POLISH WIND
ENERGY ASSOCIATION

THE FUTURE OF OFFSHORE WIND IN POLAND

PWEA Report

May 2019

CONTENTS

Executive summary 4

1 Introduction 5

2 Offshore wind farms — the verge of energy revolution 6

3 Electricity from offshore wind farms enjoys public confidence 8

4 Domestic electricity production in 2018 10

5 Wind farms — another milestone of the Polish maritime sector 13

6 Offshore wind — development and construction 14

7 Offshore wind — electricity production 16

8 Baltic Sea — the hope of the energy sector 18

9 Benefits: general effects for the economy 20

10 Benefits: development of Polish entrepreneurship 22

11 Benefits: a stable energy source 25

12 How to wisely aid offshore wind development? 26

13 Summary 30

EXECUTIVE SUMMARY

The National Power System in Poland, with total installed capacity exceeding 41 GW, is based on coal-fired power plants in more than 70%. The oldest power units will be decommissioned soon. In accordance with the cumulated decommissioning scenario presented by the transmission system operator, it will be necessary to shut down more than 20 GW of generation sources by 2035. This is caused by their age and wear as well as the planned implementation of conclusions introducing the new BAT emissions standards.

For almost fifteen years renewable energy in Poland has been developing rapidly, matching the European Union's climate policy and global megatrends. At the end of the last year renewable energy sources (RES) reached 8.6 GW of installed capacity in the National Power System.

From 2005 to 2016 wind energy experienced the highest growth rates among all RES in Poland, expanding almost 70-fold. The record breaking years was 2016, with 1225.38 MW of new capacity.

In accordance with the data published by the Energy Regulatory Office, at the end of 2018 wind farm installed capacity in Poland amounted to almost 5.9 GW, which corresponds to more than 14% of cumulated generation capacity in the National Power System. Electricity produced by the installations covered 7% of the national demand in 2018; in 2017, record-breaking in terms of wind energy output, onshore wind covered even more — 8% of the demand.

Wind energy already constitutes an important element of the Polish energy mix. Many highlights indicate that its role in the next decades will increase. Full exploitation of the onshore and offshore wind potential will enable transformation of the energy system towards low-emission economy and help to ensure energy security of the state.

As a result of the auctions for RES aid held in November 2018, 5.9 GW of wind turbines already operating in Poland will be joined by almost 1 GW of farms to be built this and next year.

A subsequent auction is announced for 2019, and the opportunity to obtain the governmental support will be open to the majority among ready-to-build projects totalling 3 GW. In a few years onshore wind farms will be joined by offshore installations in the Baltic Sea, now being developed. The first Polish offshore wind farms will commence electricity production around 2025; more than 10 GW of capacity installed in the Polish Exclusive Economic Zone is planned to be commissioned by 2040. The ambitious plans attract substantial interest among national and foreign investors.

Offshore wind is one of the most dynamically developing energy sectors in Europe. Currently, offshore installations are present in 11 European countries. The offshore leader is United Kingdom, with more than 8 GW of installed capacity. 30 GW is planned to be achieved by 2030. Germany, Denmark, Belgium and the Netherlands come next. Considering the binding target adopted by the European Union Member States last year — 32% of the share of renewable sources in gross final consumption of energy — the interest in the technology will continue to increase. Poland, willing to actively participate in the protection of the natural environment and intending to satisfy the increasing national demand for electricity, is also investing in clean renewable technologies.

The construction of offshore wind farms in Poland will bring economic, environmental and social benefits. Building wind turbines offshore enables better exploitation of their potential — offshore the wind blows for approximately 90% of the year. Furthermore, due to their unique design offshore wind turbines feature larger and more efficient generators compared to onshore machines. The construction of offshore wind farms will cause electricity in Poland to be more "green" and the Polish energy sector more environmentally-friendly.

Turbines located more than 20 kilometres from the shore will not disturb the beautiful, seaside landscape of the Polish coast while driving economic growth of coastal areas and the entire country. Expert calculations demonstrate that the construction of 6 GW of offshore wind farms will create 77 thousand jobs in Poland, bring approximately PLN 60 billion of added GDP value and PLN 15 billion of CIT and VAT revenues by 2030.

Offshore wind farms in the Baltic Sea may play a key role in energy transformation of Poland towards low-emission economy, contribute to ensuring energy security of the state and help in fighting air pollution.

Offshore wind is the best energy investment Poland may opt for!

Implementation of the ambitious plans to build offshore wind farms in the Baltic Sea requires decision-makers' support. They have to:

- → Secure offshore wind farm locations in the spatial development plan for the Baltic Sea;
- → Develop and extend port and onshore infrastructure to ensure access to electricity from offshore wind farms;
- → Create an appropriate support scheme for offshore wind farms with a clearly defined time horizon.

1 INTRODUCTION

Why Poland should pursue offshore wind?

For many Polish enterprises joining the offshore wind industry is an opportunity for substantial growth

Offshore wind may create new employment opportunities in the entire country, in particular in coastal regions and will translate into higher competitiveness of the Polish economy

Production of electricity from offshore wind farms will contribute to ensuring energy security of the state

Domestic production of fossil fuels is insufficient to satisfy energy demand of Polish citizens; therefore, Poland has to import the fuels from abroad (see the "Polish energy reality — fossil fuels" section on p. 12). The situation could be changed through production of electricity from easily accessible sources, such as offshore wind. Investments in offshore wind farms may be an effective response to the challenges facing the Polish energy sector. Additionally, following the limited inflow of EU funds after 2020, the development of the sector may become the driver of economic growth for the offshore sector and the entire economy. The diagram below briefly presents the advantages Poland may gain by including offshore wind farms in its energy strategy. You are welcome to read the entire report.

Potential benefits from offshore wind farm construction:

SOCIAL

- Support for the labour market and local entrepreneurship
- Lower electricity prices
- Guaranteed stable output and electricity supply
- Lack of social conflicts

ECONOMIC

- Incentives for economic growth
- Decreased demand for electricity imports
- Support for the national contribution to the binding European 2030 RES target
- Technological development
- Lower electricity production costs
- High tax proceeds to local and state governments' budgets

ENVIRONMENTAL

- Limited emissions of pollutants
- Counteracting climate change
- Environmentally- and human-friendly electricity production

2 OFFSHORE WIND FARMS — THE VERGE OF ENERGY REVOLUTION

The offshore wind farm industry is a rapidly growing electricity production sector

Offshore wind farms use inexhaustible wind resources in the most favourable environment — at sea

Within 10 years the share of renewable energy sources in the European Union is to increase from 20 to 32 percent

European Union obliged Member States to increase renewable energy production in the years 2020—2030. Development of the sector may contribute to:

- **Increased innovativeness of the economy**
- **Growth of the labour market**
- **Protection of European citizens from emissions of pollutants**
- **Counteracting climate change**

Indirect effects may include:

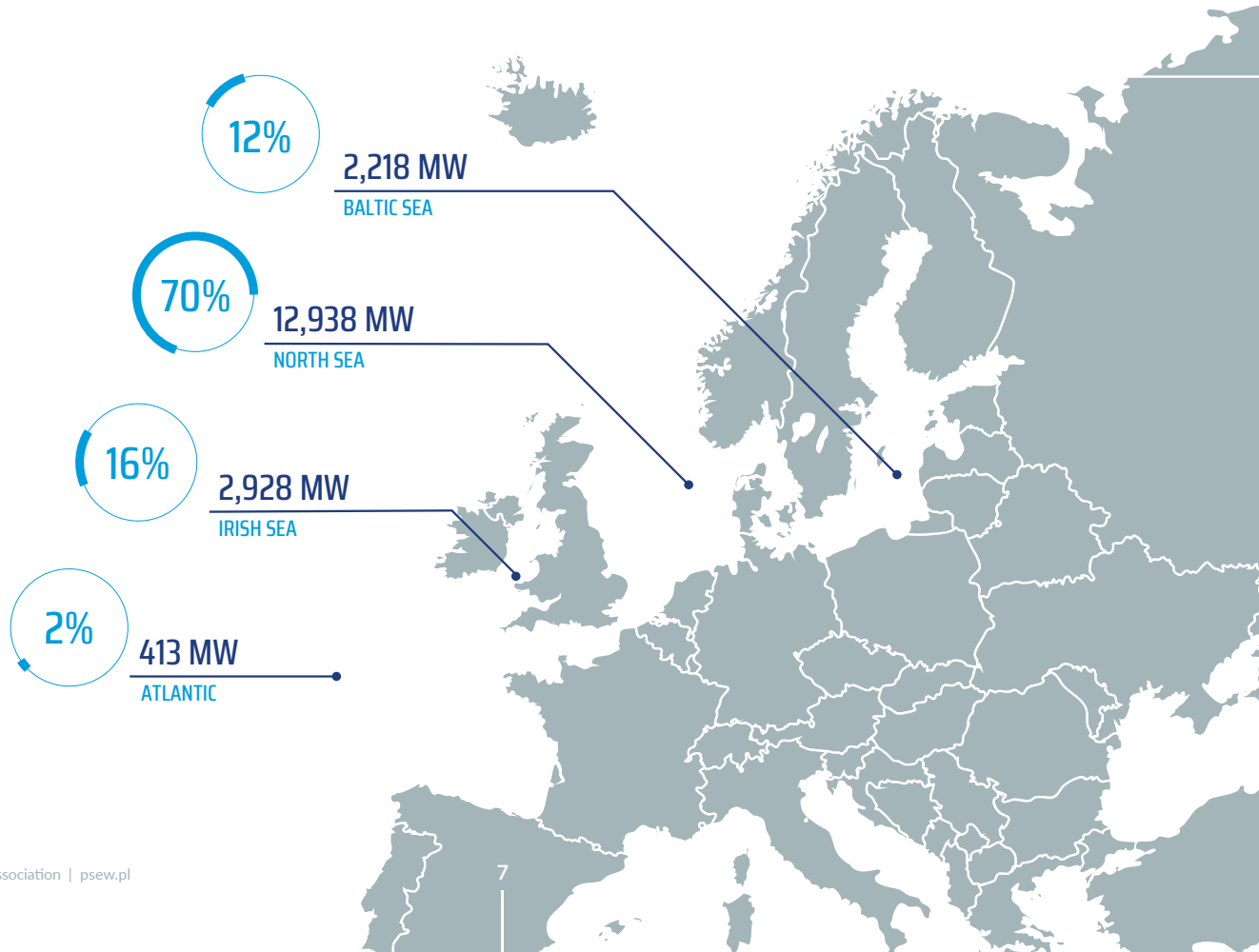
- **Low wholesale electricity prices, supporting national industry on global markets**
- **Global promotion of own technologies**

The change in the electricity generation structure entails many further technological changes — digitisation of the energy sector, investments in smart grids, development of energy storage facilities. At the end of 2018 the total offshore wind capacity in Europe reached 18,499 MW. Currently, there are 105 offshore wind farms comprising 4,543 wind turbines connected to the grid in 11 European countries, including partially connected areas (Table 2.1).

