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**Offshore Wind Power in Europe: Strategic Opportunities and
Challenges for Turbine Manufacturers**

Alexandros Zapartas 166629

Supervisor: Magoutas Anastasios

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Alexandros Zapartas

Supervising Committee

Supervisor:
Anastasios Magoutas

Co-Supervisor:
Tsoulfas Ioannis

Abstract

This dissertation investigates the strategic opportunities and challenges facing the European offshore wind industry, with particular emphasis on turbine manufacturers operating within the rapidly evolving renewable energy sector. Offshore wind has emerged as a cornerstone of Europe's energy transition, supporting the achievement of climate neutrality objectives while enhancing long-term energy security and industrial competitiveness. However, despite strong political commitment and continuous technological progress, the industry faces significant challenges, including rising capital costs, supply chain disruptions, regulatory complexity, geopolitical uncertainty, and intensifying international competition. These developments have transformed offshore wind from a purely renewable energy technology into a strategically important industry that requires comprehensive analysis from both a business and strategic management perspective.

The study uses a qualitative approach to investigate based on the analysis of secondary data obtained from academic literature, industry reports, and policy documents. To examine the external environment, industry competitiveness, and organisational strategic capability, the research applies three complementary frameworks of strategic management: PESTEL Analysis, Porter's Five Forces, and the FAMA model. These frameworks were selected because they collectively provide a comprehensive evaluation of the macro-environmental factors, competitive dynamics, and strategic responses impacting the sustainability and long-term competitiveness of the offshore wind sector in Europe.

The findings suggest that the long-term competitiveness of the European offshore wind industry will depend on its ability to balance significant growth opportunities with emerging strategic challenges. While ambitious decarbonisation policies, increasing electricity demand, technological innovation, and sustained investment create favourable conditions for future expansion, the industry remains vulnerable to inflationary pressures, supply chain dependencies, regulatory delays, geopolitical uncertainty, and intensifying competition from Asian manufacturers. These findings highlight the increasing importance of strategic adaptability and industrial resilience in maintaining Europe's competitive position within the global offshore wind market.

The study concludes that strengthening public-private collaboration, promoting regulatory harmonisation, investing in innovation, and enhancing supply chain resilience are essential for sustaining the long-term competitiveness of the European offshore wind industry. By integrating strategic management frameworks within the context of Europe's energy transition, this dissertation facilitates the understanding of how external environmental factors, competitive pressures, and organisational capabilities collectively shape strategic decision-making in the renewable energy sector.

Περίληψη

Η υπεράκτια αιολική ενέργεια έχει αναδειχθεί ως ένας από τους σημαντικότερους πυλώνες της ενεργειακής μετάβασης της Ευρώπης και της μακροπρόθεσμης ενεργειακής της ασφάλειας. Καθώς οι ευρωπαϊκές χώρες επιδιώκουν την επίτευξη των στόχων βιωσιμότητας και τη μείωση της εξάρτησής τους από τα ορυκτά καύσιμα, η υπεράκτια αιολική ενέργεια αποκτά ολοένα και μεγαλύτερη στρατηγική σημασία. Η ενεργειακή κρίση που προκλήθηκε από τη σύγκρουση Ρωσίας–Ουκρανίας κατέδειξε περαιτέρω την ανάγκη για ανάπτυξη εγχώριων πηγών ανανεώσιμης ενέργειας που ενισχύουν την ενεργειακή ασφάλεια και μειώνουν τις γεωπολιτικές εξαρτήσεις. Ωστόσο, ο κλάδος της υπεράκτιας αιολικής ενέργειας αντιμετωπίζει σημαντικές στρατηγικές και λειτουργικές προκλήσεις, όπως το υψηλό κόστος κεφαλαίου, οι διαταραχές στις εφοδιαστικές αλυσίδες, η κανονιστική πολυπλοκότητα, οι περιβαλλοντικές ανησυχίες και ο αυξανόμενος ανταγωνισμός στην αγορά.

Η παρούσα διατριβή εξετάζει τις στρατηγικές ευκαιρίες και προκλήσεις που αντιμετωπίζει ο ευρωπαϊκός κλάδος της υπεράκτιας αιολικής ενέργειας μέσω της ανάλυσης δευτερογενών δεδομένων. Η μελέτη εφαρμόζει την ανάλυση PESTEL για την αξιολόγηση των πολιτικών, οικονομικών, κοινωνικών, τεχνολογικών, περιβαλλοντικών και νομικών παραγόντων που επηρεάζουν τον κλάδο, ενώ το μοντέλο των Πέντε Δυνάμεων του Porter χρησιμοποιείται για την αξιολόγηση της δομής της αγοράς και της ανταγωνιστικής δυναμικής. Παράλληλα, το μοντέλο FAMA χρησιμοποιείται για την ανάπτυξη στρατηγικών συστάσεων με στόχο τη στήριξη της μακροπρόθεσμης ανταγωνιστικότητας, της βιωσιμότητας και της καινοτομίας μεταξύ βασικών ενδιαφερόμενων μερών, συμπεριλαμβανομένων των κατασκευαστών, των εταιρειών ανάπτυξης έργων και των φορέων χάραξης πολιτικής.

Τα ευρήματα δείχνουν ότι η υπεράκτια αιολική ενέργεια παρουσιάζει σημαντικές δυνατότητες ανάπτυξης λόγω των φιλόδοξων στόχων απανθρακοποίησης, της αυξανόμενης ζήτησης ηλεκτρικής ενέργειας, της τεχνολογικής καινοτομίας και των επενδύσεων σε ανανεώσιμες πηγές ενέργειας. Παράλληλα, ο κλάδος αντιμετωπίζει σημαντικούς κινδύνους που σχετίζονται με τον πληθωρισμό, την εξάρτηση από τις εφοδιαστικές αλυσίδες, τις καθυστερήσεις αδειοδότησης, τη γεωπολιτική αβεβαιότητα και τον εντεινόμενο παγκόσμιο ανταγωνισμό, ιδιαίτερα από ταχέως αναπτυσσόμενους κατασκευαστές στην Κίνα.

Η διατριβή καταλήγει στο συμπέρασμα ότι η διαρκής συνεργασία δημόσιου και ιδιωτικού τομέα, η εναρμόνιση των κανονιστικών πλαισίων, οι στρατηγικές επενδύσεις στην καινοτομία και η διαφοροποίηση των εφοδιαστικών αλυσίδων θα είναι καθοριστικοί παράγοντες για τη διασφάλιση της μακροπρόθεσμης επιτυχίας και ανθεκτικότητας της υπεράκτιας αιολικής βιομηχανίας στην Ευρώπη. Η μελέτη συμβάλλει στις ευρύτερες συζητήσεις γύρω από τη στρατηγική των ανανεώσιμων πηγών ενέργειας, τη βιομηχανική ανταγωνιστικότητα και τη βιώσιμη οικονομική ανάπτυξη κατά την ευρωπαϊκή ενεργειακή μετάβαση.

Keywords

- Offshore Wind Energy
- European Offshore Wind Industry
- Renewable Energy Transition
- Strategic Management
- Industrial Competitiveness
- Energy Security
- Supply Chain Resilience

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Chapter 1: Introduction

The global energy sector has experienced profound changes over the past two decades. Growing concerns regarding climate change, the long-term environmental impact of fossil fuels, and the increasing volatility of international energy markets have accelerated the transition towards more sustainable and clean sources of energy. At the same time, governments have been required to balance environmental commitments with economic growth, industrial competitiveness, and the need to ensure reliable and affordable energy supplies. These interconnected challenges have transformed renewable energy from a predominantly environmental issue into a strategic priority influencing economic policy, industrial development, and international competitiveness (IEA, 2023; European Commission, 2023).

Among the different renewable energy technologies currently available, offshore wind has emerged as one of the most promising solutions for supporting this transition. Unlike many other renewable sources, offshore wind offers the potential to generate large volumes of electricity while benefiting from stronger and more consistent wind resources than those typically available on land. Continuous improvements in turbine technology, installation methods, digital monitoring systems, and offshore infrastructure have significantly increased the efficiency and commercial viability of offshore wind projects. As a result, the sector has expanded rapidly across Europe and is expected to play an increasingly important role in achieving long-term decarbonisation targets (WindEurope, 2024).

Europe has established itself as the global leader in offshore wind development through sustained investment, ambitious climate policies, and continuous technological innovation. Countries such as the United Kingdom, Denmark, Germany, and the Netherlands have invested heavily in offshore infrastructure, creating advanced manufacturing capabilities and highly specialised supply chains. These developments have enabled Europe to maintain a leading position within the global offshore wind market while supporting employment, technological innovation, and regional economic growth. Nevertheless, maintaining this leadership has become progressively more challenging as international competition continues to intensify.

Recent geopolitical developments have further reinforced the strategic importance of offshore wind. The disruption of European energy markets following the Russia–Ukraine conflict exposed the vulnerabilities associated with dependence on imported fossil fuels and highlighted the importance of strengthening domestic renewable energy production. In response, European policymakers accelerated investment in renewable energy infrastructure through initiatives such as the REPowerEU Plan, emphasising not only climate objectives but also energy security and industrial resilience (European Commission, 2023). Consequently, offshore wind has become increasingly associated with broader strategic priorities extending beyond environmental sustainability alone.

Additionally, the offshore wind sector is experiencing significant structural change. While European manufacturers have historically dominated international markets, Chinese original equipment manufacturers (OEMs) have expanded rapidly through large-scale manufacturing capacity, vertically integrated supply chains, and strong government

support. This evolving competitive landscape has increased pressure on European firms to improve productivity, strengthen supply chain resilience, and accelerate technological innovation. Consequently, the future success of the European offshore wind sector will depend not only on technological leadership but also on the ability to respond effectively to changing political, economic, and competitive conditions.

These developments demonstrate that offshore wind should no longer be viewed solely as a renewable energy technology. Instead, it has become a strategically important industry operating at the intersection of climate policy, industrial competitiveness, technological innovation, and international business strategy. Understanding the interaction between these factors is therefore essential for evaluating the future prospects of the European offshore wind industry and identifying the strategic actions required to sustain long-term growth within an increasingly competitive global market.

Against this background, the purpose of this dissertation is to examine the strategic opportunities and challenges affecting the European offshore wind industry, with particular emphasis on turbine manufacturers operating within an increasingly competitive global environment. The study aims to evaluate how macro-environmental and competitive factors influence the industry's long-term competitiveness and strategic development. Furthermore, it seeks to develop practical strategic recommendations that can support organisational resilience, innovation, and sustainable growth within the European offshore wind sector.

To achieve this purpose, the dissertation adopts a qualitative research approach based exclusively on the analysis of secondary data obtained from academic literature, industry reports, institutional publications, and policy documents. To evaluate the external environment, industry competitiveness, and organisational strategic capability, the study integrates three complementary strategic management frameworks: PESTEL Analysis, Porter's Five Forces, and the FAMA model. Together, these frameworks provide a comprehensive perspective on the factors shaping the future competitiveness of the European offshore wind industry.

As with any research, this study is subject to certain limitations. First, the analysis relies exclusively on secondary data and therefore does not include primary empirical evidence collected through interviews or surveys. Second, the findings reflect the conditions of the European offshore wind industry during the period under investigation and may be influenced by future technological, regulatory, economic, or geopolitical developments. The remainder of the dissertation is organised into nine chapters. Chapter 2 reviews the relevant academic literature and establishes the theoretical foundation of the study. Chapter 3 presents an overview of the European offshore wind industry. Chapter 4 describes the research methodology, while Chapters 5, 6, and 7 present the strategic analyses based on the PESTEL framework, Porter's Five Forces, and the FAMA model, respectively. Finally, Chapter 8 discusses the findings and their implications, while Chapter 9 presents the conclusions of the study, acknowledges its limitations, and proposes directions for future research.

Chapter 2: Literature

This chapter reviews the academic literature relevant to the European offshore wind industry and its role within the broader renewable energy transition. The review examines key themes including renewable energy development, offshore wind expansion, energy security, industrial competitiveness, and strategic management. In addition, the chapter presents the theoretical frameworks that underpin the research, namely PESTEL Analysis, Porter's Five Forces, and the FAMA model. Through the examination of existing literature, the chapter establishes the theoretical foundation of the dissertation and identifies research gaps that justify the need for further strategic analysis of the European offshore wind sector.

2.1 Renewable Energy Transition, Offshore Wind Development, Energy Security and Competitiveness

The transition towards renewable energy is widely recognised as one of the most significant structural changes affecting modern economies. While climate change remains the principal driver of this transition, recent developments suggest that renewable energy has evolved beyond an environmental objective and is now closely associated with economic competitiveness, industrial policy, technological innovation, sustainable economic growth, and long-term energy security (Jacobsson and Lauber, 2006; Geels, 2014; Cherp and Jewell, 2014; Sovacool, 2016; Markard, 2018; International Energy Agency (IEA), 2023; International Renewable Energy Agency (IRENA), 2023; European Commission, 2023). Governments are therefore increasingly required to balance climate commitments with economic development, industrial competitiveness, energy resilience, and technological advancement within rapidly changing geopolitical environments (Porter, 1990; Ang, Choong and Ng, 2015; Grant, 2022).

This changing perspective has significantly influenced both academic research and public policy. Earlier studies primarily examined renewable energy from an environmental standpoint, emphasising its contribution to sustainable development and the reduction of greenhouse gas emissions (Jacobsson and Lauber, 2006; Schumpeter, 1942; Geels, 2014). More recent literature, however, adopts a broader perspective by recognising renewable energy as a strategic asset capable of enhancing industrial competitiveness, stimulating innovation, increasing energy independence, creating employment opportunities, and strengthening economic resilience (Sovacool, 2016; Markard, 2018; Hart, 1995; Porter and Kramer, 2011; IRENA, 2023). This evolution reflects the increasingly strategic role of renewable energy within contemporary economic, political, and industrial policy.

Within Europe, these developments have been reinforced through ambitious policy initiatives designed to accelerate the transition towards climate neutrality. The European Green Deal, the Fit for 55 legislative package, the Offshore Renewable Energy Strategy, and the REPowerEU Plan collectively demonstrate that renewable energy policy has expanded beyond environmental protection to become an essential component of industrial strategy, energy resilience, and economic competitiveness (European Commission, 2020; European Commission, 2022; European Commission, 2023; IEA,

2023). Following the Russia–Ukraine conflict, European policymakers increasingly recognised the strategic risks associated with dependence on imported fossil fuels, accelerating investment in domestic renewable energy infrastructure and strengthening policy support for offshore wind development (Cherp and Jewell, 2014; Ang, Choong and Ng, 2015; IEA, 2023).

Following the rapid expansion of renewable energy, offshore wind has gradually evolved from a relatively specialised technology into a central pillar of Europe's long-term energy strategy. Existing literature consistently identifies offshore wind as one of the most promising renewable energy technologies because of its ability to generate large volumes of low-carbon electricity while maintaining relatively high capacity factors compared with many alternative renewable energy sources (Snyder and Kaiser, 2009; Musial and Ram, 2010; Bilgili, Yasar and Simsek, 2011; Esteban and Leary, 2012; Kaldellis and Apostolou, 2017; WindEurope, 2024; GWEC, 2024; IEA, 2023). Collectively, these studies demonstrate that offshore wind has evolved into a strategic industry whose future competitiveness depends on the interaction between technological innovation, industrial policy, and organisational capability.

Unlike onshore wind projects, offshore installations benefit from stronger and more stable wind conditions, allowing turbines to operate more efficiently throughout the year. Continuous technological advances in turbine design, digital monitoring systems, floating foundation technologies, predictive maintenance, artificial intelligence, and installation techniques have significantly improved project performance while reducing electricity generation costs (Musial and Ram, 2010; Esteban and Leary, 2012; Kaldellis and Apostolou, 2017; Grant, 2022). Consequently, several researchers argue that offshore wind has reached a level of technological maturity capable of supporting a much larger proportion of future electricity demand than previously anticipated (Markard, 2018; IEA, 2023).

