

REPORT 2025



POLISH STRATEGY FOR OFFSHORE WIND INDUSTRY DEVELOPMENT

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1. Foreword



Ministry of
State Assets

Robert Kropiwnicki

Secretary of State
Ministry of State Assets

Ladies and Gentlemen,

Wind energy is one of the pillars of decarbonisation of the Polish economy. It is a strategic element of the energy transition, which in the long term will provide inexpensive electricity and improve energy security of Poland. However, it requires great investment. In the next years, expenditures on offshore wind energy will amount to hundreds of billion PLN. In accordance with the draft National Climate and Energy Plan ("NCEP"), after 2040 wind energy may provide as much as half of electricity in Poland.

The size of the investments, their scale and technological state-of-the-art constitute a development opportunity for the national industry. Therefore, we need to ensure that these investments result in the development of innovative energy industries with competence centres in Poland and high-income jobs. Today, approximately 300 Polish companies exhibit competences in the production of structural and operational elements for the offshore industry. Many are involved in wind farm projects abroad, demonstrating the capability to participate in national investments.

Ministry of State Assets is actively supporting energy transition. Key investors in the energy sector include State-owned companies. Baltic Power, an investment by Orlen S.A., will be the first Polish offshore wind farm in the Baltic Sea. Scheduled to be commissioned in 2026, it will provide electricity to approximately 1.5 million households. Baltica II, a project implemented by PGE and Danish Ørsted, is a 1.5 GW wind farm. This is one of the largest projects of this type in the Baltic Sea, capable of powering 2.5 million households. Agencja Rozwoju Przemysłu S.A. is supporting offshore wind energy by developing the shipbuilding industry. To this end, we created Grupa Przemysłowa Baltic, whose task is to modernise Polish shipyards. Companies that joined offshore investments include Odlewnia Rafamet and Kunia Raciborska, specialising in the production of steel and cast elements.

Offshore wind development is an opportunity not only for shipyards, but also for the steel and metal industries as well as for service providers and installers. Poland exhibits a substantial potential in terms of supply of materials and services related to the construction and operation of offshore wind farms, which includes the construction of specialised vessels.

The Polish government considers investments in the energy sector, including offshore wind farms, a priority that will create a foundation for the development of a long-term competitive advantage of the country. Within its competences, Ministry of State Assets will support companies in obtaining project financing from national and EU funds. It is also crucial that local companies – both component suppliers and engineering experts – take part in the energy transition. In the uncertain times we should emphasize technological and energy self-sufficiency of Poland.

Robert Kropiwnicki

Secretary of State

Ministry of State Assets

Foreword



Michał Jaros



Ministry of Economic Development and Technology
Republic of Poland

Secretary of State
Ministry of Economic Development
and Technology

Specification of the vision of economic development is a complex task that requires close cooperation between the Polish administration, business and the public. It should encompass a broad spectrum of issues affecting the operation of the industry, services and energy sectors. Contemporary industrial policy should be a mix of many key policies, including energy and climate policy, technological policy and resources policy.

The currently applicable Productivity Strategy lays down a certain vision for the development of the Polish economy by 2030 along with support schemes and directions to be used by the government to stimulate investment growth and enterprise productivity. The purpose of the adopted Productivity Strategy was to support a digital, green and organisational transition of Polish companies to enable the Polish economy to gain competitive advantage stemming from technological progress and know-how.

Due to the very dynamic changes now occurring in the geo-politically turbulent environment, it seems crucial to revise the strategic development directions and technologies in line with subsequent documents being developed by the EU, such as the Net-Zero Industry Act and the Critical Raw Materials Act.

Onshore and offshore wind energy sector is a substantial source of energy. Its development in Europe should be based on local technological and production capacity. The development of renewable energy sources has the opportunity to become the essential economic change determining the development of the European industry. We are on the best path to build a new sector of the economy. To enable that sector to develop a full supply chain, we need coordinated measures in the Council of Ministers, governmental agencies, local governments, state institutions and business.

I am considering this document to be the substantial base, an expert voice, supporting state planning processes and inspiring for action. It is the priority of the Ministry of Economic Development and Technology's team and myself to efficiently use internal potential and expert knowledge to achieve sustainable development of the country. Therefore, I joined the dialogue with the wind energy sector with interest to develop and implement strategic assumptions for the sector.

Michał Jaros

Secretary of State

Ministry of Economic Development
and Technology

Foreword



Miłosz Motyka



Ministry of Climate and Environment
Republic of Poland

Undersecretary of State
Ministry of Climate and Environment

Energy transition is one of the key challenges of today's economy, with decarbonisation of the energy sector being the foundation of measures aimed at climate protection and ensuring energy security.

In the face of global commitments to reduce greenhouse gas emissions and the European Union's aim to achieve climate neutrality by 2050, Poland must rapidly develop renewable energy sources. In this context, offshore wind plays a strategic role as one of the key pillars of transition of the Polish energy sector.

Owing to the perfect natural conditions in the Baltic Sea and the increasing technological and investment potential, Poland has the opportunity to become the regional leader in offshore wind development. This is not only the answer to climate challenges, but also an impulse for the national economy. Key role in the construction and operation of offshore wind farms should be played by Polish companies, actively participating in the supply chain for materials and services — from manufacture of components to installation, maintenance and innovative technological solutions. National engineering, logistical, construction or service companies need to continuously develop to be able to fully participate in implementation of projects in the Baltic Sea. Furthermore, cooperation with international industry leaders opens an opportunity for technology transfers and boosts competitiveness of the Polish offshore wind sector in foreign markets.

I would like to thank the authors of this document for their efforts to perform such a broad analysis of the offshore wind energy market. This strategy specified very ambitious directions for the development of the offshore wind energy in Poland, taking into account both climate goals and economic potential of the sector. This document is a good starting point for the development of an objective and realistic strategy taking into account the regulatory, investment and technological environment that will enable to fully exploit the opportunities opened by offshore wind development in Poland.

We will succeed in building a strong position of the Polish economy only through mutual efforts aimed at creating conditions for further dynamic and sustainable development of the offshore wind energy sector.

Miłosz Motyka

Undersecretary of State

Ministry of Climate and Environment

Foreword



Stanisław Gawłowski

Senator of the Republic of Poland
Chairman of the Climate and Environment
Committee Senate of the Republic of Poland

In order to develop national potential, increase the share of national contractors in investment projects in the country and region, and to make technologies strategic for Europe the driving force of our economic growth and export, Poland needs its own strategy for the development of a net-zero technology industry.

Wind energy should be paramount to this process.

The share of wind energy in the EU energy mix is to increase from the current 20% to 34% in 2030 and over 50% in 2050. In Poland the path will be similar. Ambitions regarding new wind capacity require increased investment in production base.

Wind energy, historically developed in the EU, is now globally spread, with other players aggressively displacing the European industry from the global wind energy market. An increasing number of wind energy components is being imported to the EU, which may lead to the PV scenario, where EU is almost entirely dependant on China.

Since 2021 the European Commission has been developing regulatory tools to increase the resilience and competitiveness of the European industry, and particular member states have been investing in new production facilities basing on their industrial strategies.

The development of offshore wind farms in Poland to date demonstrates that we must support national industry to enable it to enter the supply chain for components and services.

In practice, Europe does not have any energy resources. Energy independence and sovereignty can be ensured only through distributed, zero-emission sources. Investment expenditures related to energy transition now observed in Europe should motivate the Polish government to build a national supply chain that will become part of strategic security of Europe and its competitiveness.

With its adequate resources and sufficient potential, Poland may find its place in the middle of the revolution — but it cannot delay adopting relevant regulations and strategies. Therefore, I urge you not only to read this Strategy, but to implement it.

Stanisław Gawłowski

Senator of the Republic of Poland.

Chairman of the Climate and Environment Committee

Senate of the Republic of Poland

Foreword



Wojciech Balczun

President of the Board
Industrial Development Agency JSC

Ladies and Gentlemen,

Offshore wind energy is an important pillar of energy and economic transition in Poland. This is a rapidly growing sector that not only provides access to clean, renewable energy, but also opens a unique opportunity to develop state-of-the-art industrial and technological competence, boosting the competitiveness of the national economy in the global market.

This document answers the challenges of our times. European Union may become the beneficiary of energy diversification only through wise industrial policy. The proposals and recommendations laid down in the Strategy demonstrate that Poland exhibits a substantial potential to play a key role in the European offshore wind supply chain. Efficient use of this potential requires focused measures at the national level, including the development of local competences, technical education, innovation and development of a stable institutional and legal environment.

By implementing key projects, Agencja Rozwoju Przemysłu S.A. is playing an active role in the development of this strategic sector. The projects are performed by Baltic Towers — the leading European manufacturer of offshore wind turbine towers — and Grupa Przemysłowa Baltic, whose task is to comprehensively support development of the national offshore wind supply chain. Through these measures ARP S.A. is consolidating the position of Polish enterprises, helping them to gain key competences and compete in the international market.

Implementation of the Strategy laid down herein will create a stable investment environment that will attract foreign investors and increase the share of national companies in the construction of key offshore wind farm components. In the long term, this will contribute to the increase in technological autonomy of Poland and guarantee competitive, stable supply of renewable energy.

You are welcome to read the document and actively participate in mutual development of the future of the Polish offshore wind industry.

I wish you a pleasant experience,

Wojciech Balczun

President of the Board

Industrial Development Agency JSC

Foreword



Janusz Bil

President of the Board
ORLEN Neptun

One of the greatest challenges faced by the energy sector in Poland is the adjustment to the energy mix and resignation from limited fossil fuel resources. Offshore wind energy will play a significant role in this transition. This is a technology that will enable us to make a decarbonisation leap while maintaining energy security. It also gives a real opportunity to create a modern and prospective industry.

However, to achieve this we need a set of coordinated, comprehensive measures involving all stakeholders: developers, suppliers, industry associations and the state. Polish enterprises have the opportunity to become important players in all key offshore wind farm packages, i.e. cables, onshore and offshore substations, foundations, transport and installation, safety and environment, geotechnical survey and geology.

The development of the national offshore wind energy supply chain should focus on these areas. We can use our experience from Phase I offshore wind farm projects. Baltic Power project, implemented by ORLEN Group in cooperation with Northland Power, contracted Polish suppliers to deliver two offshore substation structures, onshore cables, build an onshore substation as well as a maintenance base in Łeba, and many more. Overall, local content will reach at least 21% over the entire project lifecycle.

As a company supporting energy transition and a party to the Sector Deal we made a commitment to achieve 45% of local content. We look forward to the highest possible share of Polish enterprises in offshore wind supply chain. We also want our investments to bring multi-dimensional social and economic benefits — and offshore wind energy projects offer such opportunities.

From our point of view as a developer this Strategy answers how to exploit this potential. The document provides specific measures for the next years, such as development of a strong supply chain, investments in component manufacture, increase in competences of Polish enterprises or education, which are to allow for exploiting the opportunities offered by offshore wind energy to the maximum extent possible.

However, we must remember that implementation of these measures requires strict cooperation and coordinated action between business, the banking sector and lawmakers. We hope that this document will be a starting point for a constructive dialogue and mutual action that will enable rapid growth of the Polish offshore wind industry.

Eventually all stakeholders want their efforts to translate into increased competitiveness of Polish companies in international markets and consolidation of the Polish economy.

Janusz Bil

President of the Board
ORLEN Neptun

Foreword



Bartosz Fedurek

President of the Board
PGE Baltica



Baltica

Polish offshore wind industry is developing rapidly. Two first projects are already under construction: Baltic Power (by Orlen and Northland Power) and Baltica 2 (by PGE and Ørsted) with a total capacity of 2.7 GW. A number of other projects will soon be subject to final investment decisions.

Furthermore, two modern installation ports (in Świnoujście and Gdańsk) and three maintenance bases (in Ustka and Łeba) are also under construction. State-of-the-art, large-scale production facilities (Baltic Towers, Vestas, Windar) are about to emerge, and national companies actively participate in Phase I supply chain — including Tier I contracts (CRIST, Grupa Przemysłowa Baltic, Tele-Fonika Kable).

We can and should be proud of their success! This is more important given the fact that the young offshore wind energy sector in Poland is growing in difficult times, not only in terms of global macroeconomic situation, but also geo-political uncertainty. However, it is certain that strategic rationale for offshore wind energy development and advantages of the technology in the context of the Polish energy sector and the entire economy remain unchanged.

PGE Baltica is PGE Group's competence centre with respect to the development, construction and operation of offshore wind farms. Currently we are implementing, together with Ørsted, the largest Phase I project in terms of capacity — Baltica 2 offshore wind farm. We are cooperating with national suppliers in many aspects to jointly achieve the assumed local content. However, our ambitions reach further. The PGE offshore wind portfolio includes areas with a total potential of approximately 7 GW. We want to pursue our plans in partnerships — a proven cooperation model enabling experience, financing and risk sharing.

Offshore wind energy in Poland will continue to successfully grow only with a stable and predictable regulatory environment, including a predictable long-term investment volume. All decisions affecting the legal environment that will be made in the next years will shape the conditions in which the entire industry will be working on the development of projects important for the country's energy mix. We all want offshore wind in Poland to go beyond the first projects. We all want to avoid investment gap, which would undermine all our achievements to date.

The success of the entire project called “development of the Polish offshore wind farm industry” required teamwork. Everyone has to strictly cooperate within the team — state institutions, developers, suppliers and financing institutions. Only then we have the chance to achieve a breakthrough.

The authors of the report embarked on a difficult journey to diagnose the issues and describe the challenges faced by the offshore wind energy sector in Poland in the recent years in a single document. This is an interesting proposal, a starting point not only for a discussion on strategic directions, but on specific joint measures enabling efficient pursuit of the breakthrough goal — the development of offshore wind in Poland.

Bartosz Fedurek

President of the Board
PGE Baltica

Foreword



Piotr Matczuk



President of the Board
Polish Development Fund

Ladies and Gentlemen,

I read the “Polish Offshore Wind Farm Industry Development Strategy” with keen interest and recommend it to you. The document, developed by Wind Industry Hub Foundation in cooperation with numerous experts, not only presents an ambitious outlook (33 GW of total potential of the Polish economic zone in the Baltic Sea), but also provides specific proposals for the development of the offshore wind industry. This is a comprehensive vision. It takes into account global trends and the nature of the Polish economy.

One of the key elements of the Strategy are Priority Implementation Programmes. They are a proposal of market segmentation. Its goal is to enable the development of a full offshore wind supply chain in Poland — starting from turbine manufacture, through construction of foundations, to innovative O&M services. Each of these segments has the potential to become the driving force of economic and technological growth.

As the President of the Polish Development Fund I am of the opinion that offshore wind is an opportunity to gain clean and stable energy and an impulse to create a new, innovative industry. It is now accelerating in Europe (EU Wind Power Package), and I think that it will accelerate in Poland.

Therefore, Polish Development Fund is active in this field. One of the pillars of our current strategy is energy transition — and wind energy is a priority. Together with partners we are involved in construction of the T5 installation terminal in Gdańsk. We offer a number of financing opportunities for participants of the entire offshore wind farm value chain. We will also aim to mobilize private equity through direct investment.

I am certain wind energy development is an opportunity we all should recognise. Therefore, I urge all stakeholders — entrepreneurs, scientists, public institutions — to actively join the discussion on the proposed strategy. Together we can build a strong, innovative offshore wind industry in Poland, contributing to sustainable development of our economy and environmental protection.

Piotr Matczuk

President of the Board

Polish Development Fund

Foreword



Paweł Pudłowski



Polish Investment
& Trade Agency
PFR Group

Vice-President of the Board
Polish Investment and Trade Agency

Ladies and Gentlemen,

On behalf of Polish Investment and Trade Agency I would like to welcome you to read the “Polish Offshore Wind Farm Industry Development Strategy”.

The document is the result of hard work and in-depth analyses aimed at creation of a comprehensive plan supporting the development of the offshore wind sector in Poland. Owing to its geographic location and access to the shallow and windy Baltic Sea, Poland faces a unique opportunity to become the leader in offshore wind and to complete energy transition.

The report includes detailed information on technology, necessary CAPEX and benefits stemming from the construction of offshore wind farms. The strategy presents a development vision of the offshore sector in particular European countries as well as an analysis of the supply chain.

Polish Investment and Trade Agency is supporting enterprises intending to increase potential for RES development and manufacture of components for the production of renewable energy, in particular in the offshore wind energy sector.

Within its competences, Polish Investment and Trade Agency provides information to investors or offers support schemes for investments consisting in the production of offshore components using public aid (TCF, governmental grant, CIT exemption or real property tax exemption) that may be used for investment co-financing or to boost their innovation; offers cooperation with the education and science sector; and provides the necessary institutional support.

Moreover, we try to support investors through location counselling using our broad network of contacts and database of investment opportunities.

You are welcome to read the report. We hope that information presented in the document will aid you in decision-making and planning of measures aimed at the development of the offshore wind energy sector in Poland.

I am certain that with mutual effort and involvement of all stakeholders, Poland will become the leader in offshore wind and exhibit a well-grown industry and a strong supply chain.

Paweł Pudłowski

Vice-President of the Board

Polish Investment and Trade Agency

Foreword



**NATIONAL FUND
FOR ENVIRONMENTAL PROTECTION
AND WATER MANAGEMENT**

Dorota
Zawadzka-Stępniaak

President of the Board
National Fund for Environmental
Protection and Water Management

The transition to low-emission economy is a great opportunity for modernisation of the Polish economy and an increase in its competitiveness in the global market. Development of renewable energy sources, in particular offshore wind, is the key measure to achieve actual changes to the Polish energy mix. Diversification of energy sources and investment in modern technologies may substantially increase energy independence and security.

National Fund for Environmental Protection and Water Management has been supporting environmental protection, sustainable development and anti-climate change measures for 35 years.

Our strategy for the years 2025–2028 includes 9 priorities, with energy transition playing an important role among them. The goal is to implement low-emission economy through increased use of renewable energy sources, development of energy infrastructure and construction of energy storage facilities. Our support is addressed to entrepreneurs, power grid operators, local governments and public institutions alike.