Table 2.1. Offshore wind farms connected to the grid at the end of 2018

COUNTRY	NUMBER OF CONNECTED OFFSHORE	TOTAL INSTALLED CAPACITY [MW]	WIND FARM CAPACITY CONNECTED IN 2018
United Kingdom	39	8,183	1,312
Germany	25	6,380	969
Danmark	14	1,329	61
Belgium	7	1,186	309
The Netherlands	6	1,118	0
Sweden	4	192	-10
Finland	3	71	0
Ireland	1	25	0
Spain	2	10	5
France	2	2	2
Norway	1	2	0
TOTAL	**105**	**18,499**	**2,649**

Offshore wind farms in Europe: North Sea hosts 70% of offshore wind installed capacity (12,938 MW). Irish Sea hosts 16% all capacity (2,928 MW). Baltic Sea, with 12% (2,218 MW), comes third. Atlantic accounts for 2% of installed capacity (413 MW).



3 ELECTRICITY FROM OFFSHORE WIND FARMS ENJOYS PUBLIC CONFIDENCE

Offshore wind enjoys the highest public acceptance among all electricity production technologies

More than 80% of Polish citizens think that electricity from offshore wind farms contributes to counteracting climate change

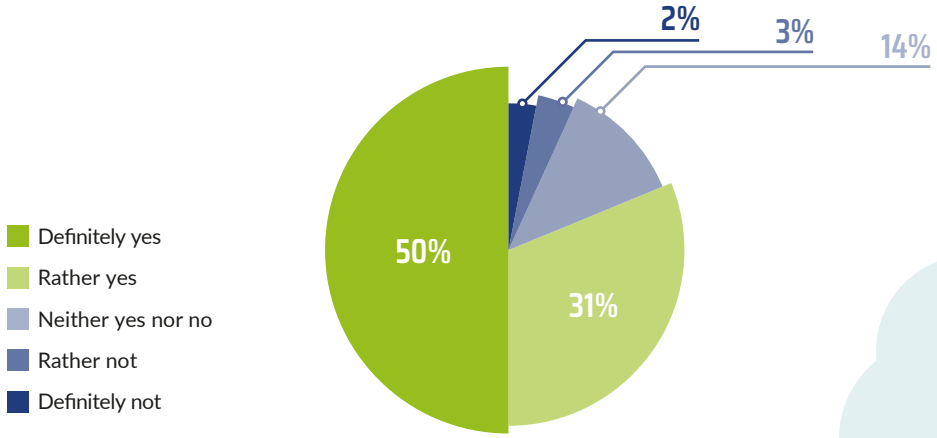
More than ¾ of Polish citizens think that offshore wind is a good or the best electricity production method from the social point of view

Almost ⅔ of Polish citizens select offshore wind as the preferred source of supply for their homes

Offshore wind enjoys the highest public acceptance among all electricity production technologies.

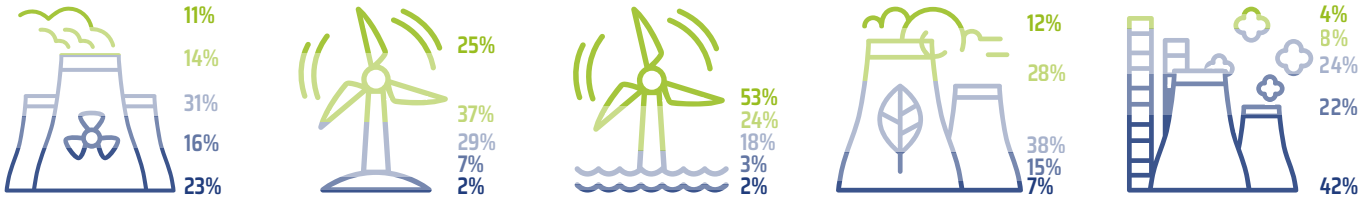
As demonstrated by a study commissioned by PWEA, Polish citizens look forward to energy sector transformation.

DO YOU THINK OFFSHORE WIND FARM DEVELOPMENT MAY CONTRIBUTE TO COUNTERACTING CLIMATE CHANGE?



81% OF POLISH CITIZENS THINK THAT OFFSHORE WIND FARM CONTRIBUTES TO COUNTERACTING CLIMATE CHANGE

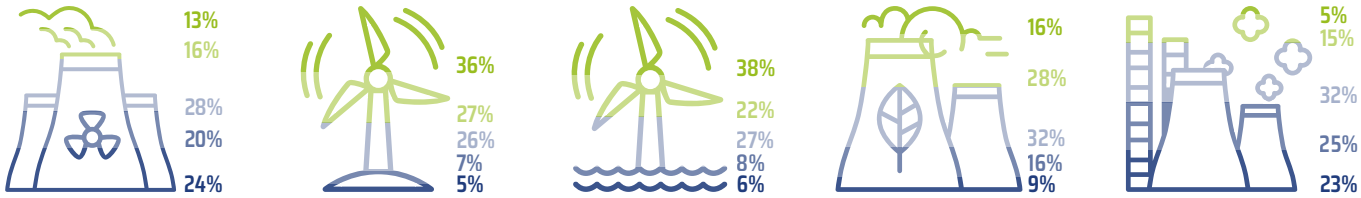
SOCIAL PERCENTPION OF PARTICULAR ELECTRICITY PRODUCTION TECHNOLOGIES



Nuclear power plant | Wind farm | Offshore wind farm | Biomass power plant | Coal-fired power plant

5 – Very good electricity production method | 4 | 3 | 2 | 1 – Very bad electricity production method

IMAGINE YOU CAN SELECT THE TYPE OF POWER PLANT SUPPLYING ELECTRICITY TO YOUR HOME



Nuclear power plant | Wind farm | Offshore wind farm | Biomass power plant | Coal-fired power plant

- I definitely support
- I rather support
- I may or may not support
- I rather not support
- I definitely not support

POLISH CITIZENS EXPRESS POSITIVE ATTITUDE TOWARDS TRANSFORMATION OF THE ENERGY SYSTEM IN POLAND

4 DOMESTIC ELECTRICITY PRODUCTION IN 2018

Polish energy sector strongly depends on fossil fuels.

CONSUMPTION

In 2018 electricity consumption in Poland reached the highest level in history

almost **171 TWh**

IMPORT

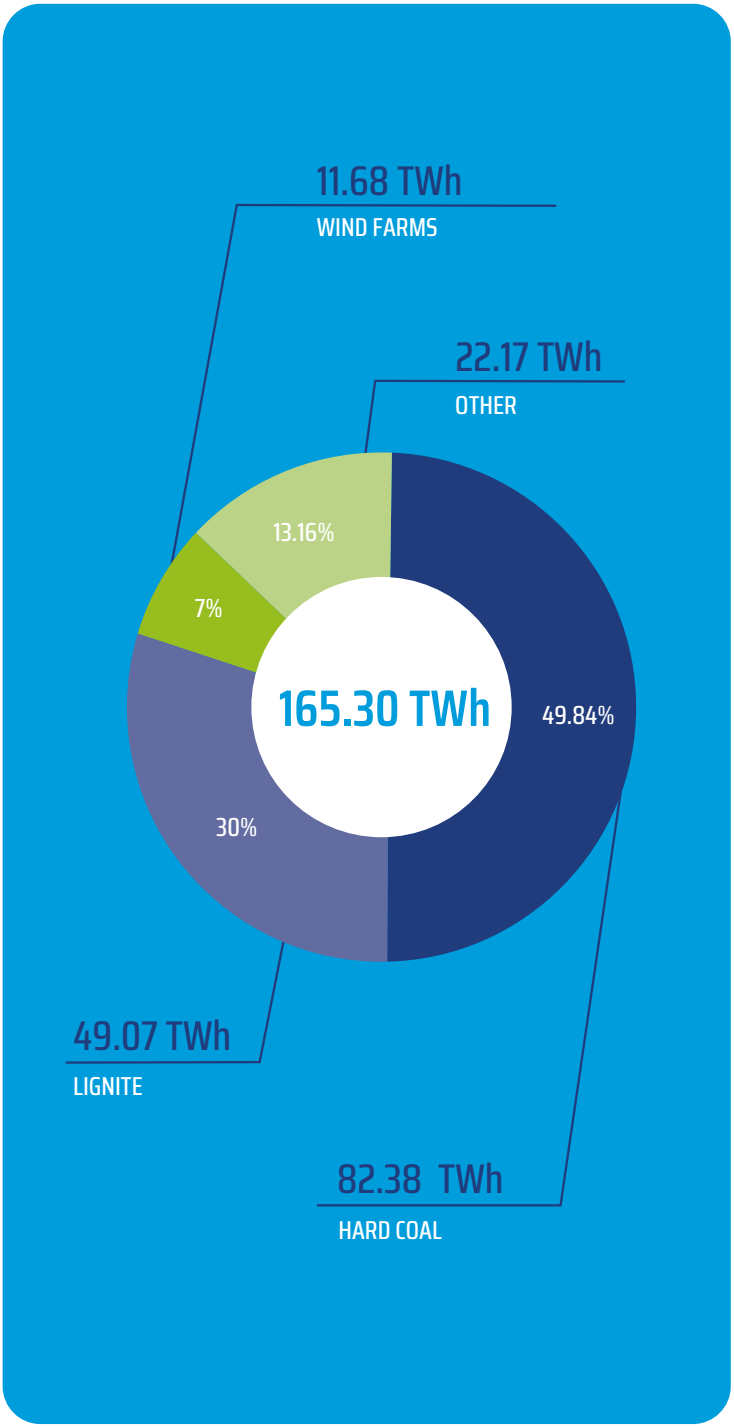
Domestic production of fossil fuels is insufficient; therefore, Poland has to import the fuels from abroad. As a result, net import of electricity to Poland in 2018 reached the highest level in history

