

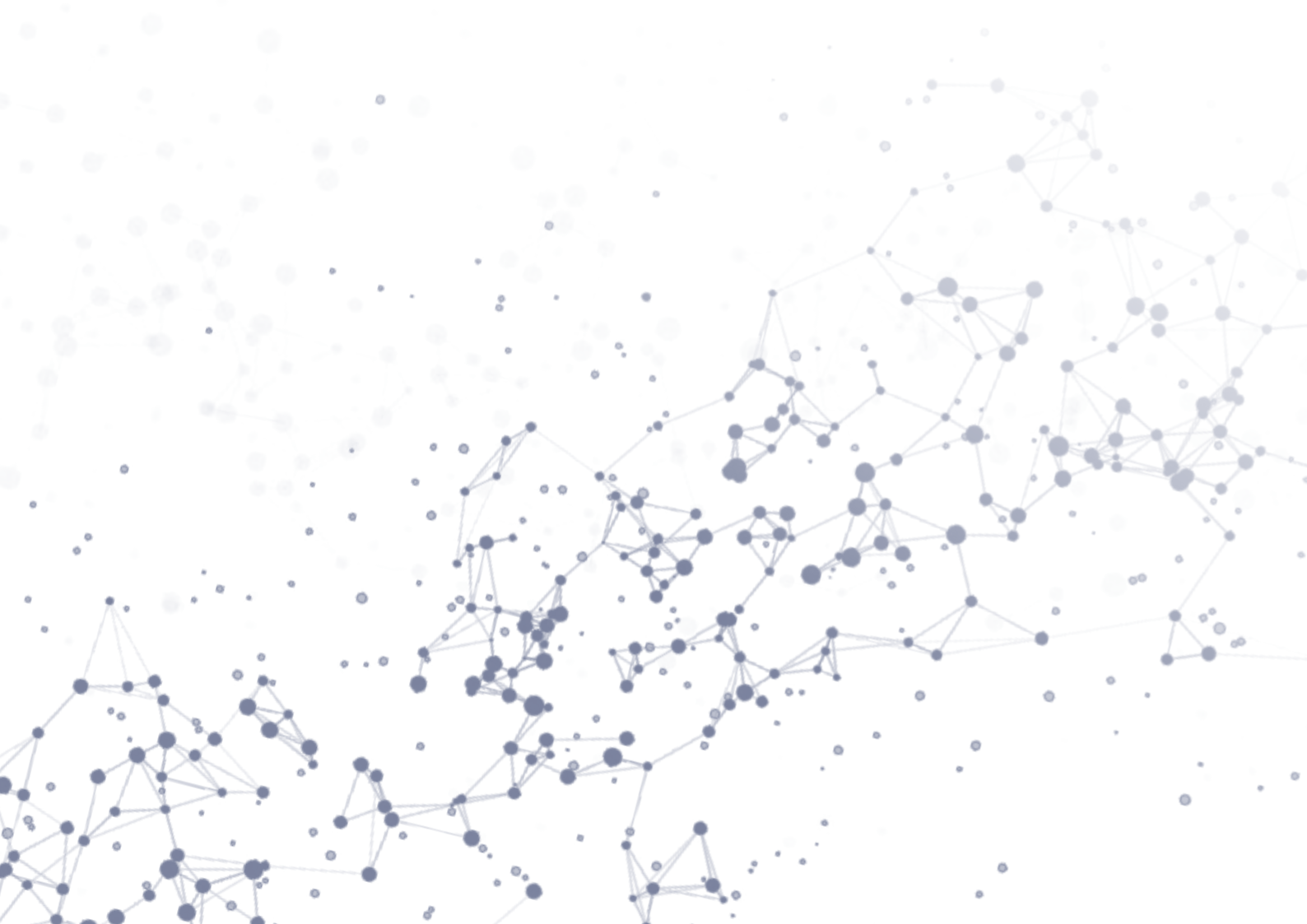
DEVELOPMENT OF ONSHORE AND OFFSHORE WIND INDUSTRY IN POLAND

Building Wind Energy Supply Chain: Action Plan



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Ten Steps for the Polish Wind Industry

Energy security of the European Union and all Member States depends on a rapid transition of the energy sector based on renewable energy sources. The departure from imported fossil fuels towards inexhaustible resources of the wind and Sun will limit economic perturbations caused by drastic price volatility of energy carriers. Moreover, by eliminating financial transfers related to the purchase of such carriers it will improve European Union's balance of payments.

The Russian attack on Ukraine emphasized the need to accelerate EU energy policy. Even the Member States that to date have been skeptical about energy transition understood that only renewable energy sources can provide access to clean and inexpensive energy. The European Union is also drawing conclusions from economic disturbance caused by the COVID-19 pandemic, seeing that energy security is strongly correlated with a strong industrial base in one's territory, capable of delivering the required volume of products and components necessary to complete all energy projects.

The *"Development of Onshore and Offshore Wind Industry in Poland. Building Wind Energy Supply Chain: Action Plan"* report summarises the importance of the European wind energy industry and demonstrates why its dynamic growth is a crucial need. Additionally, the document presents the current importance and development directions of industries related to the wind energy sector (both onshore and offshore), enabling it to become an important element of the Polish economy.

Polish industry, with experienced and renowned national enterprises, will be the base for new competences in the wind energy sector.

This will cause just transition change from a well-known slogan to hands-on measures to the benefit of tens of thousand employees and their families.

However, exploiting the undoubted opportunity faced by the Polish industry needs decisive measures that require a consensus of many different circles as well as involvement of the administration, Polish enterprises, and industry associations. Therefore, Polish Wind Energy Association established Wind Industry Hub foundation, whose primary goal is to ensure appropriate industrial base in Poland and consolidate the role of Polish enterprises in the European wind energy supply chain.



Polish Wind Industry Action Plan

The document prepared by Wind Industry Hub constitutes a starting point for a proper definition of the necessary measures that need to be taken to exploit the economic opportunity for transition of the Polish energy sector. Unleashing the potential of the Polish wind energy industry requires the following measures:

- 1 Update to the “Energy Policy of Poland” to ensure ambitious targets for the production of electricity from RES, in particular onshore and offshore wind, until 2050.
- 2 Supplementation of the “Industrial Policy of Poland” with provisions concerning the construction of a strong wind industry as an opportunity for the Polish economy and its innovativeness.
- 3 Update to the “Spatial Development Plan for Polish Maritime Areas” to specify new areas where subsequent offshore wind farm projects could be built.
- 4 Simplification of administrative procedures governing the development of onshore and offshore wind farms to accelerate project delivery and establishment of energy independence of Poland.
- 5 Support for the development of the Polish wind industry using existing and new financial mechanisms, including financing from EU funds.
- 6 Training of personnel required by the growing wind industry by providing tailored educational and reskilling programmes.
- 7 Establishment of schemes promoting the involvement of local producers within the framework of EU-level regulations.
- 8 Implementation of the Net Zero Industry Act to national legislation.
- 9 Implementation of the European Wind Charter to consolidate the wind energy industry and support local supply chains by defining quality criteria in tenders for electricity from wind farms.
- 10 Establishment of the necessary administrative base and coordination of works between Ministry of State Assets, Ministry of Maritime Economy and Inland Navigation, Ministry of Climate and the Environment, Ministry of Industry, and Ministry of Development and Technology.

Implementation of the 10 measures will bring us closer to the achievement of the ultimate goal, that is building a strong Polish industry that will become one of the pillars of the national economy.

However, one cannot forget that this is a long-term process that will require ongoing adjustment to changing environment as well as coordination between all stakeholders.

1. Introduction

Renewable energy sources are the foundation of the European Union's energy transition and one of the pillars of its climate policy. Green transition is an irreversible path taken by economies of many countries around the globe, which is demonstrated by the commitment to triple production of energy from renewable sources by 2030, signed by 118 countries during the UN-COP28 in Dubai.

Since renewable energy sources became a desired and necessary element of the energy mix, politicians, local authorities, and energy sector stakeholders combine forces to accelerate green transition.

The new geopolitical connected with the Russian aggression on Ukraine caused energy security to be associated in Europe not only with securing sufficient volume of energy and its carriers, but also with maximum possible limitation of external supply of fuels and diversification of its supply.

In the long term, the new approach to energy security should cause full transition to locally and commonly available resources, such as wind or sun, allowing customers to be delivered the least expensive energy.