Implementation of priorities related to energy transition and improvement of air quality remains the key purpose of the NFEPWM. In 2024 the Fund contracted almost PLN 18 billion in support, with plans for 2025 exceeding PLN 25 billion, of which 85% will be dedicated to energy transition and improvement of air quality.

NFEPWM will actively act to implement state-of-the-art and innovative environmental solutions. Within the “innovation” priority, support will be directed to the development of green technologies. Our mission is to drive green transition by supporting efficient initiatives that contribute to the development of the economy and are aimed at the achievement of public and environmental interest.

Dorota Zawadzka-Stępnia

President of the Board

National Fund for Environmental Protection
and Water Management

2. Key theses

This document is the result of analyses conducted in 2023 - 2024 by the expert team of Wind Industry Hub, Polish Wind Energy Association and CEE Energy Group. The document consists of four parts. The first part discusses the importance of offshore wind energy in increasing the supply of cheap and clean energy in Poland. Part two summarises the context of the strategic position of the *offshore wind* industry in the European Union. Part three focuses on drawing lessons from the first domestic experience of building offshore wind farms. Part four identifies the detailed solutions needed to implement for offshore wind farms to become an engine for the development of the Polish economy. **Priority Implementation Programs** are included at the centre of the document - a set of key market segments that (as determined by detailed market and economic analysis, experience, synergies, and safety

aspects) should be developed in Poland. The solutions concern specific, short-term actions and directional proposals for implementation in the medium and long term.

The study's overarching goal is to provide the Council of Ministers of the Republic of Poland with comprehensive materials for adopting the national **Strategy for the Development of the Offshore Wind Farm Industry**, recognising it as one of the most significant investment programmes.

The document you are holding in your hands is a summary based on a 400-page analytical document, which is a comprehensive study of the development potential of the Polish and European offshore wind energy industry.

The Strategy's key short-term directions and tools (to be implemented by the end of 2026) are:

Program package

The economic potential of the sector will be so large (even more than PLN 400 billion in spending by 2050 on OWFs in Poland and several times the potential for exports to the EU market) that the adoption of the Strategy for Offshore Wind Energy Development as a government document is a key step to give it a formal character and guarantee systemic support at the national level. The authors recommend that the Council of Ministers adopt the *Strategy for the Development of the Offshore Wind Industry by June 30, 2025*, and the detailed implementation document by December 31, 2025. The time pressure is due to the schedules for contracting components and services for the so-called Phase II *offshore* projects, as well as the open negotiation processes for international partnerships in the implementation of projects for which in 2022. The Minister of Infrastructure issued positive decisions in adjudication proceedings.

Market package

Wind power will be the foundation for the decarbonisation of the Polish economy after 2040. According to the National Energy and Climate Plan project, wind power was to account for 70% of electricity generation (136.9 TWh/yr) among RES (195.3 TWh in total).

It is necessary to ensure reliable and well-timed continuity of demand in Poland, through an ambitious implementation schedule and an effective program for granting support for OWFs in the following years -

continuity of demand is one of the most important investment incentives. The authors therefore recommend that the Council of Ministers adopt the updated PEP2050 with an overall target of 33 GW for offshore wind farms.

European package

Poland can define its contribution to the industrial Strategy in European terms, which should determine which players, products and services will have the status of European champions, which of them should use mainly regional supply chains, and which components can be imported from outside the EU without significant risk, while maintaining a certain level of production capacity in Europe. Poland will actively propose and support the provision of pan-European funds for investment, project financing and research and development in the *offshore wind* industry. The assumptions of the Strategy for the Development of the Offshore Wind Industry will be a contribution to Poland's EU policy.

Priority Implementation Programs

The Strategy will include the launch of Priority Implementation Programs, in each of the key product and service segments. Implementation of the Strategy will ensure Poland's place in building European champions in constructing wind turbines (more than 50% of components produced in Poland by value), transformers and installation services for offshore wind farms (with a national installation company with European partners). Implementation of the Strategy will promote the creation based on Polish companies and European competence of national champions in the production and installation of onshore and offshore cables and construction of the installation fleet. Implementation of the Strategy should ensure that from 2027 domestic companies will be able to provide the capacity for 100% installation of offshore substations and transition pieces for Polish wind farms - as Tier 1 suppliers (in effective consortia). The implementation document of the Strategy for Offshore Wind Farm Industry Development will identify up to three units responsible for coordinating the implementation of the Strategic Implementation Programs. The responsible units should have an adequate budget in 2025-2027 for development activities for Polish companies (recommended funds under the Gospostrateg Program).

Investment financing package

The Strategy assumes that subsidy or loan programmes will be systematically announced in Poland, providing a minimum of PLN 1 billion in capital per year for investments. The authors recommend that by 2035, the National Environmental Protection and Water Management Fund (NFOŚiGW) annually launch a program aimed at building production lines (e.g. "Innovations for the Environment - offshore wind energy") with a budget of PLN 500 million per year. It is also recommended that PLN 500 million per year of direct grants be made available to companies investing in offshore wind supply chain capacity under the government's "TCTF" (*Temporary Crisis and Transition Framework*¹) model.

Production financing package

The Strategy assumes that state guarantees will be available in the Polish Development Fund for the largest contracts in OWF projects in Poland and Europe, the Polish Development Fund/ARP/BGK/KUKE will launch a preferential guarantee program allowing continuous financing of up to €2 billion for contract implementation.

¹ https://competition-policy.ec.europa.eu/state-aid/temporary-crisis-and-transition-framework_en [Accessed 6/12/2024].

Innovation package

The Strategy stipulates that a central *offshore wind* laboratory will be established in Poland, and competitions providing a minimum of PLN 200 million for R&D activities for companies will be provided annually. An OWE Innovation Agenda will be created as part of the Strategy's implementation document. NCBiR will launch a "New Technologies in Offshore Wind Energy" program worth at least PLN 100 milliard for the R&D phase each year. The Polish Development Fund will launch a dedicated program to finance start-ups focusing on offshore wind energy solutions.

Education and Labour Package

The Ministry indicated in the implementation document (suggested Ministry of Education) will adopt and implement the Wind Energy Competency Development Program, which, with funds from the State budget, NIP and European Funds, will coordinate the development of education, qualifications, internships, apprenticeships and the construction or expansion of OWE training centres.

Security package

The Ministry of Defence or other Ministry identified in the Strategy's implementation document will issue a package of guidelines for Cybersecurity of offshore wind farms and physical security of key production nodes in Poland. Security issues will be included in the Strategic Implementation Programs, investment financing programs, and innovation and education financing programs.

Institutional package

The authors recommend that with the adoption of the Strategy, the Council of Ministers should establish an Executive Council, which would include representatives of the Council of Ministers (responsible for the various departments of government administration) at the level of secretaries or undersecretaries of state, representatives of key central offices, local government, industry organisations, including industry, chairmen of Priority Implementation Program Teams. The Council should operate under the leadership of the Plenipotentiary for Offshore Wind Energy.



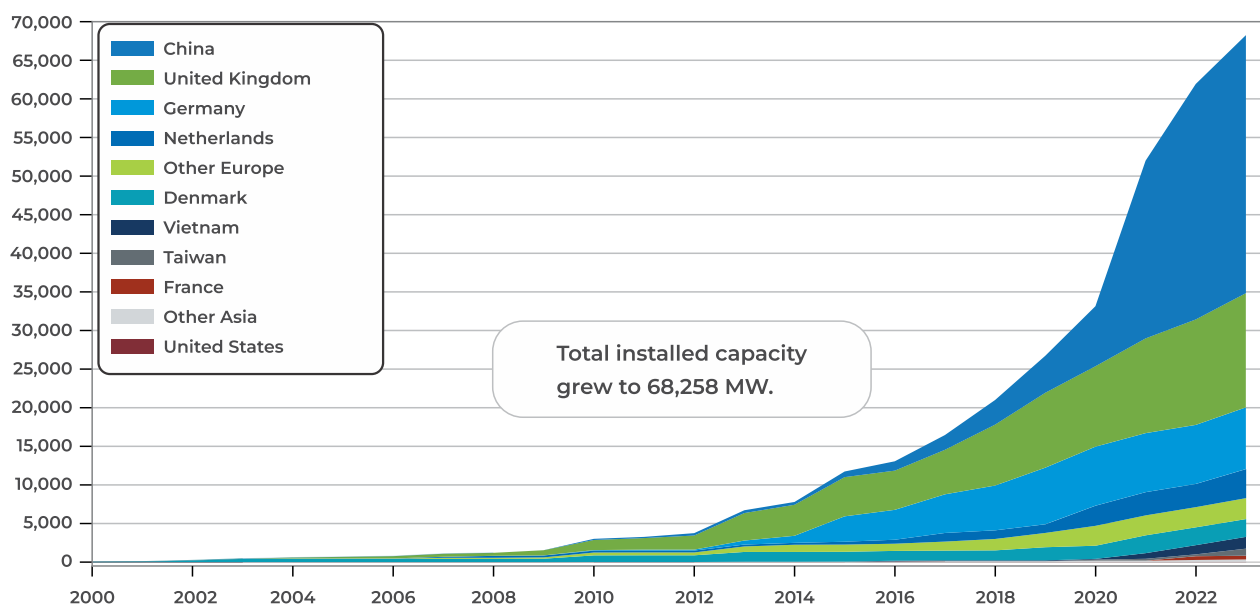
3. The importance of offshore wind energy

3.1 OFFSHORE WIND POWER IS A MATURE TECHNOLOGY WITH EUROPEAN ROOTS

Offshore wind power is a technology that provides cost-effective production of non-carbon energy. It still has significant potential for development, including increasing productivity, as well as developing the value chain to, for example, the hydrogen economy. Since the first offshore farm installations in the 1990s, offshore wind turbine technology has changed tremendously. Today's turbines are much larger, more efficient, and more dependable than their early counterparts. Introducing more than 10 MW and even 15 MW turbines make it possible to build wind farms on a larger scale and with higher efficiency.

The construction of an offshore wind farm is a multidisciplinary undertaking. It requires the cooperation of many sectors of the economy. Building and operating offshore wind farms (OWFs) involves various competencies, from offshore engineering to logistics to advanced energy technologies. Key components of such installations include offshore wind turbines with foundations, inter-array and external (export) cables, and offshore and onshore substations. The complexity of building these farms brings benefits beyond the traditional energy supply chain, supporting the development of numerous economic sectors and strengthening local competence in producing technologically advanced components.

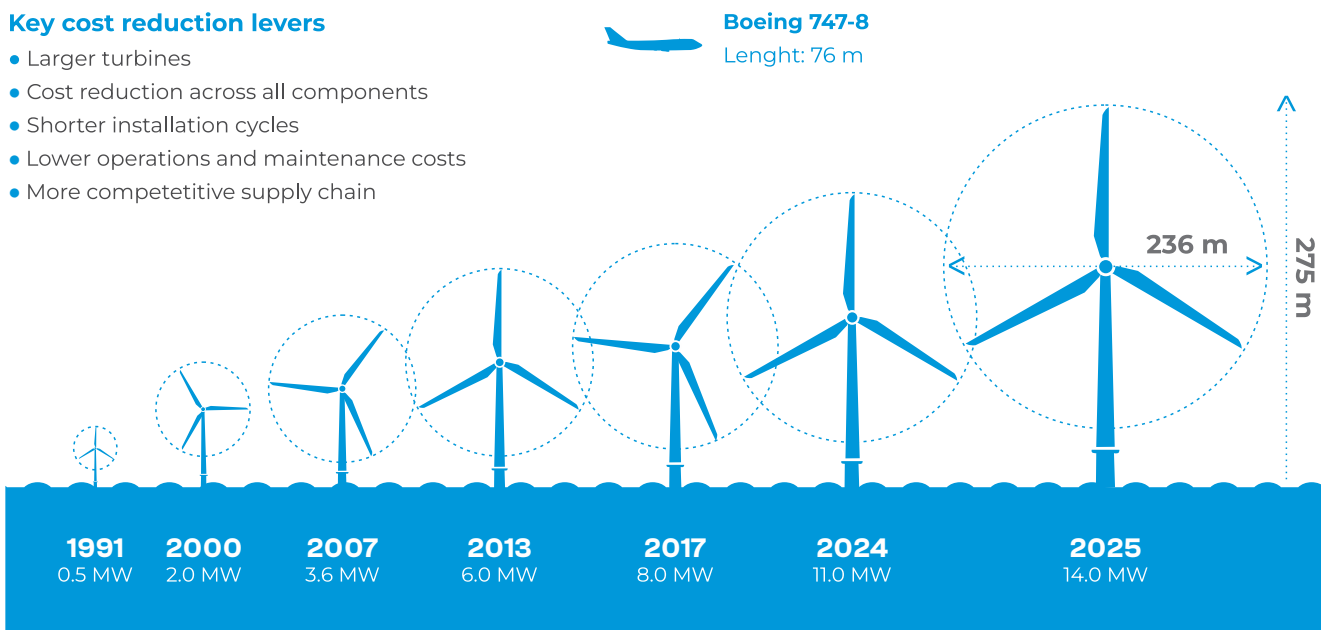
Graph 1. Global offshore wind farm installations in MW by 2023.



Source: Offshore Wind Market Report: 2024 Edition, <https://www.nrel.gov/docs/fy24osti/90897.pdf>

Figure 1. Evolution of offshore wind farm turbine size.**Key cost reduction levers**

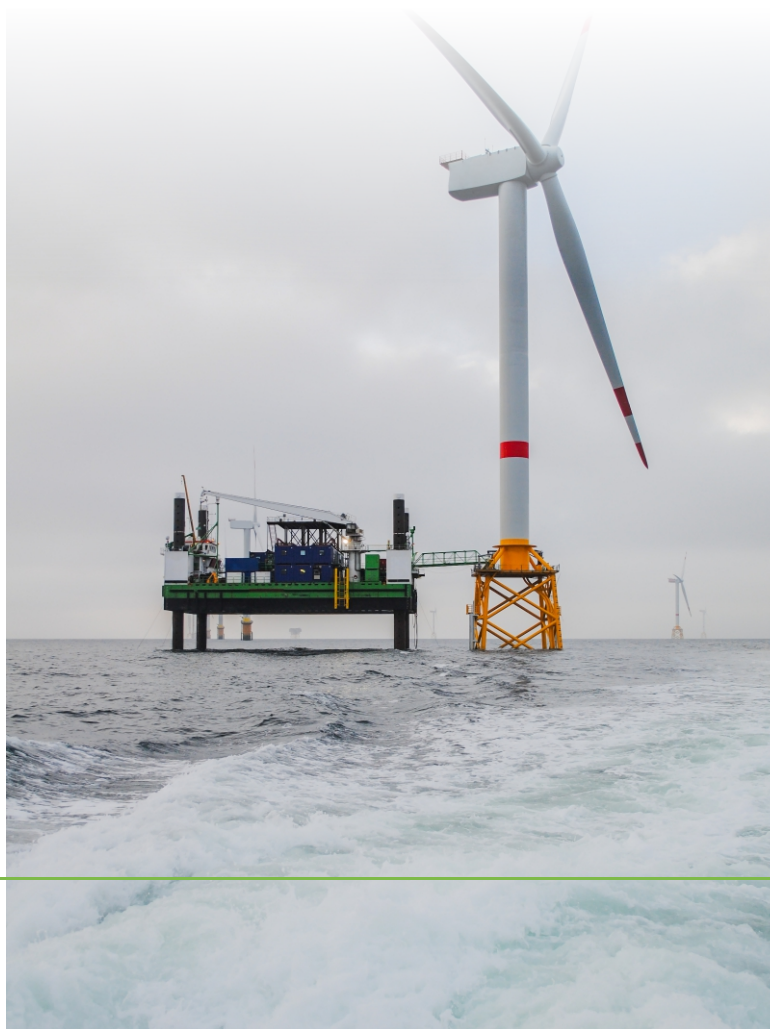
- Larger turbines
- Cost reduction across all components
- Shorter installation cycles
- Lower operations and maintenance costs
- More competitive supply chain



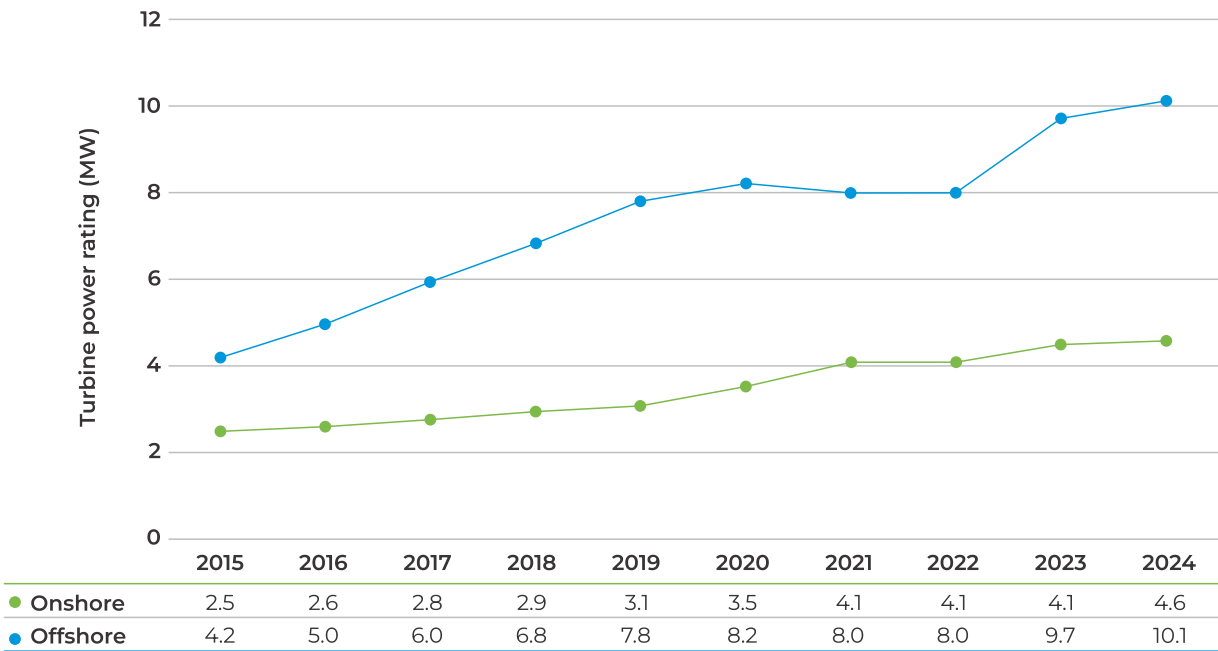
Source: <https://orsted.com/en/what-we-do/renewable-energy-solutions/offshore-wind>

3.2 EUROPE, ESPECIALLY POLAND, NEEDS ENERGY FROM OFFSHORE WIND FARMS

Wind energy, particularly the offshore sector after 2040, will be the foundation for the decarbonisation of economies; large-scale, mature technology and relatively fast project feasibility will play the most significant role. Poland began the development of offshore wind energy in response to the growing needs for decarbonisation of the energy sector, sustainable development, and environmental protection. The key documents governing this area are (1) the Polish Energy Policy until 2040 (PEP2040), which sets goals for the development of offshore wind farms, and (2) the National Energy and Climate Plan until 2030, a draft update of which was sent for public consultation by the Ministry of Climate and Environment in the fall of 2024. The Polish government expects to install about 5.9 GW by 2030 and another 12 GW by 2040, totalling 18 GW in OWFs by 2040. The total potential of the Baltic Sea's offshore areas that our country can develop, as the Polish Wind Energy Association estimates, is 33 GW, which provides a perspective for setting further development horizons beyond 2040.