5.7 TWh

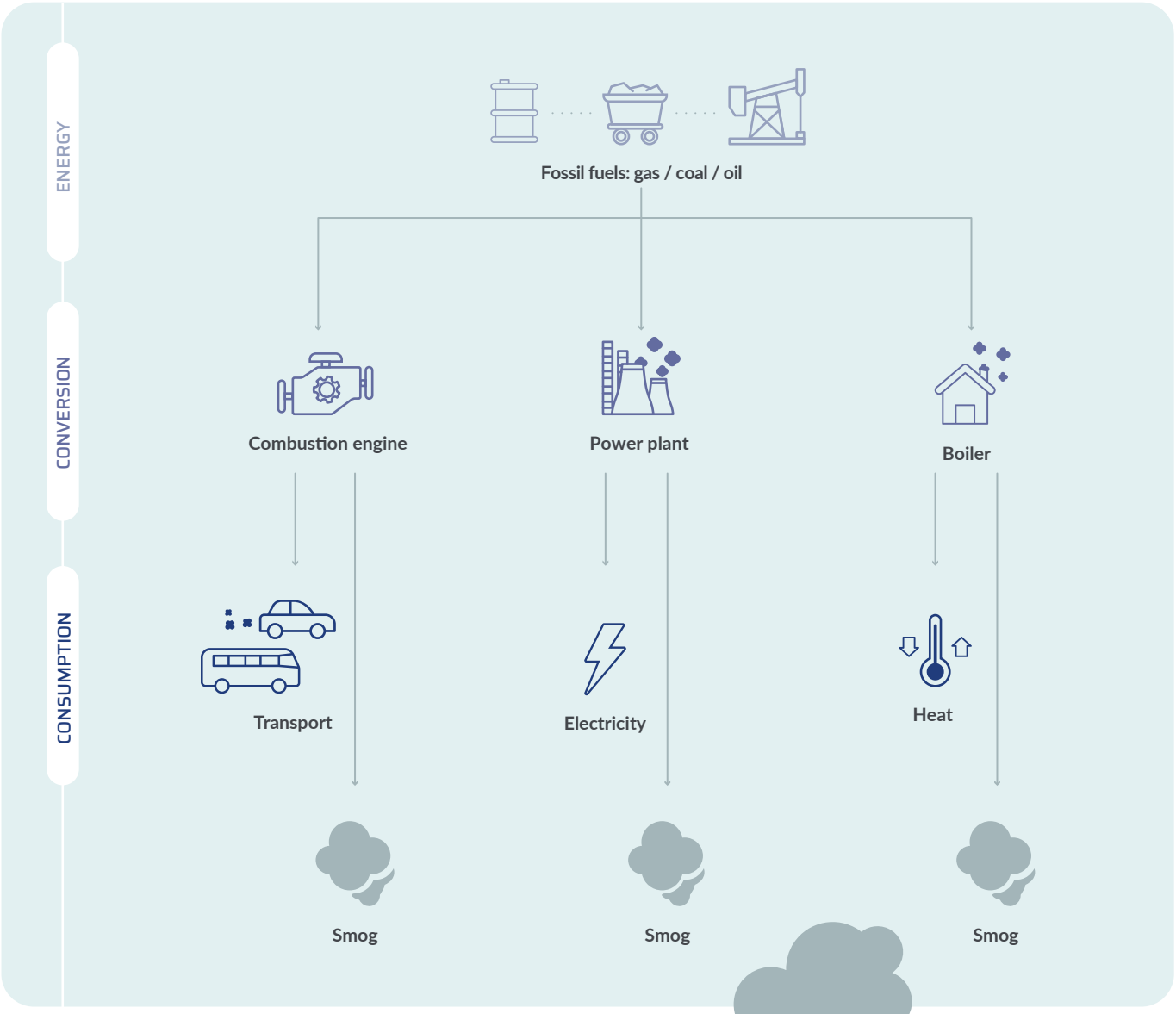
PRODUCTION

Domestic electricity production in 2018

165.3 TWh

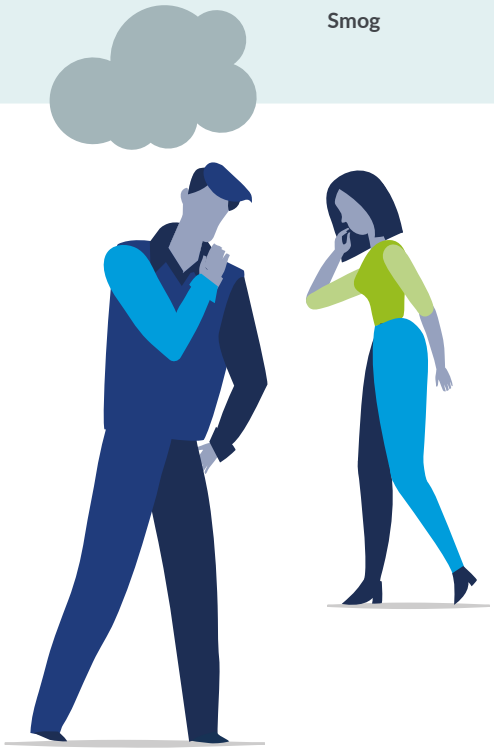


Similarly to many other countries around the world, Polish energy sector today resembles the steam engine at the beginning of the 20th century. It is based on a very simple supply chain, with the majority of revenue received by the least innovative branch of the Polish economy — coal mining.

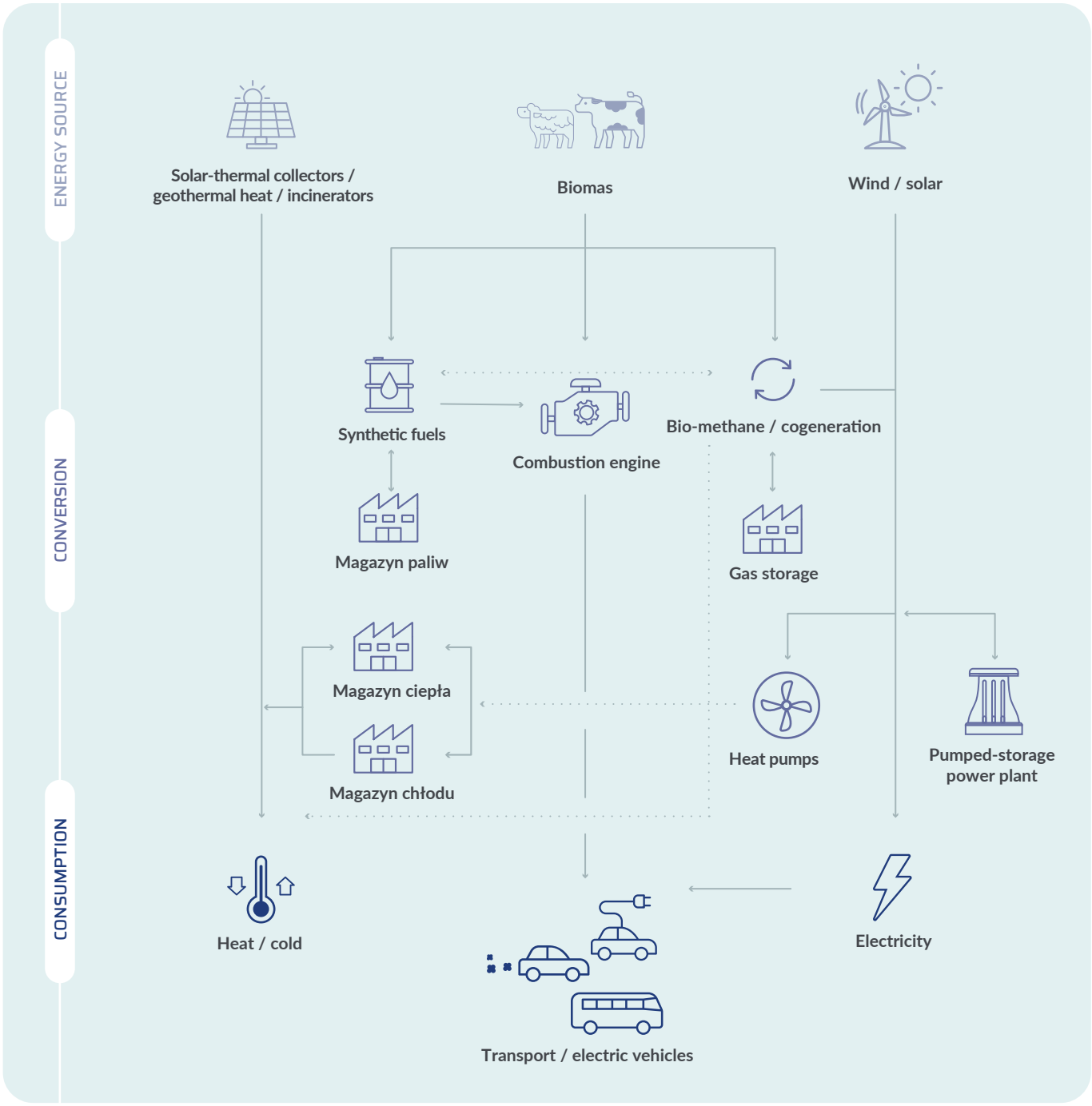


PRODUCTION OF ELECTRICITY
FROM FOSSIL FUELS CONTRIBUTES TO
OVERALL CARBON FOOTPRINT
OF ALL ELECTRICAL APPLIANCES IN POLAND,
INCLUDING ELECTRIC VEHICLES.

IT'S TIME TO CHANGE THAT!



Transformation to a new power system will require development of technologies in areas such as: energy storage, electro-mobility, cogeneration, tri-generation, heat and cold storage, heat pumps, geothermal energy, energy management systems, smart grids, smart homes and new materials, such as for instance perovskites.



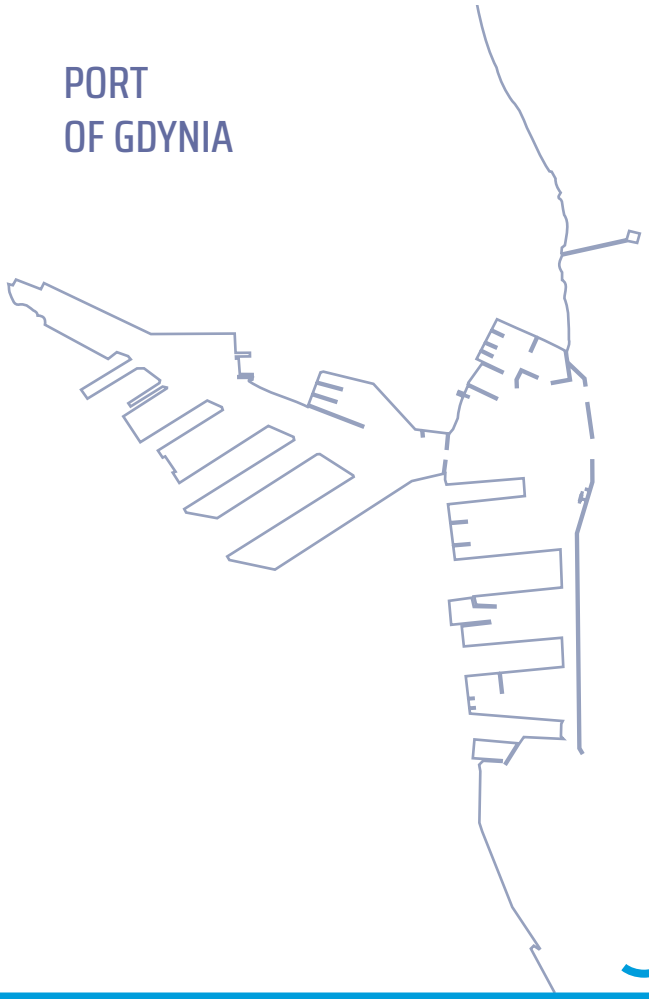
By using innovative solutions, such electricity production system will enable the Polish economy to become more sustainable and directly contribute to its growth. Whereas, conventional energy sector, in particular coal-fired, will lose its competitiveness. Next to CO_2 emission costs, conventional power plants have to incur substantial costs to mitigate emissions of a broad range of pollutants.

5 WIND FARMS — ANOTHER MILESTONE OF THE POLISH MARITIME SECTOR

Baltic Sea has always been the Polish window on the world. Today, it brings us new opportunities.