Energy security also means the capability of the national and European industry to provide sufficient capacity to complete RES investments projects (including wind energy) within the assumed time frame.

Energy transition in Poland is accelerating. Following the last parliamentary elections, it may accelerate even further.

The government appointed on 13 December 2023 declares the need to intensify energy transition efforts to enable renewable energy sources to quickly become the pillar of the Polish energy sector, securing clean and inexpensive energy for the Polish citizens.

Wind energy is one of the key driving forces of energy transition and decarbonisation. Its increasing share in the energy mix substantially increases energy security and boosts social and economic growth at the local and national level.

The power system based on distributed, zero-emission sources independent from foreign fuels is much more resilient to many threats, in particular of geopolitical nature. Furthermore, onshore and offshore wind provides a modern, efficient, and long-term development impulse for the entire economy. The impact of **multiplier effect caused by the development of a local RES industry, participation of Polish enterprises in global supply chains in the sector, and professional development opportunities for thousands of employees** related to state-of-the-art technology on the economy and the community cannot be underestimated. Beneficial effects of the sector's growth will affect future generations for the decades to come.



In the recent years supply chain for the wind energy sector has been disturbed by the COVID-19 pandemic and Russian aggression on Ukraine.

It is undoubted that coronavirus disturbed traditional business and commercial relationships, and we will feel the effects longer than in case of other economic crises. The pandemic exposed weak spots in supply chain management, which never before experienced such a disturbance and were not prepared for it.

The spread of the pandemic brought import of materials and many key components to Europe (and not only) to a halt.

After almost two years of continuing struggle within the supply chains, the situation became even more complex in February 2022, when Russia invaded Ukraine, ruining the established, relative energy security of Europe.

These crises caused great disturbance to the global supply chain, including in Europe, and the consequences of such disturbance also affected the Polish market. Increase in product and service prices, extended component delivery times, failure to meet contractual commitments, and loss of project financing are just some of the problems faced today by investors.

Therefore **it is very important to build a local, strong, and resilient industry to ensure continuity and better economic efficiency of future RES projects.** Polish industry has great potential to become an important player in the global onshore and offshore wind supply chain.

However, without a solid, strategic industrial policy focusing on RES, in particular offshore wind sector, there is a risk of failure to exploit the opportunity faced today by the Polish industry. The clock is ticking, and immediate action is crucial.

Engagement in the matters of the wind energy industry is crucial to support the growth of a strong industry and service base. To this end, Polish Wind Energy Association established Wind Industry Hub foundation, acting to improve energy and economic security by ensuring appropriate industry base in Poland and strengthening the role of Polish enterprises in the European supply chain.

The initiative is a response to current challenges related to the need to develop local wind energy supply chain and the want to satisfy ambitious EU targets for a strong and stable market and a conscious industrial policy that will establish priorities for technology and project development, specialisation of manufacturing plants, profiling of industry education or granting of financing.



2. EU policy securing long-term development of the RES industry

Modern energy sector is based on production of energy from low- or zero-emission sources. The shift towards “green” technologies is a great step towards climate neutrality, whose achievements is promoted by politicians and community organisations. Global changes to protect the environment and public health are accelerating, and Poland has ambitions to follow. EU Directives, updated on a regular basis, establish ambitious requirements for climate and energy production, expecting member states to adapt national policies to the EU model.

For several years global, European, and Polish strategic documents have clearly been indicating the desired direction: renewable energy sources are and will be a priority on the path to net zero emissions and need to be developed as fast as practicable.

The European Union, willing to become the leader on the path to climate neutrality,

designating the direction of further reforms proposed a number of legislative initiatives and packages aimed at accelerating energy transition. The proposed measures included establishment of the European Green Deal and introduction of the “Fit for 55” package.

The new regulations proposed to extend the mandatory EU Emissions Trading Scheme (ETC), introduce Carbon Border Adjustment Mechanism (CBAM), improve energy efficiency, or amend the Renewable Energy Sources Directive (RED III). The latter assumes increasing the share of energy from RES in Member States’ energy mix from 32% to 42.5% (with an option for further increase to 45%) by 2030. To achieve that, EU prepared a projection of the future energy mix until 2050 (Figure 1).

It assumes a thorough change in the fuels used in European countries within the next 30 years and a substantial increase in electricity production.

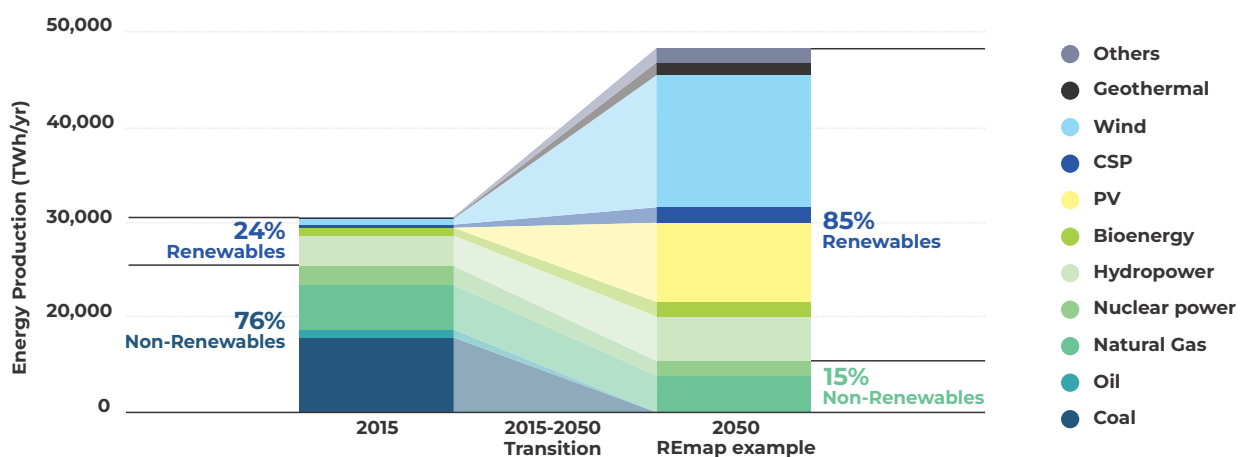


Figure 1. Production of electricity by source in the 2015–2050 period.

2.1 Net Zero Industry Act

Net Zero Industry Act — EU is supporting clean technologies and sustainable jobs

In March 2023 the European Commission proposed, as part of the Green Deal, a Regulation establishing a framework of measures for strengthening Europe's net-zero technology products manufacturing ecosystem (Net Zero Industry Act). Its assumption is to increase green technology production capacity in the EU and ensure EU Member States are ready for transition to clean energy.

The Regulation is to simplify regulatory framework and improve investment environment in EU production capacity and technology development, crucial for the achievement of EU net-zero targets and ensuring resilience of our decarbonised power system.



“We need a regulatory framework that will enable us to quickly step up the pace of transition to clean energy. Net-Zero Industry Act is the measure. It will create the best conditions for the sectors that are crucial for us to achieve climate neutrality by 2040: wind turbine, heat pump, solar panel, renewable hydrogen or CO₂ storage technologies.

The demand for the technologies is increasing in Europe and worldwide, therefore we act now to ensure that we will be able to satisfy the majority of the demand through European supplies” — Ursula von der Leyen, President of the European Commission.



Wind energy is crucial for energy security and Europe's climate goals. EU wants wind energy to satisfy 43% of electricity consumption in Europe in 2030, compared to today's 17%. This means the construction of 35 GW of new wind farms every year.



“Europe needs green industrial policy. EU needs to have in its territory an industry that will secure investment needs related to energy transition. The mechanisms laid down in the Net Zero Industry Act need to be strengthened to achieve the targets assumed by the European Commission. Public money must be used to support the development of supply chains for green technologies, similarly to what we see in other parts of the world. Otherwise, the Green Deal will be accomplished through import of technologies from outside the EU, changing our dependence on Russian oil and gas to dependence on Chinese wind turbines and PV plants. Our existing supply chains ensure jobs, economic growth, and investments for thousands of citizens. Net Zero Industry Act is our opportunity. We cannot waste it”
— said Giles Dickson, CEO of WindEurope.

The necessary rapid expansion of wind energy European supply chains requires a coherent policy and public financial support. EU seems to comprehend that, and therefore developed the Green Deal.

