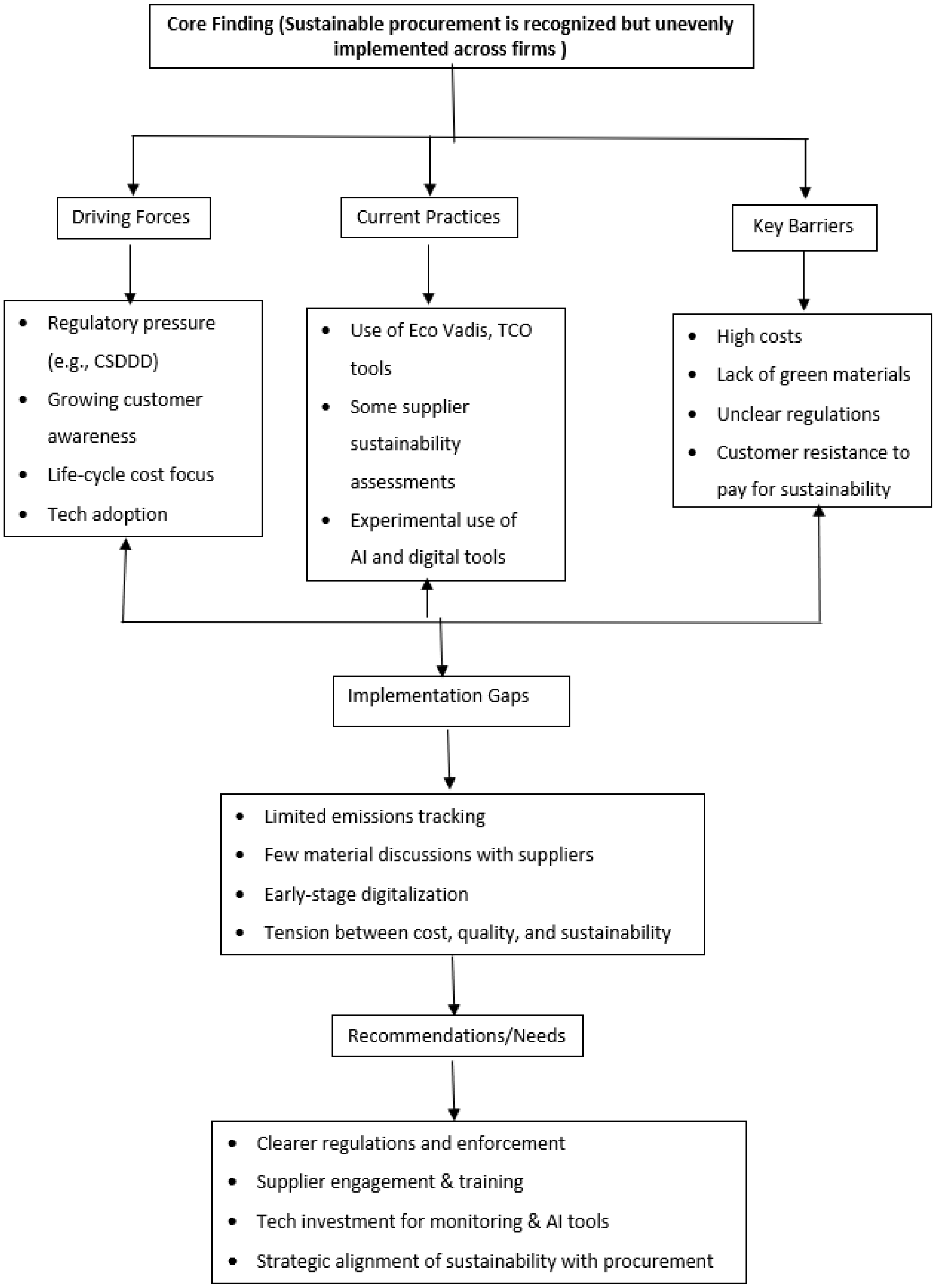

Figure 12: Summary of Findings on Sustainable Procurement in Vaasa's Wind Energy Sector

The primary drivers, present practices, implementation gaps, significant obstacles, and future requirements for promoting sustainable procurement in the industry are highlighted in this figure, which also shows the main conclusions of the empirical study.

6 Discussion

With an emphasis on sustainability, this study aimed to investigate the existing procurement environment in Vaasa's wind energy manufacturing industry. The study looked at procurement practices, barriers to sustainable sourcing, and strategic opportunities to improve operational and environmental performance using data from both quantitative surveys and qualitative interviews. A comprehensive grasp of what sustainability looks like in reality, what challenges it faces, and how it may be significantly enhanced was made possible by the mixed-methods approach.

The results show a sector in transition, one that acknowledges the increasing significance of sustainability but is still in various stages of implementation. Digital tools, emissions tracking, and supplier assessments are starting to gain popularity, but regulatory clarity, affordability, and uniformity are still difficult.

The study's main conclusions are interpreted in this part, considering current theory and real-world implications for Vaasa's wind energy manufacturing industry. Although data-driven conclusions were presented in the empirical section, this discussion considers the implications of the findings for contemporary practices, obstacles, and prospects in sustainable procurement.

For RQ1: What procurement procedures does Vaasa's wind energy manufacturing sector currently follow?

The results of the quantitative survey showed that cost-effectiveness (95%), regulatory compliance (79%), previous performance (79%), and sustainability and environmental norms (74%), are the most valued procurement factors (see Appendix 4, p. 9). These indicators suggest a procurement strategy that strikes a balance between sustainability and economic considerations. The qualitative results relate to the fact that structured assessments are frequently used to formalize supplier evaluation. For instance, businesses stated that they evaluate supplier compliance and sustainability performance using risk-based tools, internal questionnaires, and platforms such as EcoVadis.