The literature further demonstrates that offshore wind contributes to economic development well beyond electricity generation. Large-scale offshore projects generate demand across multiple sectors, including advanced manufacturing, marine engineering, logistics, digital technologies, electrical infrastructure, specialised installation vessels, and maintenance services (Bilgili, Yasar and Simsek, 2011; Kaldellis and Apostolou, 2017; WindEurope, 2024). The expansion of offshore wind has also supported employment creation, technological innovation, regional economic development, and industrial investment throughout Europe (European Commission, 2023; GWEC, 2024). From this perspective, offshore wind should not be viewed exclusively as an energy technology but also as a strategically important industrial ecosystem capable of strengthening European competitiveness within the global clean energy transition (Porter, 1990; Grant, 2022). The literature has increasingly linked offshore wind development with the concept of energy security. While earlier research primarily focused on environmental benefits and carbon emission reductions, contemporary studies recognise that renewable energy also contributes to reducing dependence on imported fossil fuels, increasing energy resilience, strengthening national security, and improving the reliability of electricity systems (Winzer, 2012; Cherp and Jewell, 2014; Ang, Choong and Ng, 2015; Geels, 2014; Sovacool, 2016; IEA, 2023; IRENA, 2023). Recent geopolitical developments, particularly the Russia–Ukraine conflict, have reinforced this perspective by demonstrating the strategic risks associated with excessive dependence on external energy

suppliers. Consequently, governments increasingly consider renewable energy deployment as an essential component of national energy security strategies rather than solely as an environmental objective (European Commission, 2023; OECD, 2023).

At the same time, offshore wind has become one of the fastest-growing global renewable energy industries. Although Europe has traditionally maintained technological leadership through companies such as Siemens Gamesa, Vestas and Ørsted, recent literature indicates that international competition has intensified considerably following the rapid expansion of Chinese original equipment manufacturers (OEMs). Supported by extensive domestic markets, vertically integrated supply chains, favourable industrial policies, and significant government investment, Chinese manufacturers have substantially strengthened their global competitive position (GWEC, 2024; IEA, 2023; WindEurope, 2024). These developments reflect Porter's (1990) argument that national competitiveness increasingly depends upon innovation, productivity, industrial capability, and supportive institutional environments rather than cost advantages alone. Similarly, Sustainable competitive advantage, according to the Resource-Based View, depends on valuable, uncommon, and organizationally embedded resources that competitors cannot easily replicate (Barney, 1991; Wernerfelt, 1984; Amit and Schoemaker, 1993).

These developments illustrate that offshore wind now occupies a strategic position at the intersection of climate policy, industrial development, technological innovation, and international competitiveness. Existing literature, therefore, increasingly argues that the future success of the sector cannot be evaluated solely through technical or environmental performance indicators. Instead, a broader strategic perspective is required—one that considers the interaction between policy, market dynamics, industrial capability, technological progress, institutional development, and organisational strategy (North, 1990; Geels, 2014; Markard, 2018; Johnson, Scholes and Whittington, 2020; Grant, 2022). This broader perspective provides the theoretical foundation for the strategic management analysis developed throughout this dissertation.

The growing importance of offshore wind has also altered the way researchers interpret the relationship between renewable energy and industrial competitiveness. Earlier studies frequently evaluated renewable energy policies primarily through environmental indicators, including carbon emission reductions and renewable electricity generation. More recent research, however, argues that renewable energy should also be assessed according to its contribution to technological leadership, industrial productivity, innovation capability, employment creation, and long-term economic competitiveness (Porter, 1990; Hart, 1995; Elkington, 1997; Porter and Kramer, 2011; Markard, 2018). This broader perspective reflects the increasing recognition that environmental sustainability and industrial competitiveness are complementary rather than conflicting policy objectives.

The offshore wind industry illustrates this relationship particularly well. Large-scale offshore projects generate significant economic activity across multiple sectors, including manufacturing, marine engineering, digital technologies, logistics, electrical infrastructure, research and development, and specialised maintenance services (Bilgili, Yasar and Simsek, 2011; Kaldellis and Apostolou, 2017). WindEurope (2024) estimates that continued offshore wind expansion will support substantial employment growth while strengthening Europe's industrial base through increased investment in manufacturing

capacity, technological innovation, and research activities. Similar conclusions are reached by Esteban and Leary (2012), who argue that offshore wind represents one of the most important industrial opportunities associated with the global clean energy transition.

Nevertheless, maintaining industrial competitiveness within the offshore wind sector has become increasingly challenging. Rising construction costs, inflationary pressures, supply chain disruptions, higher financing costs, and shortages of specialised materials have significantly affected project profitability across Europe (IEA, 2023; GWEC, 2024; IMF, 2023). At the same time, manufacturers continue to invest heavily in larger turbine platforms, floating offshore technologies, digital monitoring systems, and artificial intelligence while simultaneously attempting to reduce production costs and improve operational efficiency. Consequently, organisations increasingly require strategic capabilities that combine innovation, operational flexibility, organisational learning, and effective resource allocation (Penrose, 1959; Teece, Pisano and Shuen, 1997; Eisenhardt and Martin, 2000; Helfat et al., 2007).

An increasingly prominent theme within recent literature concerns the internationalisation of offshore wind manufacturing. Although Europe continues to possess extensive technological expertise, recent industry reports demonstrate that Chinese manufacturers have rapidly expanded global market share through economies of scale, vertically integrated production systems, advanced manufacturing capability, and sustained public investment (GWEC, 2024; WindEurope, 2024). Consequently, competitive advantage is increasingly determined not only by technological innovation but also by manufacturing productivity, supply chain integration, institutional support, and organisational adaptability (Porter, 1985; Barney, 1991; Grant, 2022).

These developments reinforce the argument that strategic management has become increasingly important within the offshore wind industry. Organisations must continuously monitor technological change, policy developments, competitor behaviour, market conditions, and supply chain risks while simultaneously maintaining sufficient organisational flexibility to respond effectively to external change (Ansoff, 1965; Mintzberg, Ahlstrand and Lampel, 2009; Johnson, Scholes and Whittington, 2020). Contemporary strategic management literature therefore emphasises that sustainable competitive advantage is no longer achieved through technological superiority alone but increasingly depends upon dynamic organisational capabilities, continuous innovation, and effective strategic adaptation (Teece, Pisano and Shuen, 1997; Winter, 2003; Grant, 2022).

2.2 Strategic Management Frameworks

Following the review of the literature relating to renewable energy, offshore wind development, energy security, and industrial competitiveness, it is necessary to establish the theoretical frameworks underpinning the strategic analysis undertaken in this dissertation. As demonstrated in the previous section, the offshore wind industry operates within a highly dynamic environment characterised by rapid technological innovation, evolving government policies, changing economic conditions, environmental regulation, and increasing international competition. Analysing such a complex environment requires the application of strategic management frameworks capable of evaluating external

influences, industry competitiveness, and organisational responses simultaneously (Ansoff, 1965; Mintzberg, Ahlstrand and Lampel, 2009; Johnson, Scholes and Whittington, 2020; Grant, 2022; Hitt, Ireland and Hoskisson, 2020).

Strategic management has evolved considerably over recent decades. Early strategic thinking focused primarily on long-term planning and organisational positioning (Ansoff, 1965). Later research recognised that competitive environments had become increasingly dynamic, requiring organisations to develop greater flexibility, continuous innovation, and adaptive capabilities rather than relying solely on formal planning processes (Mintzberg, 1994; Mintzberg, Ahlstrand and Lampel, 2009). Contemporary strategic management therefore, emphasises organisational learning, resource deployment, innovation capability, stakeholder management, and dynamic competitive advantage as fundamental determinants of long-term organisational success (Barney, 1991; Teece, Pisano and Shuen, 1997; Grant, 2022).

Within the Resource-Based View (RBV), competitive advantage is achieved through valuable organisational resources and capabilities that are difficult for competitors to imitate (Wernerfelt, 1984; Barney, 1991; Amit and Schoemaker, 1993). However, subsequent research argues that valuable resources alone are insufficient within rapidly changing markets. Organisations must also possess the ability to continuously renew, reconfigure, and redeploy these resources in response to environmental change (Teece, Pisano and Shuen, 1997; Eisenhardt and Martin, 2000; Winter, 2003). This evolution gave rise to Dynamic Capability Theory, which has become particularly influential within industries characterised by technological disruption and regulatory uncertainty, including renewable energy and offshore wind (Helfat et al., 2007).

The offshore wind industry provides an excellent example of why strategic management has become increasingly important. Organisations operating within this sector face continuous technological innovation, changing regulatory frameworks, fluctuating commodity prices, evolving supply chain structures, and increasing competition from emerging international manufacturers (IEA, 2023; GWEC, 2024; WindEurope, 2024). Consequently, maintaining long-term competitiveness requires organisations not only to understand external environmental conditions but also to develop organisational capabilities capable of responding rapidly to continuous change (Grant, 2022; Johnson, Scholes and Whittington, 2020).

Existing literature proposes numerous strategic management frameworks capable of supporting organisational decision-making. These include SWOT Analysis, the Resource-Based View, Dynamic Capability Theory, Scenario Planning, Value Chain Analysis, Blue Ocean Strategy, and Porter's Generic Strategies (Porter, 1985; Johnson, Scholes and Whittington, 2020; Grant, 2022). Nevertheless, this dissertation focuses specifically on PESTEL Analysis, Porter's Five Forces, and the FAMA model, since these frameworks collectively address the three principal dimensions relevant to this research: the macro-environment, the competitive environment, and organisational strategic capability.

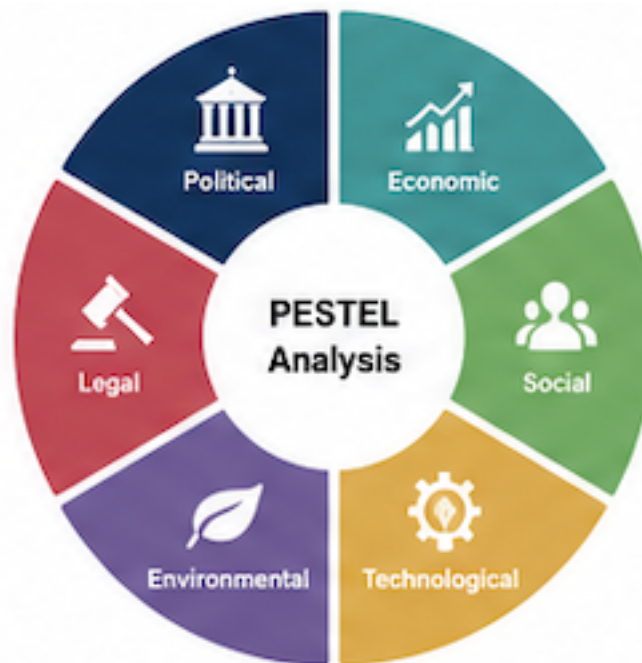
The selection of these three frameworks is consistent with previous strategic management research suggesting that no single analytical model can adequately explain organisational performance within highly dynamic industries (Johnson, Scholes and Whittington, 2020; Grant, 2022). Rather, combining complementary frameworks provides a broader

understanding of how external environmental factors interact with industry competition and organisational behaviour (Porter, 1980; Barney, 1991; Teece, Pisano and Shuen, 1997). Such integration is particularly relevant within offshore wind, where political decisions, technological innovation, financial investment, environmental regulation, and organisational adaptability continuously interact to influence long-term competitiveness

Additionally, the literature on strategic management is beginning to acknowledge that technological developments cannot offer a long-term competitive advantage without inventiveness. Instead, organisations must combine innovation with effective leadership, organisational learning, stakeholder engagement, resilient supply chains, and continuous strategic renewal (Prahalad and Hamel, 1990; Day, 1994; Freeman, 1984; Grant, 2022). These considerations are especially important within renewable energy industries, where long investment cycles, policy uncertainty, and international competition require firms to adopt flexible and adaptive strategic approaches rather than relying upon static competitive advantages.

Consequently, the three frameworks selected for this dissertation provide complementary perspectives on the strategic challenges affecting the European offshore wind industry. PESTEL Analysis examines the broader macro-environmental conditions shaping industry development. Porter's Five Forces evaluates the competitive pressures influencing profitability and market attractiveness. Finally, the FAMA model considers the organisational capabilities required to respond effectively to continuous environmental change. Together, these frameworks provide a comprehensive theoretical foundation for the empirical analysis presented in the following chapters and enable the research to examine offshore wind competitiveness from multiple strategic perspectives (Johnson, Scholes and Whittington, 2020; Grant, 2022).

PESTEL Analysis



PESTEL Framework

PESTEL Analysis is one of the most widely recognised frameworks for analysing the macro-environment within which organisations operate. The model enables decision-makers to examine the external Political, Economic, Social, Technological, Environmental, and Legal factors that influence organisational performance and long-term strategic decision-making (Aguilar, 1967; Fahey and Narayanan, 1986; Johnson, Scholes and Whittington, 2020; Yüksel, 2012). Unlike internally focused strategic tools, PESTEL emphasises that organisational success is strongly influenced by developments occurring beyond the direct control of management. Consequently, it has become one of the most frequently applied frameworks in strategic planning, public policy analysis, and industry evaluation across both private and public sector organisations (Gupta, 2013; Rastogi and Trivedi, 2016).

The origins of PESTEL Analysis can be traced to early environmental scanning approaches developed during the 1960s. Aguilar (1967) argued that organisations must continuously monitor changes occurring within their external environment in order to anticipate future opportunities and threats. Subsequent research expanded this concept by demonstrating that effective strategic management requires organisations to interpret environmental change systematically rather than responding only after changes have occurred (Fahey and Narayanan, 1986; Johnson, Scholes and Whittington, 2020). More recently, Yüksel (2012) emphasised that PESTEL provides an integrated approach for evaluating multiple dimensions of the external environment simultaneously, making it particularly valuable within industries characterised by rapid technological development and regulatory uncertainty.

The offshore wind industry represents one of the clearest examples of an industry whose development is heavily influenced by external environmental conditions. Political decisions determine renewable energy targets, subsidy mechanisms, offshore leasing programmes, permitting procedures, and investment incentives. Consequently, government

policy directly influences both project feasibility and long-term investor confidence (European Commission, 2023; IEA, 2023; IRENA, 2023). Political stability and policy consistency have therefore become fundamental determinants of offshore wind investment across Europe, particularly given the long planning and construction periods associated with offshore energy infrastructure (Johnson, Scholes and Whittington, 2020; Grant, 2022).

Economic factors also exert considerable influence on offshore wind development. Large-scale offshore projects require substantial capital investment, making the industry particularly sensitive to inflation, interest rates, exchange rate fluctuations, commodity prices, labour costs, and access to long-term finance (IEA, 2023; GWEC, 2024). Recent increases in construction costs, financing expenses, and inflationary pressures have demonstrated how wider macroeconomic conditions directly influence project profitability and investment decisions (International Monetary Fund, 2023; OECD, 2023). From a strategic perspective, organisations capable of improving operational efficiency while maintaining financial resilience are better positioned to remain competitive during periods of economic uncertainty (Grant, 2022; Porter, 1985).

Social factors have become increasingly important as offshore wind projects expand throughout Europe. Public acceptance, stakeholder engagement, workforce availability, community support, and environmental awareness significantly influence project implementation and long-term industry development (Freeman, 1984; Aitken, 2010). Although offshore wind generally enjoys higher public acceptance than conventional fossil fuel infrastructure, concerns relating to marine ecosystems, fishing communities, visual impacts, and coastal development continue to influence planning decisions (Aitken, 2010). Consequently, successful offshore wind projects increasingly require effective stakeholder management alongside technical and financial capability (Freeman, 1984).

Technological factors represent one of the principal drivers of competitiveness within the offshore wind industry. Continuous advances in turbine capacity, floating foundations, digital monitoring systems, predictive maintenance, artificial intelligence, and automation have substantially improved operational efficiency while reducing electricity generation costs (Musial and Ram, 2010; Esteban and Leary, 2012; Kaldellis and Apostolou, 2017). Existing research consistently demonstrates that organisations investing in research and development, innovation capability, and digital transformation are more likely to achieve sustainable competitive advantage (Barney, 1991; Teece, Pisano and Shuen, 1997; Grant, 2022). These technological developments have transformed offshore wind into one of the most innovative sectors within the global renewable energy industry.