Almost all wind farms built in Europe to date use turbines manufactured in Europe. There are more than 250 facilities manufacturing turbines and components all over the continent. However, European wind energy supply chain already developed bottlenecks. Production capacity of foundation manufacturers or installation vessel shipyards is already booked for several years ahead. The wind energy industry must buy power cables, gearboxes, and even steel towers from China. Out of almost 800 plants worldwide manufacturing wind turbine components 45% is located in China, 31% in Europe, 7% in India, 5% in Brazil and 4.5% in the US, Canada and Mexico. Components are manufactured in almost 40 countries, but complete machines (i.e. nacelles, blades, towers, generators, gearboxes, and bearings) only in few, namely China, Germany, India, Spain, and the US. Several new factories are already under construction, but this is not enough to ensure the scale of wind energy expansion so needed by Europe. We need great investments in production facilities, ports, networks, ships, cranes, and qualified personnel now.

The European Parliament is working on the final version of the Net Zero Industry Act, whose implementation is to enable the achievement of the assumed objectives. One of crucial issues is the possibility to introduce non-price

criteria for RES auctions. It will promote social, economic, and environmental value offered by European clean energy industry. Such criteria should encourage enterprises to implement innovative solutions with respect to sustainable development, biodiversity protection, or security.

Currently, exclusive application of the price criterion leads to developers bidding towards the lower limit of profitability, and even offering payments for the right to build a wind farm, what often leads to abandonment of an investment (withdrawal from the auction contract) due to lack of profitability.

2.2 Wind Power Action Plan

Wind Power Action Plan — a new opening for wind energy in Europe

Wind Power Action Plan features guidelines for key measures to accelerate wind power development in Europe set by the European Commission. The guidelines are to increase the competitiveness of the European wind energy sector, in particular in the context of unequal fight with manufacturers from China.

The proposed measures are to strengthen the position of the European wind industry and increase Europe's capability to independently achieve its climate and energy goals.

Wind Power Action Plan emphasizes the following areas as key measures to strengthen the European wind energy industry:

Proper auction design

The Commission is proposing a new set of project pre-qualification criteria. These include data security and cybersecurity, environmental protection, and delivery guarantee.

Contract indexation

The Commission emphasizes key importance of indexation of auction prices and tariffs by Member States.

Investment financing

The Action Plan specifies a number of measures to aid investment financing in new plants, infrastructure and manpower related to wind energy.

Increased role of the European Investment Bank (EIB)

EIB is also to play a crucial role, for it will provide de-risking tools and guarantees to cover the risks faced by private banks offering financial instruments to the wind energy industry.

Improved transparency of information about planned wind energy investments

National auction plans will be published on an EU digital platform. The amended “2030 National Climate and Energy Action Plans” will require EU Member States to develop 10-year wind energy investment plans, including outlook for 2040.

Level playing field

The Commission is to fully use commercial instruments at its disposal to ensure equal playing field with entities from outside Europe. The Commission is to scrupulously monitor possible unfair commercial practices.

Accelerated permitting for new wind farms

The Commission declared the launch of a special tool to aid Member States in digitisation of permitting procedures — EasyPermits, already implemented as a pilot program by local permitting authorities in Denmark and Poland.



“Green transition will not succeed without a strong industrial base and local supply chains. It is crucial that the process benefits our national enterprises. The measures proposed by the EC are consistent with wind energy development directions in Poland. Wind energy industry in our country has been focusing on the development of a local supply chain for years.

PWEA opts for streamlining of planning and permitting procedures, because we know that new jobs, higher number

of service providers and international cooperation create an opportunity not only for the wind energy market in Poland, but also for the entire national economy. Although the Polish wind energy sector faced and continues to face many problems stemming from administrative and legal constraints, wind energy investments are becoming the key pillar of energy transition in Poland, with total wind installed capacity (onshore and offshore) in 2030 to reach 20 GW”

— emphasized Janusz Gajowiecki, President of the Polish Wind Energy Association.



European Wind Charter

On 21 December 2023 the governments of EU Member States made a symbolic commitment to take urgent action for wind energy. Ministers for Energy of 23 countries, including Poland, together with representatives of more than 300 enterprises and organisations from the wind energy sector signed the European Wind Charter, committing their countries to the measures allocated to them by the Wind Power Action Plan. This broad support demonstrates that governments of the majority of EU Member States understand the strategic value of wind energy and urgent need to strengthen the European wind industry.

3. Development of the wind energy sector in Europe

255 GW Total wind installed capacity in Europe at the end of 2022



225 GW
– Onshore wind installed capacity



30 GW
– Offshore wind installed capacity

To meet the ambitious targets set by the RES Directive (RED III), **within the next 5 years the wind energy sector will have to install additional capacity exceeding half of what is already installed in Europe**, and which has been built over decades. Investment in new sources must be ramped up to an unprecedented extent, which means huge increase in

demand for wind industry products and ancillary services. The majority of investments will be implemented in the EU, a target region for 80% of export generated by Polish entrepreneurs. Polish companies developed strong bonds with the EU economy and know how to do business in the Community.

On the basis of knowledge about commenced and planned projects, it is estimated that between 2023 and 2027 Europe will install 129 GW of new wind farms, of which 98 GW in the EU.

3/4 of new wind capacity to be added in 2023–2027 will be onshore.

To achieve the ambitious 2030 target — 500 GW of wind installed capacity — EU should add approximately of 35 GW new wind capacity per year.

New onshore and offshore wind farms in Europe, 2023–2027 — WindEurope scenarios.

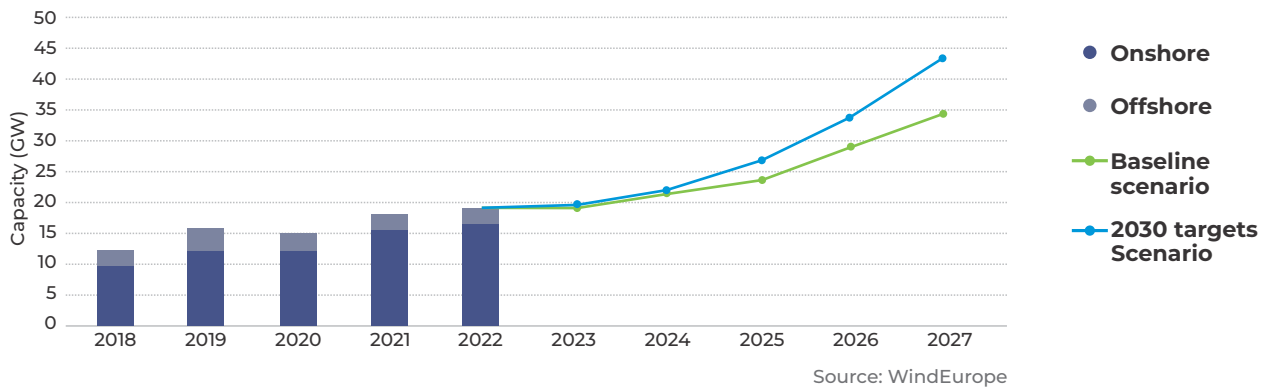


Figure 2. Growth scenarios for new wind capacity (onshore and offshore), 2023–2027. WindEurope data.

Recently, in connection with the war in Ukraine and increased costs as well as investment risk, wind capacity growth was slower, what induced the EU to take numerous measures, described above, leading to accelerate wind investments. In 2022 investors announced plans for approximately EUR 17 billion of new wind projects in Europe, assuming the construction of 12 GW of new capacity in the years to come. This is less than half of the investment made in the sector in 2021. Current EU measures are to accelerate the growth of the wind energy industry, which will directly affect service providers in Europe, including Poland.

CHALLENGES FOR THE EUROPEAN WIND ENERGY INDUSTRY

Permitting

Permitting for new wind farms needs to be accelerated. Slow administrative procedures translate into less than half the growth rate of new wind investments required to achieve REPowerEU targets.

(FIGURE 1)

Auctions

Government auctions for new wind farms are nearly all about the lowest price. This resulted in a murderous competition between contractors. Some countries even allow negative bidding, where developers have to pay for the right to build a wind farm, what reduces project profitability.

Commodity prices

High material prices and shipping costs and supply chain bottlenecks make turbines more expensive. Due to the long lead time between a wind turbine order and its actual delivery, manufacturers have to absorb these additional costs, especially when their contracts with developers do not provide for indexation.