Businesses also request emissions data (Scope 1 and 2), audit suppliers with low sustainability ratings, and intend to extend monitoring into Scope 3 emissions as part of their transparency procedures. This demonstrates a growing emphasis on supply chains' end-to-end visibility, which is consistent with the Triple Bottom Line (TBL) and Stakeholder Theory.

Not many businesses, however, have completely incorporated these procedures. The fact that some use informal benchmarking and do not have specific sustainability score systems suggests that procurement maturity differs throughout companies in the area.

For RQ2: What are the main barriers to implementing sustainable procurement methods?

Although sustainability has been incorporated into procurement frameworks, both quantitative and qualitative data show that several obstacles stand in the way of complete implementation.

While 53% of respondents were unsure of how government laws would affect procurement procedures (see Appendix 4, p. 10), 79% of respondents thought that regulatory compliance was crucial when choosing a supplier (see Appendix 4, p. 9). Delays, uneven enforcement, and complicated documentation requirements were mentioned in qualitative replies. This uncertainty affects the implementation of effective policies and impedes the advancement of sustainability objectives.

The high price of sustainable materials was cited by several respondents (72%) as a major obstacle (see Appendix 4, p. 10). Additionally, qualitative interviews show that consumers frequently refuse to pay more for environmentally friendly solutions, such as green steel, which puts pressure on prices and restricts the use of eco-friendly products.

According to numerous businesses, suppliers are still integrating sustainability, and some are unable to meet regulations pertaining to emissions reporting or material traceability. Charges were also made for broad sustainability goals lacking specific operational guidelines.

A shocking 90% of survey participants said they had experienced supply chain interruptions (see Appendix 4, p. 10), mostly because of geographic hazards, transportation problems, and shortages of raw materials. The effectiveness of sustainable procurement initiatives is weakened by this weakness.

The lack of a united, group-level strategy and the uneven digital infrastructure for handling sustainability key performance indicators increase these challenges.

For RQ3: How can Vaasa's wind energy industry improve its environmental performance and efficiency through sustainable procurement practices?

The study found a few ways to improve environmental results and procurement efficiency. The quantitative data showed that use of AI technologies for risk forecasting, emissions tracking, and total cost-of-ownership (TCO) modeling is still restricted, despite qualitative interviews indicating an increasing interest in these capabilities. Using these tools could speed up supplier evaluations and increase procurement transparency.

To pay for upfront investments, participants underlined the significance of taking lifespan costs into account. For instance, one company observed that the cost difference between Gray and Green fuel is less substantial when considering long-term efficiency and possible future fines. Formal training programs, consistent standards, and shared environmental objectives might be added to the numerous companies that presently track emissions and undertake audits. Respondents suggested focusing on regional sourcing tactics and building long-term supplier connections as ways to improve resilience and better match procurement with sustainability objectives.

There was a significant push for consistent and open policy frameworks. By giving clear implementation rules, streamlining reporting processes, and providing financial incentives, governments and regulatory bodies can encourage their development. Additionally, if consumers are more aware of the long-term advantages, like lower lifespan costs and regulatory risks, they might be more willing to engage in greener procurement options.

All things considered, Vaasa's wind energy sector has advanced significantly in incorporating sustainability into procurement. The entire impact of these initiatives is still constrained, though, by issues like unclear legislation, budgetary worries, gaps in supplier capability, and undeveloped digital ecosystems. Addressing these challenges would necessitate a combination of strategic initiatives, supportive legislation, and coordinated supplier development to achieve long-term economic and environmental resilience.

The Triple Bottom Line (TBL) Theory, Stakeholder Theory, and Resource-Based View (RBV) are three theoretical frameworks frequently linked to sustainable procurement that are strongly supported by the study's findings.

The merging of economic, environmental, and social objectives in corporate strategy is emphasized by the Triple Bottom Line (TBL) theory. Economic performance continues to be the most important aspect in Vaasa's wind energy sector, with 95% of respondents placing a higher priority on cost-effectiveness when choosing a supplier (see Appendix 4, p. 9). This is supported by interviews that show price sensitivity and consumer resistance to paying for environmentally friendly solutions. Environmental initiatives are progressing, though, as 74% of respondents said sustainability standards are essential (see Appendix 4, p. 9), and businesses mentioned utilizing EcoVadis, cutting back on single-use plastics, and investigating green materials. Codes covering labour practices, human rights, and supplier audits demonstrate social responsibility. These results indicate that businesses are trying to strike a balance between the three pillars, but there are still difficulties in completely integrating sustainability without sacrificing quality or cost.

According to stakeholder theory, organizations must manage their relationships with all parties that are impacted by their activities. Active supplier engagement, including audits, surveys, and emissions tracking—particularly for Scope 1 and 2 emissions, with future intentions for Scope 3—is indicative of this in Vaasa's wind energy sector. There is a gap between policy and practical understanding, as seen by the 53% of survey respondents who said they were confused about directives such as the Corporate Sustainability Due Diligence Directive (CSDDD). Customers' limited willingness to pay extra for sustainable materials puts pressure on businesses' prices. This limits the enthusiasm with which businesses can pursue green buying. The fundamental idea of stakeholder theory is reflected in these dynamics: striking a balance between suppliers, customers, and regulators' expectations while preserving operational and strategic alignment.