Environmental considerations remain central to offshore wind development. Although offshore wind contributes directly to reducing greenhouse gas emissions and supporting international climate objectives, projects must also minimise their impact on marine biodiversity, ecosystems, fisheries, and coastal environments (European Commission, 2023; IEA, 2023). Environmental Impact Assessments (EIAs), biodiversity protection measures, and sustainable marine spatial planning therefore represent essential components of offshore wind project development (Kaldellis and Apostolou, 2017). This demonstrates that environmental sustainability must be integrated throughout the entire project lifecycle rather than being considered solely as an outcome of renewable electricity generation.

Finally, legal factors influence every stage of offshore wind development. Planning regulations, environmental legislation, maritime law, grid connection requirements, procurement procedures, health and safety standards, and licensing frameworks collectively determine the legal environment within which organisations operate (European Commission, 2023). Several studies identify lengthy permitting procedures and regulatory complexity as significant barriers limiting the pace of offshore wind deployment across Europe (WindEurope, 2024; IEA, 2023). Consequently, improving regulatory efficiency has become an increasingly important policy objective supporting both renewable energy deployment and industrial competitiveness.

Overall, PESTEL Analysis provides a comprehensive framework for understanding the external conditions influencing the European offshore wind industry. Its principal strength lies in recognising that organisational performance is affected not only by internal strategic decisions but also by broader political, economic, social, technological, environmental, and legal developments (Yüksel, 2012; Johnson, Scholes and Whittington, 2020). Nevertheless, although PESTEL effectively explains the macro-environment within which organisations operate, it provides comparatively limited insight into the competitive relationships between firms. For this reason, the following section introduces Porter's Five Forces framework, which complements PESTEL by examining industry competition and market structure in greater depth (Porter, 1980; Dobbs, 2014).

Porter's Five Forces



Porter's Five Forces

While PESTEL Analysis provides a comprehensive understanding of the external macro-environment, it offers comparatively limited insight into the competitive relationships that exist within an industry. To complement this perspective, Porter's Five Forces framework is employed to analyse the competitive structure of the European offshore wind industry.

Developed by Porter (1980), the model argues that industry profitability and long-term competitiveness are shaped by five competitive forces: rivalry among existing competitors, the bargaining power of suppliers, the bargaining power of buyers, the threat of substitute products or services, and the threat of new entrants. Together, these forces determine the overall attractiveness of an industry and influence the strategic decisions adopted by firms operating within it (Porter, 1980; Porter, 2008; Johnson, Scholes and Whittington, 2020).

Since its introduction, Porter's Five Forces has turned into one of the most influential analytical frameworks within strategic management. Although business environments have evolved considerably since the model was first proposed, numerous researchers argue that it remains highly relevant when analysing industries characterised by technological innovation, regulatory complexity, and international competition (Grant, 2022; Dobbs, 2014; Hill, Jones and Schilling, 2020). Rather than focusing on individual organisational performance, the framework examines the structural characteristics of industries, enabling managers to identify sources of competitive pressure and evaluate long-term strategic opportunities (Porter, 1980; Johnson, Scholes and Whittington, 2020).

Within the offshore wind industry, competitive rivalry has intensified significantly over the past decade. Historically, European manufacturers such as Siemens Gamesa, Vestas, and Nordex benefited from technological leadership, extensive project experience, and strong relationships with European governments and developers. However, recent industry developments indicate that competition has become increasingly international following the rapid expansion of Chinese turbine manufacturers supported by vertically integrated supply chains, substantial manufacturing capacity, and favourable industrial policies (GWEC, 2024; WindEurope, 2024; IEA, 2023). Consequently, competitive rivalry is no longer determined solely by engineering capability but increasingly by manufacturing efficiency, economies of scale, supply chain resilience, innovation performance, and production costs (Porter, 1985; Grant, 2022; Barney, 1991).

Supplier bargaining power represents another important competitive force affecting the offshore wind sector. The manufacture and installation of offshore wind turbines require specialised components, including blades, nacelles, generators, subsea cables, foundations, transformers, installation vessels, and critical raw materials such as rare earth elements. Because many of these products are supplied by a relatively limited number of specialised manufacturers, organisations frequently experience restricted supplier choice and increased procurement risk (IEA, 2023; GWEC, 2024). Recent global supply chain disruptions have further demonstrated the strategic importance of supplier relationships and manufacturing resilience, particularly following the COVID-19 pandemic and subsequent geopolitical tensions (Christopher and Peck, 2004; Ivanov and Dolgui, 2020). Consequently, firms capable of diversifying suppliers, strengthening domestic production capacity, and improving supply chain flexibility are generally better positioned to withstand future disruptions (Grant, 2022; Teece, Pisano and Shuen, 1997).

Buyer bargaining power has also evolved as offshore wind markets have matured. In most European countries, electricity generated by offshore wind projects is procured through competitive auction systems organised by national governments or regulatory authorities. These auctions encourage cost competition while simultaneously placing considerable pressure on developers to reduce project costs and improve operational efficiency

(European Commission, 2023). Large utility companies, institutional investors, and transmission system operators also possess significant bargaining power because of the substantial financial investments associated with offshore wind developments. Consequently, manufacturers and project developers increasingly compete on cost efficiency, technological reliability, and long-term project performance rather than product differentiation alone (IEA, 2023; IRENA, 2023).

The threat of new participants remains relatively limited due to the exceptionally high barriers associated with offshore wind development. New market participants require significant financial resources, advanced engineering expertise, sophisticated manufacturing capability, access to specialised supply chains, regulatory approval, and extensive project management experience (Porter, 1980; Hill, Jones and Schilling, 2020). Nevertheless, growing global demand for renewable energy and substantial government investment have encouraged the emergence of new international competitors, particularly from Asia, thereby increasing competitive pressure within global offshore wind markets (GWEC, 2024).

The threat of substitute technologies is generally considered moderate. Offshore wind competes with alternative renewable energy sources, including onshore wind, solar photovoltaic systems, hydropower, battery energy storage, and emerging hydrogen technologies. However, existing research suggests that these technologies should not necessarily be viewed as direct competitors. Instead, they increasingly operate as complementary components of integrated low-carbon energy systems designed to improve electricity system flexibility, reliability, and resilience (IEA, 2023; IRENA, 2023; Markard, 2018). Consequently, substitution within renewable energy markets depends not only on relative cost but also on broader system integration requirements and national decarbonisation strategies.

Collectively, Porter's Five Forces indicate that the European offshore wind industry continues to present substantial long-term growth opportunities despite increasing competitive pressures. Rising international competition, supply chain disruption, technological innovation, and changing regulatory conditions have fundamentally altered the competitive landscape, requiring organisations to adopt increasingly sophisticated strategic responses (Grant, 2022; Johnson, Scholes and Whittington, 2020). Contemporary strategic management literature therefore suggests that sustainable competitive advantage depends not only upon industry position but also upon innovation capability, organisational learning, manufacturing productivity, supply chain resilience, and dynamic strategic capabilities (Barney, 1991; Wernerfelt, 1984; Teece, Pisano and Shuen, 1997; Eisenhardt and Martin, 2000).

Although Porter's Five Forces remains one of the most influential strategic management frameworks, several researchers have highlighted important limitations. Critics argue that the model assumes relatively stable industry structures and therefore may not fully capture the effects of rapid technological disruption, digital transformation, or changing institutional environments (Grant, 2022; Dobbs, 2014). Furthermore, the framework focuses primarily on industry-level competition and provides comparatively limited insight into the internal organisational capabilities that enable firms to respond effectively to environmental change. For this reason, complementary frameworks emphasising organisational adaptability and strategic flexibility have become increasingly important

within contemporary strategic management research (Teece, Pisano and Shuen, 1997; Helfat et al., 2007). These considerations provide the rationale for introducing the FAMA model in the following section.

The FAMA Model



FAMA Model

The previous sections demonstrated that PESTEL Analysis and Porter's Five Forces provide valuable insight into the external environment and competitive structure of the offshore wind industry. However, these frameworks provide a comparatively limited understanding of how organisations should respond strategically once external opportunities and threats have been identified. Contemporary strategic management literature increasingly argues that sustainable competitive advantage depends not only on analysing external conditions but also on developing organisational capabilities that enable firms to adapt continuously to changing environments (Barney, 1991; Teece, Pisano and Shuen, 1997; Eisenhardt and Martin, 2000; Grant, 2022). Unlike PESTEL Analysis and Porter's Five Forces, which primarily examine external strategic conditions, the FAMA framework focuses on the organisational capabilities required to respond effectively to these conditions.

The increasing uncertainty characterising the offshore wind industry has significantly strengthened the importance of organisational flexibility. Rapid technological innovation, changing government policies, geopolitical instability, supply chain disruption, inflationary pressures, and increasing international competition require organisations to continuously reassess strategic priorities and allocate resources efficiently (Ansoff, 1965; Grant, 2022; Johnson, Scholes and Whittington, 2020). Strategic flexibility therefore enables firms to respond effectively to changing market conditions without compromising long-term organisational objectives. Researchers have consistently argued that flexible organisations demonstrate greater resilience during periods of environmental turbulence

because they can modify strategic direction more rapidly than competitors operating with rigid organisational structures (Volberda, 1996; Sanchez, 1995).

The second component, adaptability, reflects an organisation's ability to modify its capabilities, structures, and decision-making processes in response to environmental change. Dynamic Capability Theory argues that organisations must continuously integrate, build, and reconfigure internal and external competencies to maintain competitiveness within rapidly changing industries (Teece, Pisano and Shuen, 1997). Subsequent research further suggests that dynamic capabilities enable organisations to renew strategic resources, accelerate innovation, and improve organisational performance under conditions of uncertainty (Eisenhardt and Martin, 2000; Winter, 2003; Helfat et al., 2007). Within the offshore wind industry, adaptability has become increasingly important as manufacturers respond to technological advances, evolving policy frameworks, and changing global competitive dynamics.

The third dimension, market awareness, refers to the continuous monitoring and interpretation of external market conditions. Strategic management literature emphasises that competitive advantage depends not only upon possessing valuable organisational resources but also upon understanding changing customer requirements, competitor behaviour, technological trends, and regulatory developments (Day, 1994; Kohli and Jaworski, 1990; Narver and Slater, 1990). Organisations possessing strong market orientation generally demonstrate superior strategic decision-making because they identify emerging opportunities and competitive threats more effectively than less market-oriented competitors. Within the offshore wind sector, market awareness includes monitoring government auctions, international competitors, technological developments, supply chain risks, investor expectations, and energy policy developments (Grant, 2022; Johnson, Scholes and Whittington, 2020).

The final component, agility, concerns the speed with which organisations convert strategic knowledge into effective managerial action. Organisational agility has attracted increasing attention within strategic management literature because rapidly changing business environments require organisations to respond quickly to unexpected events while maintaining operational effectiveness (Doz and Kosonen, 2010; Overby, Bharadwaj and Sambamurthy, 2006). Recent studies argue that organisational agility enables firms to improve innovation performance, strengthen resilience, and respond more effectively to market disruption (van de Wetering, Mikalef and Pateli, 2021). Within offshore wind, agility is particularly important because firms frequently encounter unexpected regulatory changes, supply chain disruption, technological breakthroughs, and fluctuating market conditions that require rapid strategic responses.

Collectively, these four dimensions provide a practical organisational perspective that complements the external analytical frameworks employed within this dissertation. While PESTEL Analysis evaluates macro-environmental conditions and Porter's Five Forces examines competitive market pressures, the FAMA framework focuses on the organisational behaviours required to respond effectively to these external influences. Rather than representing an independent strategic theory, the framework synthesises established concepts from the literature on strategic flexibility, market orientation, dynamic capabilities, and organisational agility, thereby providing an integrated perspective suitable for analysing the strategic challenges affecting turbine manufacturers

operating within the European offshore wind industry (Barney, 1991; Grant, 2022; Teece, Pisano and Shuen, 1997; Eisenhardt and Martin, 2000).

Chapter Summary

This chapter has reviewed the principal strategic management theories and analytical frameworks relevant to the European offshore wind industry. Building upon the broader literature concerning renewable energy transition, industrial competitiveness, and energy security, the review demonstrated that the offshore wind sector operates within an increasingly complex strategic environment shaped by political developments, economic conditions, technological innovation, environmental regulation, and evolving international competition (Geels, 2014; Markard, 2018; European Commission, 2023; IEA, 2023). The literature also highlighted that the industry's long-term competitiveness depends not only on renewable energy deployment but also on innovation capability, industrial resilience, supply chain performance, and effective strategic management (Grant, 2022; Barney, 1991; Teece, Pisano and Shuen, 1997).

Three complementary strategic management frameworks were selected to support the empirical analysis undertaken in this dissertation. PESTEL Analysis provides a systematic evaluation of the macro-environmental conditions affecting offshore wind development, while Porter's Five Forces examines the competitive pressures influencing industry attractiveness and organisational performance (Porter, 1980; Aguilar, 1967; Yüksel, 2012). The organisational perspective adopted through the FAMA framework further extends these analyses by emphasising the importance of flexibility, adaptability, market awareness, and organisational agility in responding to rapidly changing business environments. Collectively, these perspectives reflect contemporary strategic management theory, which increasingly argues that sustainable competitive advantage emerges through the interaction between external environmental conditions, competitive positioning, and organisational capabilities (Eisenhardt and Martin, 2000; Helfat et al., 2007; Johnson, Scholes and Whittington, 2020).

The literature review also identified several important research limitations. Although previous studies have examined renewable energy, offshore wind technology, and environmental policy extensively, comparatively fewer studies have integrated macro-environmental analysis, competitive strategy, and organisational capability within a single strategic management perspective. Furthermore, recent geopolitical developments, increasing global competition, supply chain disruption, and changing industrial policies have significantly altered the operating environment of the European offshore wind sector, creating new strategic challenges that remain insufficiently explored within existing research (GWEC, 2024; WindEurope, 2024; IRENA, 2023).

Consequently, this chapter establishes the theoretical foundation for the remainder of the dissertation. The following chapter presents the research methodology adopted to investigate these strategic challenges and explains how the selected analytical frameworks are applied to evaluate the competitiveness of European offshore wind turbine manufacturers.

2.3 Research Gap and Chapter Synthesis

The literature reviewed throughout this chapter demonstrates broad agreement regarding the strategic importance of offshore wind in supporting Europe's transition towards a low-carbon energy system. Previous studies consistently highlight the sector's contribution to reducing greenhouse gas emissions, strengthening energy security, stimulating technological innovation, and supporting sustainable economic growth (Bilgili, Yasar and Simsek, 2011; Kaldellis and Apostolou, 2017; IEA, 2023; IRENA, 2023; European Commission, 2023; WindEurope, 2024). Similarly, the strategic management literature offers a variety of analytical frameworks that enable organisations to evaluate external business environments, understand competitive pressures, and develop more effective strategic responses (Porter, 1980; Mintzberg, Ahlstrand and Lampel, 2009; Johnson, Scholes and Whittington, 2020; Grant, 2022). Collectively, these studies establish a strong theoretical foundation for understanding the contemporary offshore wind industry.

Despite this growing body of research, several limitations remain evident within the existing literature. A considerable proportion of previous studies adopts a predominantly technical or policy-oriented perspective, focusing on engineering performance, renewable electricity generation, environmental assessment, or project economics (Snyder and Kaiser, 2009; Musial and Ram, 2010; Esteban and Leary, 2012; Kaldellis and Apostolou, 2017). Although these contributions have significantly advanced knowledge of offshore wind technology and renewable energy systems, they provide comparatively limited insight into the broader strategic challenges affecting the industry's long-term competitiveness. In particular, relatively few studies examine how political developments, economic conditions, technological change, industrial policy, supply chain resilience, and international competition interact to influence strategic decision-making within the European offshore wind sector (Geels, 2014; Markard, 2018; Johnson, Scholes and Whittington, 2020).

A further limitation concerns the rapidly changing competitive environment in which European offshore wind companies now operate. Much of the earlier literature reflects market conditions characterised by relatively stable supply chains, lower financing costs, and less pronounced geopolitical uncertainty. However, recent developments—including the Russia–Ukraine conflict, increasing inflation, higher interest rates, disruptions to global logistics, and growing concerns regarding access to critical raw materials—have fundamentally altered the operating environment for renewable energy industries (Cherp and Jewell, 2014; Ang, Choong and Ng, 2015; Christopher and Peck, 2004; Ivanov and Dolgui, 2020; European Commission, 2023; IEA, 2023). These developments suggest that conclusions drawn from earlier studies may not fully reflect the strategic realities currently facing European offshore wind manufacturers and project developers.