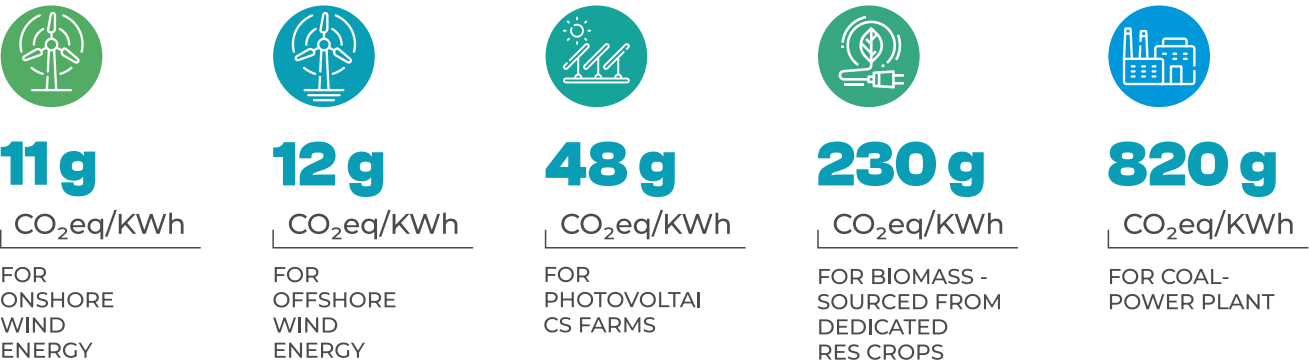


Graph 2. Average power of a single offshore wind turbine in 2015-2024 compared to the power of onshore turbines.



Source: Wind Europe.

Figure 2. Life-cycle CO₂ emissions for power generation technologies.



Source: PWEA Report "Diagnosis of the Current Situation and Potential of the National Supply Chain for Onshore Wind Energy in Poland," 2021.

There is broad agreement across political divides in Poland on the key role of offshore wind energy in the country's energy transition. This was confirmed with the unanimous passing of a law regulating the development of the sector (the Act of December 17, 2020 on the Promotion of Electricity Generation in Offshore Wind Farms), which introduces the legal framework and timetable for the next auctions for offshore wind

farm projects (auctions: 2025 for 4 GW, 2027 for 4 GW, 2029 for 2 GW and 2031 for 2 GW). Poland has a defined path for the development of the sector, but the industry points to the need to modify the legislation to accelerate the investment process in OWF in Poland (today it is the longest in Europe) and ensure that the first auction for OWF in 2025 will take place and be successful. The government's actions should ensure

long-term stability for offshore wind energy development, which will strengthen energy security and the country's sustainable development

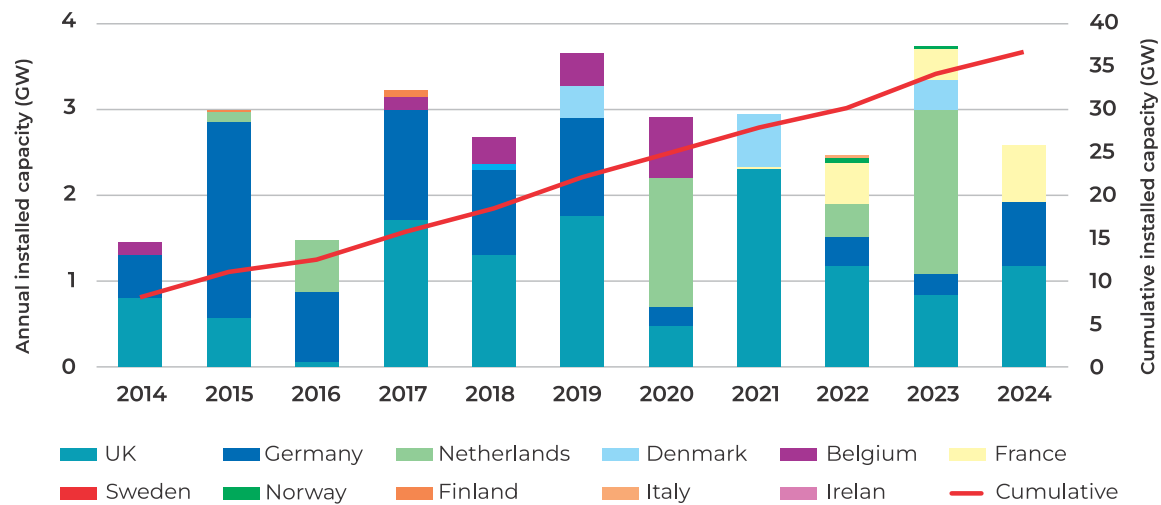
and create a full value chain for a new sector of the economy, such as OWE.

Table 1. SWOT analysis of offshore wind farm construction.

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"> • renewable energy sources • proven, effective technology • high productivity of the latest technology turbines • high innovative potential, which translates into cost-effective investments • systemic public financial support for projects • increasing demand for electricity (electrification of the economy) • technology that does not burden land areas (not competing with agriculture, housing, etc.) 	<ul style="list-style-type: none"> • unpredictable investment costs and additionally variable over time • over time due to the long preparatory process • low level of utilisation of the potential of domestic companies • multiplicity of decision-making centres in the investment process • demographic challenges in finding the right cadre of skilled workers • high expenditure on power grids for energy use in other regions
OPPORTUNITIES	THREATS
<ul style="list-style-type: none"> • shallow waters, sandy bottom, and long coastline of the Baltic Sea • increase the country's energy security • favourable wind conditions (moderately strong and stable wind) • EU's favourable policies (Green Deal) • development of coastal regions • development of shipbuilding and steel industry • new so-called "green jobs" (both in the installation and operational phases) • energy independence from imported fossil fuel sources • ultimately, lowering electricity prices in Poland • use of construction-related technologies for defense purposes 	<ul style="list-style-type: none"> • long duration of administrative processes • complex regulatory frameworks requiring constant adaptation to the current priorities of the country • lack of a clear supply chain strategy from the Polish government • possible technical problems associated with the construction and maintenance of the OWF • political and regulatory changes may affect the stability and predictability of investments • implementation of large-scale maritime projects may face resistance from various stakeholders • lack of qualified people to work on both the construction and the operation of farms • additional costs related to protecting investments against cyber, physical and hybrid threats

Source: Own elaboration.

Graph 3. Annual installations and cumulative installed capacity of offshore wind energy in Europe.

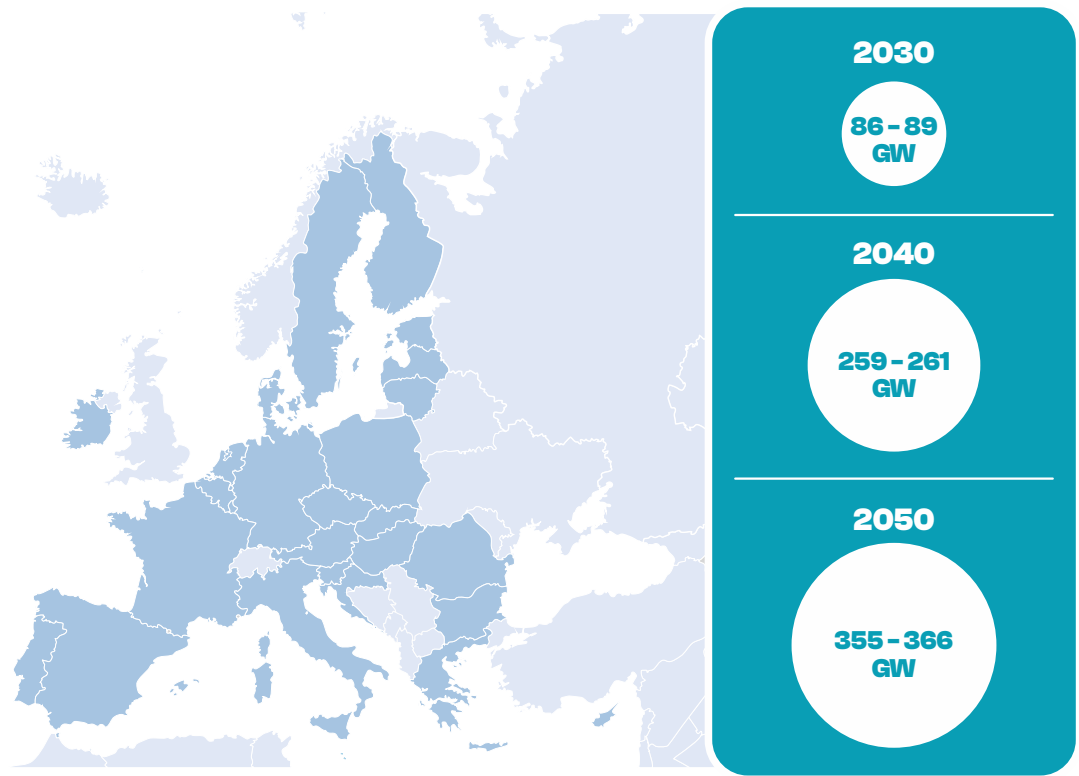


Source: Wind Europe 2025.

Poland is successfully executing its initial projects in a challenging economic environment. Several challenges have been encountered while implementing the so-called Phase I offshore wind farm projects, affecting the pace and cost of investment. The coronavirus pandemic, the energy

and gas crisis and the war in Europe, as well as rising costs of key raw materials, components, and services due to increased global demand, have not halted domestic projects, the first of which is expected to become operational in 2026.

Graph 3. Cumulative total EU countries' targets for offshore energy for 2030, 2040, 2050.



Source: European Commission, Offshore renewable energy.

4. The policy of European institutions and the state of the industry

4.1 EUROPEAN UNION POLICY

The European Union's policy of decarbonisation and independence from fossil fuels has been consistently implemented. Since the beginning of the third decade of the 21st century, the European Union has been accelerating with legislation aimed not only at decarbonisation, but also at ensuring industrial competitiveness, including by supporting the development of green technologies. The entire pro-climate package aims to maximise electrification, identifying wind power as a strategic, large-scale source of clean electricity.

Internal conditions within the community, such as the growing demand for renewable energy sources and the actions of countries outside the EU that are rapidly developing their green technology sectors, have put significant pressure on the EU to strengthen support for the clean technology industry. In response to global competition (including the actions of the U.S. and China) and the need to accelerate the energy transition, the EU has increased its commitment to green technologies, including offshore wind, through political declarations (*European Wind Power Action Plan*) and regulations (*Net Zero Industry Act*, *Critical Raw Materials Act*, *Renewable Energy Directive III*).

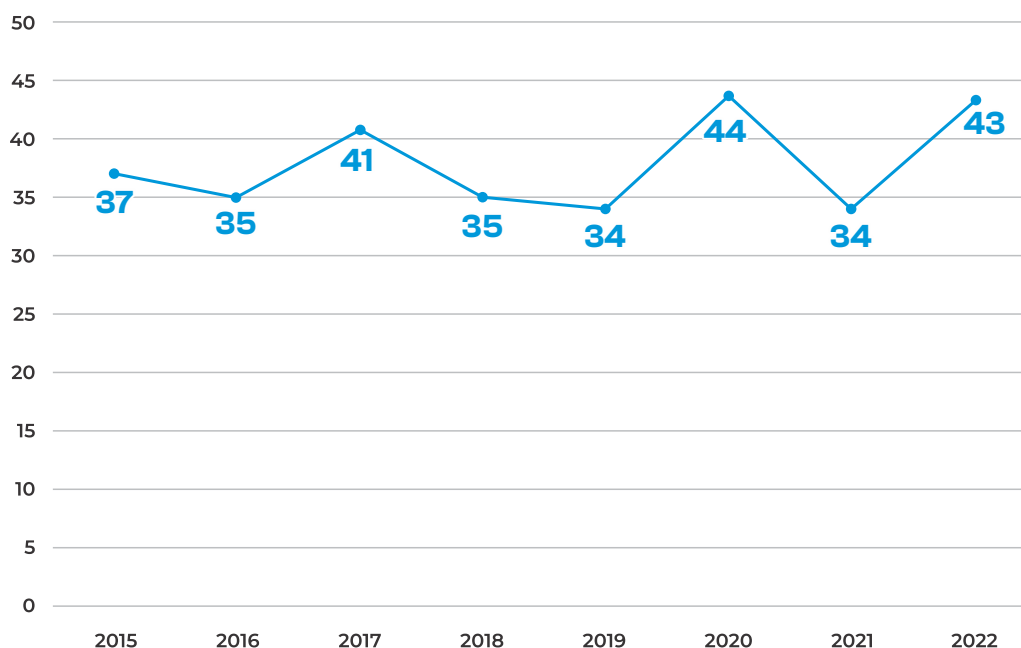
The EU Industrial Strategy aims to secure Europe's technological autonomy and reduce dependence on non-Community suppliers. This approach also has a dimension related to ensuring energy security (to avoid changing dependence on energy raw materials into de-

pendence on components for RES projects).

For many stakeholders, however, these solutions seem insufficient for European industry to remain competitive. At the same time, national positions have been adopted regarding the direction of industrial policy based on net-zero technologies (in countries such as Germany or France).

In 2024, Mario Draghi published the Report² which European Commission President Ursula von der Leyen commissioned. The report focuses on the key challenges of the EU economy, including the energy transition, and points to a key correlation with industrial policy in this regard. The document provides a detailed analysis of challenges related to energy networks, financing, permitting processes, supply chains, ensuring a level playing field for European producers and innovation. The report emphasizes the need for a new regulatory framework, speeding up decision-making processes and providing financial support for energy infrastructure development. It provides a starting point for the new European Commission (which began its term at the end of 2024) and an opportunity to adopt a pro-development course based on clean energy technologies, among other things.

² https://commission.europa.eu/topics/strengthening-european-competitiveness/eu-competitiveness-looking-ahead_en [Accessed 6/12/2024].

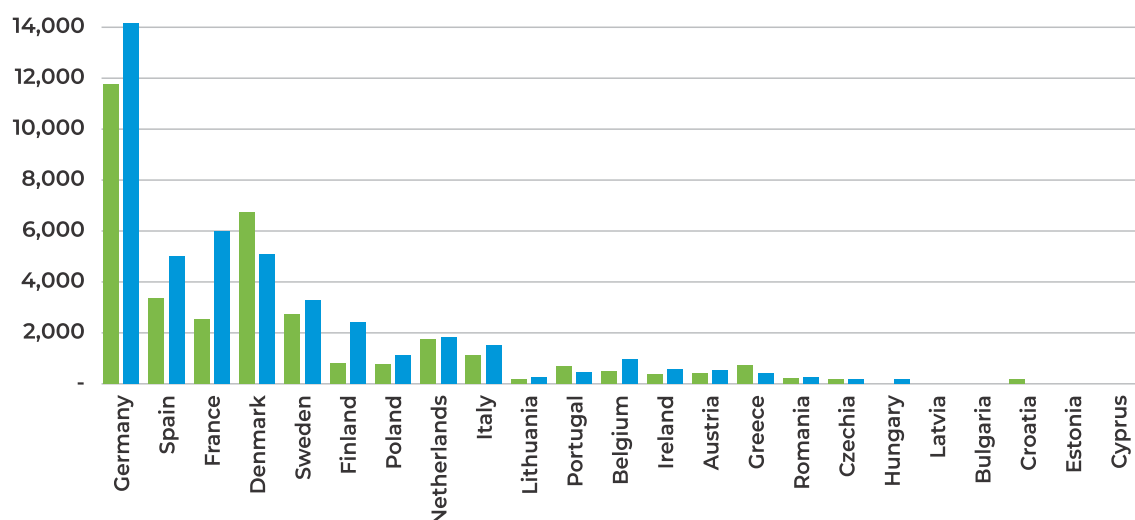
Graph 4. Turnover of the European wind industry (onshore and offshore) in billion euros.

Source: Joint Research Centre (European Commission). Publication: "Clean Energy Technology Observatory, Wind energy in the European Union". <https://data.europa.eu/doi/10.2760/0882709>

4.2 OFFSHORE WIND POWER SUPPLY CHAIN IN EUROPEAN COUNTRIES

Offshore wind energy is a technology with deep roots in Europe. The EU was one of the first players in developing production facilities for the clean energy technology. Denmark is the host of the world's first wind farm, and a country where wind covers half of the country's energy production today, it still has a key position in

offshore wind turbine production. Portugal created the first floating wind farm and the Netherlands the first offshore photovoltaic farm. Despite this, the existing clean energy technology production centres on the old continent are not distributed evenly enough across the EU.