The development of internal capacities is highlighted by the Resource-Based View (RBV) to attain long-term competitive advantage. Digital tools like bonus-malus systems and Total Cost of Ownership (TCO) calculators are being used more and more by businesses in Vaasa's wind energy sector to improve supplier selection and assess sustainability performance. AI integration for procurement tasks, including demand forecasting, emissions tracking, and risk assessment, is gaining popularity, although it is still in the early stages. Companies with ambitious aims to achieve carbon neutrality by 2030 show strategic vision by using internal goals to promote sustainable change. Furthermore, it is believed that information from audits and benchmarking is an essential resource that supports market positioning and drives best practices. These initiatives demonstrate how sustainability-related skills and knowledge are being developed as essential capabilities to enhance long-term performance and resilience.

According to the data, businesses in Vaasa's wind energy sector are still dealing with some implementation issues, but their methods are becoming more in line with cutting-edge sustainability theories and exhibit a combination of strategic capability-building, stakeholder responsiveness, and economic rationality.

6.1 Practical and Managerial Implications

Standardized and verifiable sustainability indicators should be used by companies in Vaasa's wind energy sector to increase the effectiveness and equity of supplier evaluations. Although some businesses currently employ tools like EcoVadis, industry-wide adoption would improve uniformity and transparency. Clear sustainability rating systems would make it easier for businesses to compare suppliers and guarantee that long-term environmental objectives are reflected in procurement choices.

It is crucial for businesses to take steps to prepare for legal changes, as 42% of survey participants indicated that they were unsure of the effects of laws like the Corporate Sustainability Due Diligence Directive (CSDDD) (see Appendix 4, p. 10). This entails setting up internal training courses, drafting transparent compliance procedures, and producing compliance dashboards in real time. These systems would lessen operational disruptions associated with late adaptation and assist businesses in staying in line with changing legal requirements.

AI and digital procurement tools remain insufficiently utilized despite their potential. According to the report, there is increasing interest in tools like as bonus-malus systems and Total Cost of Ownership (TCO) calculators. Additionally, there are exploratory conversations about using AI for risk forecasting, emissions tracking, and inventory optimization. Purchasing these technologies would simplify sustainability reporting, increase risk management, and improve decision-making accuracy.

72% of respondents cited the cost of green materials as a challenge, indicating that high costs are a major obstacle to sustainable procurement (see Appendix 4, p. 10). To assess the long-term financial and environmental advantages of sustainable solutions, managers need to implement life-cycle costing models. Furthermore, investigating demand forecasting techniques, long-term supplier contracts, and subsidies can assist strategic buying from sustainable suppliers while mitigating short-term costs.

Customers' unwillingness to pay extra for environmentally friendly products, as observed in survey results and interviews, indicates a lack of market readiness. Businesses should spend money on sustainability communication plans and stakeholder education, highlighting the long-term advantages of ethical sourcing, including reduced risk contact, regulatory compliance, and improved reputation. These initiatives have the potential to boost consumer support and promote wider adoption of investments in sustainable procurement.

Additionally, by actively participating in industry-specific forums and cross-sector initiatives, businesses can greatly increase their sustainability impact. These platforms offer chances to exchange best practices, jointly develop uniform sustainability standards, and work together on resources like green certification programs or shared supplier databases. These group initiatives foster consistency and scale within the wind energy industry in addition to fostering information sharing.

Internally, incorporating sustainability metrics into employee assessment programs and procurement KPIs is crucial to establishing environmental responsibility into day-to-day decision-making. Employees and procurement teams are more likely to match their work with long-term environmental goals when they are motivated by performance-linked goals, such as lowering carbon footprints, raising supplier sustainability ratings, or putting green procurement criteria into practice. Additionally, to help vendors—especially small and medium-sized businesses (SMEs)—meet the higher sustainability standards, supplier development initiatives must to be given top priority. Suppliers may enhance the sustainability of the entire supply chain and improve their environmental practices by receiving performance feedback, technical support, and training.

Together, these tactics can create a thorough and future-ready basis for sustainable procurement in the wind energy manufacturing industry when combined with technology adoption (such as AI-driven analytics and TCO calculators) and proactive regulatory compliance planning.

6.2 Study Limitations

Although this study provides insightful information about sustainable procurement methods in the wind energy manufacturing industry in Vaasa, it should be noted that it has some limitations. Nineteen survey responses served as the basis for the study's quantitative analysis, while a small group of industry specialists provided qualitative data. The small sample size limits how broadly the results can be applied, even though these participants have important roles in sustainability and procurement. More extensive surveys involving more businesses and geographical areas would support the validity of the themes and patterns found.

Only businesses based in Vaasa, a particular center of Finland's wind energy sector, are the subject of the study. The results might not apply to wind energy companies in other regions, which might have distinct supply chains, regulatory frameworks, or sustainability agendas, even while this adds depth and contextual relevance. Some people talked about AI, although it was mostly experimental rather than practical. Few businesses have integrated AI-powered solutions into their purchasing procedures. Therefore, it was challenging to get firm conclusions regarding AI's true impact because references to its use in risk management, emissions tracking, or supplier evaluation were hypothetical and forward-looking.

Instead of using data from existing practices, the study uses self-reported data from surveys and interviews, which may contain biased answers or represent strategic goals. For example, although many businesses claimed to have sustainability policies, qualitative data showed that they did not have quantifiable goals or clear plans for execution. The difference raises the possibility of a disconnect between sustainability principles and practical implementation. These restrictions highlight the need for more thorough evaluations of cutting-edge technology like artificial intelligence, longer observation periods, and larger and more varied sample sizes in future studies to deepen our understanding of sustainable procurement in the wind energy industry.