The literature also indicates that international competition has intensified considerably during recent years. While Europe continues to occupy a leading position in offshore wind deployment and technological innovation, Chinese original equipment manufacturers have expanded rapidly through large-scale manufacturing capacity, vertically integrated supply chains, and sustained government support (GWEC, 2024; WindEurope, 2024). Existing research acknowledges this shift but has only recently begun to explore its strategic implications for European competitiveness. Consequently, there remains limited academic

evidence examining how European firms can maintain competitive advantage within an increasingly global and cost-sensitive marketplace, particularly where competition is shaped by manufacturing scale, industrial policy, supply chain integration, and cost efficiency (Porter, 1985; Barney, 1991; Grant, 2022).

Another important observation emerging from the literature concerns the use of strategic management frameworks. PESTEL Analysis and Porter's Five Forces have been widely applied across a variety of industries, including renewable energy, manufacturing, and infrastructure development (Aguilar, 1967; Porter, 1980; Johnson, Scholes and Whittington, 2020; Dobbs, 2014). Nevertheless, these frameworks are often employed independently, with limited integration between macro-environmental analysis and competitive market evaluation. Furthermore, comparatively little attention has been given to the organisational capabilities required to respond to rapidly changing external conditions. This suggests that combining complementary strategic frameworks may provide a more comprehensive understanding of the challenges affecting industries characterised by technological innovation, regulatory complexity, and international competition (Teece, Pisano and Shuen, 1997; Eisenhardt and Martin, 2000; Helfat et al., 2007; Grant, 2022).

This dissertation addresses these limitations by adopting an integrated strategic management perspective that combines PESTEL Analysis, Porter's Five Forces, and the FAMA model. Rather than examining offshore wind solely through environmental, technological, or economic perspectives, the study evaluates how macro-environmental developments, competitive market dynamics, and organisational strategic capabilities interact to influence the long-term competitiveness of the European offshore wind industry. By integrating these complementary approaches, the research provides a broader and more contemporary assessment of the strategic environment than is commonly found within existing literature (Johnson, Scholes and Whittington, 2020; Grant, 2022).

The study also contributes by examining the offshore wind industry within the context of recent geopolitical and economic developments. In particular, it considers how changing energy security priorities, increasing global competition, supply chain resilience, and industrial policy influence the strategic position of European manufacturers. These issues have become increasingly important following the acceleration of renewable energy investment across Europe and the emergence of new international competitors (IEA, 2023; GWEC, 2024; WindEurope, 2024). Consequently, the dissertation seeks to bridge the gap between traditional renewable energy research and contemporary strategic management by providing a holistic assessment of the industry's future opportunities and challenges.

Overall, the literature reviewed throughout this chapter demonstrates that offshore wind has evolved from a specialised renewable energy technology into a strategically important industry influencing climate policy, industrial competitiveness, technological innovation, and economic resilience. At the same time, the review highlights that existing research has not fully examined the combined influence of macro-environmental conditions, competitive dynamics, and organisational strategic capabilities within the current European context. Addressing this gap provides the central motivation for the present study and establishes the theoretical foundation for the strategic analyses presented in the following chapters.

Chapter 3: Overview of the European Offshore Wind Industry

The European offshore wind industry has experienced remarkable growth over the past three decades, evolving from a relatively small renewable energy sector into one of the most strategically important industries supporting Europe's energy transition. Driven by ambitious climate policies, technological innovation, and sustained public and private investment, offshore wind has become a central component of the European Union's long-term objectives for decarbonisation, energy security, and industrial competitiveness. Unlike many emerging renewable technologies, offshore wind has reached a relatively mature stage of development, supported by established supply chains, experienced project developers, and a strong regulatory framework that continues to encourage large-scale investment (WindEurope, 2024; European Commission, 2023).

Europe has established itself as the global leader in offshore wind through sustained policy support, technological innovation, and highly developed industrial capabilities, with the United Kingdom, Denmark, Germany and the Netherlands remaining its principal markets. As a result, the region has established an integrated offshore wind ecosystem comprising turbine manufacturers, project developers, component suppliers, financial institutions, research organisations, transmission system operators, and government agencies working collectively to support industry expansion.

Despite this strong position, the European offshore wind industry is entering a period of significant transformation. Increasing global competition, supply chain constraints, inflationary pressures, and geopolitical developments have introduced new strategic challenges that influence both project delivery and long-term competitiveness. At the same time, ambitious renewable energy targets continue to increase demand for offshore wind capacity, placing additional pressure on manufacturers, infrastructure, and investment. Understanding the current structure of the industry is therefore essential before examining the strategic analyses presented in the subsequent chapters.

This chapter provides an overview of the European offshore wind industry by examining its historical development, market characteristics, principal stakeholders, recent investment trends, and emerging challenges. Establishing this context supports the strategic analyses presented later in the dissertation by illustrating the environment within which European offshore wind companies currently operate.

3.1 Historical Development of the European Offshore Wind Industry

The development of the European offshore wind industry reflects the gradual evolution of renewable energy from a niche environmental initiative into a strategically important industrial sector. During its early stages, offshore wind projects were primarily viewed as experimental investments aimed at demonstrating the technical feasibility of large-scale electricity generation in marine environments. High construction costs, limited

technological capability, and considerable engineering challenges initially constrained industry growth, restricting offshore wind development to a relatively small number of demonstration projects located mainly in Northern Europe.

As technological capabilities improved and governments introduced more supportive renewable energy policies, the industry entered a period of sustained expansion. Long-term investment programmes, favourable regulatory frameworks, and increasing private sector participation created the conditions necessary for large-scale commercial deployment. Countries including Denmark, Germany, the United Kingdom, and the Netherlands gradually established themselves as leaders within the sector by investing not only in offshore wind farms but also in specialised manufacturing facilities, port infrastructure, research institutions, and highly integrated supply chains. These investments transformed offshore wind from an emerging technology into a commercially viable industry capable of supporting Europe's wider decarbonisation objectives.

Technological innovation played a central role throughout this development process. Early offshore wind farms relied on relatively small turbines installed close to shore, limiting electricity generation capacity and increasing maintenance requirements. Over time, continuous improvements in turbine design, blade technology, installation methods, subsea infrastructure, and digital monitoring systems significantly increased operational efficiency while reducing the levelised cost of electricity. As turbines became larger and more reliable, developers were able to construct projects further offshore, accessing stronger and more consistent wind resources while improving overall project economics (WindEurope, 2024).

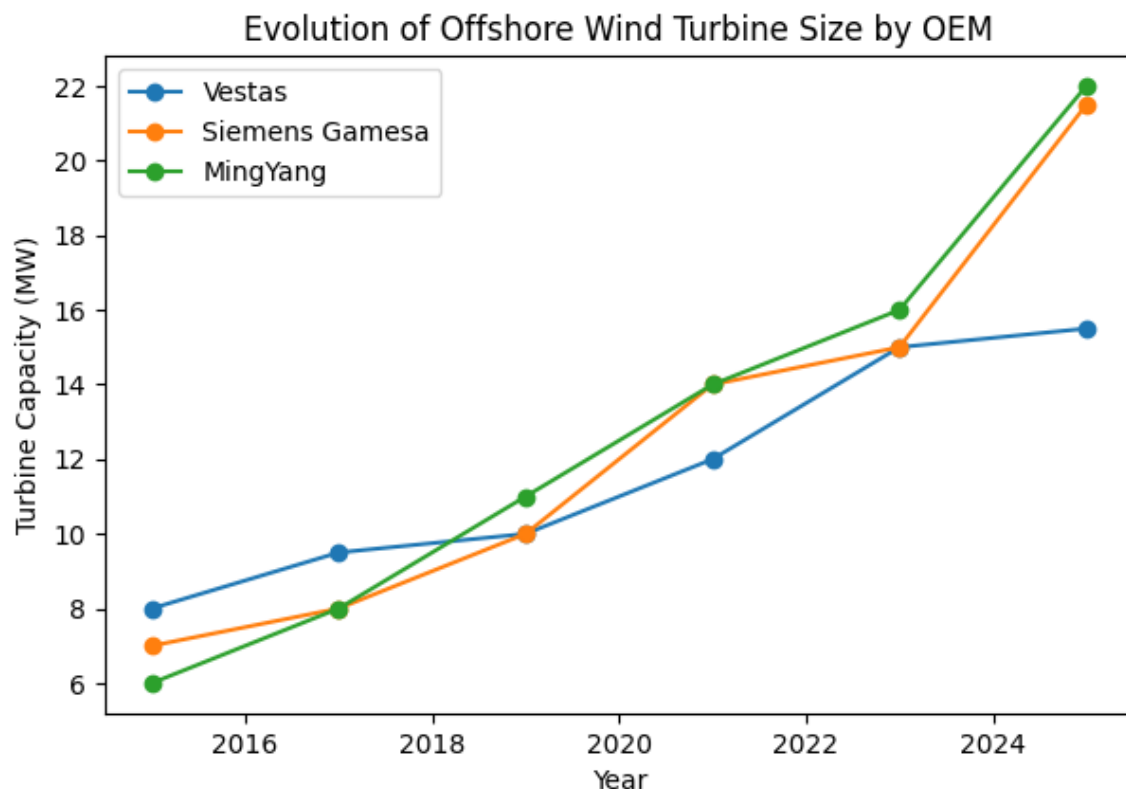
The industry's expansion was further accelerated by the increasing integration of renewable energy into European climate and industrial policy. Rather than treating offshore wind solely as an environmental initiative, policymakers increasingly recognised its potential to strengthen industrial competitiveness, stimulate innovation, create highly skilled employment, and reduce dependence on imported fossil fuels. The introduction of the European Green Deal and subsequent policy initiatives reinforced this strategic perspective by linking renewable energy deployment directly with long-term economic development and industrial resilience (European Commission, 2023).

More recently, the industry has entered a new phase characterised by rapid expansion alongside increasing strategic complexity. Although installed capacity continues to grow, organisations now operate within a significantly more challenging environment than in previous decades. Rising inflation, increasing financing costs, supply chain disruptions, shortages of critical raw materials, and intensifying international competition have altered the conditions under which offshore wind projects are developed. These factors have shifted managerial attention from expansion alone towards issues of productivity, supply chain resilience, cost efficiency, and long-term competitiveness.

At the same time, global market dynamics have changed considerably. While Europe continues to possess extensive experience in offshore wind deployment and technological innovation, other regions—particularly China—have expanded manufacturing capacity at an unprecedented pace. Chinese original equipment manufacturers have benefited from large domestic markets, vertically integrated production systems, and sustained industrial policy support, enabling them to compete increasingly within international renewable

energy markets. Consequently, the competitive advantage historically enjoyed by European manufacturers can no longer be considered guaranteed, reinforcing the importance of continuous innovation and strategic adaptation.

Nevertheless, future leadership will depend not only on continuing to install additional offshore wind capacity but also on maintaining technological leadership, strengthening domestic manufacturing capabilities, improving supply chain resilience, and responding effectively to an increasingly competitive global environment. These developments establish the strategic context for the analyses presented in the following chapters, particularly the evaluation of the external environment, competitive dynamics, and organisational capabilities of European offshore wind manufacturers.



3.2 Current Market Structure and Key Industry Stakeholders

The European offshore wind industry has developed into a highly interconnected ecosystem involving a diverse range of stakeholders whose activities collectively determine the pace of industry growth and long-term competitiveness. Unlike conventional manufacturing sectors, offshore wind projects require extensive coordination between public institutions, private companies, financial organisations, infrastructure providers, and research institutions throughout the entire project lifecycle. As a result, industry performance depends not only on the capabilities of individual organisations but also on the effectiveness of collaboration across the wider value chain.

At the centre of this ecosystem are the original equipment manufacturers (OEMs), responsible for designing, manufacturing, and continuously improving offshore wind turbine technology. Companies such as Siemens Gamesa, Vestas, Nordex, and GE Vernova have historically driven technological innovation within the European market, investing heavily in larger turbines, improved blade design, digital monitoring systems, and predictive maintenance technologies. Their ability to innovate has played a critical role in improving energy output while reducing operational costs, contributing significantly to the commercial maturity of offshore wind projects.

Alongside manufacturers, project developers represent another essential component of the industry. These organisations are responsible for identifying suitable project locations, securing regulatory approvals, arranging financing, managing construction activities, and overseeing long-term operational performance. Their role requires balancing commercial objectives with environmental regulations, stakeholder expectations, and increasingly complex project delivery requirements. As offshore wind farms continue to increase in size and technical complexity, developers have become central coordinators within the wider industry network.

The contribution of suppliers has also become increasingly significant. Offshore wind projects depend upon complex international supply chains providing turbine components, subsea cables, foundations, electrical systems, installation vessels, specialised engineering services, and maintenance equipment. Recent disruptions affecting global logistics have demonstrated that supply chain resilience is now a strategic issue rather than simply an operational concern. Delays in component availability or increases in raw material costs can have substantial implications for project timelines and overall investment viability. Consequently, manufacturers and developers are placing greater emphasis on supplier diversification, long-term strategic partnerships, and increased domestic manufacturing capacity.

Financial institutions and investors also play a fundamental role in supporting industry expansion. Offshore wind projects require substantial capital investment and typically involve long development periods before generating commercial returns. As a result, banks, pension funds, infrastructure investors, and other institutional investors have become key stakeholders within the sector. Their investment decisions are strongly influenced by regulatory stability, predictable revenue mechanisms, and long-term government policy. According to IRENA (2023), maintaining investor confidence remains essential for accelerating renewable energy deployment while supporting continued technological innovation and infrastructure development.

Public authorities represent another critical stakeholder group. National governments, regulatory agencies, and European institutions influence industry development through renewable energy targets, licensing procedures, environmental regulation, electricity market design, and industrial policy. Unlike many other industries, offshore wind remains highly dependent on public policy because investment decisions are closely linked to regulatory certainty and long-term political commitment. Consequently, collaboration between policymakers and industry participants continues to shape both market development and investment confidence across Europe.

Research institutions and universities contribute by supporting technological innovation, workforce development, and knowledge transfer. Continuous advances in turbine engineering, materials science, digital technologies, and offshore infrastructure have been made possible through close cooperation between industry and academia. In addition, research organisations increasingly support the commercialisation of emerging technologies, including floating offshore wind systems, advanced energy storage solutions, and artificial intelligence applications for predictive maintenance and operational optimisation.

The interaction between these stakeholders demonstrates that competitiveness within the offshore wind industry cannot be attributed to individual organisations alone. Instead, long-term success depends upon the effectiveness of the wider industrial ecosystem. Manufacturers rely on resilient suppliers, developers depend on supportive regulatory frameworks, investors require policy certainty, and governments seek continued private investment to achieve renewable energy targets. This high level of interdependence distinguishes offshore wind from many traditional industries and reinforces the importance of adopting a systems perspective when evaluating future industry development.

Recent literature increasingly argues that this collaborative ecosystem will become even more important as international competition intensifies. The rapid expansion of Chinese manufacturers, combined with continuing pressure on European supply chains and manufacturing costs, suggests that future competitiveness will depend not only on technological leadership but also on the ability of European stakeholders to coordinate investment, strengthen industrial partnerships, and accelerate innovation across the entire value chain. These developments highlight the strategic importance of stakeholder collaboration in maintaining Europe's leading position within the global offshore wind industry.

3.3 Current Market Trends and Future Outlook

The European offshore wind industry continues to experience strong long-term growth despite operating within an increasingly challenging business environment. Ambitious climate targets, rising electricity demand, and the need to strengthen energy security have reinforced the strategic importance of offshore wind across Europe. At the same time, the industry faces significant pressures resulting from inflation, increasing capital costs, supply chain disruption, and growing international competition. These contrasting developments illustrate that while market opportunities remain substantial, maintaining long-term competitiveness has become considerably more complex.