Graph 5. Turnover of wind sector component manufacturers in EU Member States in 2021 (green) and 2022 (blue) in million euros.

Źródło: Joint Research Centre (European Commission). Publication: "Clean Energy Technology Observatory, Wind energy in the European Union". <https://data.europa.eu/doi/10.2760/0882709>

Currently, the European manufacturing supply chain for Tier 1 and Tier 2 offshore wind power is still mainly based on companies from EU member states. Tier 1 and Tier 2 suppliers have 140 plants in Europe, of which about 80% are in the EU. Tier 1 suppliers are mainly located in the leading offshore wind markets in Europe, i.e. around the North Sea and the Baltic Sea, in countries such as Germany, Denmark, the UK, the Netherlands and Belgium, as well as in countries that can benefit from the experience of a strong onshore wind supply chain (Spain).

The offshore wind farm technology development has sparked supply chain interest in many countries worldwide, reducing Europe's dominance and competitiveness. The increased competitiveness of non-European markets, offering cheaper production and strong state support, has significantly affected Europe's share of the global supply chain, forcing European manufacturers to restructure and innovate at high cost to maintain their position in the sector. European companies have incurred significant development expenditures not offset by profits (Siemens), and some have even gone bankrupt (e.g., ST3 Offshore).

At the same time, European capacity for the construction of local offshore wind farms will soon be in short supply to an extremely high degree. Each procurement package is characterised by significant capacity shortfalls compared to the planned demand in the coming years, resulting from already announced auctions for *offshore wind* and final investment decisions (FID), as well as the European power building goals. Individual European countries, recognising the trend of regionalisation of supply chains, are taking concrete steps to build manufacturing and service capacity. On the other hand, China already has an enormous potential geared toward export expansion.

By 2030, investment in the cleantech supply chain covered by the M. Draghi Report's analysis could reach at least €52 billion (if the current share of EU industry in meeting regional demand is maintained). If the EU increases production capacity as envisioned by the *Net Zero Industry Act* (NZIA) regulation, the amount could reach €92 billion. If the EU wanted to meet 100% of its demand, the investment allocated to European industry would amount to €119 billion. Further investments, estimated at €23 billion, will be needed between 2031 and 2040 to increase EU production capacity further.

4.3 THE CHALLENGES OF EUROPE'S COMPETITIVENESS IN THE SUPPLY CHAIN

There are many supply chain risks for offshore wind farms, with slowing globalization, loss of competitiveness, and geopolitical tensions being the main ones. Other net-zero technologies show effects when such risks materialize. The EU increasingly relies on imports to meet its growing demand, making it a net importer of clean technologies today. In the case of wind turbines, where it maintains a trade surplus, its trade balance is deteriorating (EU imports increased by 504% between 2012 and 2022). The EU relies on growing imports from Asia, particularly China. As

for batteries, the value of imports increased 7.5 times between 2017 and 2023. Moreover, the EU's trade deficit doubled for key heat pump components between 2021 and 2022. In 2023, the value of EU imports from China was about €43 billion in photovoltaics, wind technology, batteries, and heat pumps. For batteries and some photovoltaic components, the EU's dependence also extends to production machinery, which can cause bottlenecks when maintenance and repairs are needed or limit market availability.

Table 2. Summary of manufacturing bottlenecks in the global supply chain (excluding China).

Components	2023-2026	2027-2030	2031-2033
Nacelles	<div></div>	<div></div>	<div></div>
Blades	<div></div>	<div></div>	<div></div>
Towers	<div></div>	<div></div>	<div></div>
Gearboxes	<div></div>	<div></div>	<div></div>
Converters	<div></div>	<div></div>	<div></div>
Generators	<div></div>	<div></div>	<div></div>
Cables	<div></div>	<div></div>	<div></div>
Steel	<div></div>	<div></div>	<div></div>
Castings	<div></div>	<div></div>	<div></div>
Installation vessels	<div></div>	<div></div>	<div></div>

Legend
 No bottlenecks
 Potential bottleneck
 Narrow bottleneck

Source: GLOBAL SUPPLY CHAIN STUDY, ERM, own analysis.

In the coming years, by 2030, China's capacity for offshore wind power will be significantly higher than global demand. China is extensively supporting clean technologies through subsidies and low-cost loans. Other countries, such as India, Japan, and Brazil, have also launched programs to develop local production in renewable technologies. For example, financial support for these technologies is less concentrated in the EU. Today's global race for competitiveness in green technologies is based on economic protectionism.

Challenges to the competitiveness of European manufacturers are increasing. The cost of building new production facilities in the EU and the US is 70% to 130% higher per unit of production capacity than in China, due to higher labour costs, energy prices and raw materials, especially for steel and other key materials. The EU sources only 2% of the raw materials needed for wind turbines, while China has a 43% global share, according to the M. Draghi Report. Clean technologies, such as batteries, wind turbines and electrolyzers, require access to critical raw materials, of which the EU extracts only 1%-5%. Some raw materials, such as

lithium and graphite, the EU is 100% dependent on imports. Demand for permanent magnets and rare earths in the EU is estimated to increase five-fold by 2030. The EU's cleantech manufacturing sector also faces a shortage of skilled labour. Between 2015 and 2020, employment in the sector grew by 12%, but at the same time the number of vacancies doubled, posing a challenge to the industry's continued growth. EU spending on innovation in decarbonisation technologies is lower than in Asia.



5. Challenges of the Polish supply chain

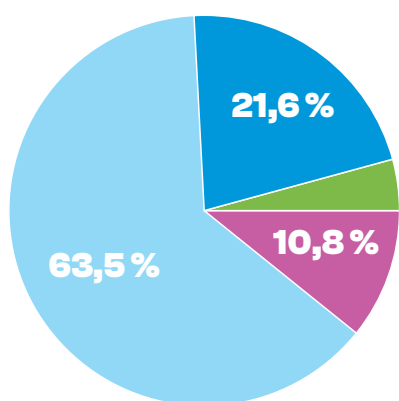
5.1 EXPERIENCE FROM THE CONSTRUCTION OF THE FIRST FARMS IN POLAND

Despite the many interested companies, a low participation rate in domestic projects is recorded. A May 2023 survey conducted by Bank Gospodarstwa Krajowego³ indicated that over two hundred companies in Poland could potentially participate in OWE projects, of which 20 are already actively involved in the industry and about 112 are currently planning their involvement in OWE projects.

Small participation of domestic companies in Phase I and untapped potential. Analysis of the involvement of Polish companies in the so-called Phase I, in the CAPEX part of the projects, indicates an estimated share of a few to a dozen percent (depending on the project and on the readiness of

the most significant ongoing industrial investments - to supply Polish projects). At the same time, taking into account the technical and organizational potential of domestic **companies**, it should be considered that it would be possible for them to sign more contracts for components or services such as Offshore Substations, foundation transition pieces, installation vessels (as Tier 2), or cables. The lack of Polish **suppliers** as Tier 1 makes it difficult to build a local supply chain for Tier 2 and Tier 3 suppliers, because foreign suppliers involve **their** technology convoy in contract execution. As part of the implementation of the provisions of the supply chain plans, Phase I investors primarily conducted outreach activities for procurement proceedings.

Graph 6. Results of the 2023 Wind Energy Market Stakeholder Survey.



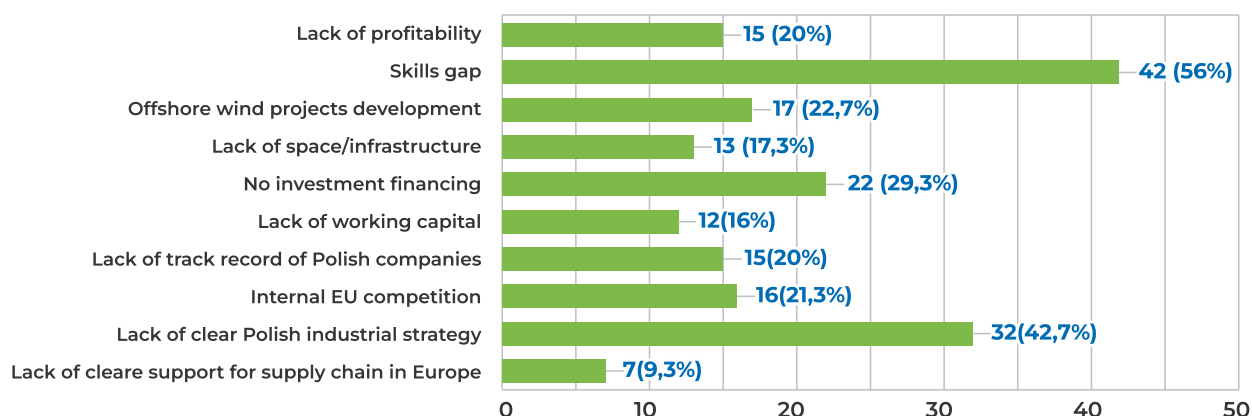
How would you assess the participation of Polish companies in the construction of the first phase of offshore wind energy?

- It is a failure
- Should be better
- It's OK
- We used the chance in full

Source: CEE Energy Group, PWEA.

³https://www.bgk.pl/files/public/Pliki/Analizy_ekonomiczne/Local_content_w_offshore_gotowosc_polskich_przedsiębiorcow_do_rozwoju_morskiej_energetyki_wiatrowej.pdf [Accessed 6/12/2024].

What are key threats for Polish offshore wind supply chain? (pick 3)



Source: CEE Energy Group, PWEA.

The reasons for domestic companies' low level of involvement in the construction of Phase I offshore wind farms in Poland are complex.

Primarily, the construction of offshore wind farms in Europe over the past few years has not resulted in the development of domestic companies at the Tier 1 level, making it impossible to engage or build the capacity of lower-tier suppliers. Domestic engineering companies do not design components and systems (e.g., offshore substation or foundation components), which significantly narrows the opportunity to format products under the assets and competencies of domestic companies. Developing a supply chain requires con-

fidence that the business will be stable and profitable, and that the entity can provide adequate resources to invest and expand competencies and resources. Contract execution requires a fundamental level of quality in all preparation and production/service processes. Financing (and financial security through guarantees) of contracts is a significant barrier to entry into European supply chains. Polish companies do not have adequate financial "mass" or cannot offer the full financial guarantees required of a new supplier. The lack of proper scale of operations further hinders the race for human resources.



Figure 4. Contracting models.

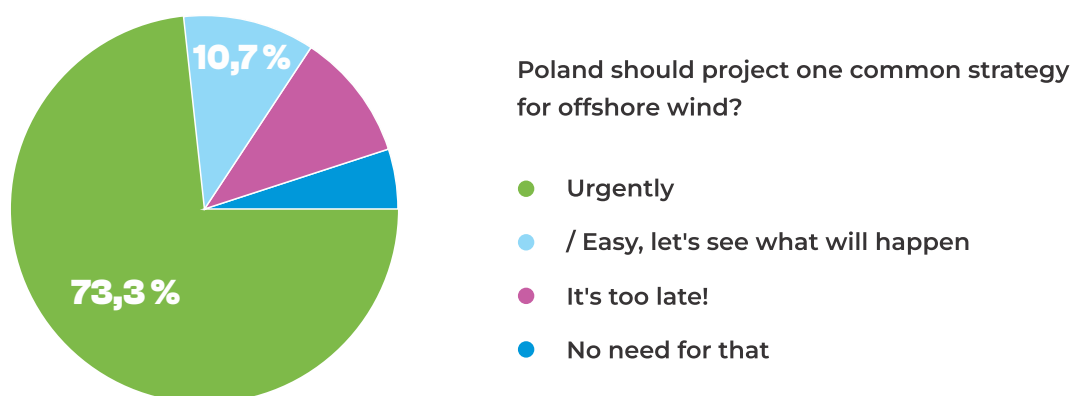
	 Centralised model	 Multi-contract strategy	 Hybrid model
Number of contracts	Packages, covering 1 to 3 scopes of work	Over 9	4 to 9
Contract price	Relatively high, includes risk premium, lump sum	Relatively low compared to EPCI	Average
Risk exposure	Relatively low, usually capped	Relatively high responsibility of the contracting authority for interfaces between contractors	Average
Control by the contracting authority	Relatively low	High, direct	High, but less than with EPCI

Source: Development of offshore wind farms. Legal aspects of contracts in the sector, Wind Industry Hub, DWF.

The prevailing view among Polish companies is that domestic investments should be a turning point for their development. Implementing the first contracts on Polish farms will enable the acquisition of references and the necessary

experience. The lack of references, the acquisition of which requires investment (with an elevated level of risk), in turn results in a lack of opportunity for more significant export involvement.

Graph 7. Results of the 2023 Wind Energy Market Stakeholder Survey.



Source: CEE Energy Group, PWEA.

The preparation period for constructing the first offshore farms in Poland has been used to help Polish companies understand how to define their procurement strategy properly. Domestic companies and institutions should already mostly understand what an investor is responsible for in a project and what a Tier 1 and Tier 2 supplier is responsible for. On the other hand, domestic investors have acquired valuable knowledge of how the proper arrangement of a procurement strategy can allow more Polish companies to be involved.

During the implementation of Poland's Phase I offshore wind farms, controversy arose over insufficient consideration of security of supply from non-EU countries in procurement processes. Key elements, such as the construction of offshore substations and cables, are produced outside the EU (including in China and Vietnam). Poland still lacks dedicated Cybersecurity standards for turbines and transformer stations and guidelines for local contractors and ship operators responsible for installing OWFs.

Although Poland already has a developed set of regulations for the construction and operation of offshore wind farms, OWE supply chain legislation needs to be adapted. National regulations aimed at ensuring the participation of Polish companies need to be clarified and must be a compromise between the need to comply with European competition rules and the ambition to create a domestic ecosystem for the development of indigenous technologies. Sector regulations, including those relating to so-called "supply chain plans," are a solution that requires further development and improvement.

New investments in production facilities for OWE in Poland are welcomed, but they are mainly carried out with a substantial share of foreign capital and based on foreign know-how. The announced investments in the supply chain for offshore wind power in Poland are mainly concentrated around foreign concerns (Vestas, Windar, GRI - with IDA participation). The international players lead the way in the construction of key components, such as turbines

and wind towers, and in this context, the willingness of their capital to engage in Poland should be seen unequivocally positively. Nevertheless, there are also domestic companies that, in partic-

ular segments of the supply chain, reveal significant potential for development into a Tier 1 supplier but face difficulties in obtaining financing and making investments.

Table 3. Economic benefits of industrial development depending on the nature of the entity, according to Forum Energii analyses.

Criterion/entity	Polish company, production in Poland	Polish subsidiary of a foreign company, production in Poland*	Foreign company, production abroad
Benefits for Poland			
Knowledge	Yes, institutional and owned by staff	Yes, owned by personnel	No
Technology transfer	No	Yes	No
Profits	Most often reinvested in Poland	Partially transferred to the mother company	No
Wages	Yes	Yes	No
Tax revenues	Supporting the national and local budget	Probably partially leaked	No
Company development	Organic	According to the strategy of the mother company	Abroad
Demand for local services	Rather higher	Often from the country of the mother company	Mainly non-tradable (those that must be performed on site)

*These are generally larger companies than domestic ones, which means higher productivity and higher wages.

Source: Forum Energii ‘New Industrial Deal 2024+ How to reasonably modernise Polish industry’.

Education

Poland's vocational education system, especially in *the offshore wind* sector, lags behind solutions compared to more developed markets. This is a systemic challenge, not specifically for *the offshore wind* industry. Despite the positive trend seen in recent years - with greater company involvement in training processes and apprenticeship programs - there is a lack of long-term dedicated systems to support the development of technical and higher education for the wind industry. This causes challenges evident in supply chain companies' limited involvement in education projects, e.g., at BCU competitions.⁴ Phase I investors are eager to develop programs to spread sector knowledge. Still, there is a lack of systematic programs for practical training, commissioned courses, and integration with Polish companies, which delays the development of the domestic technical workforce. Spot activities in this area (Pomeranian and West Pomeranian Voivodeships) may also be insufficient regarding the sector's human resource needs.

⁴ <https://www.gov.pl/web/nauka/iii-nabor-w-konkursie-na-utworzenie-branzowych-centrow-umiejtnosci> [Accessed 6/12/2024].