Almost a century ago the construction of Port of Gdynia became the growth driver of the country. Today, the outlook for the offshore wind farm industry may become the growth driver of the Polish economy and the maritime sector.

PORT OF GDYNIA



For many years the Baltic Sea has been crucial for the Polish economy. Ports along the Baltic coast are the Polish window to the world.

The construction of the Port of Gdynia, completed in the 1920s, was a milestone for the Polish maritime economy. The port brought new commercial opportunities for the Second Polish Republic and soon became one of the key ports in the Baltic Sea and the main base of the Polish Navy, protecting the Polish coast.

Shipbuilding industry has been an important branch of the Polish maritime sector from the very beginning. Shipyards in Gdynia, Gdańsk or Szczecin launched hundreds of vessels promoting Poland and our shipbuilding industry in the world. Polish shipyards also take part in the production of wind turbine components, preparing Poland for a technological leap into the future.

6 OFFSHORE WIND — DEVELOPMENT AND CONSTRUCTION

The production of offshore wind farms may become the flywheel of the Polish economy

As the efficiency of turbines increases, unit cost of wind farm construction is driven down. Wind farms become increasingly less expensive, therefore increasingly competitive

PROJECT PLANNING AND DEVELOPMENT (7 YEARS)

SCOPE OF DEVELOPMENT WORKS

INVESTMENT SITES FOR INDUSTRIAL PLANTS

Manufacture ofwind turbine elements and components

New jobs

Development of Polish enterprises

Wind studies

Geological survey

Environmental studies

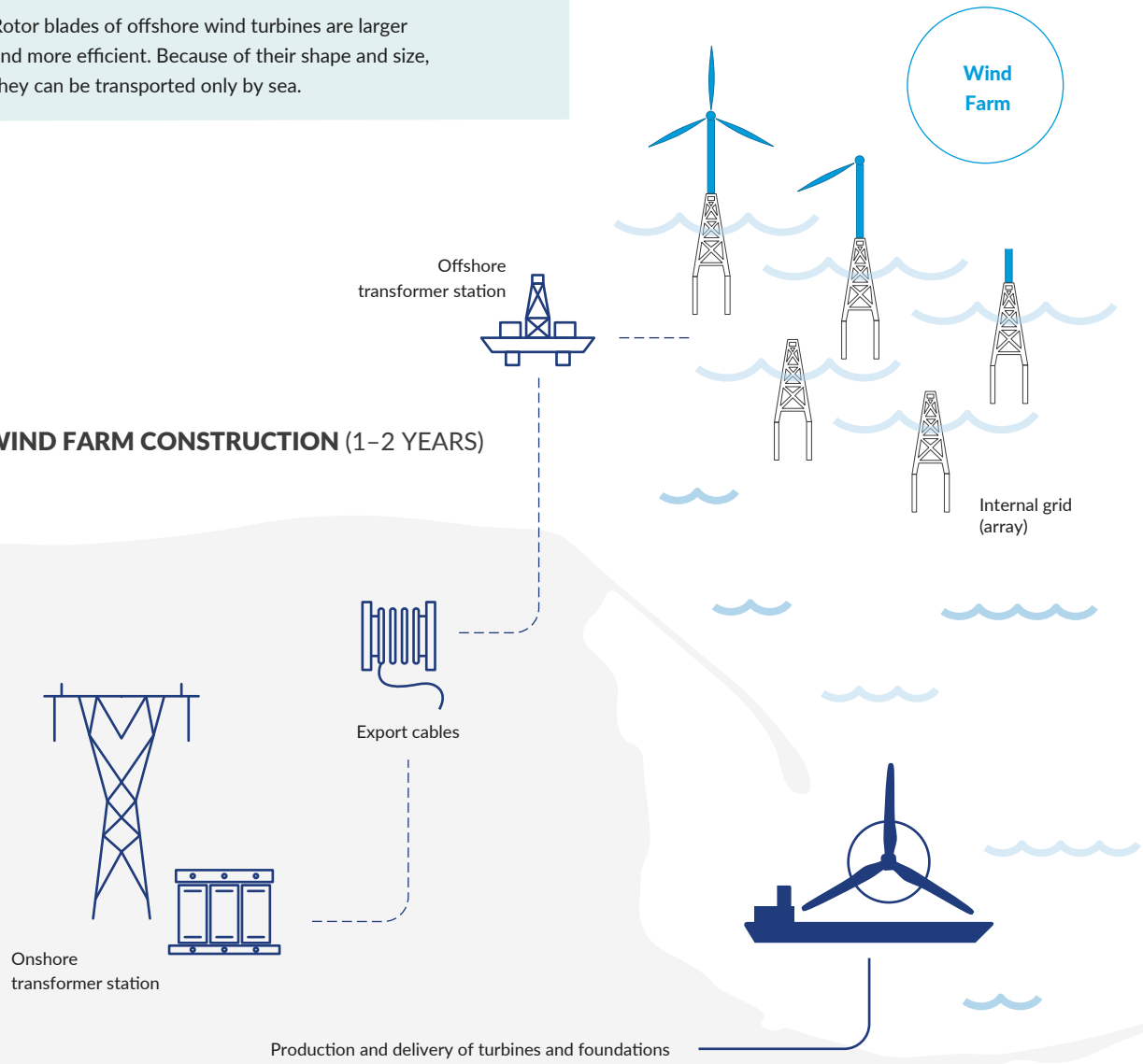
Planning and development works

Administrative matters

Wind turbines become larger and more efficient. New machines are to reach as much as 12 MW. Currently, the highest operational capacity in 9.5 MW (onshore: 7.5 MW)

Rotor blades of offshore wind turbines are larger and more efficient. Because of their shape and size, they can be transported only by sea.

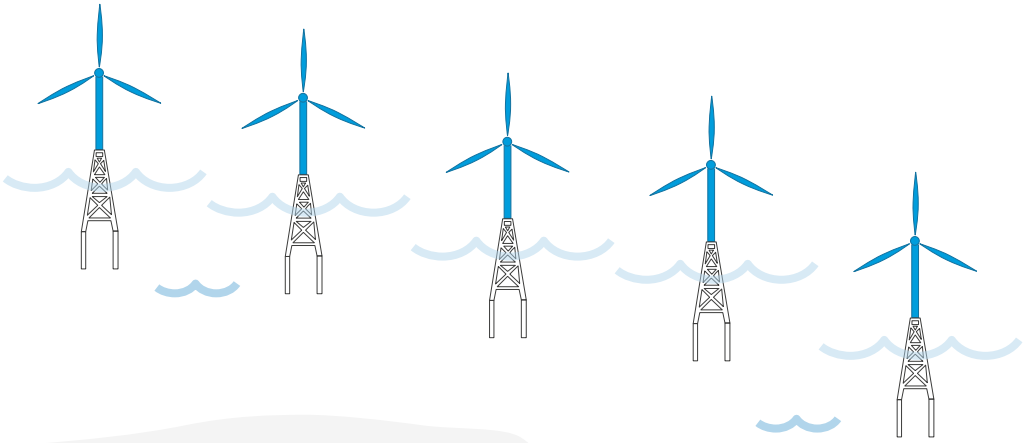
WIND FARM CONSTRUCTION (1–2 YEARS)



During construction an investor implements measures to protect the marine environment, such as damping during foundation piling

Construction is performed outside special protection periods for marine mammals, fish and birds. It is crucial to make the Baltic Sea friendly for everyone

7 OFFSHORE WIND — ELECTRICITY PRODUCTION

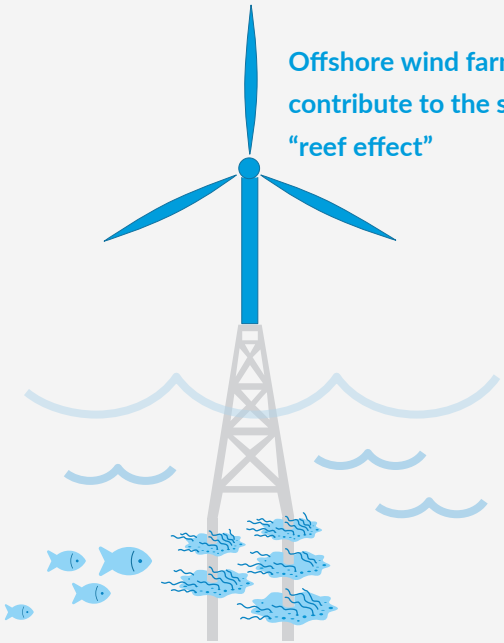


OPERATION (20–30 YEARS)

Predictable output is the key advantage of offshore wind.

CAPACITY FACTOR:

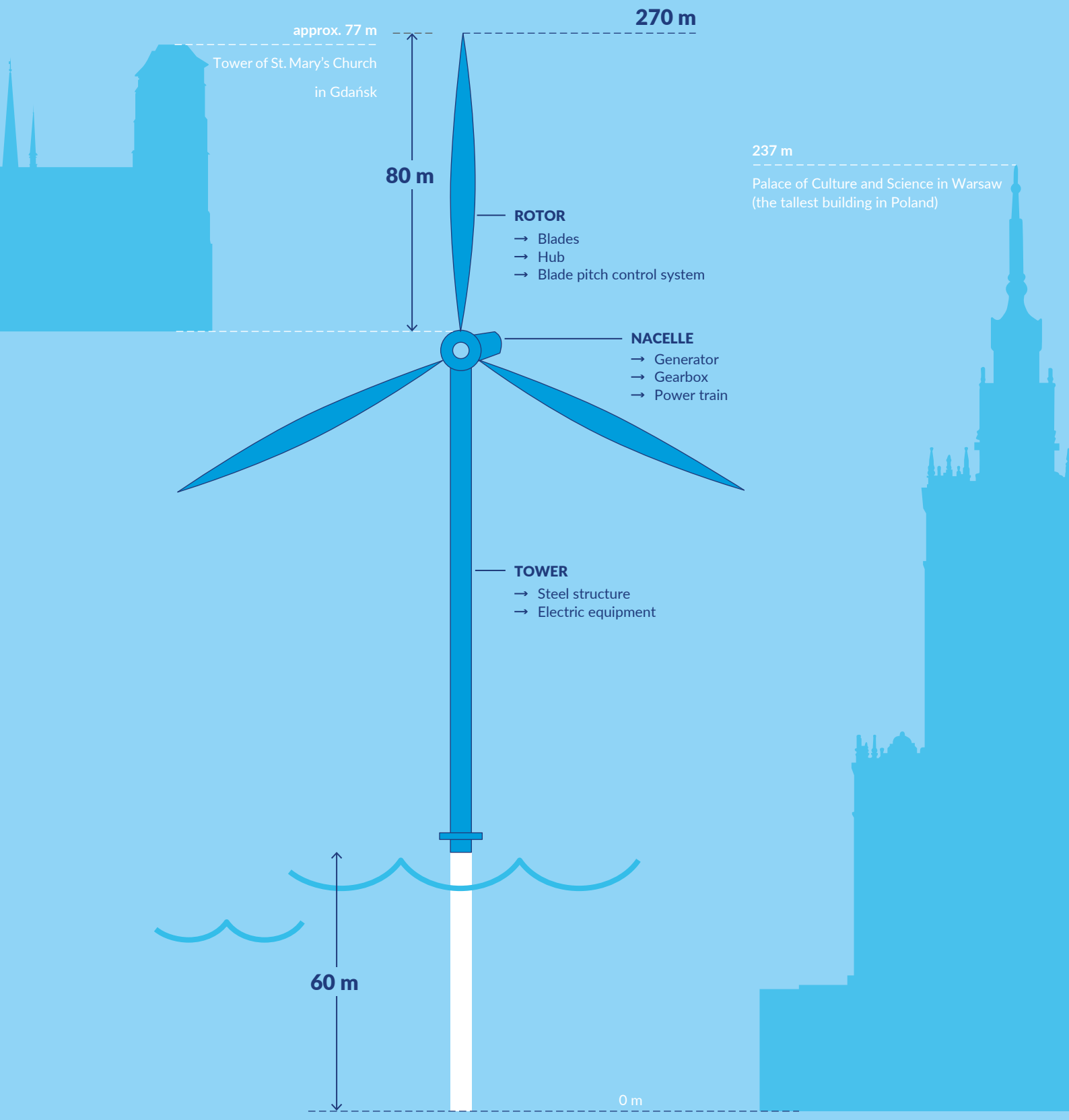
- → **50%** — for **offshore wind farms**
- → **40%** — for onshore wind farms
- → **approx. 10%** — for PV plants