One of the most significant trends shaping the industry is the continued increase in turbine size and generation capacity. Technological advances have enabled manufacturers to develop larger and more efficient turbines capable of producing greater amounts of electricity while reducing the overall cost of energy generation. Improvements in digital monitoring systems, predictive maintenance, and artificial intelligence have further enhanced operational performance by increasing reliability and reducing maintenance requirements. These developments continue to strengthen the commercial viability of offshore wind projects and encourage further investment across European markets.

At the same time, governments have accelerated renewable energy deployment through policies aimed at achieving climate neutrality and reducing dependence on imported fossil fuels. Initiatives such as the European Green Deal and REPowerEU have encouraged additional investment in offshore wind infrastructure while simplifying permitting procedures and supporting cross-border energy cooperation (European Commission, 2023). Nevertheless, the pace of deployment continues to depend on the ability of governments and industry stakeholders to address regulatory delays, infrastructure constraints, and workforce shortages.

Supply chain resilience has emerged as another defining issue for the industry. Recent disruptions highlighted the vulnerability of global manufacturing networks and the importance of securing reliable access to critical materials, specialised vessels, and key components. Consequently, both policymakers and industry participants are increasingly prioritising supply chain diversification, domestic manufacturing capability, and strategic partnerships to reduce future operational risks.

International competition is also expected to intensify over the coming years. While European manufacturers continue to lead in technological expertise and project experience, Chinese companies are expanding rapidly through large-scale manufacturing, lower production costs, and strong domestic policy support. This changing competitive landscape is likely to increase pressure on European firms to improve productivity, accelerate innovation, and strengthen industrial collaboration. Future competitiveness will therefore depend not only on continued technological advancement but also on strategic investment, effective policy implementation, and the resilience of the wider offshore wind ecosystem.

Overall, the European offshore wind industry remains well positioned to support Europe's long-term energy transition. However, sustaining this position will require coordinated action between governments, manufacturers, project developers, investors, and research institutions to ensure that future growth is supported by innovation, industrial competitiveness, and resilient supply chains. These market conditions provide the practical context for the strategic analyses undertaken in the following chapters of this dissertation.

3.4 Chapter Summary

This chapter examined the current structure and development of the European offshore wind industry, providing the necessary context for the strategic analyses presented in the following chapters. The discussion demonstrated that offshore wind has evolved into a mature and strategically significant industry supported by strong policy frameworks, technological innovation, and extensive industrial collaboration. At the same time, the industry is facing an increasingly complex operating environment characterised by geopolitical uncertainty, supply chain disruption, rising project costs, and intensifying international competition.

The chapter also highlighted the interconnected nature of the offshore wind ecosystem, where manufacturers, project developers, suppliers, investors, research institutions, and policymakers collectively influence industry performance. While Europe continues to hold a leading position in global offshore wind deployment, maintaining this advantage will

require continued investment in innovation, resilient supply chains, supportive industrial policies, and effective stakeholder collaboration.

Building on this industry overview, the following chapter outlines the research methodology adopted in this dissertation. It explains the research philosophy, research design, data collection methods, and analytical approach adopted to examine the strategic opportunities and challenges facing the European offshore wind industry.

Chapter 4: Research Methodology

This chapter describes the methodological approach adopted to investigate the strategic opportunities and challenges affecting turbine manufacturers operating within the European offshore wind industry. The research methodology was designed to address the objectives established in Chapter 1 while remaining consistent with the theoretical framework presented in the literature review. As the study focuses on strategic management rather than technical engineering, the research employs a qualitative approach based on the analysis of existing academic literature, industry reports, institutional publications, and market data. This methodological choice enables a comprehensive examination of the political, economic, technological, and competitive factors shaping the contemporary offshore wind sector.

The chapter first explains the research philosophy and overall research design before describing the methods used for data collection and analysis. It then discusses the application of the analytical frameworks adopted in this dissertation, namely PESTEL Analysis, Porter's Five Forces, and the FAMA model. Finally, the chapter considers issues relating to research reliability, validity, ethical considerations, and study limitations, thereby demonstrating the transparency and credibility of the research process.

4.1 Research Philosophy, Approach and Design

The selection of an appropriate research methodology is fundamental to ensuring that research findings are credible, transparent, consistent and aligned with the study's objectives (Saunders, Lewis and Thornhill, 2023). As this dissertation examines the strategic challenges affecting turbine manufacturers within the European offshore wind industry, a qualitative research methodology was considered the most appropriate approach. Qualitative research enables the exploration of complex organisational, political, and economic phenomena by examining relationships that cannot be adequately explained through quantitative measurement alone (Creswell and Creswell, 2023).

The study adopts an interpretivist research philosophy, recognising that strategic decision-making is influenced by the perceptions and interactions of organisations, policymakers, investors, and other stakeholders rather than by objective variables alone (Saunders et al., 2023). Within the offshore wind sector, business decisions are shaped by regulatory change, technological innovation, geopolitical developments, and evolving market conditions. Consequently, understanding these interrelated factors requires an interpretative rather than a purely positivist perspective.

An inductive research approach was selected because the study develops conclusions from the critical analysis of existing evidence rather than testing predetermined hypotheses (Bryman, 2021). Academic literature, industry reports, and publications from organisations such as the International Energy Agency (IEA), WindEurope, the European Commission, and the International Renewable Energy Agency (IRENA) were systematically analysed to identify recurring themes relating to competitiveness, renewable energy policy, supply chain resilience, and technological innovation. These

findings subsequently informed the application of the PESTEL Analysis, Porter's Five Forces, and the FAMA model.

The research employs a qualitative case study design, examining the European offshore wind industry as a strategic ecosystem rather than focusing on a single organisation. Yin (2018) argues that case study research is especially suitable for examining contemporary phenomena in their real-world context, particularly when the distinctions between the phenomenon and its environment are ambiguous. This approach enables a comprehensive evaluation of the external environment, competitive dynamics, and organisational capabilities that shape the long-term competitiveness of the European offshore wind industry.

4.2 Data Collection

The present study is based exclusively on secondary data, reflecting the strategic nature of the research objectives and the broad industry perspective adopted throughout the dissertation. Secondary research enables the systematic examination and synthesis of existing knowledge derived from academic publications, institutional reports, industry statistics, government documents, and market analyses. According to Saunders, Lewis and Thornhill (2023), secondary data are particularly appropriate when investigating industries that have already generated substantial empirical evidence, allowing researchers to evaluate existing knowledge critically while identifying broader strategic patterns.

The decision to employ secondary data was influenced by the characteristics of the European offshore wind industry. The sector has been extensively examined by international organisations, government agencies, academic researchers, and industry associations, providing access to a wide range of reliable information relating to market development, policy frameworks, technological innovation, industrial competitiveness, and investment trends. Consequently, the use of secondary sources enabled the research to evaluate multiple dimensions of the industry without the practical limitations associated with large-scale primary data collection (Creswell and Creswell, 2023).

Academic journal articles constituted the primary source of theoretical evidence, particularly in relation to renewable energy transitions, strategic management, competitive advantage, and industrial policy. Peer-reviewed publications were complemented by reports produced by internationally recognised organisations, including the International Energy Agency (IEA), the International Renewable Energy Agency (IRENA), WindEurope, the Global Wind Energy Council (GWEC), and the European Commission. These organisations regularly publish comprehensive assessments of offshore wind deployment, investment activity, technological developments, and policy implementation, making their publications particularly valuable for analysing recent industry developments.

To ensure the relevance and reliability of the evidence, priority was given to publications released within the last five years wherever possible. Earlier academic studies were included only where they represented seminal contributions to strategic management theory, such as Porter's Five Forces (Porter, 1980), or widely accepted methodological guidance, including Saunders et al. (2023), Creswell and Creswell (2023), Bryman (2021),

and Yin (2018). This approach ensured that the dissertation combined established theoretical foundations with current evidence reflecting the rapidly evolving nature of the offshore wind industry.

Data collection followed a structured review process. Relevant literature was identified through academic databases, including Scopus, Web of Science, and Google Scholar, using keywords such as offshore wind, renewable energy, European energy policy, strategic management, PESTEL analysis, Porter's Five Forces, industrial competitiveness, and supply chain resilience. Industry reports and policy documents were obtained directly from the official websites of international organisations and European institutions to ensure the authenticity and credibility of the information utilised throughout the research.

Although secondary research offers significant advantages in terms of accessibility, breadth of evidence, and cost efficiency, it also presents certain limitations. The researcher has limited control over the methods through which the original data were collected, while differences in publication dates, analytical approaches, and institutional objectives may influence the interpretation of findings (Saunders et al., 2023). To minimise these limitations, information was systematically compared across multiple academic and institutional sources, ensuring that the conclusions presented in this dissertation were supported by consistent evidence rather than relying on individual publications.

Overall, the use of secondary data provided a robust evidence base for addressing the research objectives. By integrating academic literature with industry reports and policy documentation, the study develops a comprehensive understanding of the strategic factors influencing the competitiveness of turbine manufacturers operating within the European offshore wind industry.

4.3 Data Analysis and Application of the Strategic Frameworks

The analysis undertaken in this dissertation follows a structured qualitative approach designed to evaluate the strategic environment affecting turbine manufacturers operating within the European offshore wind industry. Rather than relying on statistical modelling or formal hypothesis testing, the research synthesises evidence obtained from academic literature, institutional reports, and industry publications to identify recurring strategic themes and assess their implications for long-term competitiveness. This approach is consistent with qualitative strategic management research, where the objective is to understand complex relationships between external environmental factors, competitive dynamics, and organisational responses rather than to establish causal relationships through quantitative analysis (Saunders, Lewis and Thornhill, 2023).

To ensure analytical consistency, the study adopts a three-stage framework. First, the external macro-environment was examined using PESTEL Analysis, enabling the identification of political, economic, social, technological, environmental, and legal factors influencing the offshore wind industry. As noted by Johnson, Scholes and Whittington (2020), PESTEL provides a systematic method for evaluating external developments that may create opportunities or threats for organisations. Within this dissertation, the framework was used to assess the influence of renewable energy policies,

macroeconomic conditions, technological innovation, environmental regulation, and geopolitical developments on the competitiveness of European turbine manufacturers.

The second stage of the analysis applied Porter's Five Forces to examine the competitive structure of the European offshore wind industry. The framework was selected because it provides a structured assessment of the factors influencing industry attractiveness, including competitive rivalry, supplier power, buyer power, barriers to entry, and the threat of substitute technologies (Porter, 1980). Applying the model enabled the research to evaluate how increasing international competition, supply chain concentration, procurement practices, and technological developments influence the strategic position of European manufacturers within the global offshore wind market.

Finally, the FAMA model was incorporated as a complementary strategic framework to evaluate the organisational capabilities required to respond effectively to external change. While PESTEL and Porter's Five Forces primarily examine external conditions, the FAMA model focuses on organisational flexibility, adaptability, market awareness, and agility, highlighting the capabilities required to maintain competitiveness in rapidly evolving business environments. Therefore, its inclusion extends the analysis beyond environmental assessment by considering how organisations can translate strategic insights into effective managerial responses.

The findings generated through these three frameworks were subsequently integrated rather than interpreted independently. This comparative approach enabled common themes to be identified across the analyses, strengthening the overall interpretation of the results. For example, issues relating to supply chain resilience, technological innovation, regulatory complexity, and international competition emerged consistently across all three frameworks, demonstrating that these challenges cannot be understood from a single analytical perspective. Integrating the findings, therefore, provides a more comprehensive understanding of the strategic environment than would be achieved through the application of any individual framework alone (Johnson et al., 2020).

Overall, the analytical strategy adopted in this dissertation provides a coherent framework for examining the strategic opportunities and challenges affecting European offshore wind turbine manufacturers. The integrated application of PESTEL Analysis, Porter's Five Forces, and the FAMA model forms the basis of the analyses presented in Chapters 5, 6, and 7 and supports the development of the discussion and conclusions presented in the final chapters.

4.4 Reliability, Validity and Ethical Considerations

Ensuring the credibility and trustworthiness of research findings represents an essential component of academic research. Within qualitative studies, reliability and validity are achieved not through statistical replication but through methodological transparency, the careful selection of data sources, and the consistent application of analytical procedures (Bryman, 2021; Saunders et al., 2023). Accordingly, this dissertation adopted a systematic research process designed to enhance the reliability of the findings while minimising potential sources of bias.

Reliability was supported through the use of established and reputable information sources. Academic evidence was obtained primarily from peer-reviewed journal articles, while industry data were collected from internationally recognised organisations, including the International Renewable Energy Agency (IRENA), the International Energy Agency (IEA), WindEurope, the Global Wind Energy Council (GWEC), and the European Commission. Using multiple independent sources enabled key findings to be cross-checked, thereby reducing the likelihood of relying on isolated or potentially biased evidence.

The validity of the research was strengthened through methodological triangulation. Rather than drawing conclusions from a single type of evidence, the study integrates academic literature, policy documentation, market reports, and industry statistics to develop a comprehensive understanding of the strategic issues affecting the offshore wind industry. Comparing evidence across different sources improves confidence that the conclusions accurately reflect current industry conditions rather than the perspective of any individual organisation or publication (Yin, 2018).

Ethical considerations were relatively limited because the research relied exclusively on publicly available secondary data. No interviews, surveys, or personal information were collected, and therefore issues relating to participant confidentiality or informed consent did not arise. Nevertheless, the research adhered to accepted principles of academic integrity by ensuring that all sources were appropriately acknowledged using the Harvard referencing system and that the interpretation of evidence remained objective, balanced, and accurately represented the findings of the original authors.

Although every effort was made to ensure the quality of the research, several limitations should be acknowledged. Secondary data are subject to the scope, methodology, and objectives of the organisations that originally produced them. Furthermore, the offshore wind industry continues to evolve rapidly, meaning that policy developments, technological advances, and market conditions may change after the completion of the study. These limitations have been acknowledged throughout the research and should be considered when interpreting the findings. At the same time, they provide opportunities for future research to build upon and extend the present study.

Chapter 5: PESTEL Analysis of the European Offshore Wind Industry

This chapter applies the PESTEL framework to examine the external environment influencing the European offshore wind industry. Building upon the theoretical discussion presented in Chapter 2 and the industry overview provided in Chapter 3, the analysis evaluates the political, social, economic, technological, environmental, and legal factors that shape the strategic position of turbine manufacturers operating within Europe. Rather than describing the individual components of the framework, the chapter focuses on how these external forces influence investment decisions, industrial competitiveness, technological innovation, and long-term market development.

The European offshore wind sector operates within an environment characterised by significant regulatory intervention, rapid technological progress, evolving climate policies, and increasing international competition. These conditions create both opportunities and challenges for manufacturers seeking to maintain competitiveness in an increasingly dynamic market.



PESTEL Framework

5.1 Political Factors

Political developments continue to exert a decisive influence on the European offshore wind industry. Unlike many manufacturing sectors that are primarily driven by market demand, offshore wind development depends heavily on public policy, long-term regulatory stability, and government investment. National renewable energy targets, auction mechanisms, permitting procedures, and industrial strategies collectively shape the investment environment within which manufacturers and project developers operate (European Commission, 2023).

Over the past decade, European energy policy has increasingly integrated climate objectives with industrial competitiveness and energy security. The European Green Deal and the REPowerEU Plan illustrate this shift by promoting accelerated renewable energy deployment while simultaneously seeking to strengthen domestic manufacturing capabilities and reduce dependence on imported fossil fuels (European Commission, 2023). As a result, offshore wind has become an important component of broader European industrial policy rather than simply a renewable energy technology.

Recent geopolitical developments have further reinforced the strategic importance of government intervention. The disruption of European energy markets following the Russia–Ukraine conflict exposed the risks associated with external energy dependence and accelerated investment in domestic renewable energy infrastructure (IEA, 2023). Consequently, policymakers increasingly view offshore wind as contributing not only to decarbonisation but also to economic resilience and strategic autonomy.

Despite this supportive policy environment, regulatory complexity remains a significant challenge. Lengthy permitting procedures, differences in national regulatory frameworks, and delays in grid connection continue to slow project implementation across several European markets. These constraints increase project costs and create uncertainty for investors and manufacturers, highlighting the importance of regulatory harmonisation and more efficient approval processes (WindEurope, 2024).