(FIGURE 2)

International competition

Almost all wind turbines installed to date were manufactured in Europe. However, today Chinese manufacturers win with their European counterparts on price and terms and conditions, and are starting to win orders in Europe.

Figure 1

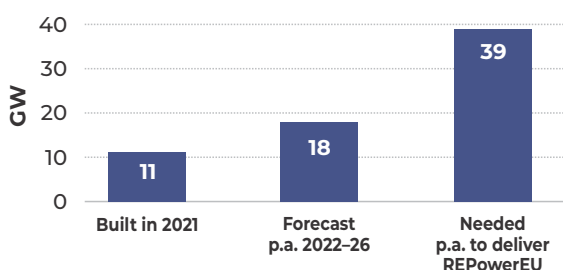
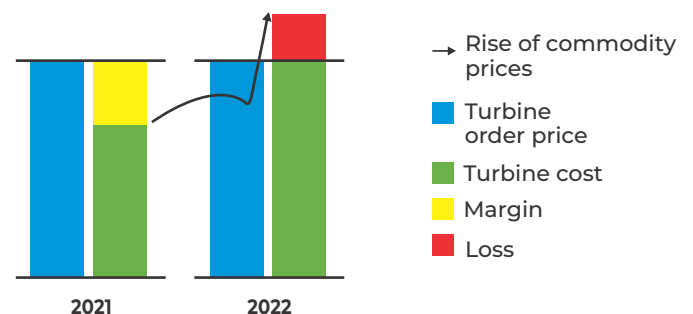


Figure 2



Protective and support measures offered by the European Commission give Polish industry a great opportunity to obtain new orders and grow. Today, we are facing unique opportunity to develop Polish RES industry.

Stimulating growth of the wind energy sector in Europe requires increased competitiveness of the supply chain and implementation

of new business models. Governments of Member States debate on solutions to the problems outlined above, which recently increased the level of investment risk. One is certain — if Europe is to achieve its climate and energy targets, the wind energy sector must accelerate.

DEVELOPMENT OF THE WIND ENERGY SECTOR IN POLAND

9.3 GW

onshore wind installed capacity in Poland (+1.8 GW under construction)



0 GW
– Offshore wind installed capacity

5.9 GW is planned for installation by 2030, with first electricity from offshore wind turbines likely to be fed into the grid in 2026

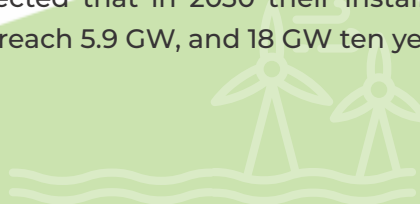
In 2022, wind energy contributed 115 of electricity production in Poland. From January to November 2023 the share was close to 13%.

The proposed update to EPP2040, prepared in March 2023, assumes increase in wind installed capacity to 20 GW onshore and 18 GW offshore by 2040.

The total potential of offshore wind in Poland is estimated at as much as 33 GW (in accordance with PWEA own work).

In accordance with the proposed update to the “Energy Policy of Poland until 2040”, adding a new scenario, in the next two decades wind capacity will experience an unpre-

cedented growth. Offshore wind farms will play an important role in the power system. It is expected that in 2030 their installed capacity will reach 5.9 GW, and 18 GW ten years later.



Onshore wind may reach 14 GW in 2030 and 20 GW in 2040. It is estimated that total investment expenditures in the RES sector by 2040 will amount to PLN 726 billion, of which 261.8 billion in 2023–2030 and 464.5 billion in 2031–2040. Implementation of the programme assumed in the updated EPP by 2030 will require a total of PLN 512 billion of expenditures to increase generating capacity and expand transmission and distribution grid. In accord-

ance with Credit Agricole economic experts, PLN 299 billion of financing sources has already been secured for projects scheduled until 2030, which entails a PLN 213 billion gap between the outlined investment plans and financing sources. Nonetheless, the financing instruments, in particular EU funds, have already been allocated to wind energy. Now it is crucial to efficiently obtain such funds.

Figure 3 Onshore wind capacity in Poland — growth forecast

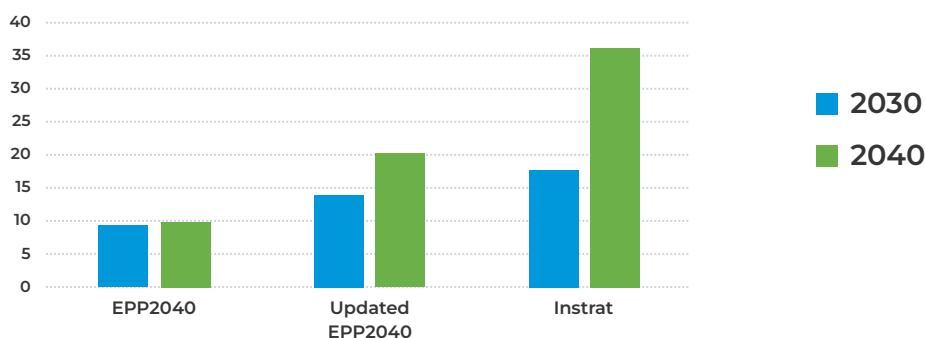
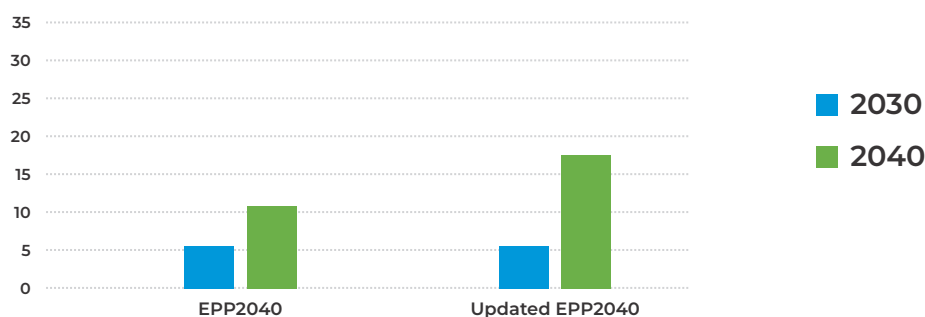


Figure 4 Offshore wind capacity in Poland — growth forecast



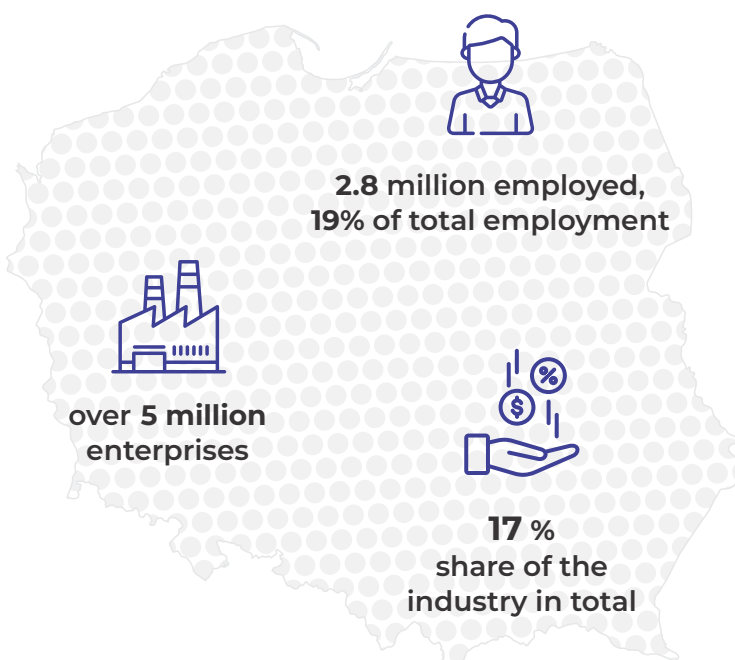
In the context of the assumed growth of wind energy in Poland, the approach of the new government to EPP2040 updates will be crucial. Pre-election announcements indicated

that energy transition will accelerate, which may lead to establishment of even more ambitious targets for wind energy — an additional opportunity for the Polish industry.