Offshore wind farms contribute to the so-called "reef effect"

Offshore wind farm generates demand for a number of ancillary services required during its construction and operation, such as:

- accommodation and catering
- maritime and inland transport
- supply of fuel for maritime and inland transport
- supply of electricity
- property and contract insurance
- training and certification



A typical tower requires 300–400 tonnes of steel, with further 750–1200 tonnes for its supporting structure. 6 GW of offshore wind farm investments in the Polish Exclusive Economic Zone in the Baltic Sea will require one million tonnes of steel to be completed, creating a great opportunity for the Polish smelting and shipbuilding industry

Source: McKinsey&Company, *Developing offshore wind power in Poland. Outlook and assessment of local economic impact*, 2016, fig. 10, p. 12

8 BALTIC SEA — THE HOPE OF THE ENERGY SECTOR

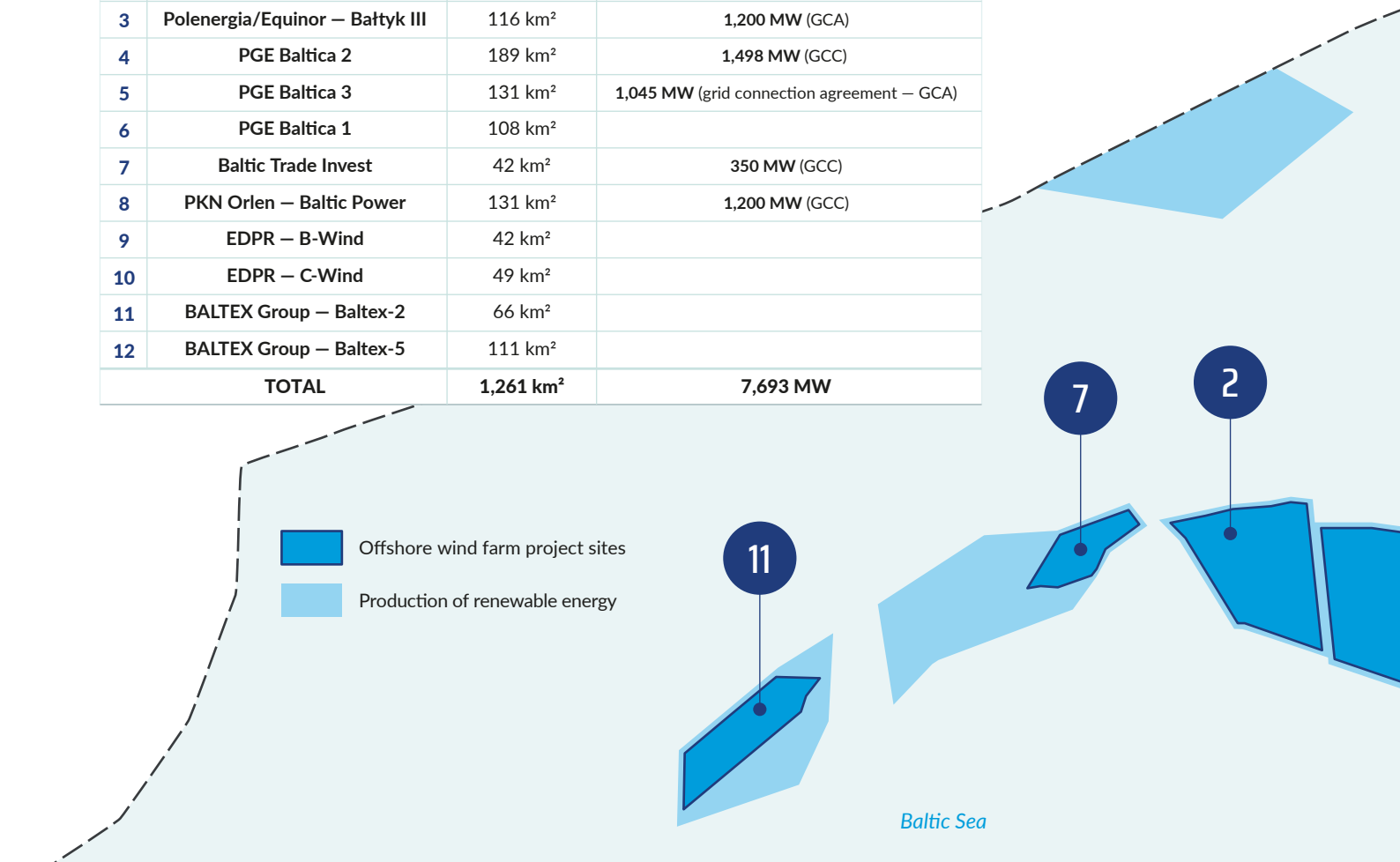
Exclusive Economic Zone — the Polish offshore

Baltic Sea has many advantages in terms of wind farm construction, such as insignificant depth and low salinity

Projects currently being in the investors' pipeline are located within the Exclusive Economic Zone

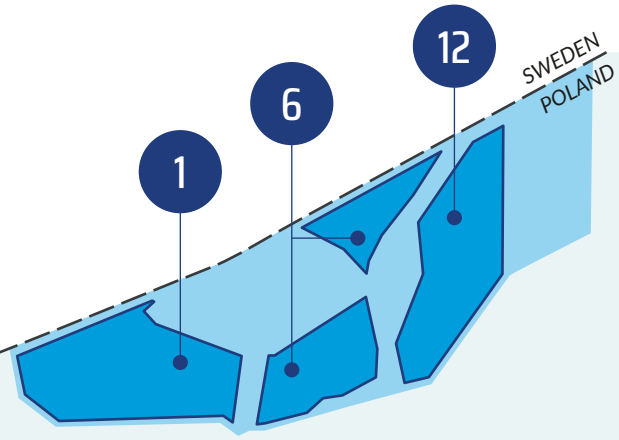
The spatial development plan for maritime areas currently being developed preliminarily establishes a number of sites with a total area of approx. 2.5 thousand km²

NO	PROJECT	AREA	GRID CONNECTION CONDITIONS
1	Polenergia — Bałtyk I	128 km²	**1,560 MW** (grid connection conditions — GCC)
2	Polenergia/Equinor — Bałtyk II	122 km²	**600 MW** (GCA) + **240 MW** (GCC)
3	Polenergia/Equinor — Bałtyk III	116 km²	**1,200 MW** (GCA)
4	PGE Baltica 2	189 km²	**1,498 MW** (GCC)
5	PGE Baltica 3	131 km²	**1,045 MW** (grid connection agreement — GCA)
6	PGE Baltica 1	108 km²	
7	Baltic Trade Invest	42 km²	**350 MW** (GCC)
8	PKN Orlen — Baltic Power	131 km²	**1,200 MW** (GCC)
9	EDPR — B-Wind	42 km²	
10	EDPR — C-Wind	49 km²	
11	BALTEX Group — Baltex-2	66 km²	
12	BALTEX Group — Baltex-5	111 km²	
	TOTAL	**1,261 km²**	**7,693 MW**



Poland's access to the Baltic Sea guarantees a number of rights and opens vast opportunities. Poland holds full jurisdiction over the territorial sea and partial jurisdiction over the Exclusive Economic Zone. The Exclusive Economic Zone (EEZ) extends up to 200 nautical miles offshore the territorial sea of a state. The boundaries of the Polish EEZ with Sweden, Russia, Denmark (since recently) and partially with Germany are established. Within their EEZ the state has exclusive fishing and extraction rights. Furthermore, they may build artificial structures and installations, such as wind farms.

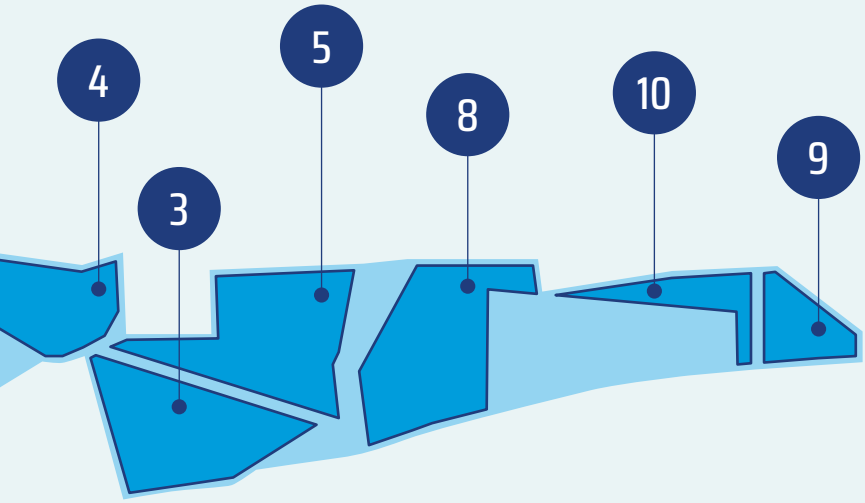
Estimating the potential of offshore wind farms in the Polish EEZ one has to take into account the area that could be allocated for wind turbine construction. The spatial development plan for maritime areas currently being developed preliminarily establishes three sites with a total area of approx. 2.5 thousand km². Considering German and Danish experience as well as estimates of wind resources in the Baltic Sea, it may be assumed that the potential of the Polish EEZ reaches at least 10–12 GW, with output potential of 50 TWh per year. This is almost one third of today's annual electricity consumption in Poland! In the "maximum" scenario the figures reach 80 TWh with 20 GW of installed capacity.