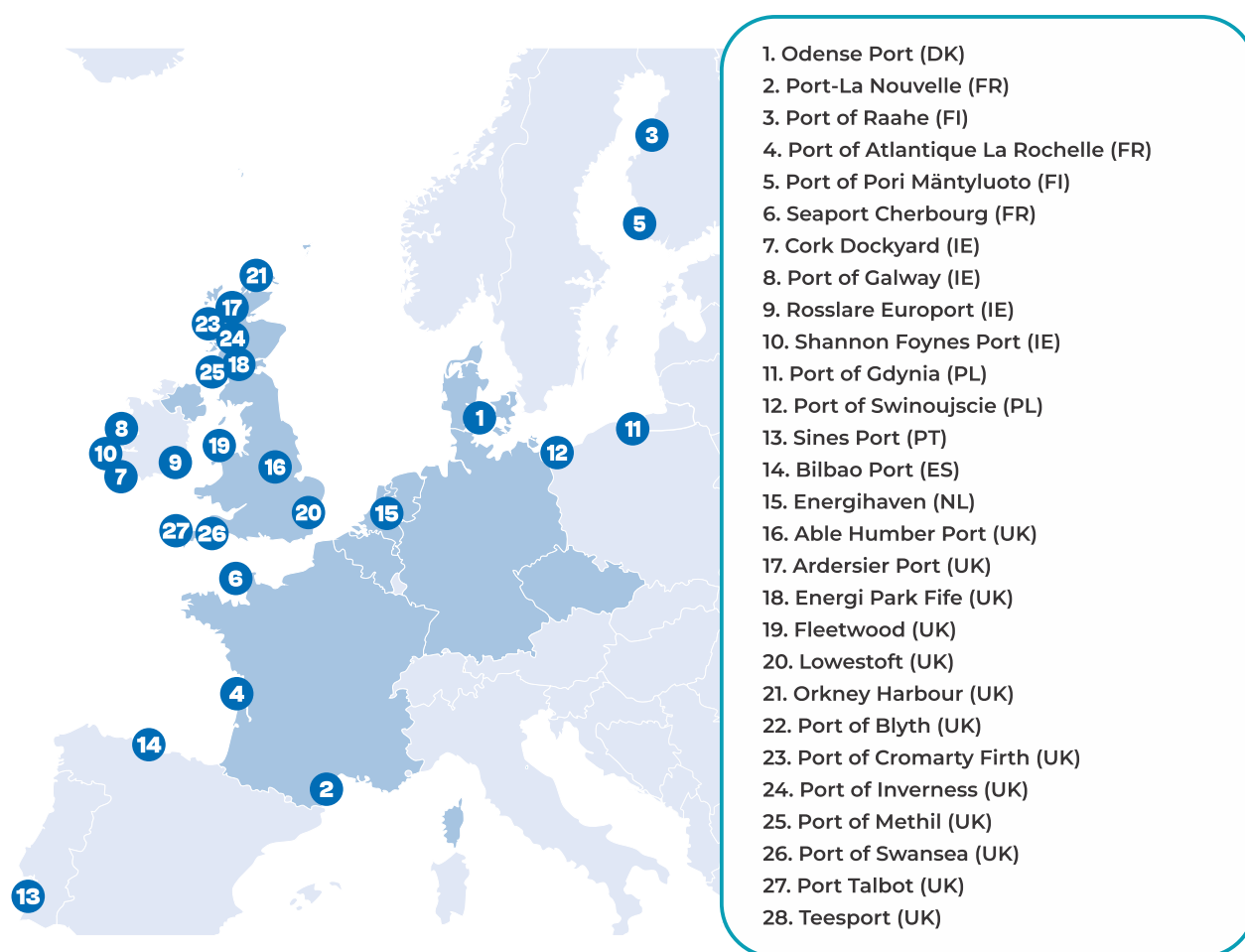
Innovation

The wind power industry, firmly rooted in Western Europe, has developed instruments to support innovation. However, Poland's problem is still the under-utilisation of Community financial instruments (grants and loans) for R&D. The Sector Deal for offshore wind energy in Poland has so far been exclusively expert, and while it has developed initial methodological input, there has been a lack of any implementation activities. The area of R&D in offshore wind energy at the national level seems to be recognized but not coordinated among stakeholders for the time being. Meanwhile, among other things, talks are well advanced between the European Commission and the *European Technology Innovation Platform on Wind* (ETIPWind) regarding creating a partnership with dedicated funding for OWE. This partnership is to be formed in correlation with the announcement of the wind energy roadmap for Europe in the spring of 2025. Without the Polish industry's conscious participation in this process and coordination at the state administration level, we may again be left out of the key developmental impulses of the wind industry.

Ports and infrastructure

The development of installation ports for *offshore* wind energy in Poland is being conducted "at the last minute," despite the crucial importance of these investments for the success of *offshore projects*. Port infrastructure is being built without a time reserve even though it was planned. A few years ago, it was assumed that an installation terminal would be built in Gdynia and start operating as early as 2024, but it was decided to move the base to Gdansk, which prolonged the investment process. The change of location and the resulting delays prompted ORLEN to build its terminal in Swinoujscie. Investors have taken the initiative to make service ports function as operational bases for operating offshore farms. So far, five locations for service ports have been designated in Pomerania. Two such bases will be established in Leba, two more in Ustka, and one in Wladyslawowo. The port in Wladyslawowo has not been supported by the NIP, although, according to experts, relatively small expenditures could quickly adapt it to the industry's requirements. Darlowo and Kolobrzeg are also indicated among the locations of service and/or auxiliary ports.



Figure 5. Ports planning to support construction of offshore wind projects - Europe.

Source: CWEA, Brinckmann, September 2023.

Financing

The system of financing investment and innovation for OWE, a key sector in Poland, is developing very slowly. Although NCBiR, NFOŚiGW and the Ministry of Development and Technology have launched dedicated programs, the challenge is the long waiting time for decisions and the often predominantly loan-based formula, which may not be enough of a developmental boost. There is a lack of dedicated guarantee programs, which is crucial for companies to emerge as Tier 1 providers. Recently, the Export Credit Insurance Corporation seems to be supplementing the instrumentation in this regard. Still, some entities openly admit that they see the need to adapt the system of financial instruments to the industry's needs, as today there is a lack of dedicated support tools in areas not defined in the KPO. The NIP has proven to be the biggest disappointment for the domestic supply chain, as the largest funds have been allocated to invest in financing farm projects rather than the supply chain.

Institutions

Despite attempts, including signing a national Sector Deal for OWE, Poland lacks government-level coordination of this key industrial sector. Attempts to implement public policies (e.g., the Gospostrateg Program was cancelled/not resolved) and strengthen regional clusters have been unsuccessful. For specific projects that Poland could successfully attract, the lack of this coordination and the lack of prioritization of this sector has resulted in the loss or delay of hundreds of millions of euros of investment.

6. Strategy for Poland

6.1 SYSTEM SOLUTIONS

The economic potential of the sector is so significant (more than PLN 400 billion in spending by 2050 on farms in Poland alone) that the adoption of the Strategy for Offshore Wind Energy Development as a government document is a key step to give it a formal character and guarantee support at the national level. Such a document would set the organizational and regulatory framework that would enable the implementation of projects in this field and ensure their compliance with EU standards and priorities, such as autonomy in the supply of clean energy technologies. By adopting the Strategy, Poland could effectively manage the implementation of *offshore wind* projects, harmonizing them with national law and setting goals in areas such as supply chain development, acceleration of administrative procedures and support for domestic companies. Incorporating the Strategy into official state policy would raise its profile, enable more efficient use of public and EU funds, and increase the Polish industry's chances of establishing a presence in the European wind supply chain. A strategic approach, that is, making all stakeholders aware of the OWE investment program, is a national priority that will support accelerating all processes around the *offshore wind* industry - whether permitting farms, building factories, or establishing financing instruments and grant programs.

A clear path for constructing domestic wind farms can provide domestic companies up to 40% of the supply chain. There should be a reliable and well-timed continuity of demand in Poland for OWF investment through an effective program for granting OWF support in subsequent years - continuity of demand is one of the most important investment incentives.

Promoting cooperation among Polish enterprises as a means of strengthening the certainty of executing long-term, multi-million-dollar contracts. By creating strong consortia and partnerships, Polish enterprises can better compete in the international *offshore wind* market and implement complex large-scale projects. Cooperation between companies enables sharing of resources, knowledge, and experience, which leads to increased operational efficiency, cost reduction and minimization of project execution risks, ultimately strengthening regional supply chains.

Maximise the benefits of foreign investment. Encouraging major Tier 1 suppliers in individual components to locate at least some of their facilities in Poland will only be a first step. It is essential to actively encourage a gradual increase in their cooperation with domestic companies, to weave into global supply chains specialised suppliers from Poland that can supply competitively selected, essential components of products offered by Tier 1 suppliers.



6.2 POLISH INFLUENCE ON EUROPEAN REGULATIONS

Implementation of the NZIA (Net-Zero Industry Act⁵) in Poland is a key element in accelerating the development of the offshore wind sector and other technologies related to the economy's decarbonisation. The NZIA reinforces the assumptions of the RED III (Renewable Energy Directive)⁶. The directive simplifies and accelerates permitting processes for renewable energy source projects by strengthening local supply chains within the EU. For Poland, this means, among other things, speeding up administrative procedures, which are often one of the main barriers to implementing *offshore* projects. As part of implementing the NZIA, Poland could introduce more transparent and digital procedures for obtaining permits, significantly reducing investment preparation time. Another critical aspect of NZIA implementation is support for innovation and local companies by promoting the production of components within the EU. At the same time, Poland, while implementing the NZIA, should be prepared to adapt this law to the needs of the national budget, which has a concrete dimension in promoting the establishment of the Sovereignty Fund, which will increase the funds available for the new technology industry.

Poland should be ready to indicate its proposal within the framework of an industrial Strategy in European terms, defining which products and services will reach the status of European champions, which ones should use mainly regional supply chains, and which components can be imported from outside the EU without significant risk, while maintaining a certain level of production capacity in Europe. Priority Implementation Programs are such a proposal. With this approach, we can define our significant role in a properly integrated EU industrial system. Securing a minimum share of Poland's and Europe's

autonomy in the supply of selected clean energy technologies and their components, at various stages of the value chain, is a key step towards increasing the reliability and predictability of supply for OWE projects. As part of an integrated European approach, such a move will allow faster production ramp-up in case of market disruptions, help retain know-how in the EU and improve transparency of the cost structure in the supply chain. For Poland's dialogue with other regional economies to be possible, we must stop being a "black box" in industrial policy and the Strategy for OWE supply chain development, from which neighbouring countries cannot read plans, priorities, and potential synergies. The assumptions of the Polish Strategy can be a contribution to Poland's key proposals for shaping EU industrial development regulations.

Systemic alignment of EU funds and solutions.

Providing EU-wide funds for investment, project financing, and R&D in the offshore wind industry is in the interest of Poland, which cannot realistically compete in terms of public funds with countries with higher GDP levels in the EU. Mobilization of instruments like IPCEI (*Important Projects of Common European Interest*⁷), or the Innovation Fund, as well as new ones - the Sovereignty/Competitiveness Fund - will be crucial. The future Multiannual Financial Framework⁸ (MFF) should simplify the financing process for cleantech manufacturing projects by providing adequate resources and offering companies a single point of contact. It is important to support both capital expenditures (CAPEX) and operating expenditures (OPEX) for a limited period, especially during the initial phase of production ramp-up. State aid for clean technologies should be transferred to the EU level, and the Temporary

⁵ https://single-market-economy.ec.europa.eu/industry/sustainability/net-zero-industry-act_en [Accessed 6/12/2024].

⁶ https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-directive_en [Accessed 6/12/2024].

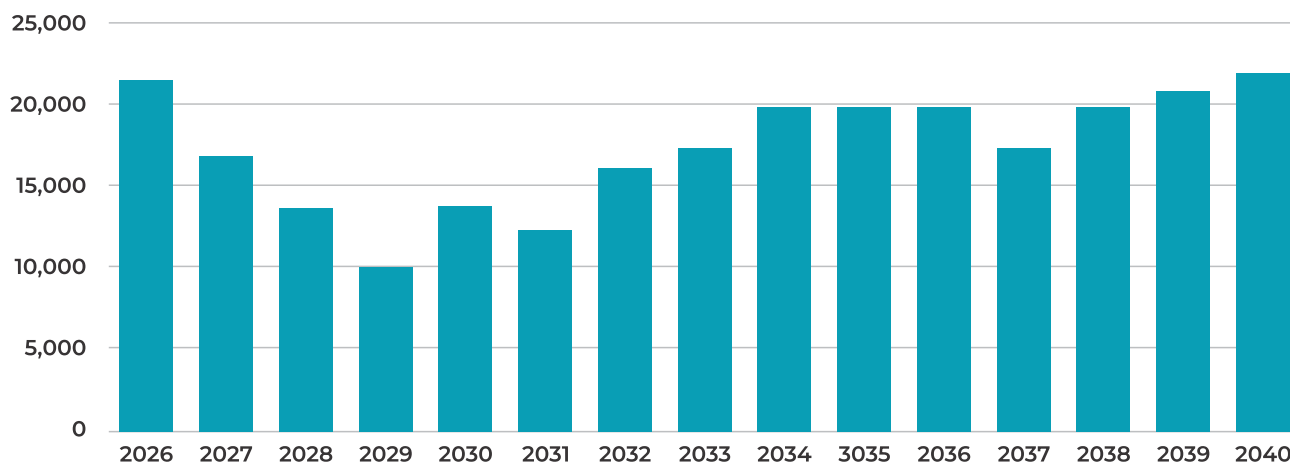
⁷ https://competition-policy.ec.europa.eu/state-aid/ipcei_en [Accessed 6/12/2024].

⁸ <https://www.gov.pl/web/finanse/wieloletni-plan-finansowy-panstwa> [Accessed 6/12/2024].

Crisis and Transition Framework (TCTF⁹) can be extended beyond 2025, also covering the construction of the installation fleet. In this case, the

€110 million limit that applies in Poland should be lifted.

Graph 8. Estimates of CAPEX expenditures in constructing offshore wind farms in Poland until 2040 (PLN million).



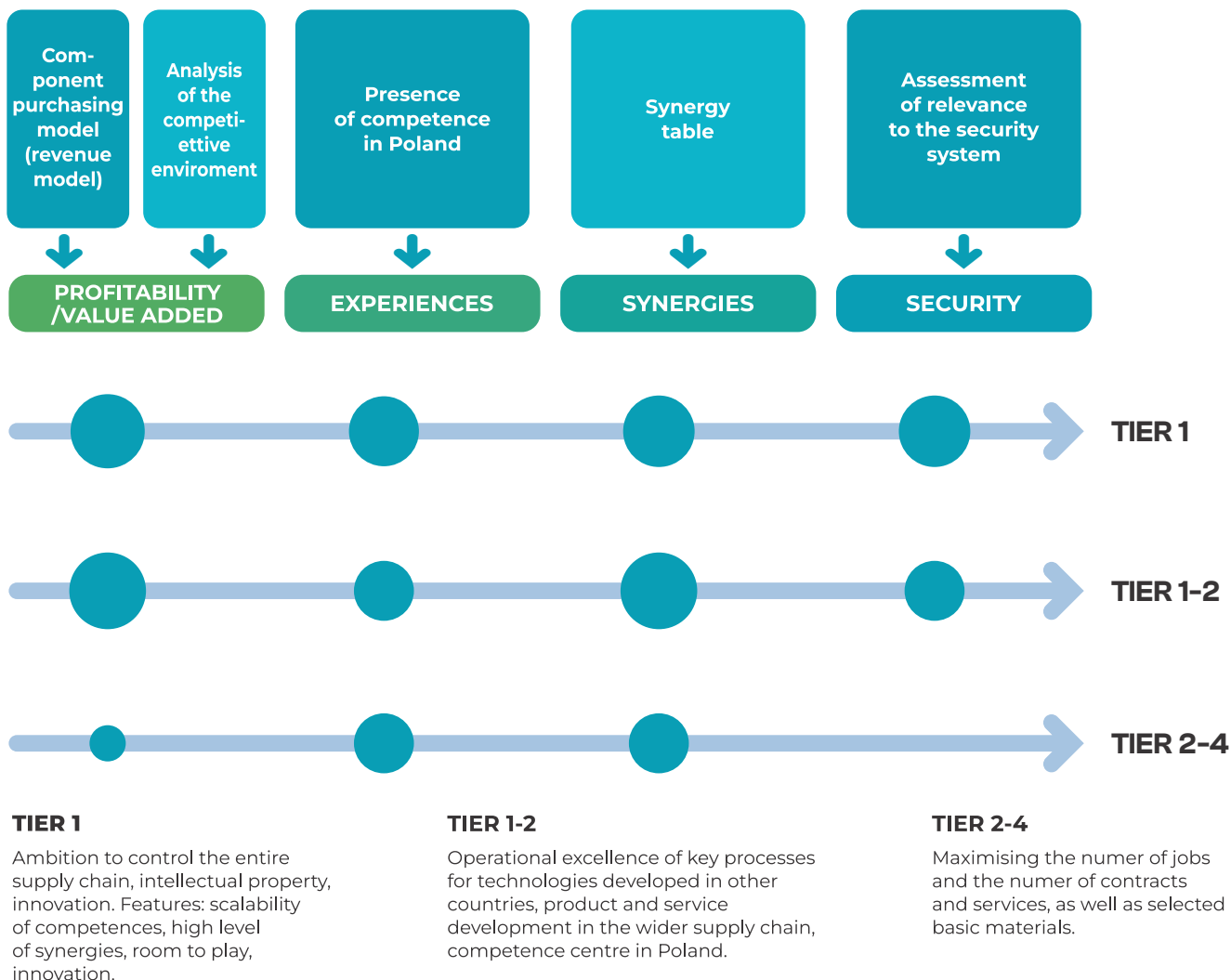
Source: Own elaboration.

⁹ https://competition-policy.ec.europa.eu/state-aid/temporary-crisis-and-transition-framework_en [Accessed 6/12/2024].



6.3 PRIORITY IMPLEMENTATION PROGRAMS

Figure 6. Methodology for selection of priority programs.



Source: Own elaboration.

Modern wind farm planning, design and monitoring services are a key component of the Strategy

The program assumes that most (more than 50%) of the work on development and implementation projects (DEVEX) will be conducted in Poland. This will enable Poland to develop local competence in managing offshore wind energy projects, ensuring an elevated level of control over every stage of the investment process. It will also enable the creation of jobs in specialised fields such as *offshore* engineering and wind farm design, which will eventually strengthen the Polish offshore wind industry and other areas of the economy. Our country has the potential to design key connection infrastructure (offshore substation and cable connections).

Entire supply chain for offshore wind turbine

Developing a local supply chain for offshore wind turbine components is key to achieving Europe's independence in this area. Poland should be a key hub for European industrial champions in this product. The program's goal is to ensure that between 50-75% of the components for the turbines being developed in Europe (in terms of financial value to Tier 2 level) will be manufactured in Poland. This includes providing knowledge of the key raw materials and technologies required for production.

Table 4. Cost shares of individual components in an offshore wind farm turbine.