By providing insightful information about sustainable procurement procedures in the wind energy industry, this study closes the knowledge gap between academic theory and real-world application. By highlighting important forces and challenges, it advances academic understanding while assisting business professionals in creating more strategic and sustainable procurement methods.

6.3 Research Ethics and Trustworthiness

Throughout the examination, ethical guidelines were strictly complied with. The goal of the survey and interviews was explained to the participants, and their involvement was entirely voluntary. Names, roles, or identifiable organizational data were gathered to preserve participant anonymity and safeguard company-sensitive information. Interview transcripts were coded to exclude any identifying information, and survey responses were collected without recording IP addresses or needing login passwords. To provide a fair and impartial representation of all points of view, ethical standards were followed throughout the analysis, and all data were presented truthfully and without manipulation.

Although the wind energy industry in Vaasa is the primary focus of this study, other industries that face comparable sustainability and procurement issues can benefit from the procurement strategies and challenges identified, such as adopting digital procurement tools, navigating supply chain disruptions, maintaining regulatory compliance, and striking a balance between cost and sustainability. For instance, industries such as manufacturing, hydropower, and solar energy frequently face similar challenges when it comes to maximizing procurement procedures for sustainable results. Businesses in these sectors, including those outside of Vaasa, can learn a lot from this study as they try to integrate sustainable buying methods into their daily operations.
By offering practical methods to improve procurement sustainability, like introducing lifecycle costing, enhancing supply chain transparency, and embracing digital tools, the study's conclusions provide significant advantages to businesses. To improve procurement procedures, these insights assist decision-makers in setting priorities for expenditures in fields like artificial intelligence, emissions monitoring, and supplier audits. The report also identifies important risks, such as supply chain interruptions and regulatory changes, and provides practical solutions for overcoming these obstacles. Businesses can improve their environmental performance and increase the resilience of their procurement processes by implementing these suggestions.
This study's credibility was established by combining quantitative survey data with qualitative interview data, and the results were cross-checked using triangulation to increase their reliability. Reputable theories, including the Resource-Based View (RBV), Stakeholder Theory, and the Triple Bottom Line (TBL), were used to frame the analysis further. While organized frameworks for thematic analysis were used to ensure uniformity, reliability was maintained by making sure that the survey and interview questions were the same for every participant. To ensure that the

conclusions were based in the procurement procedures and sustainability concerns within the context of Vaasa's wind energy sector and avoided over-generalizations, validity was achieved by clearly linking the research questions with the data gathering tools.

6.4 Suggestions for Future Research

Building on the knowledge gathered from this study, some directions for further investigation are suggested to enhance the comprehension of sustainable procurement in the wind energy industry:

Future research should monitor the effects of government rules over time, as 42% of survey participants said they were unclear about their implications, especially about the Corporate Sustainability Due Diligence Directive (CSDDD) (see Appendix 4, p. 10). How businesses modify procurement processes, create internal compliance systems, and incorporate new regulatory requirements could all be investigated using a continuous method. From a business viewpoint, this would also assist in evaluating how well policies are communicated and enforced. Even while the current study discovered interest in AI applications, including demand forecasting, risk assessment, and emissions tracking, there is still little real placement of these applications. Future studies should investigate actual case studies of automation and artificial intelligence in wind energy purchase. In areas like cost optimization, transparency, and operational efficiency, this could highlight best practices, adoption challenges, and measurable advantages.

Customer unwillingness to spend extra for sustainable materials is a significant barrier, according to both survey results and interviews. Future studies should examine how consumers view green procurement, specifically how their desire to support sustainability is influenced by value perception, awareness, and trust. Comprehending this relationship could help businesses defend long-term investments in sustainability and guide more successful stakeholder engagement strategies. Although companies are keeping an eye on Scope 1 and 2 emissions, both data sets show that Scope 3 tracking is still in its early stages. It would be very helpful to conduct a targeted study on how businesses may develop systems to measure and report emissions from logistics, indirect suppliers, and the product lifecycle. This is especially important for attaining genuine supply chain transparency and complying with upcoming EU regulations.

In addition to expanding on existing research, these fields would provide useful advice for decision-makers, business executives, and sustainability specialists as they navigate the changing environment of green procurement in the wind energy sector.

6.5 Evaluation of Own Development

I have grown academically, professionally, and personally throughout this research project. By combining quantitative and qualitative methods, I became stronger in mixed-method research, which has been essential in improving my analytical thinking and methodological understanding. I also strengthened my skills in data collection, thematic analysis, and statistical interpretation, which helped me navigate the challenges of interpreting diverse data sources. Using tools like surveys and interviews taught me how to effectively structure research instruments and analyse responses methodically and objectively.

My critical thinking and academic writing abilities were enhanced by directly collaborating with my supervisors and considering their comments. Additionally, I improved my ability to communicate professionally and coordinate projects by learning how to interact with external stakeholders, like interview and survey respondents. One of the most important lessons I learned was how to effectively manage my time and adjust to unforeseen obstacles, including delays in data collecting, which improved my ability to bounce back and solve problems.

I now have a much deeper understanding of sustainable procurement in terms of subject-specific development. I learned a lot about the practical use of sustainability standards such as the Corporate Sustainability Due Diligence Directive (CSDDD) in corporate settings, especially in the wind energy industry. My understanding of how abstract sustainability ideas may be converted into workable procurement strategies has grown because of this. Additionally, I gained a greater understanding of how crucial supply chain transparency, stakeholder participation, and regulatory compliance are to achieving sustainability goals.

All things considered, this research experience has improved my academic and technical abilities and prepared me for future positions in sustainability-related fields like supply chain management, corporate responsibility, and energy sector innovation. It has also motivated me to investigate more opportunities where I can use this knowledge to promote socially and environmentally conscious business practices.