PWEA estimates are more ambitious. The industry predicts it is possible to reach 33 GW of offshore capacity, if only we exploit the full potential of the Polish Baltic Sea areas. The report specifies 20 new areas in the Polish Baltic Sea area that could be allocated for offshore wind development, including 18 in the Exclusive Economic Zone and 2 within the territorial sea. Had the entire potential of the Baltic Sea been exploited, offshore wind could contribute to as much as 57% of electricity demand in Poland, with local companies contributing as much as 45%.

4. The role of industry for the Polish economy

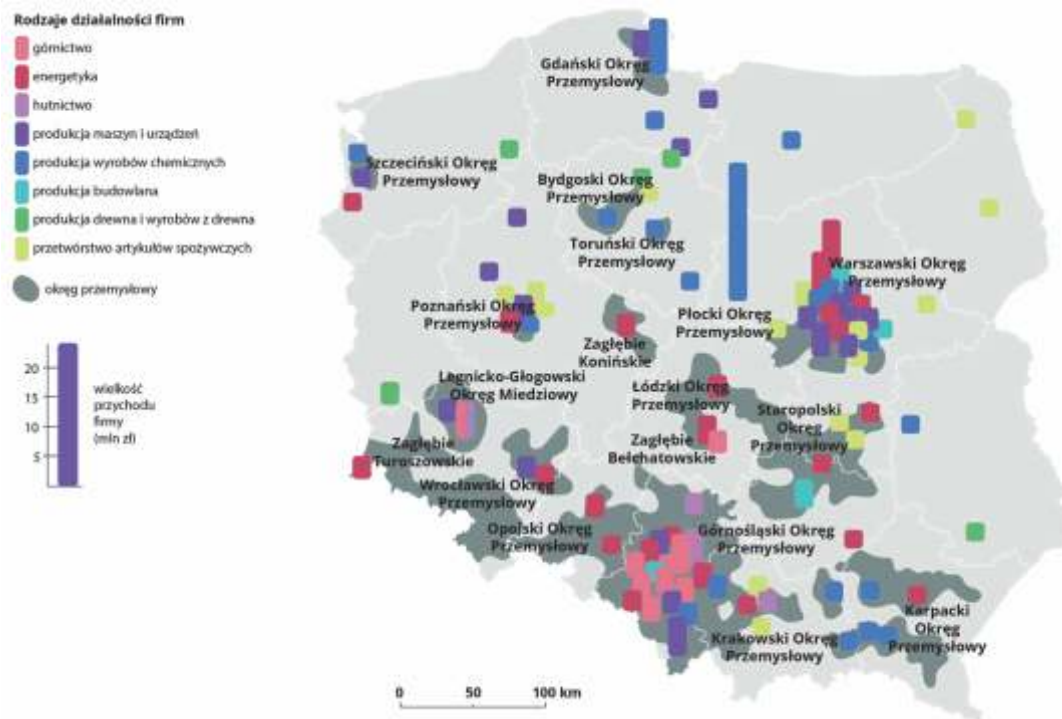
Industry in Poland



Central Statistical Office's data for the second quarter of 2023 demonstrate that industry in Poland employs more than 2.8 million people, approximately 19% of all employed.

Polish industry is contributing approximately 17% of GDP, making Poland the leader among key European Union economies in which the share of industry in GDP has increased in 2000–2023. However, 17% is still less than in Germany, Czech Republic, Austria and Hungary, which aim to become the industrial backbone of Europe. Industry is crucial for our country, and its role will only increase in the next decades. In the face of re-industrialisation of Europe, **the need to revise “Industrial Policy of Poland”, in particular in the part applicable to the RES sector, becomes a necessity.**

Industrial districts in Poland — current industry-heavy areas



Low-emission transformation of the energy industry leads to creation of new industrial centres next to sustainable energy sources. Today, it is not only output market, accessibility and access to qualified personnel that matters — it is crucial to have access to renewable energy sources free of CO₂ emission charges and transmission fees that ensure electricity prices enabling competition with other manufacturers. Construction of industry in direct vicinity of the sea and RES has already commenced worldwide.

For example, Sweden adopted a decarbonisation programme for industrial production and is becoming one of the leaders in green steel, aluminum or battery chemistry manufacturers. Construction of wind farms in the Baltic Sea and the planned nuclear power plants in northern Poland, hence access to inexpensive, zero- or low-emission electricity induced the

Polish government to consider locating new green industrial zones in northern Poland. There are to be special energy zones located within northern part of the country. An investor that builds its industrial plant in such a zone will be entitled to a discount quality fee and variable network fee, resulting in lower electricity prices than outside the energy zone.

Furthermore, in some locations the investors are to be able to connect to Gaz-System's gas network. The preliminary location of special energy zones is in the vicinity of Słupsk, Suwałki, Ostaszewo (two zones near Toruń), Szubin (near Bydgoszcz) and Olsztyn. The zones will be dedicated to large electricity customers with annual consumption exceeding 100 GWh, planning to build energy storage facilities.

This concept may provide additional support for the development of offshore industry in northern Poland.

Polish industry — SWOT ANALYSIS (on the basis of Ministry of Economic Development and Technology analyses, 2021)

Strengths	Weaknesses
<ul style="list-style-type: none"> ▶ Substantial manufacturing potential ▶ High product quality ▶ Dynamic and flexible enterprises, in particular in the face of an economic crisis ▶ Large number of small and medium enterprises strongly capable of absorbing new manufacturing technologies and techniques ▶ Increasing export and new export markets ▶ Presence in Poland of manufacturing plants and distribution centres of leading global manufacturers ▶ Highly qualified engineering personnel ▶ Arrangement of industries in clusters ▶ Increasing export capability 	<ul style="list-style-type: none"> ▶ Production discontinuity risk due to long supply chain ▶ The role of a subcontractor supplying less technically complex products with low added value ▶ Poor knowledge of Polish brands in international markets ▶ Relatively poor financial standing and low capitalisation of enterprises ▶ Lack of investment funds in Polish companies ▶ Insufficient cooperation between companies and R&D centres at the national and international level ▶ Lack of investment in human capital and management systems for complex industrial ▶ The need to incur substantial expenditures on low-emission transition/transition to net-zero economy ▶ Poor organisation of local enterprises ▶ Risk aversion among national enterprises
Opportunities	Threats
<ul style="list-style-type: none"> ▶ Size and stability of the national market and its growth potential ▶ Operation within the common European market ▶ Sustained interest of foreign investors in starting component production ▶ Development of production automation and digitisation technologies ▶ High quality of technical education at Polish universities ▶ Increasing cooperation between R&D centres and industry with respect to innovation ▶ National market as a stable new technology incubator ▶ Potential intensive use of advanced “green” technologies in manufacture ▶ The need to increase the share of recycling as a result of circular economy implementation ▶ Development of renewable energy sources, energy storage facilities and smart power grid ▶ Rapid progress of digitisation of public services 	<ul style="list-style-type: none"> ▶ De-localisation of production and investment ▶ Continuing increase in electricity prices ▶ High dependence of the economy on growth of European and global markets ▶ Increase in prices and difficult access to resources and components ▶ Legislative inflation/excessive regulation ▶ Outflow of experts abroad and insufficient number of personnel in the Polish market ▶ Low level of professional education (secondary schools, universities) ▶ Slow development of industry schools, lack of qualified personnel with secondary technical education ▶ Knowledge and equity concentration around relatively few companies in the market ▶ Loss of demographic advantage ▶ Insufficient interdisciplinary approach of the Polish science

Further strengths and opportunities should be found when analysing the industry in terms of current and future investment in onshore and offshore wind. The recently adopted strategic documents, i.e. Net Zero Industry Act, Wind Power Action Plan or European Wind Charter, as well as preferential approach in the EU to development of the RES industry, give an optimistic outlook for the strengthening industry and allow for preparing for adequate growth thereof.