Overall, the political environment presents substantial opportunities for continued industry growth through sustained policy support and ambitious renewable energy targets. However, maintaining these opportunities depends upon regulatory consistency, effective policy implementation, and continued cooperation between governments and industry stakeholders.

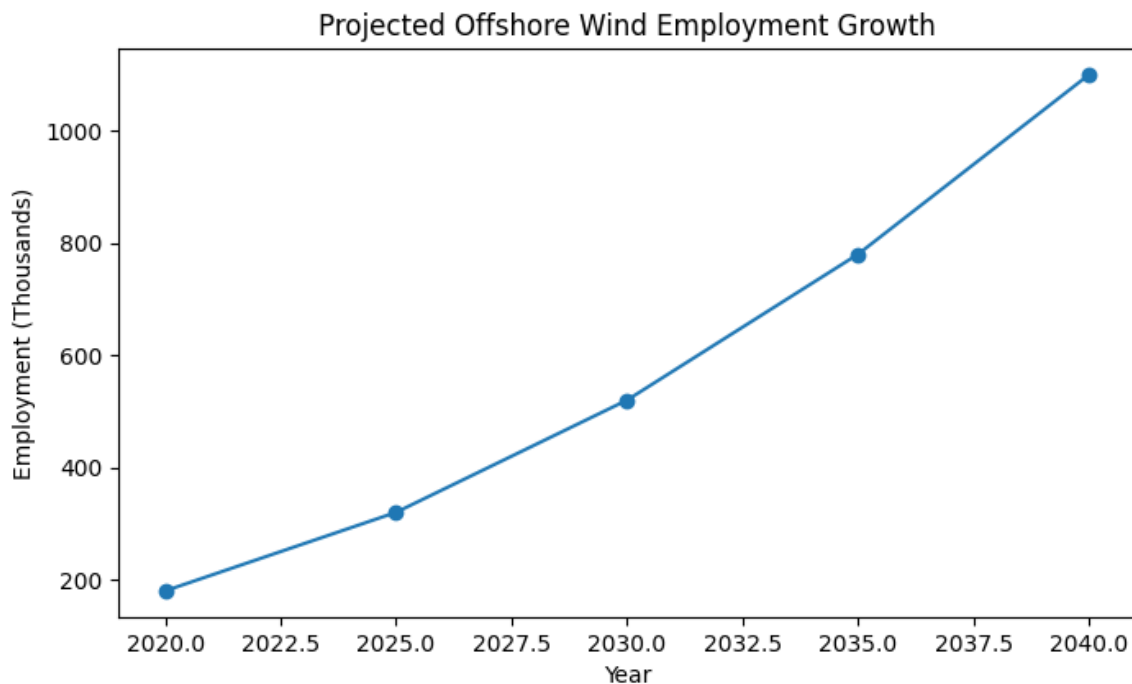
5.2 Economic Factors

Economic conditions have become one of the principal determinants of long-term competitiveness within the European offshore wind industry. Although long-term market prospects remain positive, recent macroeconomic developments have significantly increased financial pressure across the sector. Rising inflation, higher interest rates, increasing construction costs, and volatility in commodity markets have affected both project economics and manufacturers' profitability (IEA, 2023).

Offshore wind projects require substantial upfront capital investment and typically involve long development periods before generating financial returns. Consequently, access to affordable financing remains essential for continued industry expansion. Higher borrowing costs have increased the cost of capital for developers while reducing the financial attractiveness of new projects. Several planned offshore wind developments have therefore experienced delays or contract renegotiations as investors reassessed project viability under changing economic conditions (WindEurope, 2024).

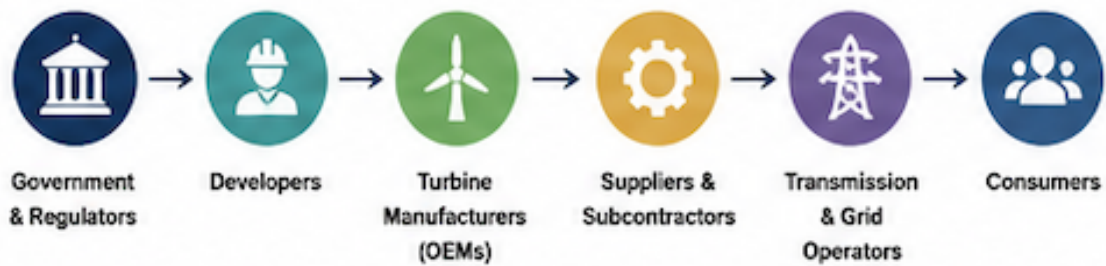
At the same time, increasing demand for renewable energy infrastructure has intensified competition for critical raw materials, specialised vessels, electrical equipment, and skilled labour. Supply constraints affecting steel, copper, rare earth elements, and semiconductor

components have contributed to higher manufacturing costs throughout the offshore wind value chain. These pressures have reduced profit margins for turbine manufacturers while increasing uncertainty surrounding project delivery schedules (GWEC, 2024).



Despite these short-term challenges, the long-term economic outlook remains favourable. Continued government support, ambitious decarbonisation targets, and growing private-sector investment continue to stimulate market expansion across Europe. Offshore wind also generates significant economic benefits beyond electricity production, including employment creation, industrial development, regional investment, and technological innovation (IRENA, 2023). Consequently, the sector continues to represent an important contributor to both economic growth and industrial competitiveness.

Overall, the current economic environment presents a combination of short-term financial pressures and long-term growth opportunities. Maintaining competitiveness will therefore depend upon improving cost efficiency, strengthening domestic supply chains, encouraging investment, and enhancing productivity across the offshore wind value chain.



European Offshore Wind Value Chain

5.3 Social Factors

Social factors increasingly influence the development of offshore wind projects, particularly as renewable energy infrastructure expands across European coastal regions. Public support for renewable energy remains generally high due to growing awareness of climate change, environmental sustainability, and energy security. This favourable social environment has contributed to the political acceptance of offshore wind as a central component of Europe's energy transition (European Commission, 2023).

Nevertheless, social acceptance cannot be assumed. Local communities, environmental organisations, fishing industries, and coastal stakeholders frequently express concerns regarding the environmental and economic impacts of large-scale offshore developments. Issues including visual impact, marine biodiversity, fishing activities, and local employment opportunities often influence project approval processes. As a result, effective stakeholder engagement has become an increasingly important element of project planning and implementation.

Workforce development also represents an important social challenge. The rapid expansion of offshore wind has increased demand for highly skilled engineers, technicians, project managers, and specialised maritime personnel. Existing labour shortages have encouraged greater investment in education, vocational training, and collaboration between industry and academic institutions to ensure that the workforce can support continued market growth (WindEurope, 2024).

Overall, social factors contribute both opportunities and constraints for the offshore wind industry. Strong public support provides a favourable environment for renewable energy expansion, while effective stakeholder engagement and workforce development remain essential for ensuring the long-term sustainability of the industry.

5.4 Technological Factors

Technological innovation remains one of the primary drivers of competitiveness within the European offshore wind industry. Continuous advances in turbine design, digital technologies, installation methods, and offshore infrastructure have significantly improved operational efficiency while reducing the levelised cost of electricity. These developments

have enabled offshore wind to evolve from an emerging renewable technology into a commercially viable source of large-scale electricity generation (IEA, 2023).

One of the most significant technological trends has been the rapid increase in turbine size and generating capacity. Larger turbines are capable of producing more electricity while reducing the number of installations required for each project, thereby improving overall project economics. At the same time, advances in floating offshore wind technology are expanding development opportunities into deeper waters, increasing the geographical potential for future offshore wind deployment across Europe (WindEurope, 2024).

Digitalisation has also transformed industry operations. Artificial intelligence, predictive maintenance, remote monitoring systems, digital twins, and advanced data analytics have improved asset management by reducing maintenance costs, increasing equipment reliability, and extending turbine operational lifetimes. These technologies enable manufacturers and operators to optimise performance while improving the long-term financial viability of offshore wind projects (GWEC, 2024).

However, maintaining technological leadership requires sustained investment in research and development. Increasing competition from international manufacturers, particularly from China, has accelerated innovation while reducing product development cycles. Consequently, European manufacturers must continue investing in advanced technologies to preserve their competitive advantage within an increasingly global market.

Overall, technological innovation represents both a competitive advantage and a strategic necessity. Organisations capable of continuously improving efficiency, reliability, and manufacturing capability will be better positioned to maintain leadership within the evolving offshore wind industry.

5.5 Environmental Factors

Environmental sustainability forms the foundation of offshore wind development and remains one of the principal justifications for continued investment across Europe. Offshore wind contributes directly to reducing greenhouse gas emissions, supporting climate neutrality objectives, and decreasing dependence on fossil fuels. These environmental benefits continue to strengthen political and public support for renewable energy investment while reinforcing the industry's strategic importance within European climate policy (European Commission, 2023).

Despite these advantages, offshore wind developments must also address environmental challenges associated with marine ecosystems. Project developers are required to undertake comprehensive environmental impact assessments to evaluate potential effects on marine biodiversity, fisheries, seabird populations, and coastal ecosystems. Balancing renewable energy expansion with environmental protection has therefore become an essential element of sustainable offshore wind development.

The legal environment is equally important in shaping industry competitiveness. Offshore wind projects are subject to complex regulatory frameworks covering licensing procedures, spatial planning, environmental protection, grid connection, maritime law, and

health and safety requirements. Although these regulations provide essential safeguards, lengthy permitting procedures and inconsistent regulatory practices across European countries continue to delay project implementation and increase development costs (WindEurope, 2024).

Recognising these challenges, the European Union has introduced measures aimed at accelerating permitting processes and improving regulatory coordination through initiatives associated with the European Green Deal and REPowerEU (European Commission, 2023). These reforms seek to reduce administrative barriers while maintaining high environmental standards, thereby supporting both renewable energy deployment and industrial competitiveness.

Overall, environmental sustainability and regulatory effectiveness are closely interconnected. Long-term industry growth depends not only on achieving ambitious climate objectives but also on creating an efficient legal framework capable of facilitating timely investment while ensuring responsible environmental management.

5.6 PESTEL Synthesis

The PESTEL analysis demonstrates that the European offshore wind industry operates within an external environment characterised by significant opportunities alongside increasing strategic challenges. Strong political commitment, ambitious climate policies, technological progress, and growing public support continue to create favourable conditions for industry expansion. At the same time, inflation, financing constraints, supply chain vulnerabilities, regulatory complexity, and intensifying international competition place increasing pressure on manufacturers and project developers.

Importantly, these external factors should not be considered independently. Political decisions influence investment confidence, economic conditions affect technological innovation, regulatory frameworks shape environmental performance, and social acceptance determines the pace of project implementation. The interaction between these factors illustrates the complexity of the contemporary offshore wind industry and highlights the need for integrated strategic decision-making.

Overall, the analysis suggests that Europe's future competitiveness will depend on its ability to translate favourable policy conditions into sustained industrial performance. Strengthening domestic manufacturing, accelerating innovation, improving regulatory efficiency, and enhancing supply chain resilience will be essential for maintaining Europe's leadership within the global offshore wind market. These findings provide the foundation for the industry-level competitive analysis developed in the following chapter through the application of Porter's Five Forces framework.

Chapter 6: Porter's Five Forces Analysis of the European Offshore Wind Industry

Following the assessment of the external environment through the PESTEL framework, this chapter examines the competitive structure of the European offshore wind industry using Porter's Five Forces. While the previous chapter identified the macro-environmental conditions influencing the sector, the present analysis focuses on the competitive pressures that shape industry attractiveness and influence the strategic position of turbine manufacturers.

The European offshore wind market has become increasingly competitive as technological innovation accelerates, global manufacturing capacity expands, and governments pursue ambitious renewable energy targets. Established European manufacturers now face growing pressure from international competitors, changing procurement practices, and evolving customer expectations. Applying Porter's Five Forces enables a structured evaluation of these competitive dynamics and identifies the factors most likely to influence long-term industry competitiveness.

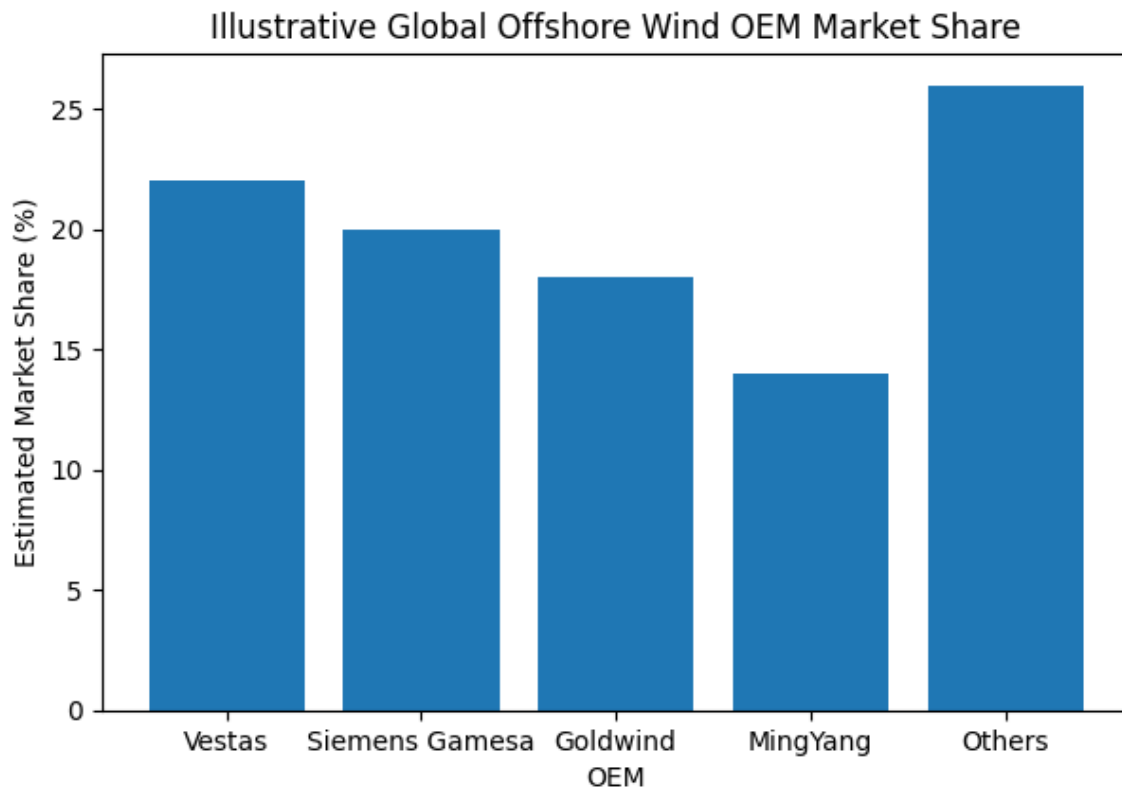
6.1 Competitive Rivalry

Competitive rivalry within the European offshore wind industry has intensified considerably during the past decade. Historically, European manufacturers benefited from technological leadership, extensive operational experience, and close cooperation with governments and project developers. Companies such as Siemens Gamesa, Vestas, Nordex, and GE Vernova established strong market positions through continuous innovation and long-term investment in offshore wind technology.

The competitive landscape has changed significantly in recent years. Chinese manufacturers have expanded rapidly by combining large-scale domestic production, vertically integrated supply chains, and sustained government support. Their ability to manufacture turbines at lower cost while increasing production capacity has intensified competition across international markets, placing increasing pressure on European manufacturers to improve productivity and reduce costs (GWEC, 2024).

Competition is no longer based solely on technological performance. Manufacturers increasingly compete through manufacturing efficiency, supply chain integration, after-sales services, digital solutions, and project delivery capability. Consequently, competitive advantage depends upon a broader combination of technological expertise, operational excellence, and strategic flexibility rather than engineering capability alone.

Despite these pressures, Europe retains important competitive strengths. Long-standing relationships with project developers, advanced engineering expertise, established regulatory knowledge, and strong research capabilities continue to provide significant advantages within the global offshore wind market. Maintaining these advantages will, however, require continued investment in innovation and industrial productivity.