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Research data management plan for the thesis

1. General description of the data

Both quantitative survey results and qualitative interview transcripts make up the research data for this thesis. To obtain general information about sustainable procurement methods, the survey was sent electronically to experts employed in Vaasa's wind energy industry. Furthermore, semi-structured interviews were performed with chosen participants to go deeper into themes and experiences. Triangulation of findings and a more thorough comprehension of the research issue were made possible by this mixed-method approach.

2. Documentation and quality of the data

To preserve consistency and dependability, the research data were carefully recorded. During the theoretical and conceptual development stage, topics found in the interview recordings were used to code and transcribe the recordings. Anonymized IDs like "Interviewee A" or "Respondent 1" were used to identify participants; neither names nor job titles were recorded. A secure web form was used to gather survey responses; no IP addresses or email addresses were gathered. Each participant was asked an identical set of questions to guarantee the quality of the documentation, and the themes were confirmed by comparing the interview replies with survey trends.

3. Storage and backup

Throughout the thesis process, all information—including survey results and interview transcripts—was kept on a password-protected PC and backed up on a safe external drive. The researcher was the only person with access to the data; no other parties were given any access. To guard against loss or accidental disclosure, data files were labeled methodically and stored in well-organized folders. To improve information security, raw data files have been secured and stored apart from analytical documents.

4. Ethical and legal issues related to storage

Throughout the whole data management process, ethical issues were given top priority. There was no collection or storage of any sensitive personal information, including names, contact information, or identification unique to the company. Every participant was made aware of the study's objectives and that participation was entirely voluntary. They received guarantees that their answers would be kept confidential and used only for scholarly research. No portion of the raw data will be published or shared with outside parties, and the researcher retains ownership of the data. According to the research ethics norms of Kajaani University of Applied Sciences, usage rights are limited to this thesis project.

5. Opening of the data and long-term storage

Since the data is context-specific and anonymized, it is not meant for long-term storage or public access outside of the thesis process. However, if the necessary ethical approval is secured, the data may be reviewed if necessary for additional scholarly investigation or confirmation. Until further academic usage is authorized by the university and participants, the data will be safely maintained for the duration of the thesis review process and then disposed of responsibly.

6. Use of AI

While maintaining academic integrity and the research's learning objectives, this thesis was prepared using artificial intelligence (AI) techniques as supportive intelligence in compliance with Kajaani University of Applied Sciences (KAMK) criteria.

The AI tools listed below were used:

During content analysis, ChatGPT (OpenAI, GPT-4, April–May 2024) was utilized to help group interview material and offer structural recommendations for the thesis's arrangement. https://chat.openai.com/

Selected passages were paraphrased and refined using Quill Bot (2024) to enhance academic tone, coherence, and clarity. https://quillbot.com/

An editing tool called Grammarly (2024) was used to examine spelling, grammar, and general language fluency. https://www.grammarly.com/

All AI-generated information was carefully examined, edited, and reorganized to guarantee compliance with ethical and academic norms. No private data, including interview transcripts or personal information, was input into any AI tool in accordance with KAMK's data protection policies and the EU General Data Protection Regulation (GDPR). Artificial intelligence was not an author; it was only a helpful tool.

Appendix 1 – Interview Questions

1. Could you please introduce yourself and describe your role in the company?

2. Could you describe the procurement procedure in your company?

3. Where do you source your materials from? From which countries do your suppliers operate?

4. What do you think are the main challenges and barriers you face while implementing sustainable procurement methods in your company?

5. Do you use any strategies to balance cost and sustainability?

6. Does your company have specific sustainability criteria for suppliers? If yes, what are they?

7. Are there any specific methods or practices that you believe could be improved to enhance sustainability performance in the supply chain, particularly concerning suppliers?

8. What role do technologies like AI, blockchain, or data analytics play in procurement for wind energy? How do they help with procurement?

9. What steps could your company take to further enhance environmental performance and efficiency in the wind energy sector in Vaasa, particularly through sustainable procurement?

Appendix 2 – Thematic content analysis sample interview excerpts.

Key Principle	Theme	Code	Quote from Interview	
			COMPANY 1.	COMPANY 2.
Supplier Evaluation	Supplier Assessment Process	Sustainability Assessments	*"Every time we onboard a new supplier, they must complete specific assessments, including a sustainability assessment with dozens of questions." participant D.*	
		EcoVadis Ratings	*"We have started using a tool called EcoVadis... This tool rates suppliers based on their sustainability performance." participant E.*	
		Risk Evaluation		"We follow a supplier evaluation program where we first collect information by sending out surveys to suppliers... We also have automated systems in place that flag potential risks."participant B.
		Sustainability Criteria		"Currently, we do not have a specific scoring system for sustainability, but incorporating one in the future would be beneficial."participant B.
	Transparency and Collaboration	Supplier Audits	*"If a supplier's score on the sustainability assessment is too low, we are required to conduct an on-site audit to evaluate their sustainability practices." participant D.*	
		Group-Level Strategy	*"We need a group-level approach for setting and enforcing sustainability requirements, but this is still missing at the moment." participant D.*	
		Supplier Transparency		"We request information about their Scope 1 and Scope 2 emissions... Currently, our focus is on Tier 1 suppliers, but in the future, we plan to extend this transparency requirement to Tier 2 and Tier 3 suppliers."participant A.
		Industry Collaboration		"We focus on benchmarking—learning from others and collaborating with industry leaders to improve our
	Supplier Readiness	Early Stage of Supplier Discussions		"We are not yet at a stage where we always discuss the sustainability level of materials with suppliers. We are still very early in this process." participant C.
		High-Level Targets	*"At the moment, we do have sustainability targets for suppliers, but they are still quite high-level... The exact expectations are not always clearly defined." participant E.*	