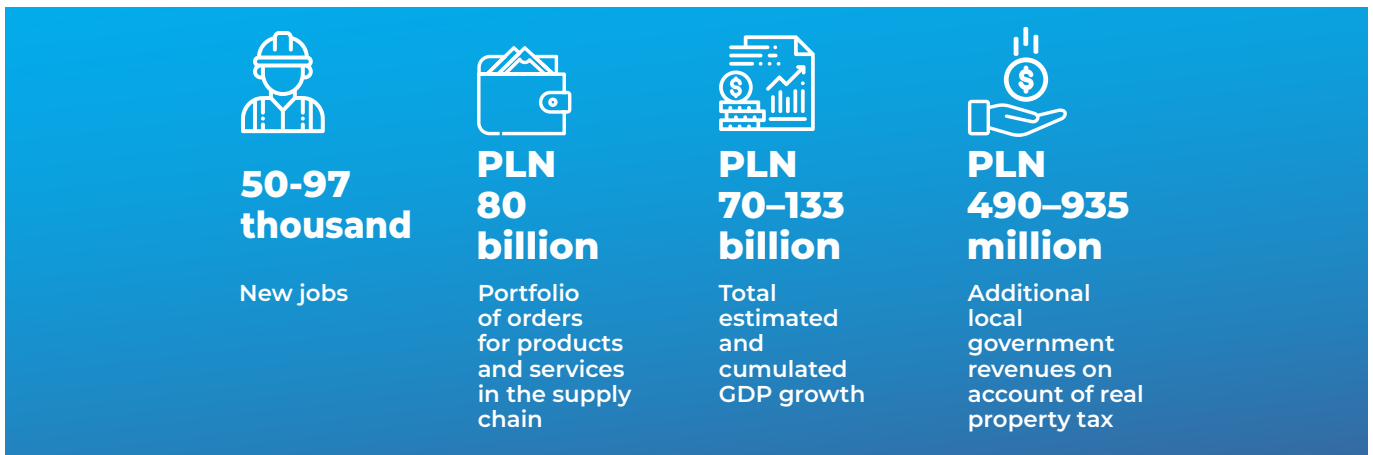
5. Potential of onshore wind supply chain in Poland

Onshore wind development in Poland has a substantial impact on GDP, labour market and prospects for production facilities. Implementation of subsequent onshore projects will be a stimulus to Polish enterprises operating within the supply chain.

A report by the Polish Wind Energy Association and Instytut Jagielloński demonstrates that, in the best development scenario (18 GW by 2030 and 36 GW by 2040), new wind farms will guarantee PLN 70–133 billion of GDP growth, PLN 490–935 million of additional revenue for local governments, approximately

PLN 80 billion of orders for products and services in the supply chain and from 51 to 97 thousand new jobs in the 2030 perspective. For this to happen, currently applicable regulations pertaining to onshore wind farm location require adjustment.

The portfolio of contracts for products and services in onshore wind farm supply chain may amount to as much as PLN 80 billion by 2030. This means average annual turnover between PLN 6 and 9 billion.



The potential of local content in the onshore wind farm supply chain is currently estimated at 55–60% and may reach as much as 75% within the next 10 years.



Investments in the development of wind energy technologies in Poland not only pursue goals related to climate change and environmental protection, but also implement innovations to production and enable expansion

in the EU markets. Appropriate use of the EU funds through investments in innovative manufacturing infrastructure for RES will in the long term translate into economic growth, quality of life and high quality jobs.

One of key challenges for energy transition is local content, meaning the development and implementation of solutions enabling retention of the highest possible investment amount in the national economy, development of supply chain and export of Polish enterprises, and creation of new jobs.

Basic resources used in manufacture and installation of wind farms include concrete, steel, composite materials (fiberglass, carbon fibre, polymers and other), copper, and aluminium.

Most of these resources are produced in Poland. The table below presents the average volume of materials necessary for the construction and commissioning of a 50 MW onshore wind farm.

RESOURCE	TONNES NEEDED
CONCRETE (used for foundations and access roads)	22,826
STEEL (used for wind turbine towers, flanges, nacelle, structural elements, cast nacelle and rotor elements)	6,687
COMPOSITES (used for rotor blades, hub, nacelle, cable ducts)	1,051
ALUMINIUM AND COPPER (electrical components, cables, equipment)	301

Apart from manufacturing, Polish companies may also successfully accept orders related to particular stages of wind energy investment cycle. These include environmental

and technical analyses, legal services, support in site selection and securing financing, electrical connections, installation and transport services, civil works, maintenance, and repairs.

Estimated expenditures on the construction of onshore wind farms, 2022–2030

DEVELOPMENT PHASE (site selection, environmental, financial, legal and technical analyses)

In accordance with estimates made 2 years ago, by 2030 the market for services related to the development of onshore wind farms in Poland may reach from PLN 4.5 to PLN 8.5 billion, interconnection fees included. Without interconnection fees, the market may reach from PLN 3.2 and PLN 6 billion, meaning **prospective average annual revenue for enterprises in the supply chain between PLN 300 million and almost PLN 700 million.**

TURBINE INSTALLATION

The market for supplies related to turbine installation phase with respect to onshore wind farms in Poland may reach from PLN 26 to PLN 48 billion in 2030. **Turbine supply, including transport of key components — nacelle, rotor and tower — will be the largest market.**

In the base variant, the revenue potential for suppliers of nacelle components or their sub-suppliers exceeds PLN 2 billion. For rotor components (including manufacture of blades and cast elements) it exceeds PLN 1 billion. The market for the supply of wind turbine towers may, on average, be worth as much as PLN 900 million per year.

CONSTRUCTION AND GRID CONNECTION PHASE (site preparation, civil works, electrical installations and connection, commissioning)

The market for the supply of components and services related to construction and grid connection phase may reach from PLN 9 to PLN 17 billion in 2022–2030. Most significant market in this investment phase includes the supply and connection of electrical installations.

Average annual revenue that may be achieved by enterprises in the supply chain in that segment is approximately **PLN 700 million**. Civil works related to site preparation entail average annual revenue bundle of approximately **PLN 600 million**. Enterprises providing comprehensive onshore wind farm commissioning services could participate in a market exhibiting approximately **PLN 200 million** of annual turnover.

OPERATION, MAINTENANCE AND DECOMMISSIONING PHASE (or repowering)

This phase is a cost category spread over time. Assuming 25 years of operation, it would include ongoing maintenance and spare parts replacement costs. According to available information, **average annual operation and maintenance cost per 1 MW is approximately PLN 0.15–0.2 million**. The most significant item in the costs list (up to 50%) is maintenance and replacement of components on-site.

FINANCING

EIB: EUR 5 billion for European wind energy producers

European Investment Bank (EIB) approved an **EUR 5 billion initiative to support enterprises manufacturing wind turbine components**. The financing is part of EIB's contribution to the European wind energy package and is to further accelerate just and rapid transition to zero-emission technologies while stimulating national industrial innovation. **It is expected that the programme will support investments of companies producing wind energy, grid infrastructure, and key components for the wind energy sector.**

This is a key element of coordinated support provided EIB and the European Commission for the EU wind energy sector, necessary to pursue the European Green Deal.

6. Potential of offshore wind supply chain in Poland

Polish industry has great potential to become an important player in the global offshore wind supply chain. However, without a solid, strategic industrial policy focusing on RES, in particular offshore wind sector, there is a risk

of falling behind. Immediate update of assumptions to industrial policy of Poland is crucial to support creation of a strong and stable offshore wind supply chain.

New industry benefits so-called local content — Polish companies forming part of offshore wind production and supply chains. **Entrepreneurs comprising the national supply chain exhibit a potential to soon become capable of offering key structural elements, including turbine towers, turbine components or offshore substations. However, this requires urgent support and decisive investment. Moreover, the Polish industry has full capability to produce components, including installation and maintenance vessels. A conscious state industrial policy, giving priorities to development of plants, projects, industry education of acquisition of financing, is necessary.**

Large investments boost local suppliers: the Vestas plant

Vestas' investment plans in Szczecin, including the construction of a wind turbine assembly plant, is a substantial milestone in the growth of emerging local content in Poland. The Danish turbine manufacturer will supply components for offshore wind farms in the Baltic Sea and other areas. The facility in Szczecin, which will employ 700, is scheduled to be commissioned in 2024. **Orders from the sector will benefit not only Polish employees, but also suppliers from all over the country. Experience of industries similar to offshore demonstrate that the Szczecin plant will create 3 to 4 times the number of indirect jobs in collaborating plants.**



Offshore wind turbine tower factory: Baltic Towers

A joint venture between ARP S.A., Baltic Towers sp. z o.o. and Spanish company GRI Renewable Industries, S.L. is building a new offshore wind turbine tower factory.