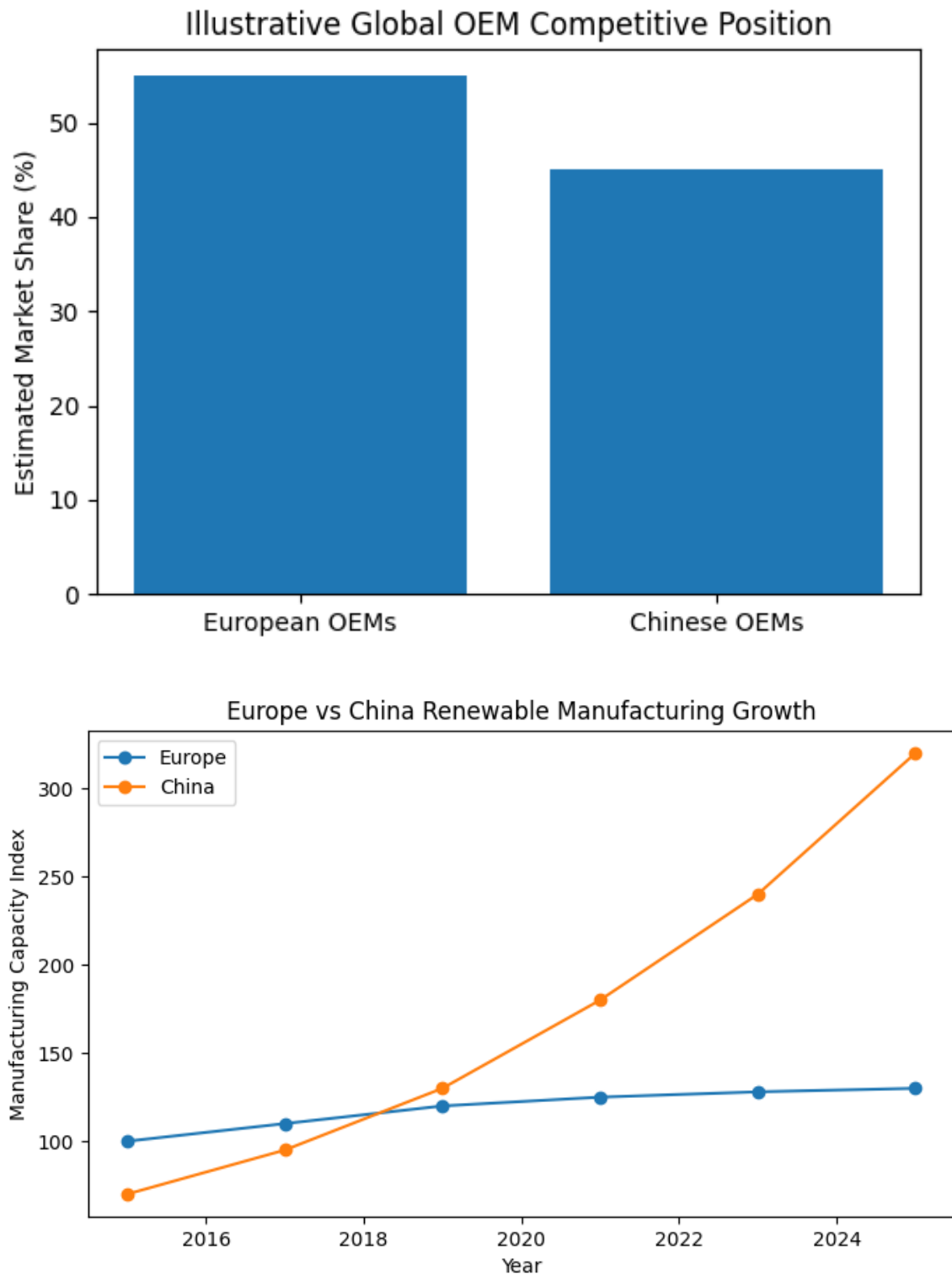


6.2 Threat of New Entrants

The offshore wind industry continues to present substantial barriers to entry. Developing competitive turbine manufacturing capabilities requires considerable financial investment, advanced technological expertise, specialised production facilities, and extensive research and development resources. In addition, manufacturers must comply with demanding regulatory standards while establishing relationships with developers, suppliers, and certification bodies.

These factors continue to protect established firms from rapid market entry. Nevertheless, increasing global investment in renewable energy has encouraged the emergence of new competitors, particularly from Asia. Government support, expanding domestic markets, and industrial policy have enabled several new manufacturers to develop capabilities more rapidly than previously anticipated.

Although barriers remain high, entry is no longer impossible. The emergence of financially supported international manufacturers demonstrates that industrial policy and manufacturing scale can significantly reduce traditional entry barriers. Consequently, existing European firms can no longer rely solely on historical market leadership as protection against future competition.



6.3 Bargaining Power of Suppliers

Supplier power remains relatively strong within the offshore wind industry because many critical components are produced by a limited number of specialised suppliers. Turbine manufacturers depend upon reliable access to steel, rare earth materials, power electronics,

subsea cables, specialised bearings, installation vessels, and other technically complex components.

Recent disruptions affecting international logistics demonstrated the vulnerability of global supply chains. Delays in material availability and rising input costs affected production schedules throughout the industry while increasing overall project costs. These developments highlighted the strategic importance of supplier diversification and long-term procurement partnerships (IEA, 2023).

European manufacturers have increasingly responded by strengthening supplier relationships, expanding regional manufacturing capacity, and reducing dependence on individual suppliers. Improving supply chain resilience has therefore become an important strategic objective extending beyond cost management to encompass operational continuity and long-term competitiveness.

6.4 Bargaining Power of Buyers

The bargaining power of buyers has increased as the offshore wind industry has matured and procurement processes have become more competitive. Utility companies, energy developers, and public authorities increasingly procure offshore wind capacity through competitive auctions, placing significant pressure on manufacturers to reduce costs while maintaining high technical standards. This environment has shifted competition away from purely technological performance towards a broader combination of price, reliability, operational efficiency, and lifecycle service provision (European Commission, 2023).

Large project developers typically possess substantial negotiating power due to the scale of offshore wind investments and the relatively limited number of major turbine suppliers. At the same time, customers increasingly demand larger turbines, improved operational performance, and comprehensive maintenance agreements, requiring manufacturers to expand the range of services offered alongside their products. Consequently, buyer expectations now extend beyond equipment supply to include long-term technical support and performance optimisation.

Despite stronger buyer influence, manufacturers retain some bargaining power because offshore wind turbines remain highly specialised products requiring advanced engineering expertise and extensive certification. The limited number of globally established manufacturers therefore continues to restrict buyer choice, particularly for large-scale offshore projects. Nevertheless, increasing international competition is gradually strengthening buyers' negotiating position, encouraging manufacturers to differentiate themselves through innovation, reliability, and service quality rather than price alone.

6.5 Threat of Substitute Technologies

The threat of substitution within the offshore wind industry remains relatively moderate. Offshore wind competes with alternative renewable technologies, including onshore wind, solar photovoltaic systems, hydropower, battery storage, and emerging hydrogen technologies. However, these technologies are generally viewed as complementary

components of Europe's broader energy transition rather than direct substitutes (IEA, 2023).

Each renewable technology offers distinct advantages depending on geographical conditions, resource availability, infrastructure requirements, and electricity demand. Offshore wind provides relatively high and consistent electricity generation, making it particularly valuable for supporting large-scale decarbonisation objectives and improving electricity system reliability. Consequently, although alternative technologies continue to expand rapidly, they are unlikely to replace offshore wind entirely within the European energy mix.

Future technological developments may alter the competitive relationship between renewable energy technologies. Advances in energy storage, hydrogen production, and smart electricity networks could increase flexibility within renewable energy systems while changing investment priorities. Nevertheless, current evidence suggests that offshore wind will remain a central component of Europe's long-term energy strategy because of its scale, maturity, and ability to generate substantial volumes of low-carbon electricity.

6.6 Industry Competitiveness Synthesis

The Five Forces analysis demonstrates that the European offshore wind industry continues to operate within an attractive long-term market while facing increasingly demanding competitive conditions. High barriers to entry and sustained market growth continue to support industry development; however, these advantages are offset by intensifying rivalry, growing buyer expectations, persistent supply chain challenges, and increasing international competition.

Taken together, the findings indicate that competition is no longer determined solely by technological innovation. Manufacturing efficiency, supply chain resilience, cost competitiveness, strategic partnerships, and organisational responsiveness have become equally important sources of competitive advantage. The emergence of Chinese manufacturers illustrates this transition, highlighting that industrial scale and coordinated policy support can significantly influence global market dynamics alongside technological capability.

Overall, the analysis suggests that maintaining Europe's leadership in offshore wind manufacturing will require a broader strategic approach than in previous decades. Future competitiveness will depend upon continued investment in innovation, stronger industrial collaboration, more resilient supply chains, and policies capable of supporting domestic manufacturing while responding effectively to increasing international competition. These conclusions provide the basis for the strategic recommendations developed in Chapter 7 through the application of the FAMA model.

Chapter 7: Strategic Recommendations Using the FAMA Model

The previous chapters examined the external environment and competitive structure of the European offshore wind industry through PESTEL Analysis and Porter's Five Forces. Together, these frameworks identified the principal political, economic, technological, and competitive challenges influencing turbine manufacturers. Building upon these findings, this chapter applies the FAMA model to evaluate how organisations can respond strategically to an increasingly dynamic business environment.

Rather than identifying additional external challenges, the purpose of this chapter is to translate the preceding analyses into practical strategic recommendations. The FAMA model provides an appropriate framework for this objective by emphasising organisational flexibility, adaptability, market awareness, and agility as capabilities that enable firms to respond effectively to changing market conditions. Consequently, the chapter focuses on strategic responses capable of strengthening long-term competitiveness within the European offshore wind industry.



FAMA Model-Strategic Capability Framework

7.1 Applying the FAMA Model to the European Offshore Wind Industry

The findings presented in Chapters 5 and 6 demonstrate that the competitiveness of European turbine manufacturers is influenced by factors extending beyond technological

capability alone. Regulatory uncertainty, changing economic conditions, global supply chain disruption, and increasing international competition require organisations to develop strategic capabilities that support continuous adaptation. Within this context, the FAMA model provides a useful framework for interpreting how firms can respond proactively to external change rather than simply reacting to emerging challenges.

Flexibility is reflected in the ability of organisations to adjust production strategies, diversify supplier networks, and respond efficiently to changing market conditions. As demonstrated in the PESTEL analysis, inflation, material shortages, and regulatory changes require manufacturers to maintain sufficient operational flexibility to minimise disruption while continuing to meet project requirements.

Adaptability has become increasingly important as offshore wind technologies and competitive conditions continue to evolve. European manufacturers must invest continuously in research and development while adapting their business models to emerging technologies such as floating offshore wind, digital asset management, and artificial intelligence. Organisations capable of responding rapidly to technological change are more likely to preserve long-term competitive advantage.

Market awareness enables organisations to anticipate developments affecting future competitiveness. Continuous monitoring of policy developments, customer requirements, competitor strategies, and technological innovation supports more informed strategic decision-making. This capability is particularly important given the rapid expansion of Chinese manufacturers and the changing structure of international renewable energy markets.

Finally, agility determines the speed with which strategic decisions are implemented. Identifying market opportunities provides limited competitive value unless organisations can respond effectively. Firms capable of accelerating innovation, adjusting investment priorities, and implementing operational change rapidly are generally better positioned to succeed within highly dynamic industries such as offshore wind.

Taken together, these four capabilities illustrate that sustaining competitiveness depends not only on analysing the external environment but also on developing organisational capacities that enable effective strategic responses to continuous change.

7.2 Strategic Recommendations

The preceding analyses demonstrate that the European offshore wind industry continues to benefit from strong policy support, technological expertise, and long-term market potential. At the same time, the analyses highlight increasing challenges associated with international competition, supply chain vulnerability, regulatory complexity, and rising project costs. Addressing these issues requires coordinated action from policymakers, manufacturers, and investors. Accordingly, the following recommendations are derived directly from the findings of the PESTEL Analysis, Porter's Five Forces, and the FAMA model.

Recommendations for Governments and Policymakers

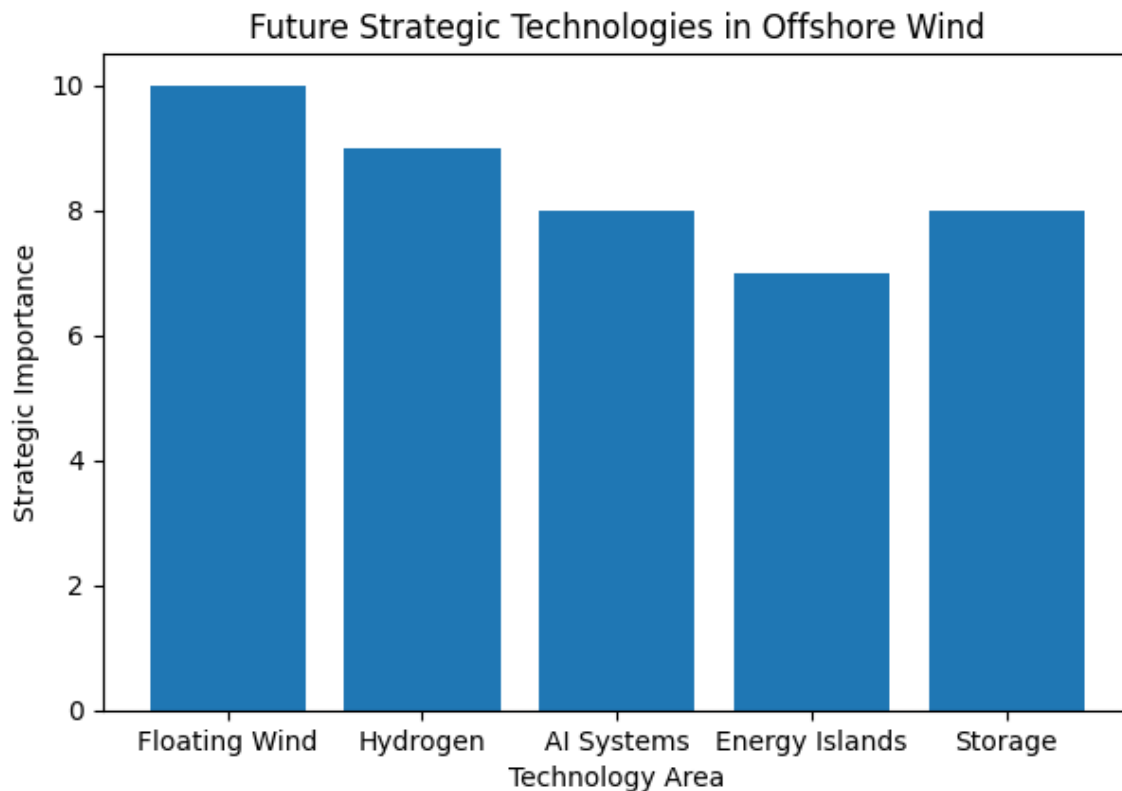
Governments should continue strengthening the policy framework supporting offshore wind development while placing greater emphasis on industrial competitiveness alongside renewable energy deployment. Although initiatives such as the European Green Deal and REPowerEU have accelerated investment, further improvements are required to simplify permitting procedures, expand grid infrastructure, and reduce administrative delays that continue to affect project implementation (European Commission, 2023).

Industrial policy should also focus on reinforcing domestic manufacturing capacity and strengthening European supply chains. Greater investment in research and innovation, workforce development, and strategic manufacturing capabilities would reduce dependence on imported components while enhancing Europe's long-term competitive position. Coordinated policies at both national and European levels will therefore remain essential for balancing climate objectives with industrial resilience and economic growth.

Recommendations for Turbine Manufacturers

European manufacturers should prioritise continuous innovation while improving operational efficiency and supply chain resilience. Maintaining technological leadership alone is unlikely to guarantee long-term competitiveness as international competitors increasingly combine advanced technology with lower production costs. Consequently, organisations should invest in digital technologies, artificial intelligence, predictive maintenance, and next-generation turbine platforms while simultaneously improving manufacturing productivity and reducing production costs.