sustainability in the buying process	Cost vs. Sustainability	Cost vs. Sustainability	*"One of our key challenges is finding the right balance between cost and sustainability." participant D.*	"The biggest challenge arises when we buy finished products from suppliers... The difficulty lies in ensuring that suppliers follow the correct guidelines and requirements regarding what materials they
		Customer Willingness to Pay	*"One of the challenges is that our customers are not yet willing to pay extra for sustainable raw materials, such as green steel or eco-friendly sheet metals." participant E.*	
		Cost Pressure		"Balancing cost and sustainability is very difficult... We are not yet at a stage where we always discuss the sustainability level of materials with suppliers." participant C.
		Life-Cycle Thinking		"We ensure that maintenance does not become a significant cost over time. This means we incorporate life-cycle thinking into how we design our solutions."participant C.
		Cost Pressure		"There is always a cost pressure when discussing sustainability. It becomes a balancing act between sustainability, cost, and procurement efficiency."participant
		Cost-Effective and Lightweight Materials		"We work extensively on using materials that are cost-effective. When materials are lightweight or cost-effective, they are often more sustainable as well." participant C.
		Long-term Benefits		"When you calculate the total cost, including potential fines for using conventional methods, the price difference between gray fuel and green fuel becomes
	Quality and Sustainability	Recycled Materials	*"If we increase the amount of recycled plastic too much, it could affect the performance and safety of the product... There are limits to how much recycled plastic we can currently use." participant E.*	
		Quality vs. Sustainability		"Sustainability is crucial, but if a product is sustainable yet compromises safety, then it's not worth it... Quality cannot be compromised."participant A.
		Supplier Quality Audits		"In supplier development, we conduct supplier assessment audits, quality process audits, and quality assurance inspections."(KT -

		Supplier Quality Audits		quality assurance inspections." (A
Operational and regulatory obstacles	Compliance with Regulations	CBAM (Carbon Border Adjustment Mechanism)	*"The basic idea is that we must report to the European Union how much emissions are generated in the production of the parts we purchase from outside Europe."*	
		EU Regulations		"Legislators are continuously introducing new regulations... For example, the Corporate Sustainability Due Diligence Directive (CSDDD) has been postponed by up to two
		Regulatory Compliance		"We closely monitor regulations to ensure compliance, but we also aim to go beyond the standard requirements."participant A.
		Country of Origin		"We need to carefully track and verify the origin of our materials... We do not simply rely on supplier declarations—we conduct inspections and verify material certificates to ensure
Material Sourcing operatinal emissions	Sustainable Materials	Green Steel		"We encourage the use of green steel, but enforcing such preferences can be
		Plastic Reduction		"We are actively working to eliminate single-use plastics... Over the past few years, we have successfully reduced single-use plastic in packaging by 80%."participant A.
	Focus on Combustion and Decarbonization	Combustion Emissions		"When it comes to combustion, it is one of the main processes where emissions are always generated. If the fuel contains carbon, such as fossil fuels, it will produce carbon dioxide emissions." participant C.
		Sustainable Fuels		"Our primary focus is on enabling our engines to run on sustainable fuels in the future."participant C.
Technology in Procurement	Digital Tools and AI	AI Integration	*"We have discussed the need to start studying how AI could be integrated into our daily*	
		Future Potential	*"It's definitely a big topic... We need to explore how AI could be applied in procurement and sustainability." participant D.*	
		AI-Driven Evaluation		"We use various digital tools for procurement evaluation... Some digital tools also incorporate bonus-malus systems, where suppliers can receive extra points for meeting specific sustainability
		Total Cost of Ownership (TCO)		"We have a Total Cost of Ownership (TCO) calculation system that helps us determine the best supplier based on multiple
		AI and Data Requirements		"AI and data requirements increase energy consumption... It's a good initiative to consider the carbon footprint of these decisions." participant C.

Possibilities for enhancement	Future Preparedness	Emission Reduction Targets		"Our goal is to reduce Scope 1 and Scope 2 emissions by 25% by 2030... Varsila aims to achieve carbon neutrality in its operations by 2030."participant A.
		System-Level Decarbonization		"Our goal is to contribute to system-level and societal-level decarbonization. This requires increasing the share of renewables, such as wind energy, in the energy mix." participant C.
		Scope 1 and Scope 2 Emissions		"We have set a target to be carbon neutral in our own operations by 2030, which primarily focuses on Scope 1 and Scope 2 emissions." participant C.
		Future Preparedness	*"We anticipate that sustainability requirements will increase in the future, so our current strategy is to be prepared and to explore alternative options for sustainable materials." participant E.*	
		Complexity of Scope 3		"Scope 3 emissions, which include upstream activities, are more complex... These decisions contribute only a small portion to our overall carbon footprint." participant C.
	Supplier Development and Sustainability Initiatives	Supplier Quality Audits		"In supplier development, we conduct supplier assessment audits, quality process audits, and quality assurance inspections."(KT - Kosunen, Timo)
		Supplier Emission Tracking		CO2 emissions tracking platform... Starting in 2024, we will collect baseline emissions data from our direct and indirect suppliers."participant A.
		Life Cycle Assessment (LCA)		"We conducted a Life Cycle Assessment (LCA) of a power plant about 1.5 to 2 years ago... Procurement accounted for only 0.5% of the total emissions." participant C.
		Group-Level Strategy	*"We need a group-level approach for setting and enforcing sustainability requirements, but this is still missing at the moment." participant D.*	
		Supplier Engagement		"We are still very early in this process... The primary focus is on combustion, while for other companies, it might be different." participant C.
		Human Rights and Labor Practices		"We have sustainable codes... They cover areas like human rights, labor practices, and ensuring no child labor is used. These are more related to social impacts."