The investment will satisfy the increasing demand for wind turbine towers and substantially increase the share of Polish companies in offshore wind supply chain in the Baltic Sea. Commissioning is scheduled for 2025. The investment comprises an offshore tower production plant for the largest planned wind turbines with a capacity in excess of 15 MW, capable of delivering more than 150 towers per year. It will provide employment for approximately 400.



Windar enters Polish offshore market: new plant in Szczecin

Spanish company Windar will invest in a modern plant building wind turbine tower elements for onshore and offshore wind farms, foundations for onshore and offshore wind turbine towers as well as steel masts and towers. Zarząd Morskich Portów Szczecin i Świnoujście S.A. and Windar Polska Sp. z o.o. signed in Szczecin a preliminary lease contract for 17 ha of land located at Ostrów Grabowski within the Port of Szczecin. **With such investments, the Zachodniopomorskie province is becoming a strong hub for offshore wind development in Poland and the Baltic Sea region.**





“Our maritime, construction, production and logistic industries are by default related to offshore wind. Without recognising and exploiting the synergies through

clear industrial policy not only we lose growth opportunities, but also risk stagnation in industries which, with appropriate support, could lead international markets. We must admit this is urgent, understand what is at stake and take decisive action. It’s time for industrial policy focused on offshore wind supply chain. A policy that is modern, future-oriented and exploiting the potential of the Polish economy and demand from the European offshore market” — emphasized

Dominika Taranko, Managing Director,
Vice-President of Wind Industry Hub.

New jobs: It is estimated that offshore wind projects may create from 39 to 63 thousand jobs in Poland by 2030, including 13–21 thousand directly in offshore wind sector and 10–17 thousand indirect jobs.

- OPPORTUNITY!

Growth of the new offshore sector may entail the risk of industry bottlenecks.

However, the likelihood of such constraints may be limited through development of Polish vessel and port infrastructure as well as establishment of a supply chain for components and services.



Sectors and industries with the greatest development opportunities

HIGH DEVELOPMENT OPPORTUNITIES

LOW DEVELOPMENT OPPORTUNITIES

VESSELS

Installation of offshore wind farms requires many different kinds of vessels. Some of these vessels, such as jack-ups, cable layers or foundation installation vessels are in short supply worldwide. Furthermore, the construction of several dozen GW of installed capacity in Polish Baltic Sea waters opens vast opportunities for maintenance services together with maintenance fleet.

INSTALLATION PORTS

Polish offshore wind farms may potentially be serviced from ports in Denmark and Sweden. Nonetheless, proximity and preferred access to Polish projects give advantages to local, Polish ports — their use is crucial for the growth of the entire industrial ecosystem in Poland.

TURBINES AND COMPONENTS

Poland is known for high quality production of specialised industrial components and installation services. It may become the leading location for European wind turbine manufacturers. Construction of a nacelle housing factory may attract subsequent investments, as demonstrated by the wind turbine tower plant. Nacelle housings, cast elements, blades, control systems are elements crucial for wind turbine production. Their manufacture in Poland may bring not only new jobs, but also create strong R&D centres.

ONSHORE AND OFFSHORE TRANSFORMER STATIONS AND CABLES

Polish maritime industry plants for many years have been supplying complex steel structures for large transformer stations. The capability to assemble dedicated components forms an unexploited opportunity for additional value for Polish companies. Next to installation services using imported components it is possible to install systems (transformers, cables) manufactured in Poland.

FOUNDATIONS

Although Poland does not feature a full supply chain from resources to foundations, it is a major supplier of coking coal and coke (necessary for the production of sheet metal for towers and foundations) for European steel mills. Moreover, our country is an important supplier of large (secondary) steel structures.

PROFESSIONAL SERVICES

— in particular engineering services. As demonstrated by experience of Phase I (5.9 GW) in Poland, construction of offshore wind farms generates great demand for development works of all kinds, involving hundreds of civil, environmental protection, structural, steel, electrical and other engineers. Professional services also include business consultancy and legal services.

Strategic investment in service and processing

The assumed scale of offshore wind farm construction in the Baltic sea — and all around Europe — demands more production capacity from each element of the supply chain. Poland is a renown supplier of many components. However, the scale of offshore wind investments enables our country to launch investment in strategic elements of the supply chain for Europe — from steel production, through new installation services, innovative foundations (e.g. floating), to turbine and maintenance services development. Furthermore, possible future use of hydrogen means a series of investments, for instance in electrolyzers, storage, and transport. Poland may use this opportunity and invite a large number of new investments, complementary with capabilities of other European countries. This is also a great opportunity to stimulate the R&D sector.

Port infrastructure in Poland is well-developed. We have more than dozen sea-ports, in the mouth of both Odra and Vistula, as well as along the Baltic coast. Four of them — in Gdańsk, Gdynia, Szczecin and Świnoujście — are of fundamental importance to the Polish economy. However, port and ancillary infrastructure at these sites required modernisation and extension. Smaller ports in Władysławowo, Ustka and Łeba are already being adapted as maintenance ports for offshore wind farms. Together with offshore wind development, subsequent smaller ports are likely to be adapted to the role of maintenance ports, creating an opportunity for local communities and entrepreneurs.

Installation terminals: another opportunity for Polish entrepreneurs

Studies demonstrate that one job in a port generates eight jobs in related industries. In September 2023 ORLEN selected a contractor for the onshore part of the offshore wind farm installation terminal in Świnoujście. The project is to be implemented by Budimex. Civil works are to conclude at the turn of 2024 and 2025. Eventually the terminal is to enable installation of more than 80 offshore wind turbines per year and will be capable of handling the Baltic Power wind farm project, co-owned by Orlen, as well as other planned wind energy projects. In accordance with preliminary announcements, the second installation terminal in Gdańsk, to be built by the state, is to be complete by the end of 2025. Extension of ports in Świnoujście and Gdańsk may become one the most important milestones in the development of offshore wind energy in Poland. Construction of installation ports entails economic growth, new jobs, and an impulse for the local and regional economy.



The offshore wind market is global, with acceleration of offshore wind farm projects observed in many regions of the world. This brings certain consequences for the European

market — WindEurope indicates that to complete the offshore investments planned in Europe we will need:

- x3** Three times the production of turbines, including towers, blades, nacelles, and control systems
- x2** Double the number of installation and maintenance ports
- x2** Twice as much installation vessels used for transport and installation of turbines, cables, foundations, and substations
- x3** Threefold increase of investment in production of cables and other electrical components as well as substations

In accordance with WindEurope, Poland has a number of advantages over other countries in the region, for it exhibits:

- Strategic location
- Experience in shipbuilding
- Qualified personnel
- Features of a market clearly turning towards RES
- Substantial onshore and offshore wind potential

Today, Poland should compare itself to the French, German, Danish or Dutch market and set goals for wind industry development aspiring to this league of states. Moreover, in the European Union the course for offshore wind is currently being consolidated, as demonstrated by the documents mentioned above, such as Fit for 55/RePowerEU, Net Zero Industry Act and the latest Wind Power Action Plan.

At the same time, there are voices that we could have done better to support the development of Polish wind energy supply chain.

Not all in the industry is going smooth, among others due to a number of challenges identified in November 2023 by participants of the PWEA's Offshore Wind Poland 2023 conference.



7. Challenges for wind energy supply chain

In order to achieve the assumed wind energy capacity growth, we need to multiply available resources, services, and components. Today, Baltic Sea and related investments are an attractive market for local supply chain — but the market is not free from challenges. If offshore is to become the driving force of the

Polish economy, it is necessary to create a strategy and a specific model of cooperation to enable growth of the wind energy industry. Current practices and experience will be crucial to adapt to the standards of the offshore sector adopted in the West and to increase competitiveness of Polish enterprises.

▶ Adequate **EXPERIENCE**. On one hand, we have many entities experienced in the industry, however not necessarily in offshore wind projects, what eliminates such entities from procurement procedures where documented offshore wind experience is expected.