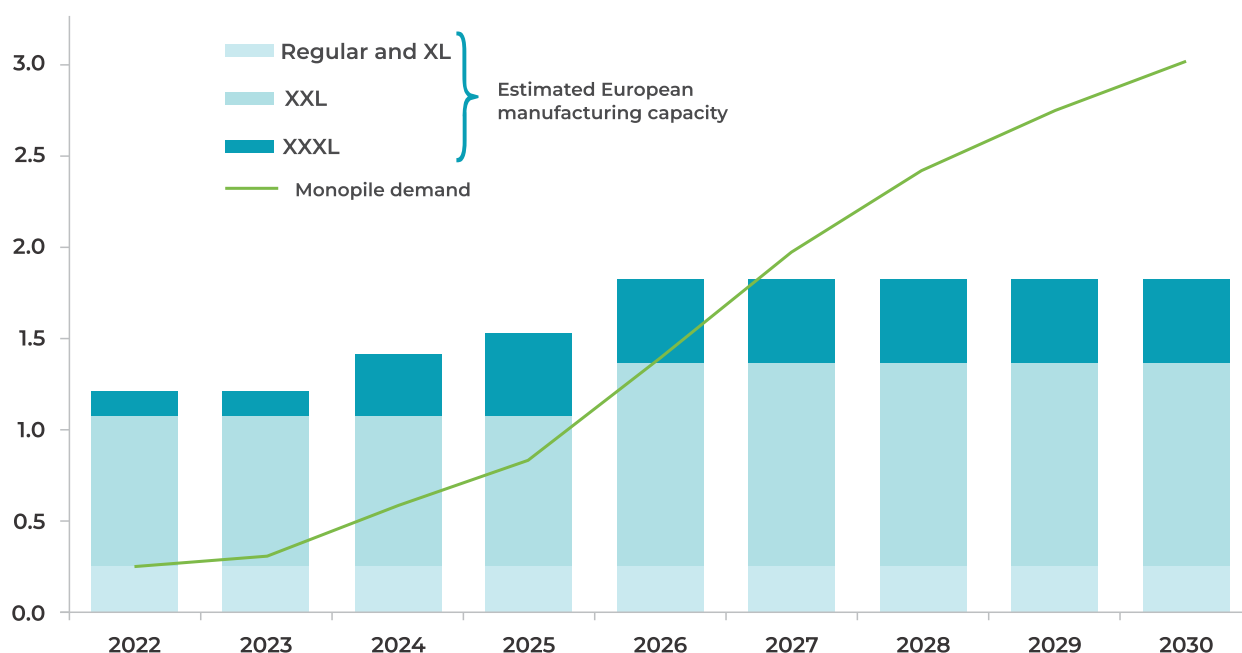
COMPONENT	Average share of costs (%)	Poland's potential
Blades (Blades)	18%-20%	HIGH
Hub (Hub)	3%-4%	HIGH
Pitch mechanisms and bearings	3%-5%	AVERAGE
Turbine front cover (Spinner, Nose cone)	1%	HIGH
Low speed shaft (Low speed shaft)	2%	HIGH
Bearings	2%	AVERAGE
Gearbox	16%	AVERAGE
Mechanical brakes	1%	AVERAGE
Generator	9%-11%	HIGH
Variable speed electronics	10%-12%	HIGH
Yaw mechanism and bearings	2%	AVERAGE
Main frame (Main frame)	4%	HIGH
Electrical connections	5%	HIGH
Hydraulics, cooling system	2%	HIGH
Nacelle cover	2%	HIGH
Control, security	3%	HIGH
Tower, including sheet metal and flanges	17-20%	HIGH
TOTAL POTENTIAL (excluding heavy plate)		~65%

Source: Own elaboration.

Foundation assembly for offshore wind farms

Domestic shipyards and ports have an extremely high potential for assembling foundations, especially the transition piece, jacket, floating foundations, and monopile type. Despite the dependence on external supplies of heavy plate, locating foundation production facilities in Poland will intensify the industrial development of Baltic ports.

Graph 9. Projected volume of monopile production in Europe vs. estimated demand in 2022-2030 (m tons).

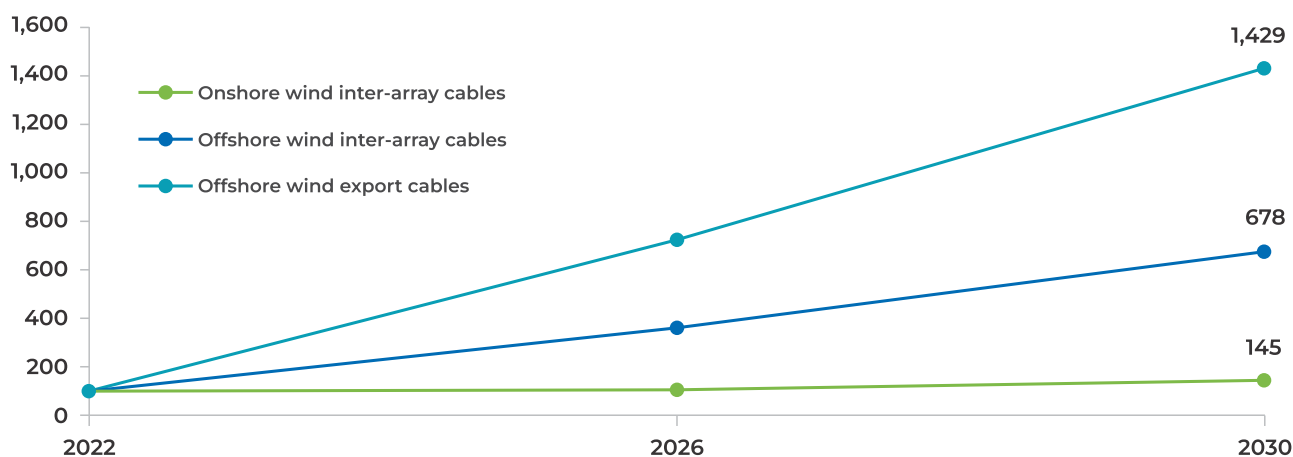


Source: A Rystad Energy report in cooperation with WindEurope, The State of the European Wind Energy Supply Chain.

National Offshore Substation Project

Any offshore substation for Polish farms should be built domestically, allowing the development of Polish shipbuilding and electrical and auxiliary equipment industries. Developing the design potential will preserve Poland's competence in offshore engineering, while the critical energy infrastructure, of which OWFs will be a component, will ensure digital security.

Graph 10. Indexed growth in demand for inter-array cables and Export Cables Onshore, index, 2022=100.



Source: A Rystad Energy report in cooperation with Wind Europe, The State of the European Wind Energy Supply Chain.

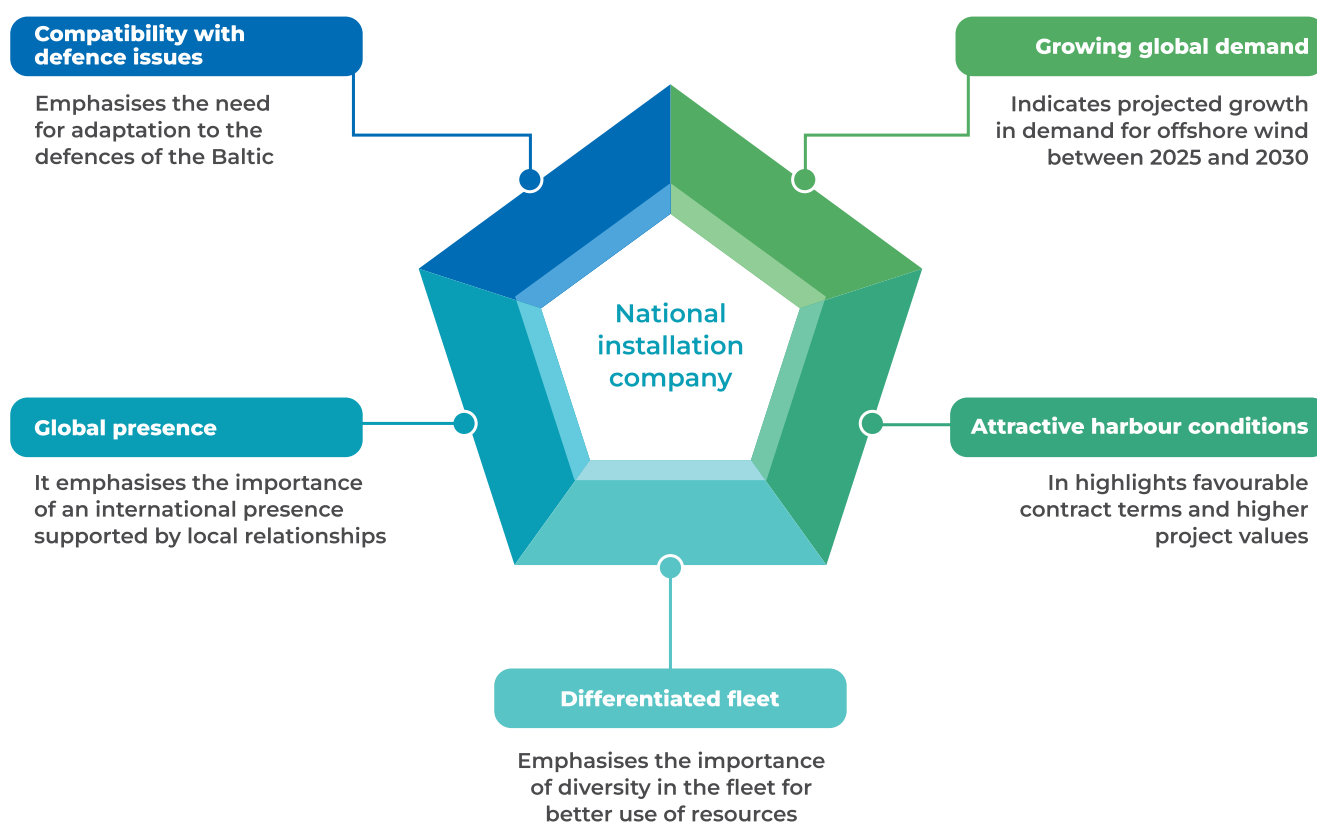
Cables

Poland should identify and support the ambition to develop a European champion of cable production for *offshore wind*. A key element of the program will also be to support the building of cable production capacity for offshore wind farms in Poland, which will further strengthen the local supply chain and reduce dependence on foreign suppliers.

A new European offshore wind farm installation company based in Poland

OWE Transport and installation are the domain of large European companies, and Poland should support their development. The national goal is to establish a regional European installation company, which will be headquartered in Poland. The capacity to install offshore wind farms will be conducted by a national company, which, in partnership with a European champion, will increase Poland's autonomy in installing offshore wind farms, reducing project costs and speeding up investment implementation. The program will help build a modern installation and support the fleet and increase the competence of Polish companies in the international market. The program aims to return specialised shipbuilding production for offshore wind, particularly the installation fleet, to Europe and propose Poland as the leading production site. Poland has at least three unique assets that can build or convert its installation vessels.

Figure 7. Factors supporting the creation of a national installation company.



Source: Own elaboration.

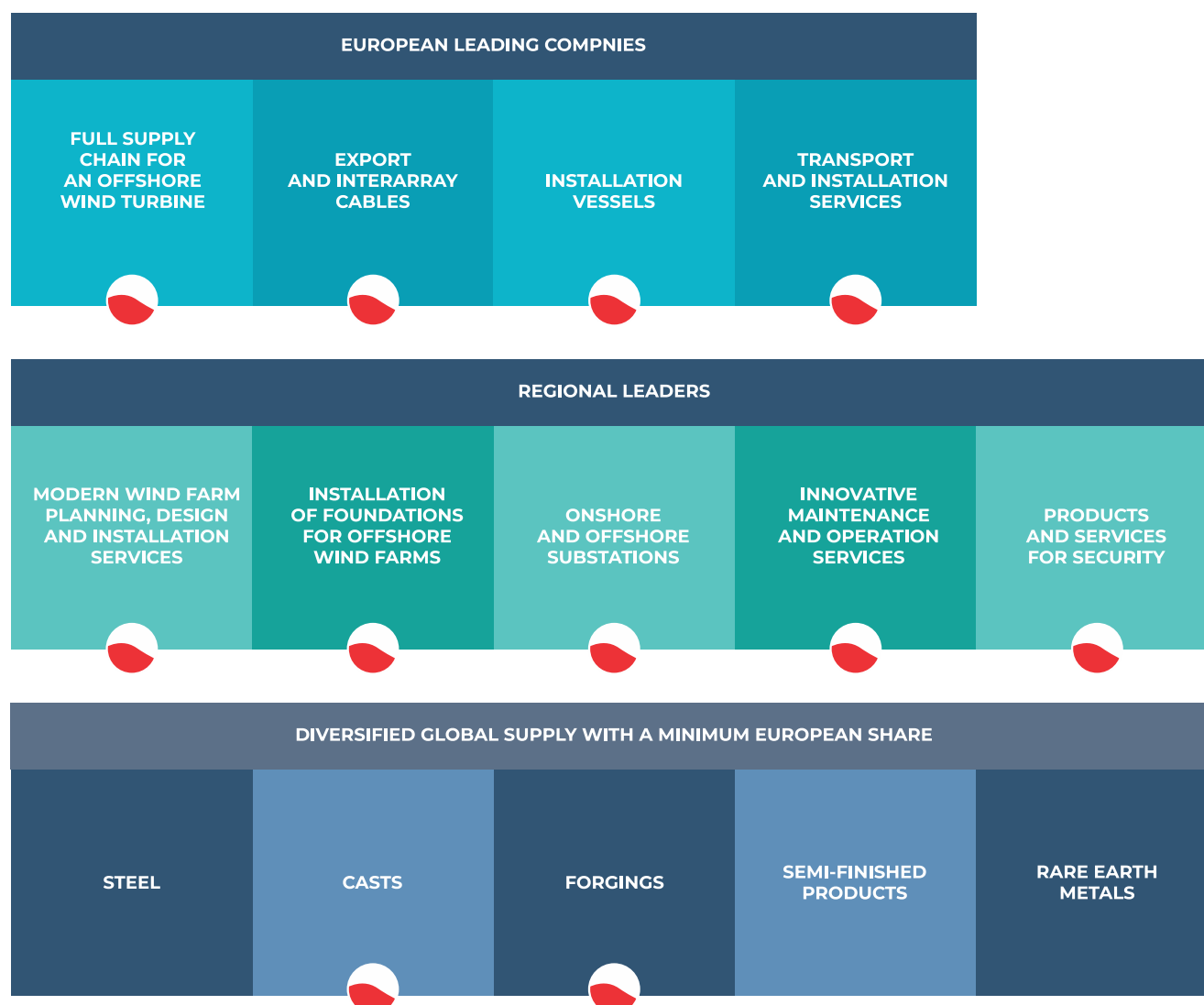
Innovative maintenance and operation services

This program focuses on developing modern maintenance and operation services for offshore wind farms, using the latest technologies such as artificial intelligence and automation. The program also aims to develop state-of-the-art tools and systems that enable remote or unmanned monitoring and maintenance of wind farms, minimising downtime, reducing maintenance costs, and ensuring their physical safety. Implementing innovative solutions in O&M (operation and maintenance) will increase the efficiency of farm operations, which will translate into long-term economic and environmental benefits for Poland, but will also make it possible to provide such services to foreign projects.

Security

The evolution of the perception of offshore wind farms as critical infrastructure, as well as their use in the development of dual-use technologies, makes it necessary to define the role of the domestic defence industry in developing offshore wind farms in Poland and around the world.

Figure 8. Strategic vision for key offshore wind supply chain industries in the EU.



Source: Own elaboration.

As the authors of the Strategy argue, that in order to increase the share of Polish industry in the European offshore wind energy market, it is necessary to introduce the concept of '*European content*' to the domestic market instead of the traditional '*local content*'. The idea is that Polish industry should not only provide services for local projects, but also play an important role in the European supply chain.

The idea of '*European content*' is also important from the point of view of the challenges facing the industry, which, on the one hand, faces a strategic need to consolidate its resources and skills in order to effectively meet the challenges of global competition and contribute to accelerating the green

energy transition. On the other hand, certain economic activities, particularly those related to the maritime industry and logistics, are likely to remain the domain of individual member states for many years to come.

The offshore wind supply chain in Europe, in the authors' opinion, can be divided into three levels, ranging from full European integration supporting market leaders, through regional and national players, to more diversified global supplies with a smaller European share. Each of these levels covers different areas of activity in which Europe can make its presence felt on the international stage, ensuring security of supply and strengthening energy independence.

6.4 FINANCING

Grant programs

Funding innovative projects that increase the efficiency of *offshore wind* technology increases the attractiveness of investments and their rates of return. Examples of programs include the NCBiR-NTE program,¹⁰ NFOŚiGW's "Innovations for the Environment", or TCTF's "Government Grant". The directional goal should be that by 2035, NFOŚiGW will launch a program like "Innovations for the Environment - offshore wind energy" every year with a budget of PLN 500 million per year, and government grants in the "TCTF" model will make available PLN 500 million per year of direct grants every year.

National Reconstruction Plan (KPO)

Increasing the efficiency of NPO spending. The funds from the National Reconstruction Plan should once again be reviewed, particularly concerning the loan facility for the construction of offshore wind farms. If there is a risk of underspending (assessed as real), the possibility of redirecting funds to the supply chain should be explored.

Income from EU ETS

EU ETS revenues should be directed toward investment in developing clean technology production capacity. Achieving this goal requires allocating a portion of its own ETS revenues to the production of these technologies, with a specific percentage of spending for the OWE supply chain.

¹⁰ <https://www.gov.pl/web/ncbr/ncbr-oglosilo-iii-konkurs-w-ramach-strategicznego-programu-badan-naukowych-i-prac-rozwojowych-nowe-technologie-w-zakresie-energii--nte> [Accessed 6/12/2024].

Investments in the supply chain

Poland should minimise risks and mobilize private investment in the supply chain. Public-private partnerships in this area should be promoted. For example, investors (including industry builders of farms) should be encouraged to invest in clean technology production by creating equity funds, managed by the Polish Development Fund/BGK. Public guarantees and counter-guarantees, implemented by, for example, the EBI, should support commercial banks in covering the risk of investments in clean technology production.