Appendix 3: Survey question

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Section 1 of 8

Survey on Sustainable Procurement Practices in the Wind Energy Sector

Form description

1.) Company name

Short answer

Short-answer text

2.) Your designation

Short answer

Short-answer text

3.) What is your company's primary role in the wind energy sector?

Multiple choice

- Electrical Systems and Grid Integration Solutions
- Energy Storage Solutions
- Turbine Manufacturing and Supply
- Component Manufacturing (e.g., Generators, Transformers, Converters)

Section 2 of 8

Procurement Practices in Wind Energy

Description (optional)

4.) Does your company have a dedicated sustainability department for proqurement?

Multiple choice

- yes
- No

5.) What are the most important criteria for supplier selection in your company? (Select all that apply)

Checkboxes

- Cost-effectiveness
- Sustainability and environmental standards
- Reliability and past performance
- Compliance with regulations

6.) Does your company have specific sustainability policies for procurement?

Multiple choice

- Yes — Go to section 3 (Sustainabilty policies)
- No — Go to section 4 (supply chain disruptions)

Section 3 of 8

Sustainabilty policies

Description (optional)

7.) If yes, what are the key elements of your sustainability policies?

Multiple choice

- Use of recycled or eco-friendly materials
- Energy-efficient production and transportation
- Ethical labor and fair trade practices

8.) How important is sustainability in your procurement decisions?

Linear scale

1 to 5

1 Not Important

5 Extremely Important

9.) What are the biggest challenges in sourcing sustainable materials for wind energy?

Checkboxes

- High costs of sustainable materials
- Limited availability of green-certified suppliers
- Lack of clear regulations and standards

Section 4 of 8

supply chain disruptions

Description (optional)

10.) Has your company faced supply chain disruptions affecting procurement?

Multiple choice

- Yes — Continue to next section
- No — Go to section 6 (Sustainability v... Considerations)

Section 5 of 8

Untitled section

Description (optional)

11.) What were the main causes of these disruptions?

Checkboxes

- Raw material shortages
- Geopolitical risks and regulations
- Logistics and transportation issues
- Supplier capacity limitations
- Other (please specify) __________

12.) How does your company mitigate procurement risks?

Multiple choice

- Long-term contracts with suppliers
- Sourcing from multiple suppliers
- Investing in local supply chains
- Other (please specify) __________

Section 6 of 8

Sustainability vs. Cost Considerations

Description (optional)

13.) Between cost considerations and sustainability, which has a greater influence on procurement decisions in your company?

Multiple choice

- Cost considerations are more important
- Sustainability and environmental impact are more important
- Both are equally important

14.) Has your company adopted any strategies to reduce procurement costs while maintaining sustainability?

Multiple choice

- Partnering with green-certified suppliers
- Improving logistics efficiency
- Investing in digital procurement tools
- Other (please specify) __________

15.) Do you think government policies and regulations are driving sustainability in procurement?

Multiple choice

- Yes
- No
- Maybe

16.) Has your company invested in digital tools for procurement?

Multiple choice

- Yes — Go to section 7 (Digital Transforma...on in Procurement)
- No — Go to section 8 (Future Trends and Recommendations)

Section 7 of 8

Digital Transformation in Procurement

Description (optional)

17.) What role does Artificial Intelligence (AI) play in your company's wind energy procurement process

Multiple choice

- Automating procurement decisions
- Enhancing supplier evaluation and risk assessment
- Predicting demand and optimizing inventory
- AI is not used in our procurement process

18.) What role does Blockchain technology play in your company's wind energy procurement process?

Multiple choice

- Improving supply chain transparency and traceability
- Enhancing contract security (e.g., smart contracts)
- Reducing fraud and ensuring ethical sourcing
- Blockchain is not used in our procurement process

19.) How does Big Data contribute to your company's wind energy procurement process?

Multiple choice

- Improving data-driven decision-making
- Analyzing market trends and supplier performance
- Optimizing cost and efficiency through predictive analytics
- Big Data is not used in our procurement process

Section 8 of 8

Future Trends and Recommendations

Description (optional)

20.) In the next 5-10 years, which procurement trends do you think will have the biggest impact on wind energy?

Multiple choice

- Increased local sourcing and shorter supply chains
- More emphasis on supplier sustainability audits
- Greater reliance on AI and automation
- Stricter government policies and regulations
- Growing importance of circular economy principles

21.) What are the key barriers preventing the widespread adoption of sustainable procurement in wind energy?