Manufacturers should also diversify supplier networks and strengthen strategic partnerships across the European value chain to minimise exposure to future supply chain disruptions. Greater collaboration with universities, research institutions, and technology companies will further support innovation and accelerate the commercialisation of emerging offshore wind technologies, particularly floating offshore wind systems and digital asset management solutions.



Recommendations for Investors and Financial Institutions

Long-term investment will remain essential for supporting the continued expansion and competitiveness of the European offshore wind industry. Financial institutions should continue supporting renewable energy projects while recognising the increasing importance of stable regulatory environments and predictable investment conditions. Close cooperation between governments and investors can reduce financial uncertainty and encourage greater private-sector participation in large-scale offshore wind developments.

Investment strategies should increasingly consider long-term industrial competitiveness alongside short-term financial performance. Supporting research and development, domestic manufacturing, and resilient supply chains will strengthen the broader offshore wind ecosystem while reducing exposure to geopolitical and economic risks. Such investments will contribute not only to renewable energy expansion but also to Europe's wider objectives relating to industrial development, energy security, and sustainable economic growth.

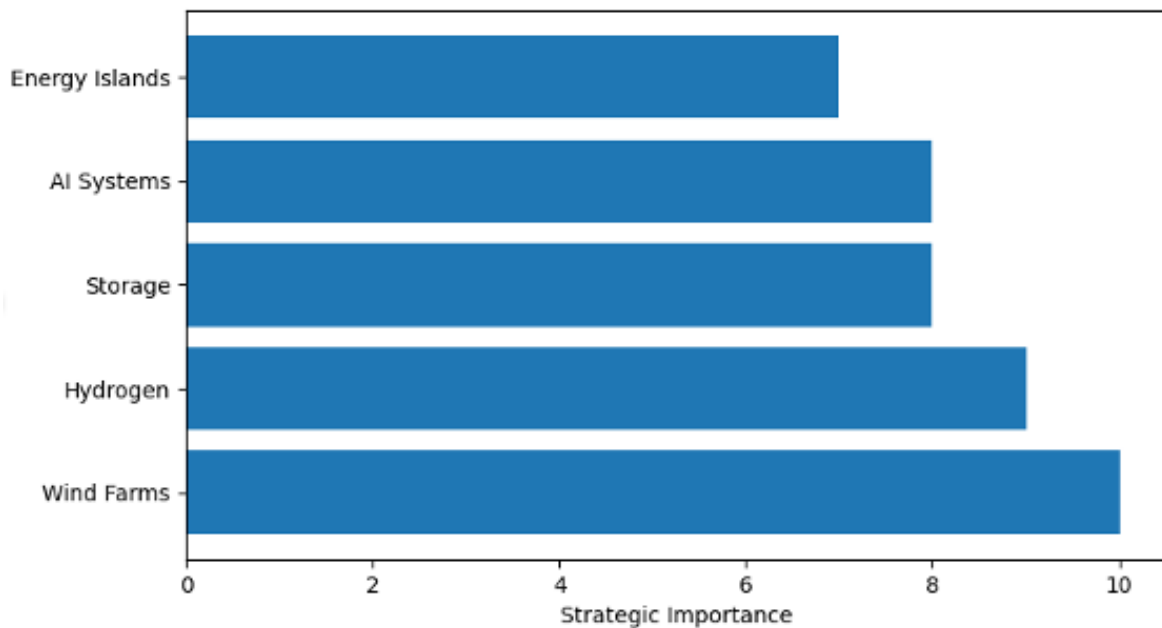
7.3 FAMA Synthesis

The application of the FAMA model demonstrates that sustaining competitiveness within the European offshore wind industry depends not only on understanding external market conditions but also on developing organisational capabilities that enable effective strategic responses. While the PESTEL Analysis identified the macro-environmental forces influencing the sector and Porter's Five Forces evaluated the industry's competitive

structure, the FAMA model provides a practical perspective on how organisations can respond to these challenges through greater flexibility, adaptability, market awareness, and agility.

The three analytical frameworks should therefore be viewed as complementary rather than independent. Together, they demonstrate that long-term competitiveness will depend on the ability of organisations to align strategic decision-making with technological innovation, resilient supply chains, supportive public policy, and rapidly changing global market conditions. Firms capable of combining these capabilities will be better positioned to respond to increasing international competition while supporting Europe's long-term leadership in offshore wind manufacturing.

Overall, the findings of this chapter reinforce the importance of proactive strategic management within the offshore wind industry. Competitive advantage is no longer determined solely by technological capability or market position but increasingly by the capacity of organisations to anticipate change, respond rapidly to emerging challenges, and collaborate effectively across the wider industrial ecosystem. These conclusions provide the foundation for the discussion in the following chapter, where the findings are interpreted in relation to the existing literature and the research objectives.



Chapter 8: Discussion

The preceding chapters examined the European offshore wind industry from three complementary strategic perspectives. The PESTEL analysis identified the macro-environmental conditions shaping industry development, Porter's Five Forces evaluated the competitive structure of the market, and the FAMA model provided a framework for interpreting the organisational capabilities required to respond to these challenges. This chapter synthesises these findings and discusses their implications in relation to the literature reviewed in Chapter 2 and the research objectives established in Chapter 1.

Rather than presenting additional analysis, the discussion critically interprets the findings by examining how political developments, economic conditions, technological innovation, and increasing international competition collectively influence the long-term competitiveness of European offshore wind manufacturers.

8.1 Discussion of Findings - External Environment and Industry Competitiveness

The PESTEL analysis confirmed that the European offshore wind industry continues to benefit from a supportive political and regulatory environment. This finding is consistent with previous research, which identifies government intervention as a fundamental driver of renewable energy investment and industrial development (European Commission, 2023; IEA, 2023). Policies associated with the European Green Deal and REPowerEU have strengthened investor confidence while accelerating offshore wind deployment across Europe. However, the findings also indicate that policy support alone is insufficient to guarantee long-term competitiveness. Regulatory complexity, lengthy permitting procedures, inflationary pressures, and supply chain disruptions continue to constrain project delivery and increase development costs.

These findings reinforce the argument presented by Johnson, Scholes and Whittington (2020), while also suggesting that the strategic challenges currently facing the European offshore wind industry are broader than those traditionally associated with renewable energy development. In particular, competitiveness is increasingly shaped by geopolitical uncertainty, supply chain resilience, and industrial policy alongside technological innovation.

Competitive Dynamics and Global Market Transformation

The application of Porter's Five Forces demonstrates that competition within the offshore wind industry has evolved considerably. Although Europe continues to possess significant technological expertise and operational experience, its competitive advantage is increasingly challenged by the expansion of Chinese manufacturers and the globalisation of renewable energy supply chains. This finding supports recent industry reports while also indicating that technological leadership alone is no longer sufficient to sustain competitive advantage. Instead, manufacturing scale, industrial policy, and operational efficiency have become equally important determinants of long-term competitiveness.

(GWEC, 2024). The analysis also suggests that traditional sources of competitive advantage are becoming less sustainable. Long-standing market leadership no longer provides sufficient protection against international competitors capable of combining lower production costs with expanding technological capability. Consequently, European manufacturers must increasingly differentiate themselves through innovation, operational efficiency, and strategic collaboration rather than relying solely on historical market position.

Organisational Adaptation and Strategic Capability

The findings generated through the FAMA model indicate that organisational capabilities play a central role in sustaining competitiveness under conditions of continuous environmental change. Flexibility, adaptability, market awareness, and agility emerged as complementary capabilities enabling organisations to respond effectively to policy uncertainty, technological disruption, supply chain challenges, and increasing international competition.

This interpretation extends the findings of the PESTEL and Porter analyses by demonstrating that external pressures alone do not determine organisational performance. Instead, competitive outcomes depend upon how effectively firms interpret environmental change and translate strategic insights into operational decisions. These findings therefore support the broader strategic management literature, while also demonstrating that organisational capabilities become increasingly valuable when firms operate within highly dynamic and policy-driven industries such as offshore wind (Johnson et al., 2020).

8.2 Implications - Academic Implications

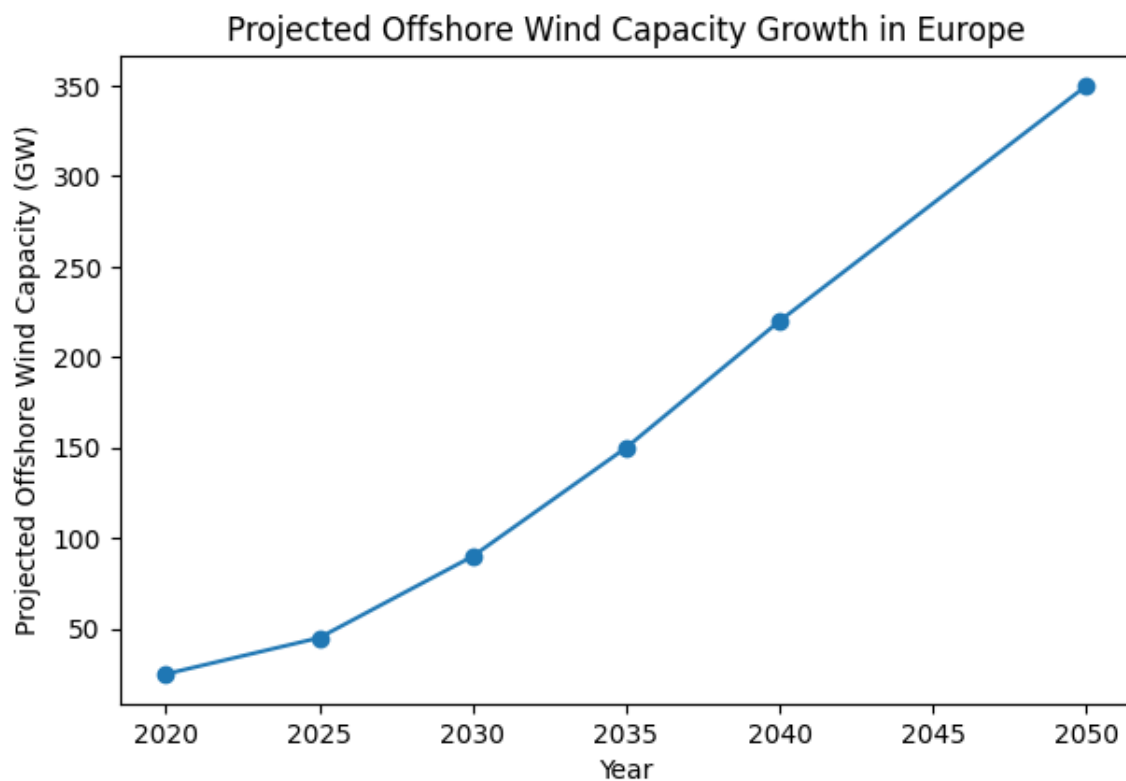
The findings contribute to the existing strategic management literature by demonstrating the value of integrating multiple analytical frameworks when examining complex industrial environments. Rather than applying PESTEL Analysis, Porter's Five Forces, and the FAMA model independently, the dissertation illustrates how these approaches collectively provide a more comprehensive understanding of the strategic challenges affecting the offshore wind industry. This integrated perspective extends previous research, which has often examined environmental factors or competitive dynamics in isolation.

Managerial Implications

For managers operating within the offshore wind industry, the findings highlight the importance of adopting a proactive rather than reactive strategic approach. Maintaining competitiveness will require continuous investment in technological innovation, resilient supply chains, workforce development, and digital capabilities. Organisations should also strengthen collaboration across the wider industrial ecosystem while monitoring international market developments to anticipate future competitive threats. Taken together, these findings suggest that long-term competitiveness will depend less on individual technological breakthroughs and more on organisations' ability to integrate innovation, operational resilience, and strategic adaptability into their long-term strategic decision-making.

Policy Implications

The analysis demonstrates that government policy will continue to influence the future competitiveness of the European offshore wind industry. Policymakers should therefore prioritise regulatory consistency, faster permitting procedures, support for domestic manufacturing, and continued investment in research and innovation. Strengthening cooperation between governments, industry, and research institutions will be essential for ensuring that renewable energy expansion is accompanied by sustained industrial competitiveness.



Chapter 9: Conclusion

This dissertation set out to examine the strategic challenges and opportunities affecting turbine manufacturers operating within the European offshore wind industry. By integrating PESTEL Analysis, Porter's Five Forces, and the FAMA model, the study developed a comprehensive assessment of the external environment, competitive dynamics, and organisational capabilities influencing long-term industry competitiveness. The combined application of these frameworks enabled the research to move beyond a purely descriptive assessment of offshore wind development by providing an integrated strategic evaluation of the factors shaping the industry's future.

The findings demonstrate that Europe continues to occupy a leading position within the global offshore wind market due to its advanced technological capabilities, supportive policy framework, and well-established industrial ecosystem. However, this competitive position is becoming increasingly challenged by changing geopolitical conditions, higher project costs, supply chain disruption, regulatory complexity, and growing international competition. In particular, the rapid expansion of Chinese manufacturers illustrates the changing nature of global competition and highlights the importance of maintaining technological leadership alongside manufacturing efficiency and industrial resilience.

The research further demonstrates that long-term competitiveness cannot be secured through technological innovation alone. Sustainable competitive advantage increasingly depends upon organisational adaptability, resilient supply chains, effective collaboration between industry stakeholders, and supportive public policy. Consequently, the future success of the European offshore wind industry will depend upon the ability of governments, manufacturers, investors, and research institutions to respond collectively to an increasingly dynamic international environment.

Overall, the dissertation concludes that offshore wind should be viewed not only as a renewable energy technology but also as a strategically important industrial sector contributing to energy security, economic development, technological innovation, and climate policy. Maintaining Europe's leadership will therefore require integrated strategic decision-making that balances industrial competitiveness with long-term sustainability objectives while enabling organisations to respond effectively to an increasingly dynamic global environment.

Contributions of the Research

This dissertation contributes to the existing literature by adopting an integrated strategic management perspective for analysing the European offshore wind industry. While previous studies have frequently examined renewable energy from technical, environmental, or policy perspectives, the present research combines macro-environmental analysis, competitive industry evaluation, and organisational strategic capability within a single analytical framework.

A further contribution lies in the application of complementary strategic management models. Rather than employing PESTEL Analysis, Porter's Five Forces, and the FAMA

model independently, the dissertation demonstrates how these frameworks collectively provide a broader understanding of the challenges affecting turbine manufacturers operating within an increasingly competitive international market. This integrated approach offers both academic value and practical relevance for strategic decision-making.

Finally, the study contributes to contemporary discussions regarding European industrial competitiveness by examining offshore wind within the context of recent geopolitical developments, energy security concerns, and increasing global competition. These issues have become particularly significant following the acceleration of renewable energy investment across Europe and the emergence of new international competitors.

Limitations

Several limitations should be acknowledged when interpreting the findings of this dissertation. First, the research is based exclusively on secondary data obtained from academic literature, institutional reports, and industry publications. Although these sources provide comprehensive evidence, the researcher had no control over the methods through which the original data were collected.

Second, the offshore wind industry is evolving rapidly. Technological innovation, policy developments, investment patterns, and competitive conditions continue to change, meaning that some industry data may become outdated over time. Consequently, the conclusions presented in this dissertation should be interpreted within the context of the information available during the period of the study.

Finally, the research focuses specifically on the European offshore wind industry and turbine manufacturers. While several findings may have broader relevance, they should not be generalised automatically to other renewable energy technologies or geographical regions without further investigation.

Recommendations for Future Research

Future research could extend the present study in several directions. Comparative analyses examining differences between European and Asian offshore wind manufacturers would provide valuable insight into the factors influencing international competitiveness. Similarly, future studies could investigate the strategic implications of emerging technologies, including floating offshore wind, hydrogen integration, artificial intelligence, and digital asset management.

Further research employing primary data collection, including interviews with industry executives, policymakers, and investors, would complement the secondary research undertaken in this dissertation by providing additional practical perspectives regarding strategic decision-making within the offshore wind sector.

Finally, future investigations may consider applying alternative strategic management frameworks or comparative case study approaches to evaluate how different institutional environments influence renewable energy competitiveness. Ultimately, continued research into the strategic management of offshore wind will be essential for supporting Europe's

long-term competitiveness and the successful transition towards a more sustainable and resilient energy future.

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