In accordance with the investor's perspective willing to complete a project on time and within budget, an inexperienced subcontractor that needs time for learning and onboarding is related to much higher risk. On the other hand, entities experienced in offshore wind in the North Sea or other basins as well as in offshore in the Baltic Sea, but not necessarily offshore wind, seem to be at the top of the list of potential subcontractors, although usually they lack sufficient knowledge and experience to act in the Polish regulatory environment. **Cooperation between Polish and foreign companies seems to be the optimum solution. However, to contribute to the development of national competences, it would need to be based on truly partner principles.**

▶ **FINANCING** of cooperation, in particular a model for remunerating services providers, who cannot be encumbered with “crediting” offshore wind projects through invoicing after service completion and approval of acceptance certificates (often with a due date of 60–90 days). **In the opinion of contractors active in the sector, a contractual standard should include lump-sum remuneration enabling smooth, ongoing work as well as establishment and upkeep of permanent teams and equipment base. This is a Western standard, recognised in many countries and often causing contractors performing orders in this model abroad to resign from providing services in Poland.**

COMPREHENSIVE NATURE of orders for contractors. Due to their scale, offshore wind projects require thorough understanding of the nature and scope of works on both sides of the contract. First, it requires both parties to provide complementary teams being partners to each other, and second, forces subcontractors to establish consortia. Apparently, an investor who contracts a consortium leader limits its risk. However, actually it loses control over the entire team, usually comprising a large number of rather unrelated companies. Contractual provisions will not guarantee project completion on time and within budget, if the other side does not feature a well-managed team with very good understanding of all the intricacies of the project. **Obviously, subcontractors are capable of developing such relations between them (Tier 1 vs Tier 2, Tier 3, etc.), but this not only requires time and expenditure, but also common understanding of the goal, which is not only to complete one's tasks, but the entire project.** This is the reason why smaller Polish service providers feel more confident when performing just a part of the works as a subcontractor of a larger contractor. This is a natural way for the industry to learn and grow, yet it precludes development of competences required for independent provision of comprehensive services.

The need to secure **CONTINUITY** of orders in the industry. The lack of a coherent, consistently followed economic strategy for offshore development in Poland is a problem. Prospect for new types of orders, their number and scale that is difficult to predict makes it difficult for suppliers to plan their growth and, to a certain extent, slows down the adaptation to requirements of offshore developers. Some initial assumptions are eventually implemented in a very different way, for instance with respect to installation port. Furthermore, one should consider binding the subcontractor and investor with a commitment to implement projects together in several locations, what would enable the industry to plan revenue in a longer perspective, and warrant the developer that it will not be left without contractors when projects in different markets cumulate.

High **STANDARDS** for the offshore industry. There is a need to harmonise QHSE procedures applied by the industry. For many developers appropriate quality, health, safety, environment, and public involvement standards are a prerequisite for commencement of negotiations with a given entity. On the other hand, there are voices that sometimes a manufacturer may gain more by performing a number of other contracts for a similar service, yet with much less restrictive requirements, than adapting to standards established by offshore wind employers. **At the same time, some developers openly speak of qualification or audit procedures to verify the skills and standards declared by subcontractors.**

Lack of **INCENTIVES** for local content growth. Investors are insufficiently motivated to contract services locally. This might be changed by auctions allowing for non-price assessment criteria. The lack of incentives is also seen by the industry, which must implement all investments on its own, with just promises of great prospects in the next years. Experience requires no less than prudence, which is often construed as being passive. High entry costs are related to the need to employ industry consultants and/or adapt production. National enterprises rarely have equity for such purposes. Although it seems today banks need investments in RES technologies, therefore look more favourably, the knowledge about instruments improving project profitability is not common.

PERSONNEL AND COMPETENCES are related to multiple local content threads. We often hear about many Polish industry experts implementing projects abroad, who did not receive sufficient incentives (financial or related to continuity of employment) to return to Poland. However, the bench of offshore experts often causes shortage of persons capable of appropriately reading the documentation (with each developer having a different standard), finding all the nuances — and even shortage of time and personnel to file questions to Terms of Reference in procurement procedures. Without substantive dialogue between both parties to the contract there will be no smooth performance and satisfaction from cooperation. To the contrary, lack of understanding may appear. Hands-on experts emphasize that often the dialogue is carried out through legal offices of both organisations, which add to contracts provisions that are difficult to accept and understand, what results is departure from project assumptions, disproportionate relations, and lack of trust between partners.

Furthermore, with today's unemployment rates and demographic outlook, the entire industry will face shortage of personnel, both experts and blue collars. This is a substantial challenge, at the same time being an opportunity for a socially just energy transition, i.e. moving employees from closing industries to offshore wind.

EXTENDED AND STRATEGIC thinking about offshore wind projects not just in terms of energy sources, but comprehensive industrial solutions harnessing offshore wind to produce hydrogen, biofuels, or in other industrial procedures would allow for a better, long-term use of the economic potential of offshore wind, even if such approach would require and update to timelines (for instance due to technology developments). **Cooperation between sectors forced by economic environment requires further extension of competences and imposes thinking about offshore wind local content in a broader sense, as the RES industry.**

Understanding **DETERMINANTS** of state-owned companies, being the leading investors in the Polish Baltic Sea area and, in the opinion of offshore service providers, whose purchasing procedures are not flexible enough and whose forms of communication with contractors at the selection stage are inefficient.

All above aspects lead to a situation where developers are forced to contract available services and components (including Chinese ones) or be exposed to untimely and costly project implementation, or expiry of permits and decisions. At the same time it is possible that as

the number of offshore wind projects grows over time, there will be a shortage of particular elements of the supply chain. Today, offshore market is global, causing qualified entities, even from Poland, capable of selecting employers from different countries and markets.

Therefore, the need to build a strong, local supply chain seems to be our *raison d'état*, in particular where we openly admit that without fast completion of Polish offshore wind projects we will face issues with balancing the power system due to scheduled decommissioning of coal-fired units in the years to come.

We recommend taking the following urgent actions:

Acceleration of investment (permitting) procedures

Presentation of a long-term vision for the development of the offshore sector through updates to the spatial development plan for maritime areas and Energy Policy of Poland

Creation of an industrial strategy of Poland, taking into account the development of the offshore and onshore industry

Establishment of an Offshore Industry Development Department in a ministry responsible for industrial policy to smoothly deliver the required measures

Establishment of dedicated funds to support the industry necessary for wind energy development

Reference:

IRENA: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2021/Oct/IRENA_RE_Jobs_2021.pdf?rev=98960349dbab4af78777bc49f155d094

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PWEA and IJ report "Diagnosis of the current situation and national potential of the onshore wind supply chain in Poland together with recommendations for optimisation of its development":

<https://wysokienapiecie.pl/92158-w-europie-powstaja-zielone-okregi-przemyslowe-w-polsce-tez-powinny/>

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Benefits of highly developed onshore and offshore wind supply chain

To avoid recession, Poland must launch investments in sectors that will bring certain and stable profits in the next decades and increase the involvement of Polish enterprises and industry.

Data stemming from PWEA reports demonstrate that in the best technology development scenarios, when full potential of onshore and offshore wind is exploited (assumed capacity: 36 GW and 33 GW, accordingly), by 2040 we may gain measurable benefits.

More than 100 thousand new jobs

More than PLN 450 billion value added for the Polish economy

Possible revenues of Polish enterprises in the construction phase — almost PLN 100 billion

Creation of a stable and competitive industry in Europe

Establishment of international partnerships

Long-term and comprehensive contracts with developers



8. Wind Industry Hub — the response to market and industry needs



Acknowledging the need to support the development of a strong industrial and service base for the wind energy sector, Polish Wind Energy Association established the Wind Industry Hub foundation. The goal of the Wind Industry Hub is to act to improve energy and economic security by ensuring

appropriate industry base in Poland and strengthening the role of Polish enterprises in the European supply chain.

Wind Industry Hub has been established as a response to the needs of developing industry related to the wind energy sector. Through its actions, we will give strength to Polish companies expanding into foreign markets and boost inflow of foreign investments to Poland. Our mission is to build strong business relationships, transfer knowledge and technology, and promote joint projects between national and foreign industrial entities active in the wind energy sector.

Cooperation with the governmental administration and the support for business and legal environment will be the primary tools for co-developing a coherent industrial policy of Poland and stimulating dynamic growth of the Polish wind industry.

Key objectives of Wind Industry Hub will also include support for Polish companies and institutions in implementation of the EU policy with respect to consolidation of the European industry supplying components for net-zero energy technologies.

Wind Industry Hub will actively participate in key sector events and initiatives fostering cooperation between the wind energy and ancillary industries.

Polish industry urgently needs a smart action plan aimed at supporting onshore and offshore wind supply chain.

Interested in details? Contact us!

<https://www.windindustry.pl/>



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