Short answer

Short-answer text

Required

22.) What improvements would you suggest for making procurement in wind energy more efficient and sustainable? *

Short-answer text

Appendix 4: Frequency Table (n=19)

Survey Question	Options	Frequency	Percentage
1.) Company name	Wärtsilä	6	31.60%
	ABB	4	21.10%
	Hitachi	4	21.10%
	Vestas	5	26.30%
3.) What is your company's primary role in the wind energy sector?	Electrical Systems and Grid Integration Solutions	5	26.30%
	Energy Storage Solutions	5	26.30%
	Turbine Manufacturing and Supply	4	21.10%
	Component Manufacturing (e.g., Generators, Transformers, Converters)	5	26.30%
4.) Does your company have a dedicated sustainability department for procurement?	Yes	12	63.20%
	No	7	36.80%
5.) What are the most important criteria for supplier selection in your company? (Select all that apply)	Cost-effectiveness	18	94.70%
	Sustainability and environmental standards	14	73.70%
	Reliability and past performance	15	78.90%
	Compliance with regulations	15	78.90%
	Availability and commitment	1	5.30%
6.) Does your company have specific sustainability policies for procurement?	yes	18	94.70%
	no	1	5.30%
7.) If yes, what are the key elements of your sustainability policies?	Use of recycled or eco-friendly materials	5	29.40%
	Energy-efficient production and transportation	3	17.60%
	Ethical labour and fair-trade practices	9	52.90%
8.) How important is sustainability in your procurement decisions?	level 3	5	27.80%
	level 4	6	33.30%
	level 5	7	38.90%
9.) What are the biggest challenges in sourcing sustainable materials for wind energy?	High costs of sustainable materials	13	72.20%
	Limited availability of green-certified suppliers	8	44.40%
	Lack of clear regulations and standards	11	61.10%
10.) Has your company faced supply chain disruptions affecting procurement?	yes	17	89.50%
	no	2	10.50%
11.) What were the main causes of these disruptions?	Raw material shortages	11	64.70%
	Geopolitical risks and regulations	10	58.80%
	Logistics and transportation issues	10	58.80%
	Supplier capacity limitations	7	41.20%
12.) How does your company mitigate procurement risks?	Long-term contracts with suppliers	4	23.50%
	Sourcing from multiple suppliers	12	70.60%
	Investing in local supply chains	0	0%

	others	1	5.90%
13.) Between cost considerations and sustainability, which has a greater influence on procurement decisions in your company?	Cost considerations are more important	5	26.30%
	Sustainability and environmental impact are more important	2	10.50%
	Both are equally important	12	63.20%
14.) Has your company adopted any strategies to reduce procurement costs while maintaining sustainability?	Partnering with green-certified suppliers	5	27.80%
	Improving logistics efficiency	8	44.40%
	Investing in digital procurement tools	5	27.80%
15.) Do you think government policies and regulations are driving sustainability in procurement?	Yes	10	52.60%
	No	1	5.30%
	May be	8	42.10%
17.) Has your company invested in digital tools for procurement?	Yes	15	78.90%
	No	4	21.10%
18.) What role does Artificial Intelligence (AI) play in your company's wind energy procurement process	Automating procurement decisions	3	20%
	Enhancing supplier evaluation and risk assessment	4	26.70%
	Predicting demand and optimizing inventory	3	20%
	AI is not used in our procurement process	5	33.30%
19.) What role does Blockchain technology play in your company's wind energy procurement process?	Improving supply chain transparency and traceability	1	7.10%
	Enhancing contract security (e.g., smart contracts)	1	7.10%
	Reducing fraud and ensuring ethical sourcing	3	21.40%
	Blockchain is not used in our procurement process	9	64.30%
20.) How does Big Data contribute to your company's wind energy procurement process?	Improving data-driven decision-making	1	7.10%
	Analysing market trends and supplier performance	3	21.40%
	Optimizing cost and efficiency through predictive analytics	2	14.30%
	Big Data is not used in our procurement process	8	57.10%
21.) In the next 5-10 years, which procurement trends do you think will have the biggest impact on wind energy?	Increased local sourcing and shorter supply chains	3	15.80%
	More emphasis on supplier sustainability audits	6	31.60%
	Greater reliance on AI and automation	5	26.30%
	Stricter government policies and regulations	3	15.80%
	Growing importance of circular economy principles	2	10.50%

22.) What are the key barriers preventing the widespread adoption of sustainable procurement in wind energy?	• Complex regulation. • Competition focuses mainly on price level, and sustainability does not come without cost. • Cost efficiency • Material availability • Price pressure from wind turbine manufacturers • Managing supply chain transparency and complexity • Suppliers who meet sustainable procurement requirements. • Limited Availability of Sustainable Materials • Resistance to Change & Lack of Awareness • High Initial Costs • Resistance to Change & Lack of Awareness • Supply Chain Complexity & Limited Transparency • Limited Availability of Sustainable Materials		
23.) What improvements would you suggest for making procurement in wind energy more efficient and sustainable?	• Simple and clear regulations. • Reducing dependency on Chinese components. • Strategic relations/clusters with other politically aligned countries or companies • Region based procurement - end location of wind turbine, define the area for procurement. • Clear group level instructions and targets would help to prioritize sustainability over cost savings • Automation • Local supply chains, invest in sustainable supply chain instead of chasing lowest cost • Adapting new processes • Well planned procurement strategy, procurement practices should be aligned with organisational goals and objectives • use of sustainable materials, quality certification. • Implement Financial Incentives & Green Financing • Enhance Workforce Training & Awareness • Increased Use of Recyclable & Sustainable Materials • Promote Local Sourcing • Standardize Sustainable Procurement Guidelines		

Appendix 5: Cross-table

Table A: Dedicated Procurement Department and Supply Chain Disruptions (n = 19)

Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
dedicated proquremenrt department × has company facesupply chain disruption	19	100.0%	0	.0%	19	100.0%

dedicated proquremenrt department × has company facesupply chain disruption

			has company facesupply chain disruption		
			no	yes	Total
dedicated proquremenrt department	no	Count	1	11	12
		Row %	8.3%	91.7%	100.0%
	yes	Count	1	6	7
		Row %	14.3%	85.7%	100.0%
Total		Count	2	17	19
		Row %	10.5%	89.5%	100.0%