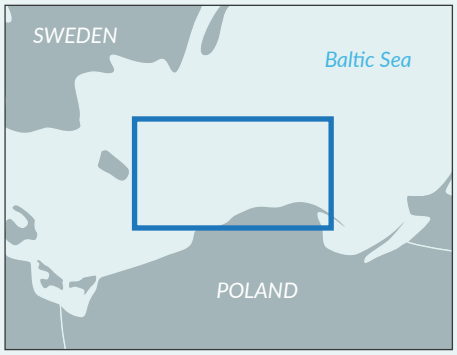


Baltic Sea

KEY ADVANTAGE OF OFFSHORE WIND FARMS

In accordance with the law, offshore wind farms will be located within the Polish Exclusive Economic Zone, hence out of sight of inhabitants of coastal areas and tourists resting on the beaches. The lack of social conflicts is a great advantage of the technology.





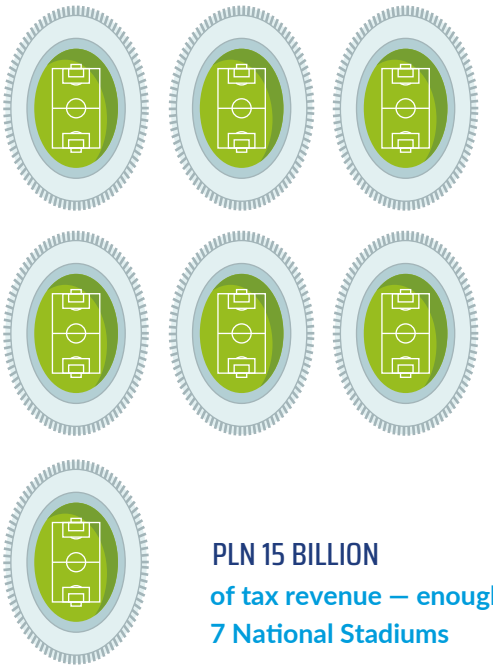
9 BENEFITS: GENERAL EFFECTS FOR THE ECONOMY

- Offshore wind may contribute as much as PLN 60 billion to GDP by 2030
- Offshore wind farms may contribute PLN 15 billion to the state and local governments' budgets by 2030
- Offshore wind may become one of the economic growth drivers in Poland after 2020, when the current financial perspective will end

Offshore wind energy brings innovation to the Polish economy

What macro effects will be brought by offshore wind farms? It is estimated that the construction of 6 GW in the Baltic Sea will create 77 thousand jobs and bring approximately **PLN 60 billion of added GDP value and PLN 15 billion of CIT and VAT revenues**.[1] Apparently, the project is of no small importance for the entire Polish economy. Furthermore, the entire supply chain may also work for **export**. The construction of a strong industry supporting the offshore wind energy sector will consolidate the position of Poland, also on the regional scale.

Next to Denmark, Germany and Poland, offshore wind farms will also be built by other Baltic Sea states. Polish enterprises may deliver up to 50 percent of components required to build offshore wind farms. Currently, the majority of the enterprises is export-oriented; however, the scale of their operations could substantially increase had the domestic market opened to them. Moreover, offshore wind energy development in Poland will require education of experts in many areas, not only technical. This opens new cooperation opportunities for the business and scientific sectors in terms of R&D and educational projects.



PLN 15 BILLION
of tax revenue — enough to build 7 National Stadiums

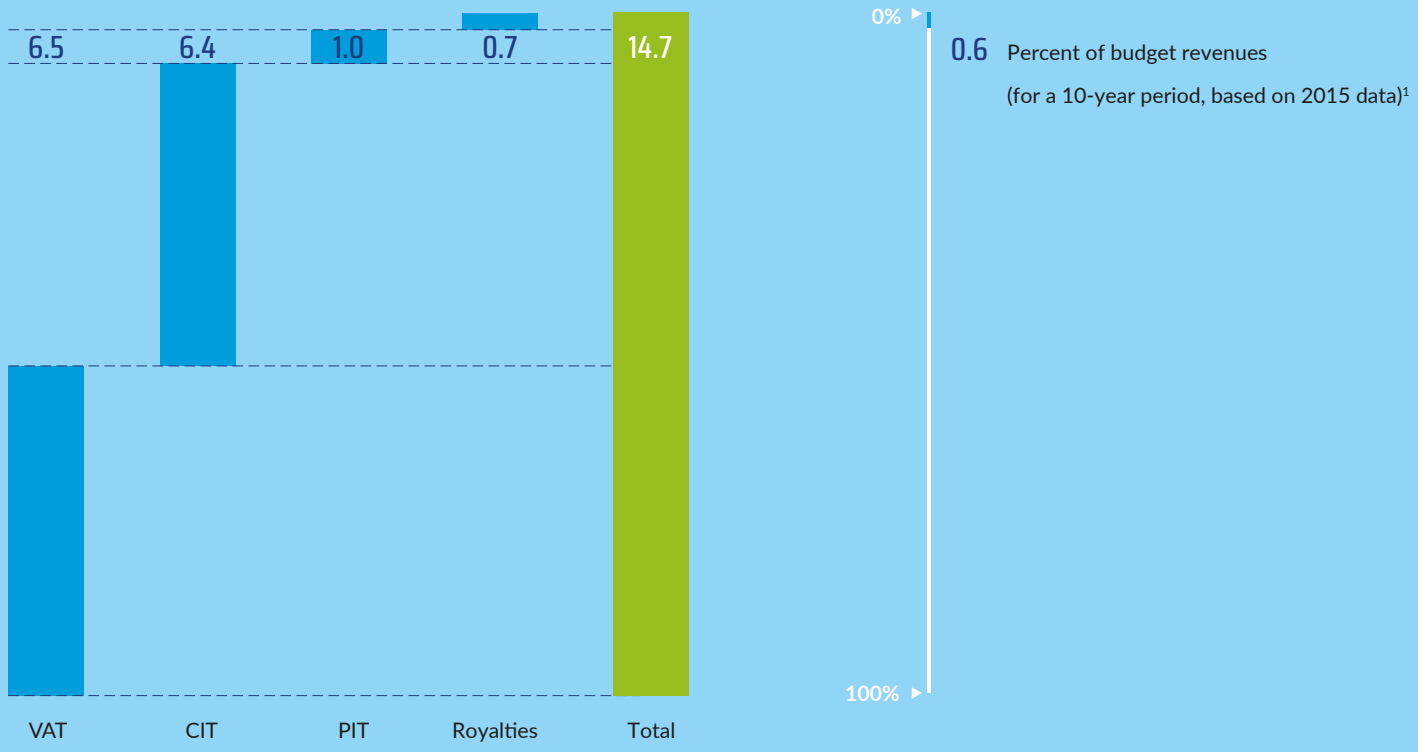
1540 KM

PLN 60 BILLION
allows for the construction of 1,540 km of expressways

[1] Source: McKinsey & Company: Developing offshore wind power in Poland. Outlook and assessment of local economic impact, 2016

The development of offshore wind energy in Poland may bring PLN 15 billion of budget revenues from taxes and fees

IMPPACT ON BUDGET REVENUES BUDŻETOWE, PLN BILLION



Source: McKinsey&Company, Developing offshore wind power in Poland. Outlook and assessment of local economic impact, 2016, fig. 18, p. 24

The market has a great outlook. Power utilities tend to perceive offshore wind farms as the source of clean, pollution-free electricity more and more often. In Poland the pioneers of offshore wind farm projects include **Polenergia** and **PGE**. The companies hold the most advanced Baltic Sea projects. However, a serious approach to offshore wind is also demonstrated by other companies, such as **PKN Orlen** or **Tauron**.

It could be said that in favourable environment offshore wind will become the key development path of the energy sector in Poland. For traditional power utilities offshore wind will become the way to reduce carbon footprint of their production portfolio, eventually translating into lower **customer prices**. Furthermore, it will improve their financial standing, for offshore wind is a stable source of revenue, in particular if appropriate contracts are signed. For other investors this will be just a profitable business, for the developing country will need more and more electricity.

[1] compared to 260 billion of 2015 tax revenue. Source: Central Statistical Office; McKinsey

10 BENEFITS: DEVELOPMENT OF POLISH ENTREPRENEURSHIP

Offshore wind farms create development opportunities for Polish steel and shipbuilding industry

- Manufacture of wind farms and foundations are two key elements of the supply chain
- Offshore wind energy may contribute to the creation of 77 thousand jobs by 2030
- Offshore wind farms will create new employment opportunities in the entire country, in particular on the coast
- For many Polish enterprises joining the offshore wind industry is an opportunity for substantial growth

Offshore wind energy supply and value chain is very long and comprises numerous institutions and companies. More than 100 Polish entities that could successfully join the development, construction and operation of wind farms in the Polish Baltic Sea have already been identified.

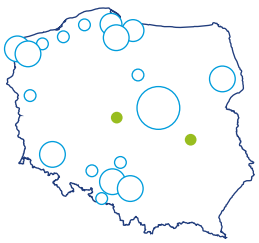
The project supply chain primarily includes the manufacture of turbine components, such as blades, pitch control system, generators, gearboxes, power trains etc. Furthermore required are steel tower structures, supporting structures, electric equipment. The construction of 6 GW of wind turbines requires one million tonnes of steel. In Poland there are many companies capable of developing appropriate designs, performing offshore tests and delivering and installing many parts and components.

Offshore wind farm investments also require other elements, such as investment sites for industrial plants, maritime and inland transport, accommodation and service providers, training etc. Furthermore, offshore wind farms entail an entire dedicated fleet: heavy-lift jack-up (HLJV), cable-laying (CLV) and offshore support vessels (OSV). Polish design offices already gained experience in their design, whereas Polish shipyards — in their construction. Therefore, offshore wind energy development will be a strong development impulse for the shipbuilding industry.

The sector's development will also benefit ports, where new piers and basins will be necessary. This also pertains to smaller harbours, such as Ustka, Darłowo, Kołobrzeg, Władysławowo and Łeba. In accordance with preliminary assumptions, construction and maintenance vessels are to operate from such smaller ports. Although offshore wind farm construction will require investment in the modernisation of the ports, demand for their services will be secured for decades, because typical offshore wind farm lifetime is at least 25 years.

There are many cable and electric equipment manufacturers in Poland that may deliver supplies and equipment required to build offshore wind farm connection grids.