Export support program

Internationalization support program, export support. Programs that finance enterprises' participation in international trade fairs and support the establishment of foreign partnerships should be made available expeditiously and significantly increased. Coordinated cooperation with the State Investment and Trade Agency and foreign diplomatic missions is essential.

Dedicated Investment Fund

The Dedicated Investment Fund should ultimately be a key component in supporting infrastructure development and innovative solutions in the offshore wind sector. The fund should be designed to finance projects that aim to develop the modern infrastructure needed to manufacture, install and service offshore wind farms. Thanks to the fund, Polish companies can participate in large-scale projects, accelerating the country's energy transformation and strengthening their position in the European *offshore wind* market.

Targeted financing for industrial consortia

Encourage the formation of industrial consortia to implement projects, sharing risks and costs jointly. Targeted financing of industrial consortia is a key mechanism to support implementing large, complex projects such as offshore wind development. The formation of industrial consortia enables companies to work together, allowing them to share the risks and costs of projects more efficiently. These consortia can bring together various companies, from large firms (even investors) to SMEs, increasing their ability to implement more ambitious projects that might be difficult for individual companies to complete. Working based on joint financing and cooperation, industrial consortia are more likely to access public funding sources, such as EU funds or government programs. One example is the mechanism of the Sector R&D Programs of the Polish Development Fund (Polish Development Fund) and the National Centre for Research and Development (NCBiR), which supports cooperation between companies and research institutes within industrial consortia, offering funding for research, development, and innovation.

Port Infrastructure Development Program

A long-term program to finance port development and modernization will be necessary to encourage investors to build factories. Adequate preparation of land, access roads, fortifications, and fairways determines a location's competitiveness, as exemplified by the preparation of investments on Grabowski Island.

Guarantee support program

Establish a guarantee fund to support companies producing components for *offshore wind*, securing performance and quality guarantees. The EBI's new initiative¹¹ (worth €5 billion) supporting the production of components for wind power in the EU should be urgently implemented in the country to take advantage of it, yet for Phase I of the Polish *offshore*. The goal should be to launch a preferential guarantee program to enable continuous financing of contract performance up to €2 billion.

Working capital financing

Creating preferential lines of credit for enterprises to secure working capital to produce *offshore elevator* components in close cooperation between the industry and banks such as BGK.

Long-term contracts with a government guarantee

The introduction of long-term contracts for the supply of selected components or services, in which the financial risk will be secured by the state, and for which it is necessary to secure demand for long-term financing of operations. An example is long-term charter contracts for installation vessels, which can enable financing of the purchase (construction).

Cooperation with the EU

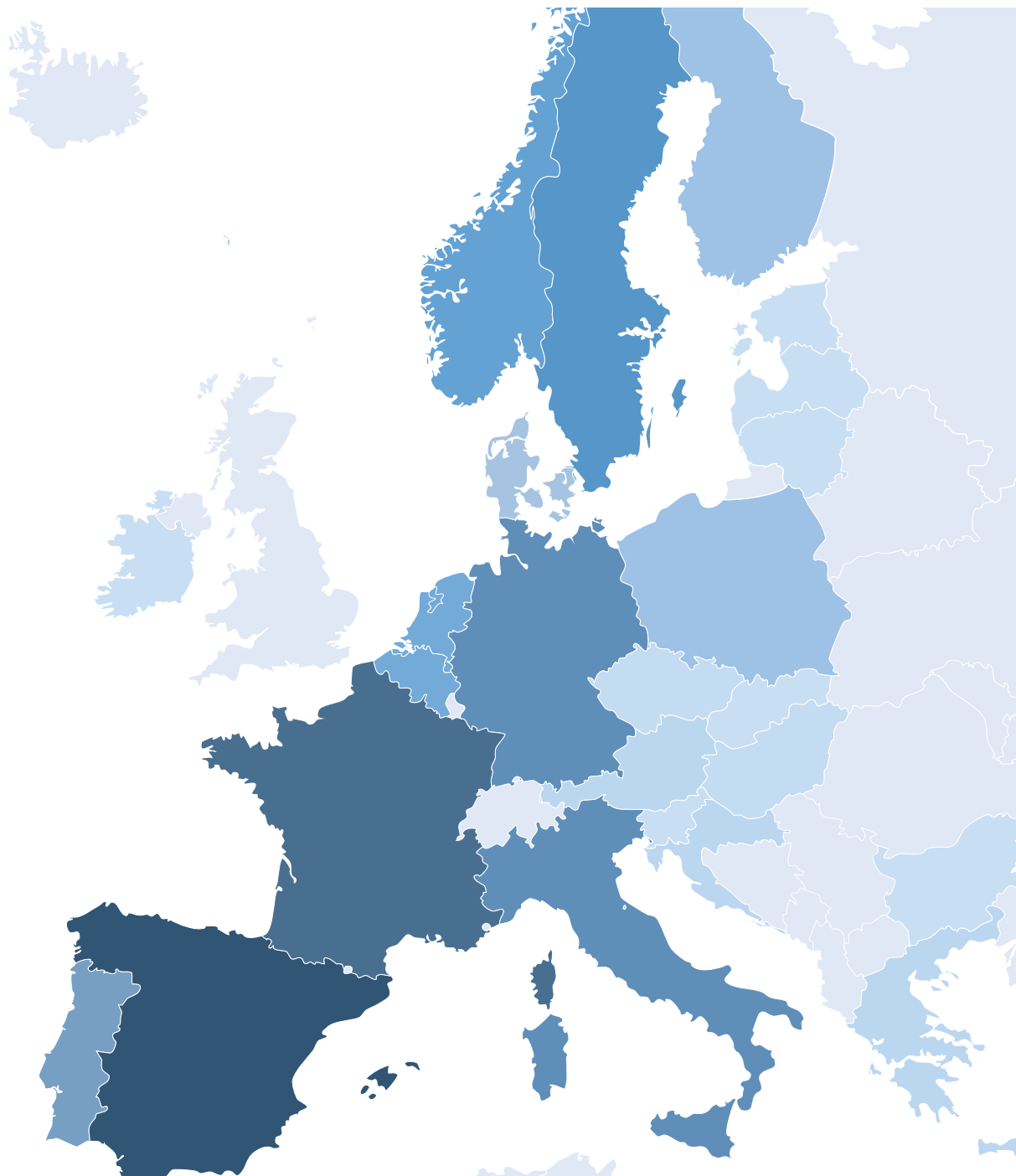
Strategic for Poland is cooperation with the EU, in particular improving the availability of the Innovation Fund and creating a Sovereignty Fund: Cooperation with the EU on the creation of new support instruments for offshore wind and optimization of the use of funds by Poland is essential. The European Commission awarded funding in October 2024 to 6 wind energy projects in the latest call for the EU Innovation Fund. All awarded projects will invest in new wind energy capacity, and four will be for offshore wind.¹² One of them is to be implemented in Poland. So far, however, the Innovation Fund's winning projects are primarily from outside CEE countries.

¹¹ <https://www.eib.org/en/press/all/2023-341-poland-investeu-eib-supports-one-of-the-world-s-largest-wind-farms-with-eur610-million-in-financing?lang=pl> [Accessed 6/12/2024].

¹² <https://windeurope.org/newsroom/news/eu-innovation-fund-awards-big-grants-to-6-innovative-wind-turbine-factories/> [Accessed 6/12/2024].



Figure 9. Intensity of use of support from the Innovation Fund until 2025 (darker color - high, lighter color - low).



Source: https://dashboard.tech.ec.europa.eu/qs_digit_dashboard_mt/public/sense/app/6e4815c8-1f4c-4664-b9ca-8454f77d758d/sheet/bac47ac8-b5c7-4cd1-87ad-9f8d6d238eae/state/analysis, as of March 23, 2025.

Table 5. Summary of investment needs based on analyses of individual Priority Implementation Programmes.

PRIORITY IMPLEMENTATION PROGRAMMES	ESTIMATED INVESTMENTS
Modern services for the planning, design and monitoring of wind farms	PLN 250 – 500 MIL
Full supply chain for offshore wind turbines *blades, transformers, nacelle assembly, castings, nacelle covers, control systems – investments beyond those currently being implemented	PLN 2 – 3 BN
Assembly of foundations for offshore wind farms	PLN 2 BN
Cables	PLN 1 – 2 MIL
National offshore transformer station project	PLN 0.5 – 1 BN
New European offshore wind farm installation company based in Poland *jack-up and/or heavylift x2, cable ship	PLN 5 BN
Innovative maintenance and operation services	PLN 500 MIL
Safety	PLN 1 - 2 BN
TOTAL [investments]	PLN 12 – 16 BN

Source: Own elaboration.

6.5 EDUCATION AND WORK

The issue of labour shortage is crucial for the development of the supply chain, a systemic approach is needed. The Ministry indicated in the Strategy's implementation document (suggested Ministry of Education) can adopt and implement the Wind Energy Competency Development Program, which, with funds from the state budget, NIP and European Funds, will coordinate the development of education, qualifications, internships, apprenticeships and the construction or expansion of training centres.

There is a need to map skills gaps and implement training programs. Key will be ensuring recognition of qualifications for wind technology and facilitating access to the labour market for skilled workers, such as technicians from other countries. The introduction of dedicated work permits could facilitate hiring professionals in key areas.

Creation of dedicated majors at undergraduate, graduate and postgraduate levels. New majors specialising in *offshore wind* will be created with degree programs emphasising marine engineering, turbine design, project management, and energy technology. Flexible, modular curricula that can be easily updated to keep up with technology developments in the *offshore wind* industry and are in line with EU qualification systems will be important. Programs could include both theoretical and practical classes, using the latest simulators.

Retraining for specialists in related industries. Introduce intensive specialised courses for willing experienced workers in other industries. Establishing intensive retraining programs for engineers, technicians, and specialists from other industries (e.g., civil power, marine engineering) to gain the necessary competencies to work in the *offshore wind* sector, as well as professional certifications, can support labour market transformation.

Educational support at primary and secondary school levels. Integration of *offshore wind* topics in schools, using the example of projects in the Pomeranian and West Pomeranian provinces, has yielded excellent results in terms of student interest. The target is to introduce Renewable energy sources, including offshore wind, into school curricula through modules in physics or geography. In the short term, introducing a "pedagogical innovation" standard for implementation for willing schools will allow rapid introduction of the subject matter in specific institutions.

Continuing education and e-learning technologies. E-learning platforms, the creation of online platforms with courses on offshore wind energy available to a wide audience, from students to experienced engineers, will allow for flexible education that can be integrated with professional work.

International cooperation and knowledge exchange. International exchange programs, enabling experience abroad, in countries that are leaders in *offshore wind* (e.g. Denmark, Germany,

UK), are possible through the Erasmus+ program. The Personnel Building Support Program can ensure that some Erasmus+ projects target the OWE industry.

Promoting careers in offshore wind. Educational campaigns that promote the *offshore wind* sector as a booming job market, targeting young people and those entering the job market, build a base of interested and informed young school graduates. Open days and industry workshops, educational fairs (such as Edu Offshore Wind), organisation of meetings and debates (as in PWEA's educational programs), open days at energy companies and thematic workshops at schools inspire young people to choose a career in the renewable energy sector.

Government support and education funding. Introducing subsidised scholarships paid by employers for so-called patronage classes will support the industry's long-term credibility. Tax credits and other financial support for companies that invest in training and developing their employees in *offshore wind* technology are essential.

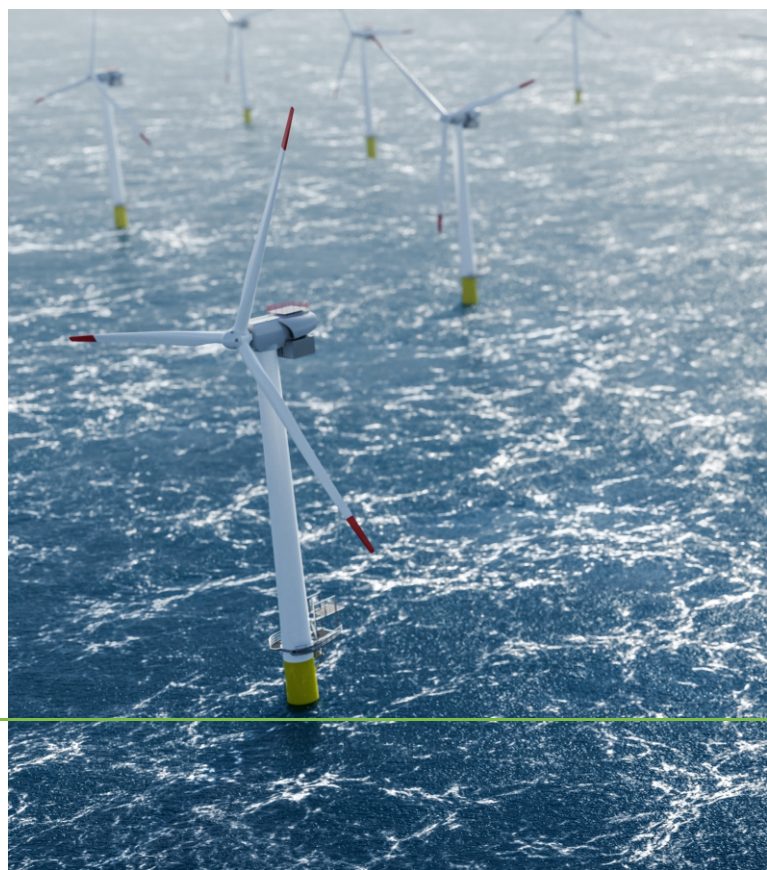


Figure 10. Projected labor market growth by 2030 in wind energy (onshore and offshore) in Europe.

WHAT WE EXPECT IN 2030			
420 GW of wind Energy capacity	514 000 Total jobs in wind energy	360 000 Direct jobs	38 000 Jobs in planning
141 000 Jobs in manufacturing	72 000 Jobs in installation	7 000 Jobs in decommissioning	61 000 Jobs in operation and maintenance

Source: Wind Europe.

6.6 INNOVATIONS

R&D Council under the Ministry of Development and Technology. Establish a coordinating council: The Ministry of Development and Technology could function as a coordinator that supports the development of an R&D agenda for *offshore wind*, in cooperation with state (NCBiR, PARP, Polish Development Fund) and European institutions. Establish permanent relations with European Commission and ETIPWind representatives to access EU funds for R&D in the *offshore wind* sector.

Creating a Strategic Innovation Agenda that defines the priorities of issues and is an input to European programs and the ETIP initiative will make it possible to systematise topics. Creating a map of specialisations for Polish companies within the European ETIPWind platform, which will allow effective participation in EU research projects worth several billion euros. Increase participation in international R&D projects by actively involving Polish institutions and companies in EU consortia, creating a sectoral platform for cooperation with European institutions, promoting participation in EU-funded projects.

Using artificial intelligence to optimise the supply chain. The advantage of competitors in advanced technologies such as AI can inspire Poland to invest in technologies that support *offshore wind* development, such as artificial intelligence for designing, managing wind farms, servicing turbines or monitoring efficiency.

Targeted funds for research and development. NCBiR grant programs: support research and development of offshore wind technologies through dedicated funding programs that promote innovation in productivity, cybersecurity, reduced carbon footprint, optimised operation and maintenance, and AI. The short-term goal should



be for NCBiR to launch a "New Technologies in Offshore Wind" program of at least PLN 100 million each year for the R&D phase (within PLN 500 million, which includes the investment phase), continuing the programs currently announced, and for the Polish Development Fund to launch a dedicated funding program for start-ups dedicated to offshore wind solutions, using the support instruments currently in place.

Innovative farm development and construction phase framework. Create an innovative, percentage-defined supply chain framework that equitably divides risk among companies for innovative design, implementation, and optimisation services, allowing for the development of riskier technologies, while exploring opportunities to leverage innovation during the construction phase.

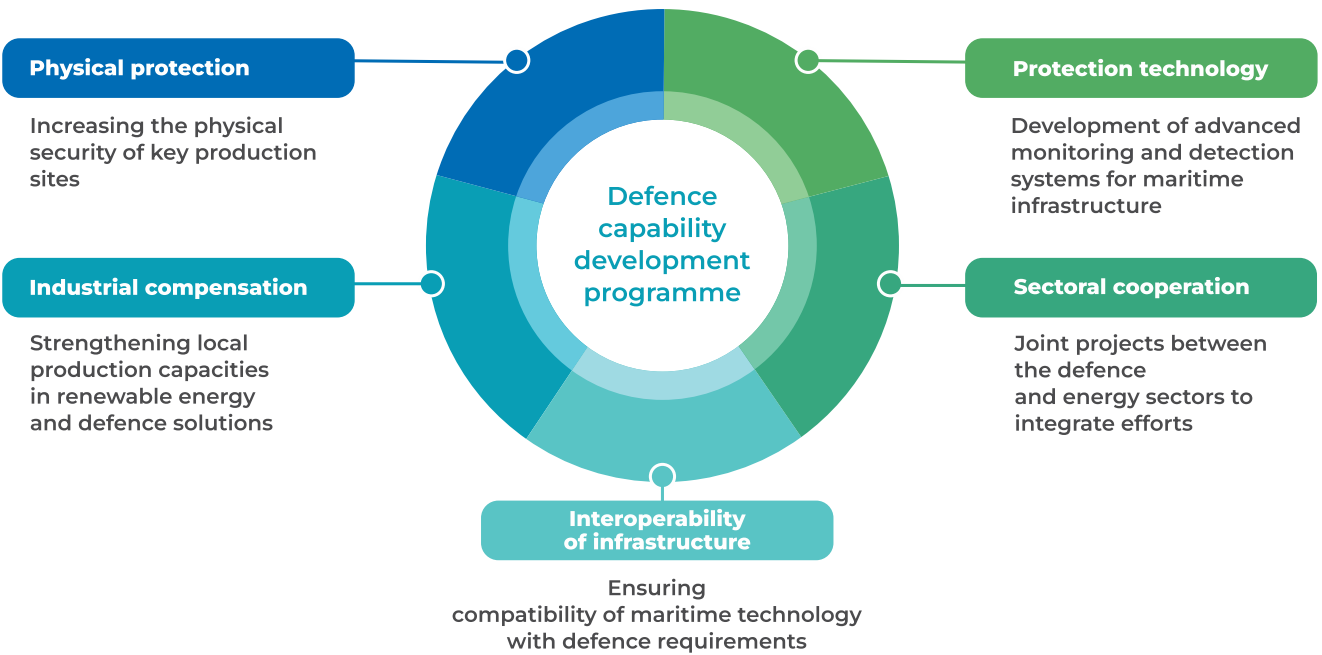
6.7 SECURITY

Security issues will be addressed in Priority Implementation Programs, investment funding programs, innovation, and education.