Offshore wind — Supply chain in Poland



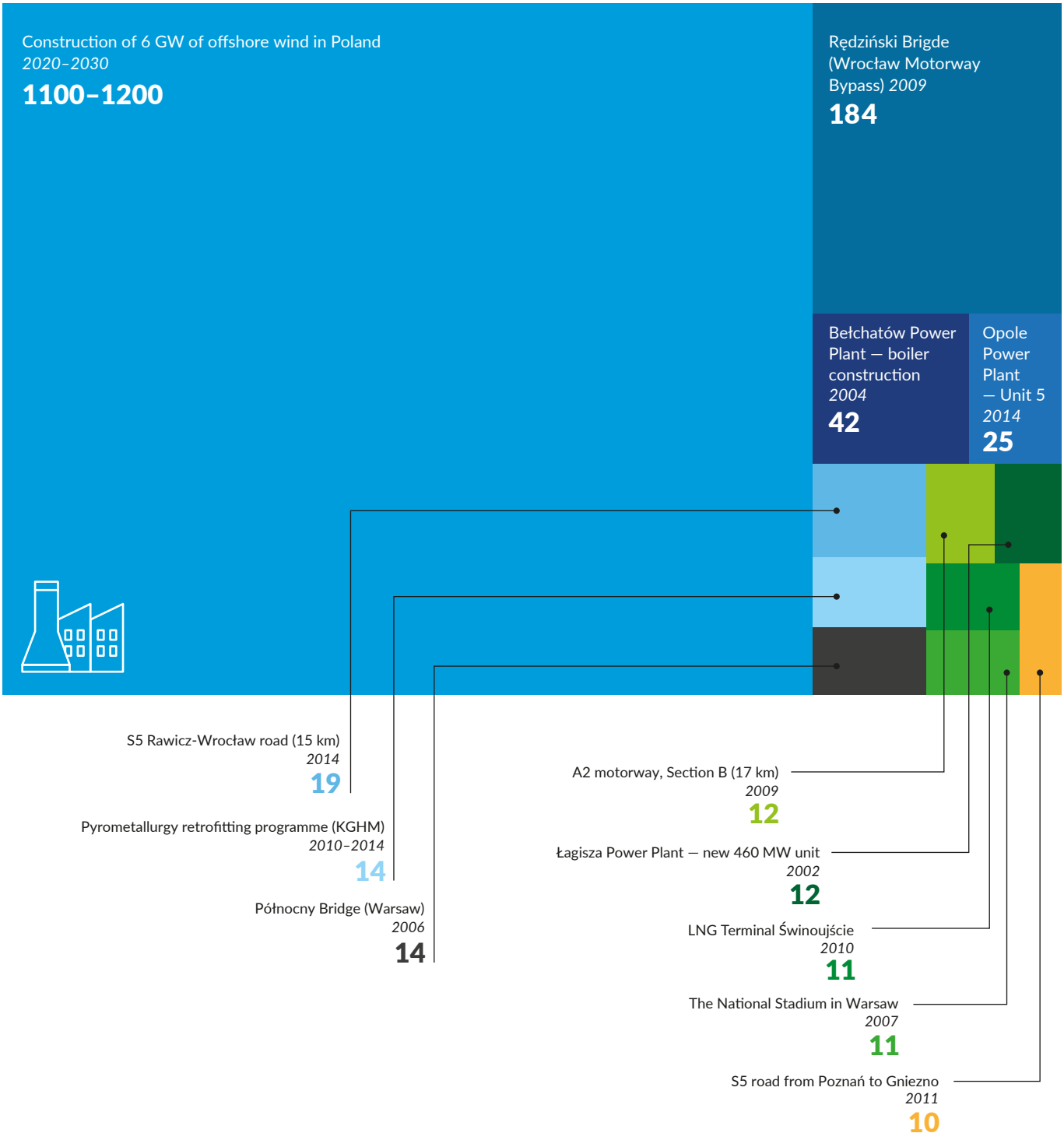
77 THOUSAND
new jobs in the offshore sector in Poland in 2030 — equal to the population of Konin or Siedlce

78
active enterprises in the Polish offshore wind farm supply chain

PLN 60 BILLION
GDP growth by 2030 due to offshore wind farms

Wind energy development could become the largest steel-intensive project of the last 25 years

THE LARGEST INFRASTRUCTURAL PROJECTS IN POLAND BY STEEL CONSUMPTION (THOUSAND TONNES)



Source: McKinsey&Company, Developing offshore wind power in Poland. Outlook and assessment of local economic impact, 2016, fig. 20, p. 26

More than 140 entities participating in the offshore wind energy supply chain in Poland were identified

Entities participating in the offshore wind energy supply chain in Poland

ABB Sp. z o.o.	JW Steel Construction Sp. z o.o.	Przedsiębiorstwo Robót Czerpalnych i Podwodnych Sp. z o.o.
Agencja Rozwoju Przemysłu S.A.	K2 Management	Przemysłowy Instytut Maszyn Budowlanych Sp. z o.o.
BIC Polska sp. z o.o.	Katowicka Specjalna Strefa Ekonomiczna	PUP Gotech Sp. z o.o.
Bladt Industries Polska Sp. z o.o.	KCI Park Technologiczny Krowodrza S.A.	PZU Powszechny Zakład Ubezpieczeń S.A.
Bydgoskie Zakłady Przemysłu Gumowego STOMIL S.A.	Kersten Europe Sp. z o.o.	Regionalny Fundusz Gospodarczy S.A.
C.Hartwig Gdynia S.A.	KK Wind Solutions Polska Sp. z o.o.	Remontowa Shipbuilding S.A.
C.T.C. Shipbuilding	Kostrzyńsko-Słubicka Specjalna Strefa Ekonomiczna S.A.	Renewable Energy Sp. z o.o.
Centralny Ośrodek Badawczo Rozwojowy COBRABiD Sp. z o.o.	Krakowski Park Technologiczny Sp. z o.o.	Rig Engineering Sas
Centrum Produkcyjne Pneumatyki PREMA S.A.	Laboratorium Inteligentnego Miasta i Innowacyjnej Gospodarki S.A.	Senvion Polska Sp.z.o.o.
Centrum Techniki Okrętowej (CTO) S.A.	Legnicka Specjalna Strefa Ekonomiczna S.A.	SHIP – SERVICE S.A.
Crist S.A.	LM Wind Power Blades Poland Sp. z o.o.	Sieci hotelarskie i hotele
DALMOR S.A.	Lokale gastronomiczne w miastach portowych	Siemens AG
DANO Sp. z o.o.	Lotos Grupa S.A.	Siemens Gamesa Renewable Energy S.A.
DES ART Sp. z o.o.	Łambinowicka Fabryka Maszyn CELPA S.A.	SPIE Elbud Gdańsk S.A.
Doraco Sp. z o.o.	Marine Projects Ltd Sp. z o. o.	ST3 Offshore Sp. z o. o.
EDP Renewables (EDPR)	MARS Shipyards & Offshore	Stocznia Gdańsk S.A. w upadłości
ELBUD Warszawa Sp. z o.o.	Mega S.A.	Stocznia Gdynia S.A. w upadłości
Electrum Sp. z o.o.	MHI Vestas Offshore Wind A/S	Stocznia Remontowa NAUTA S.A.
Elektromontaż Gdańsk S.A.	Morska Agencja Gdynia Sp. z o.o.	Stocznia Szczecińska Nowa Sp. z o.o. w upadłości
Elektromontaż Wschód Sp. z o.o.	Morska Stocznia Remontowa „Gryfia" S.A.	Stocznia Szczecińska Porta Holding S.A. w upadłości
Elfeko S.A.	Mostostal Warszawa S.A.	StoGda Ship Design & Engineering Sp. z o.o.
Enea S.A.	Mostostal Siedlce Sp. z o.o.	Stomil-Poznań S.A.
Energa S.A.	MPL Techma Sp. z o.o.	Szczeciński Park Przemysłowy Sp. z o.o.
Energomontaż – Północ Gdynia S.A.	Nexans S.A.	TAURON Polska Energia S.A.
Energop Sp. z o.o.	NKT Cables S.A.	Technical Ship Management Sp. z o.o.
Euros Polska Sp. z o.o.	NLMK Dansteel A/S	Tele-Fonika Kable S.A
Fabryka Elementów Złącznych S.A.	Nowe Centrum Administracyjne Sp. z o.o.	Total Wind PL Sp. z o.o.
Fabryka Łożysk Tocznych – Kraśnik S.A.	Oktan Energy & V/L Service Sp. z o.o.	Tritec Production Sp. z o.o.
Fabryka Przewodów Energetycznych S.A.	Ormazabal Sp. z o.o.	VIATEC Sp. z o.o.
Fabryka Przyrządów i Uchwytów BISON-BIAL S.A.	Ośrodek Badawczo-Rozwojowy Centrum Techniki Morskiej S.A.	Vistal Gdynia S.A.
Fabryka Radiatorów „Stąporków" S.A.	Ośrodek Badawczy Ekonomiki Transportu Sp. z o.o.	Walcownia Metali Nieżelaznych „ŁABĘDY" S.A.
Federal-Mogul BIMET S.A.	PGE Polska Grupa Energetyczna S.A.	Warszawski Holding Nieruchomości S.A.
Finomar Sp. z o.o.	PGNiG Polskie Górnictwo Naftowe i Gazownictwo S.A.	Wojskowe Zakłady Inżynieryjne S.A.
General Electric International S.A.	PGO S.A.	Wojskowe Zakłady Kartograficzne Sp. z o.o.
Global Maritime Sp. z oo..	Piastowskie Zakłady Przemysłu Gumowego STOMIL Sp. z o.o.	Zakłady Chemiczne JELCHEM S.A.
Gotech Sp. z o.o.	PKN ORLEN S.A.	Zakłady Mechaniczne CHEMITEX Sp. z o.o.
Grupa Aldesa	PKP Polskie Linie Kolejowe S.A.	Zarząd Morskich Portów Szczecin i Świnoujście S.A.
GSG Towers Sp. z o.o.	Polenergia S.A.	Zarząd Morskiego Portu w Darłowie Sp. z o.o.
H. Cegielski – Poznań S.A.	Polimex-Mostostal S.A.	Zarząd Morskiego Portu Gdańsk S.A.
Hochtief Polska S.A.	Polmo Gniezno Sp. z o.o.	Zarząd Morskiego Portu Gdynia S.A.
Huta Łabędy S.A.	Polska Żegluga Bałtycka S.A.	Zarząd Morskiego Portu Kołobrzeg S.A.
Huta Stalowa Wola S.A.	Polski Holding Nieruchomości S.A.	Zarząd Morskiego Portu w Łebie
innogy Polska S.A.	Polski Rejestr Statków S.A.	Zarząd Morskiego Portu w Ustce Sp. z o.o.
INOFAMA S.A.	Polskie Centrum Badań i Certyfikacji S.A.	
Instytut Automatyki Systemów Energetycznych Sp. z o.o.	Poltramp Yard S.A.	
Instytut Morski w Gdańsku	Pomorska Specjalna Strefa Ekonomiczna Sp. z o.o.	
Int. Production JCS Sp. z o.o.	Proxmus Sp. z o.o.	
Jastrzębskie Zakłady Remontowe Sp. z o.o.	Prysmian Group (EKSA Sp. z o.o.)	

11 BENEFITS: A STABLE ENERGY SOURCE

Wind: inexhaustible energy source

Offshore wind farms operate for more than 90% of the time

Production of electricity from offshore wind farms contributes to ensuring energy security

Wind turbines produce electricity only when the wind blows, not when it is necessary. This is the very nature of wind energy and one of the most frequent charges against the technology.