Cybersecurity and control systems. Offshore wind farms rely heavily on sophisticated digital systems to monitor, control, and optimise energy production and transmission. Integrated IT and SCADA systems play a key role in farm management but make them a potential target for cyber attacks. It is essential to develop local IT systems and implement cybersecurity procedures that protect farms from malware and external in-

trusions. Continued cooperation with cybersecurity institutions and regular testing and updating of digital system security will also be an important part of the Strategy. The Ministry of Defence or another ministry identified in the Strategy's implementation document may issue a package of guidelines on Cybersecurity of offshore wind farms and physical security of key production nodes in Poland.

Figure 11. Innovative approach to defence and offshore energy.



Source: Own elaboration.

Production quality and safety standards. High-quality manufacturing of offshore wind farm components is the foundation for the safety and reliability of the entire infrastructure. All components, from turbines to transformer stations, must comply with international quality and safety standards, ensuring the long-term stability and reliability of energy systems. In implementing the Strategy for *offshore wind*, it is crucial to certify local manufacturers according to the highest quality and safety standards, but on a favourable basis to domestic companies. This will increase the level of trust in domestic suppliers, as well as create export potential for Polish companies in foreign markets.

Ensure the level of participation of domestic companies in key servicing and maintenance services. The reliability of wind farms depends mainly on an efficient maintenance and operation system. Local control of component availability allows for the development of a service network in the region, which significantly reduces response times to failures and enables maintenance to be performed quickly. With local service ports and on-site component availability, the risk of downtime in energy production will be minimised.

Innovative approach to physical security. In addition to Cybersecurity, the physical security of offshore wind farm infrastructure, as well as key production locations in and out of ports, remains an important consideration. Implementing integrated surveillance, monitoring, and physical security systems is essential to ensure protection against unauthorised access and threats of terrorism or sabotage.

Develop, in cooperation with industry agencies in the EU, plans to ensure the resilience of key supply chains. In the face of growing geopolitical risks and instability in global commodity markets, it is necessary to put in place mechanisms to monitor and verify supply chains. Such control makes it possible to identify potential risks associated with dependence on non-EU suppliers, thereby ensuring greater technological autonomy and minimis-

ing the risk of supply disruptions of components critical to the construction and operation of offshore wind farms.

Controlling Supply Chain Plans from a Security Perspective. From a security perspective, it is also crucial to ensure - through the existing supply chain plan mechanism - transparency of production and transportation monitoring processes, which will allow rapid response to possible risks and more effective risk management in the long term. Introducing surveillance systems to monitor suppliers' compliance with European and national quality and security standards is an essential step in building a resilient and secure supply chain.

Safety aspects are a high priority within the DEVEX phase. Security aspects play a fundamental role in the DEVEX phase, which includes project preparation, planning and obtaining all approvals. Potential security risks related to infrastructure, supply chains, Cybersecurity, and environmental security should already be considered at this stage. Secure implementation of the DEVEX phase requires a thorough assessment of geopolitical risks, component supply stability and compliance with regulatory requirements. It is also critical to develop strategies to safeguard against cyber threats that are already in this phase.



6.8 INSTITUTIONS

Executive Council for implementing the Strategy for Offshore Wind Farm Industry Development. The main body responsible for the implementation of the Strategy should be the Executive Council, which would include representatives of the Council of Ministers (responsible for individual government departments) at the level of secretaries or undersecretaries of state, representatives of key central offices, local government, industry organisations, including industry, and chairmen of the Priority Implementation Program Teams. The Council should operate under the leadership of the Plenipotentiary.

Teams of Priority Implementation Programs. For effective implementation of individual Priority Programs defined in this proposal of the Strategy for Offshore Wind Farm Industry Development, it is recommended to establish Teams composed of representatives of entities involved in the implementation of individual Programs, representatives of the relevant local government, representatives of government administration (from the departments: state assets, public finance, economy, maritime economy, regional development in the rank of directors of relevant departments), others necessary for the implementation of a given Priority Program.

Certification body in Poland. Poland, with the potential and relevance of offshore wind farm development, can develop its certification capabilities that will ultimately be recognised and accepted by key financing institutions.

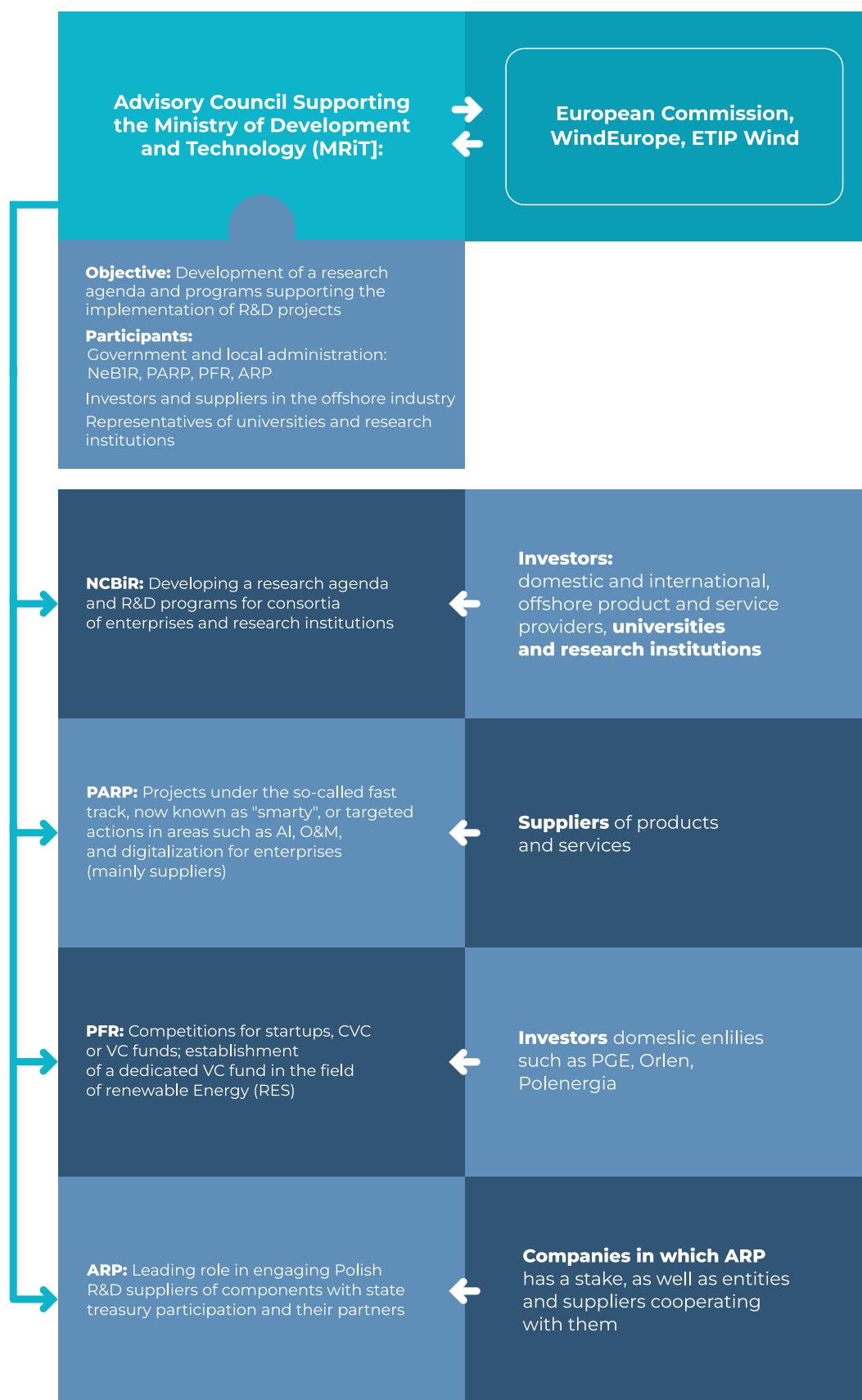
R&D Centre. A network of R&D centres dedicated to specific Priority Implementation Programs should be complemented by a single central research centre that could concentrate key exceptionally large investments in demonstration lines or cross-cutting research programs.

Education Network. The horizontal nature of the Wind Energy Competency Development Program will result in the involvement of various entities, operating independently but cooperating, who share responsibility for the results achieved. The Wind Power Competency Development Centre, operating in the office serving the minister responsible for education, should be responsible for coordinating implementation.

Clusters. The role of local clusters focused on supporting local companies, especially SMEs, will be critical to the success of the Strategy, particularly in combining the potential of Tier 1 companies, with a growing subcontractor base. Education and innovation challenges are often identified primarily at the regional cluster level.

Soft power mechanism. This mechanism plays a key role in the effective implementation of strategy in areas where legislative or regulatory action may be limited. It is a form of diplomacy and communication based on relationship building, shaping public opinion and utilising networks to support the achievement of strategic objectives.



Figure 12. Proposed ecosystem to support supply chain innovation for offshore wind in Poland.

Source: Own elaboration.

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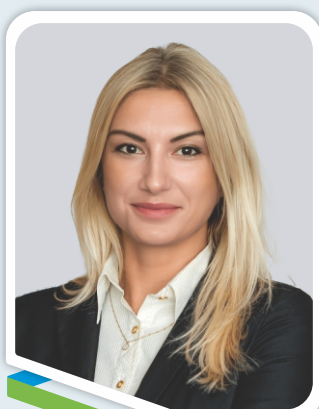
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Manager of offshore wind energy, investment, and development at PWEA. He mainly deals with regulatory issues related to offshore wind energy. Previously an employee of Enea Operator. Associated with the energy industry for 15 years. PhD in social sciences, in the discipline of economics, author of scientific publications in the field of energy, including primarily renewable energy sources with emphasis on offshore wind energy. Member of the Scientific Council for Offshore Wind Energy at the Maritime University of Technology in Szczecin.



PIOTR CZOPEK

I graduated with a degree in European political science from Akademia Świętokrzyska in Kielce and a postgraduate degree from the University of Warsaw and Collegium Civitas in Globalisation and Energy Security. Since 2008, an employee of the Ministry of Economy, then of the Ministry of Energy, where in the Department of Energy and then in the Department of Renewable and Distributed Energy he dealt with issues related to the development of RES and distributed, prosumer energy. Since 2019, as Director of the Department of Renewable Energy (Renewable Energy Sources Department) at the Ministry of Energy, and later at the Ministry of State Assets and the Ministry of Climate and Environment, he implemented the concept of energy clusters and created regulations to support the development of distributed energy. In addition, he oversaw the development of Renewable energy sources and the creation of legal conditions for their further operation, including offshore wind energy. Since January 2021, as Director of Regulatory Affairs and currently as Vice President of the Polish Wind Energy Association, he has been involved in promoting wind energy development in Poland, including implementing Polish offshore wind farm projects. Since 2022, he has been working with the RE-Source Poland Hub Foundation promoting the use of cPPA contracts in the context of RES project development and the use of green energy in enterprises. Since 2023, he has also served as Vice President of the Wind Industry Hub Foundation.



ARKADIUSZ SEKŚCIŃSKI, PHD.

PWEA vice president and vice president of the Wind Industry Hub Foundation. He has been involved in the wind energy industry since 2010.

Former board member of energy companies (PGE Baltica, PGE Energia Odnawialna, Polskie Górnictwo Naftowe i Gazownictwo). Responsible for RES project development (onshore and offshore wind farms and), production asset management and research and development projects (including power-to-gas, green hydrogen production).

Studied at the University of Warsaw (MA and PhD), Lazarski University (MBA), University of Bergen (PhD studies), University of Athens (Erasmus program).



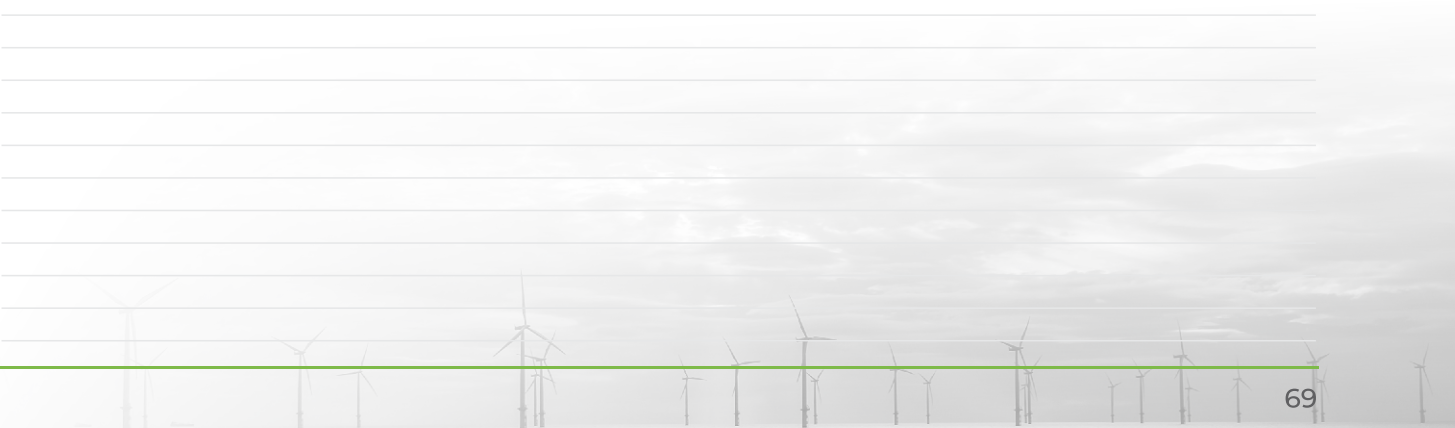
MICHAŁ MICHAŁSKI, PHD.

PhD. in economics. From 2019 to 2024, President of the Management Board of Polska Grupa Energetyczna S.A., Poland's largest private integrated energy group. Previously as a board member and development director at Polenergia. Responsible, among other things, for developing offshore wind power projects with a total projected capacity of 3,000 MW, and later for negotiating and establishing a Joint Venture with Norway's Equinor based on these projects. Acting as one of the representatives of the energy sector, he participated in the regulatory dialogue with the Polish administration that ended with the development and adoption of a regulatory package for offshore wind energy.

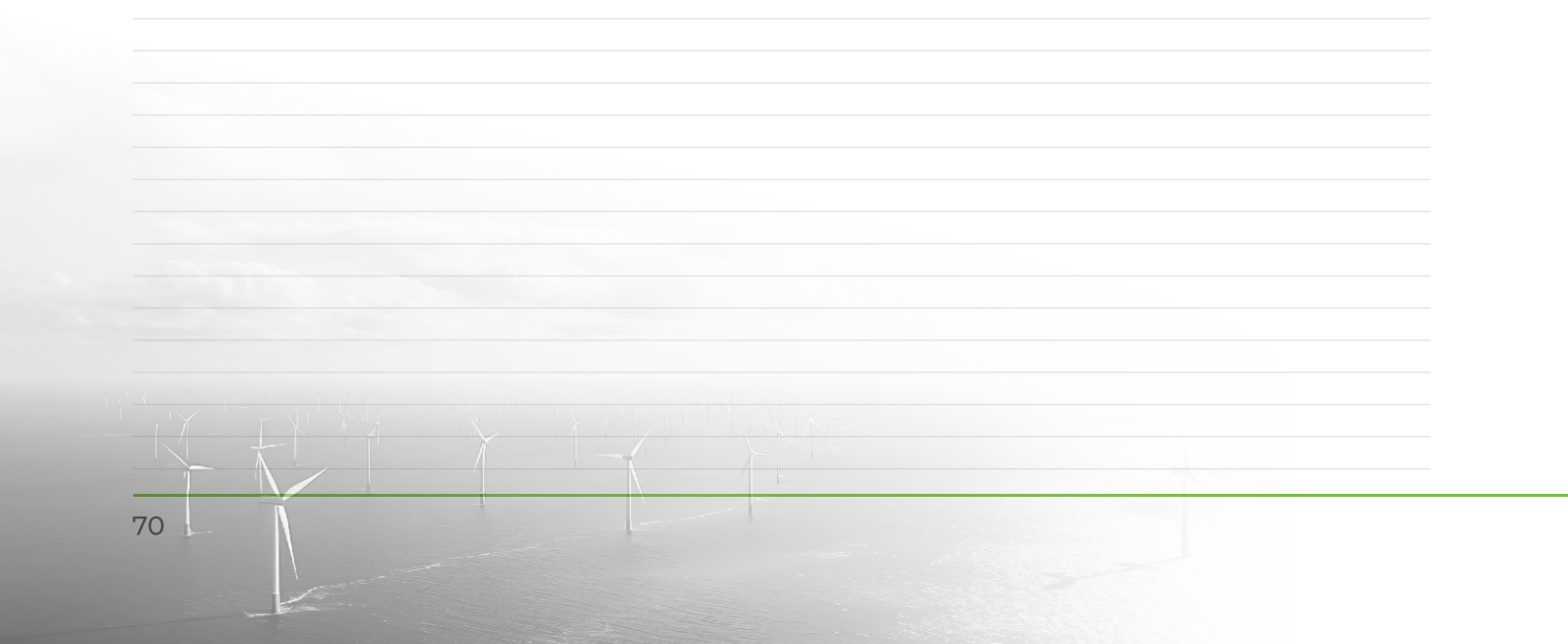
Before his time at Polenergia, he was involved in various management positions within the Kulczyk Investments group in such industries as oil & gas, automotive and telecommunications.

Notes

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