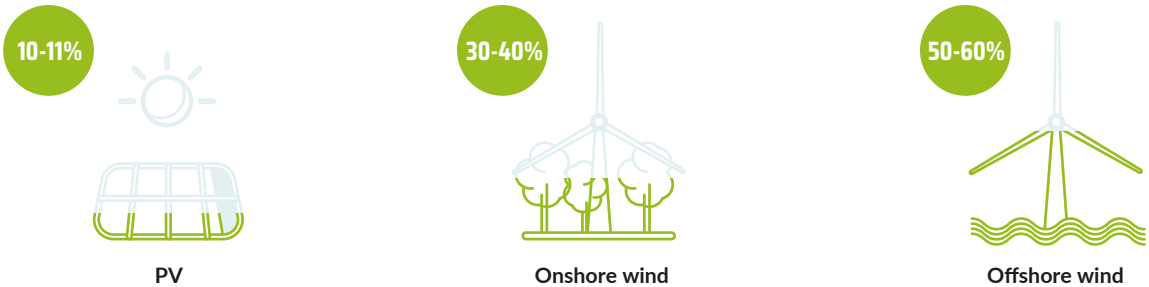
In practice offshore wind farms operate for mote than 90 percent of the time. The average capacity factor in the Polish Baltic Sea area will exceed 50 percent and may reach as much as 60 percent in the future.

Offshore wind farms will operate with capacity factor higher than the majority of hydro power plants in Poland and comparable to coal-fired power plants.

If it happens to be no wind, there is a number of solutions to face the challenge. These include existing conventional power plants, pumped-storage power plants and CHPs with heat accumulators. In the future the available options will also include the increasingly popular demand side response as well as energy storage facilities and cross-border exchange with neighbouring countries, should there be plenty of wind offshore.

Offshore wind energy is the most efficient renewable energy source

Comparison of average installed capacity factor



The conditions for PV and wind energy in Denmark are similar to Poland

12 HOW TO WISELY AID OFFSHORE WIND DEVELOPMENT?

Prospective legislative changes and administrative decisions to improve the position of offshore wind farms

TO ENSURE THE SECTOR'S FUTURE IT IS NECESSARY TO:

Secure offshore wind farm locations in the spatial development plan for the Baltic Sea

Develop and extend port and onshore infrastructure to ensure access to electricity from offshore wind farms

Create an appropriate support scheme for offshore wind farms with a clearly defined time horizon, preferably in the form of a dedicated law

CURRENTLY PENDING

1. Design
2. Construction

NEXT STEPS

1. Extension of ports
2. Construction of appropriate vessels
3. Construction of connection infrastructure

POLITICAL SUPPORT

1. Securing appropriate area and locations for offshore wind farms in the spatial development plan for Polish maritime areas now being developed.
2. Defining priorities for the use of the Polish Exclusive Economic Zone to the benefit of offshore wind farms.
3. Considering large enough areas for technical infrastructure necessary to connect offshore wind farms to the National Power System in the spatial development plan for Polish maritime areas now being developed.
4. Attractive and stable support scheme for offshore wind farms, including guarantees that electricity from offshore wind farms will be sold at an adequate price.

SUPPORT BY THE NATIONAL POWER SYSTEM OPERATOR

1. Investments in transmission infrastructure necessary to connect offshore wind farms — both short- and long-term.

With the aid of political decision-makers, the Polish offshore wind farm construction programme could be launched already in 2022.

Obviously, everything needs to be prepared sufficiently in advance. As mentioned above, in projects and studies in certain areas are already being carried out. The next step is to prepare technical facilities, i.e. **commence extension of ports and construction of appropriate vessels.** Companies already producing for the offshore wind energy sector must prepare for increased demand.

However, in order to move the entire offshore wind farm construction programme **forward, a number of administrative and political decisions is required**. This includes a political decision on the future shape of the Polish energy sector. Two issues are fundamental for wind farms.

FIRST

In order to fully exploit their potential, the place of offshore wind farms in the first in the history spatial development plan for Polish maritime areas now being developed must be guaranteed.

However, the wind industry is warning that the current draft of the plan is disadvantageous for wind farms. This is because the areas whose primary purpose is to be the production of electricity from renewable sources may be limited and no areas large enough for the construction of **technical infrastructure required to connect offshore wind farms to the National Power System** have been designated. The main reason is the planned adjustment of the existing navigation routes and the establishment of new routes, related to port expansion plans. The limitation of the offshore wind farm potential is estimated at **4–5 GW** assuming target installed capacity of **12 GW**. This would leave the investors areas enabling the construction of **7–8 GW**. The figure, although still high, in the long-term perspective limits not only the production potential, but also the range of the offshore wind farm programme in the economy and its contribution to the development of the entire country.

Furthermore, the draft spatial development plan in its current form hinders, if not precludes, potential further extension of offshore wind farm sites beyond the preliminarily proposed areas.

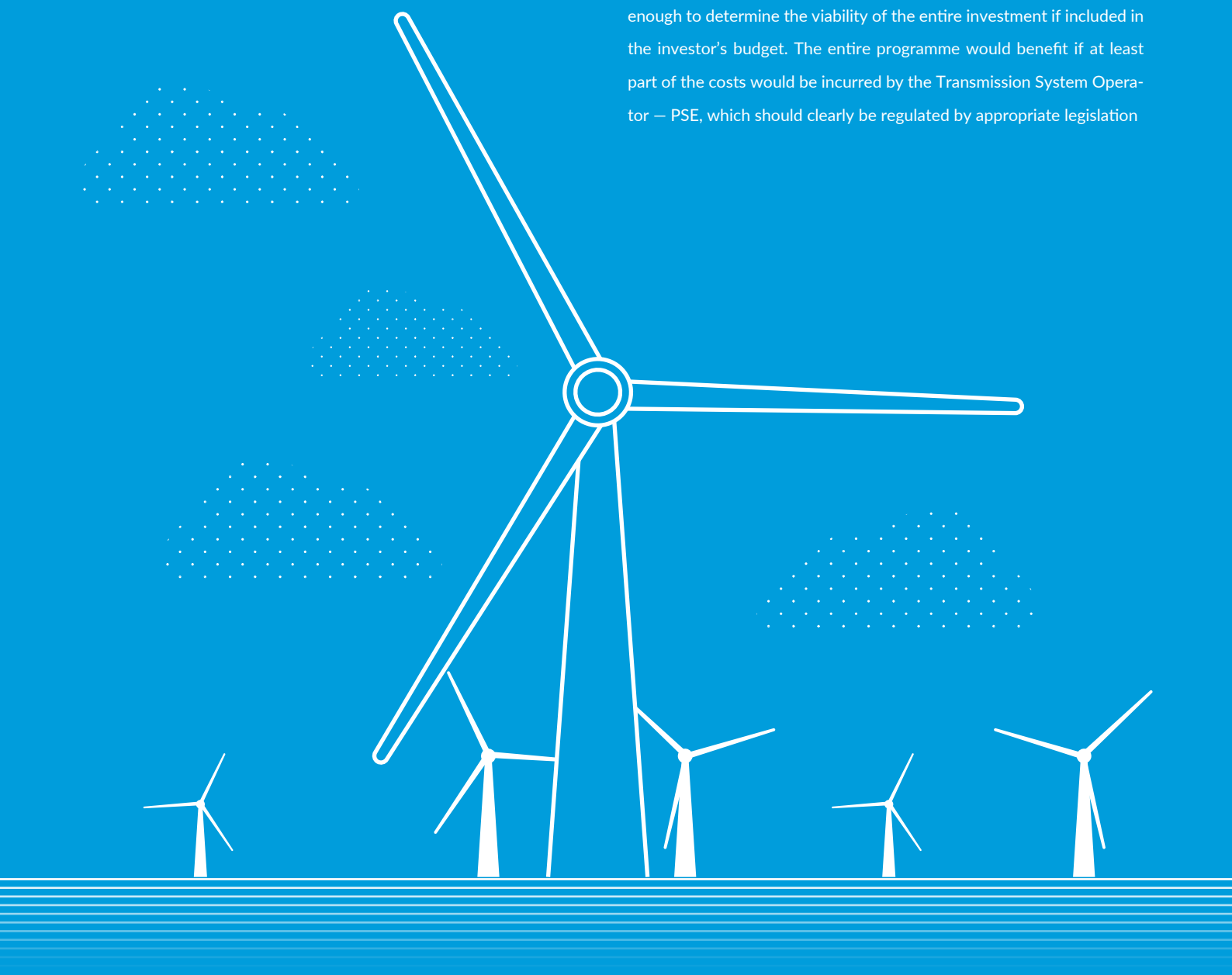
A prerequisite for the full development of the offshore wind energy programme, with all benefits for the Polish economy, is to secure the areas for the future development of the offshore wind energy sector. If one is planning to build 6 GW by 2030, the outlook and opportunities in the subsequent years are much higher. The spatial development plan of maritime areas should be a document binding for decades. Therefore, it must take into account the long-term goals and benefits stemming from offshore wind energy in the Polish Baltic Sea. It is necessary to define relevant priorities for the use of the Polish Exclusive Economic Zone, which partially is a political decision. Securing enough space for offshore wind energy to develop will be a measure of how responsible the decision is.

SECOND

The support scheme for offshore wind farms is a fundamental issue. In the future offshore wind energy will achieve *grid parity*, i.e. the capability to compete on the market with other energy sources on equal terms. The launch of the first projects will require at least a guarantee of a certain price at which electricity will be sold — this will enable minimisation of financing costs. Such guarantees of aid translate into general benefits for the entire economy.

Therefore, it is necessary to develop a dedicated support scheme for offshore wind farms as soon as possible.

There are many examples already approved by the European Commission. The Polish scheme should include projects at a different stage of development and holding various permits. Creation of such a scheme in Poland should not be a problem if supported by an appropriate political decision. This issue also inclu des connection infrastructure and power offtake from offshore wind farms. The Transmission System Operator should ensure investments in transmission infrastructure necessary to connect offshore wind farms — both in the short- and long-term. This should also be clearly regulated in a dedicated Offshore Wind Energy Act. Undersea cables, dedicated platforms or converters are costly enough to determine the viability of the entire investment if included in the investor's budget. The entire programme would benefit if at least part of the costs would be incurred by the Transmission System Operator — PSE, which should clearly be regulated by appropriate legislation



13 SUMMARY

Key implementation aspects of offshore wind farms in the Polish Baltic Sea

- The offshore wind farm industry may become the growth driver for the Polish economy and the maritime sector, in particular after 2020, when the current EU financial perspective is to end
- Almost 2/3 of Polish citizens select offshore wind as the preferred source of supply for their homes
- For many Polish enterprises joining the offshore wind industry is an opportunity for substantial growth
- Offshore wind may contribute as much as **PLN 60 billion** to the Polish GDP by 2030
- Offshore wind farms may contribute **PLN 15 billion** to the state and local governments' budgets by 2030
- Offshore wind farm development will contribute to the creation of **77 thousand jobs** by 2030 and create new employment opportunities in the entire country, in particular on the coast
- Production of electricity from offshore wind farms contributes to ensuring energy security

The decision makers have to:

- Secure offshore wind farm locations in the spatial development plan for the Baltic Sea
- Develop and extend port and **onshore** infrastructure to ensure access to electricity from offshore wind farms
- Develop a **dedicated support scheme** for offshore wind investors, preferably in the form of a dedicated law

PWEA

POLISH WIND ENERGY ASSOCIATION

psew.pl