POLISH WIND
ENERGY ASSOCIATION

Warsaw, 29 November 2019

Polish Wind Energy Association Position Paper
on the updated draft of "Energy Policy of Poland until 2040
— energy sector development strategy" (EPP 2040)

With reference to the updated draft "Energy Policy of Poland until 2040 — energy sector development strategy" ("EPP 2040") announced by Ministry of Energy on 8 November 2019, Polish Wind Energy Association ("PWEA") presents its remarks concerning the wind energy sector development. At the same time we would like to acknowledge the understanding of the wind energy sector and inclusion of part of the remarks to the first version of the draft EPP 2040 published in November 2018.

We acknowledge that:

- EPP 2040 emphasizes the important role of offshore wind energy as key technology for further development of renewable energy in Poland;
- EPP 2040 discusses offshore wind development will as one of the strategic projects within the Polish energy policy. Representatives of the industry confirm that first wind farms in the Polish Exclusive Economic Zone in the Baltic Sea will be built and commissioned already in 2025;
- EPP 2040 includes the adoption of a dedicated Offshore Wind Energy Act. We are eagerly looking forward to the adoption of the regulatory framework in 2020. This is a key prerequisite enabling the production of electricity from wind farms in the Baltic Sea already in 2025. In the industry's opinion the regulations in questions should ensure the predictability and stability of development of the first projects through a support scheme based on contracts for difference;
- EPP 2040 includes the development of onshore wind energy by enabling comprehensive repowering of existing onshore wind farms.

At the same time PWEA emphasizes that EPP 2040 should be consistent with the 2030 National Energy and Climate Plan (NECP) required from the governments of the EU countries by the European Commission. The final version of the NECP should be notified to the European Commission by 31 December 2019. There is little time to develop a relevant document. Therefore, you are kindly requested to acknowledge the remarks and recommendations presented below as important for the economic growth of Poland.

PWEA, having regard to the development of the Polish economy, maintenance of its competitiveness and increase in innovativeness as well as the decrease in the Poland's dependency on fossil fuels and imports, proposes the following amendments to EPP 2040.

1. **Enabling the construction of new onshore wind farms.** The current administrative limitations (the so-called 10 h rule, stemming from the Wind Energy Investments Act of July 2016) do not

enable development of new projects or implementation of the latest turbines in the wind farms currently under construction.

Below we present the key arguments for the elimination of barriers to onshore wind farm development:

a. Onshore wind is the least expensive electricity production technology in Poland, as confirmed by the results of the November 2018 RES auction.
   Subjecting it to restrictions and additional, costly administrative procedures actually precludes the exploitation of the abundant potential of wind in Poland that could constitute an important factor mitigating the future increase in wholesale electricity prices. The results of the last RES auction held in November 2018 indicate average wind electricity prices at the level of 196 PLN/MWh. In the same period wholesale electricity price on the Polish Power Exchange was around 300 PLN/MWh, with today's levels close to 250 PLN/MWh. Furthermore, it has to be stressed that high price competitiveness of the wind energy technology may lead to expected public aid at a minimum or zero level. This means that due to their market competitiveness wind energy installations will finance the development of other RES (as a result of returning the positive balance to Settlement Operator).
   Assuming the 15-year support period and the 20-year wind project lifetime one could have expected the auction prices to decrease event further **had it been possible to use the latest turbines in the projects**. It should be assumed that for well-developed, large projects in sites with good wind conditions the level of auctions prices could be even lower.
b. **Extremely rapid technological progress in the wind energy sector increases productivity**, decreasing implementation costs of wind energy projects.The latest wind turbines, in particular those with high unit capacity (above 3 MW), with larger rotors, are much more efficient in the use of the available wind resources. In practice this translates into the capacity to provide much higher power and more electricity at similar wind speed.
   In principle, wind speed increases with altitude, therefore **increasing turbine height also increases productivity**. Moreover, the limitation in the number of turbines substantially limits wake effect losses. This entails wind farm productivity (of equal total capacity) higher by several percent. It has been described in detail in *Schedule 1*. **Switching older generation wind turbines, for instance with a capacity of 2 MW (rotor diameter: 100 m, tip height: 155 m) to latest machined with higher unit capacity, for instance 4.2 MW (rotor diameter: 150 m, tip height: 180 m) allows for repowering a wind farm comprising of 10 wind turbines with only five machines and producing more electricity** (73.6 GWh compared to 65.8 GWh per year). This may substantially increase social acceptance for the project and decease its environmental impact.
c. In accordance with the current analyses the total economic potential of onshore wind investments is 38 GW. The 2030 market potential being part thereof 2030 has been calculated with regard to the possible exploitation of the economic potential given the existing and expected market determinants. In the short term (~2020) one should expect wind projects to be implemented under the auction scheme (approximately 3.5 GW). Currently, wind farms are the most competitive energy technology. Assuming restrictive regulations limiting available sites through the "10 h" rule are waived, in 2030 in the minimum scenario the market potential may reach 11 GW. In the

maximum scenario **the market potential may reach 22 GW**. A full analysis constitutes *Schedule 2*.

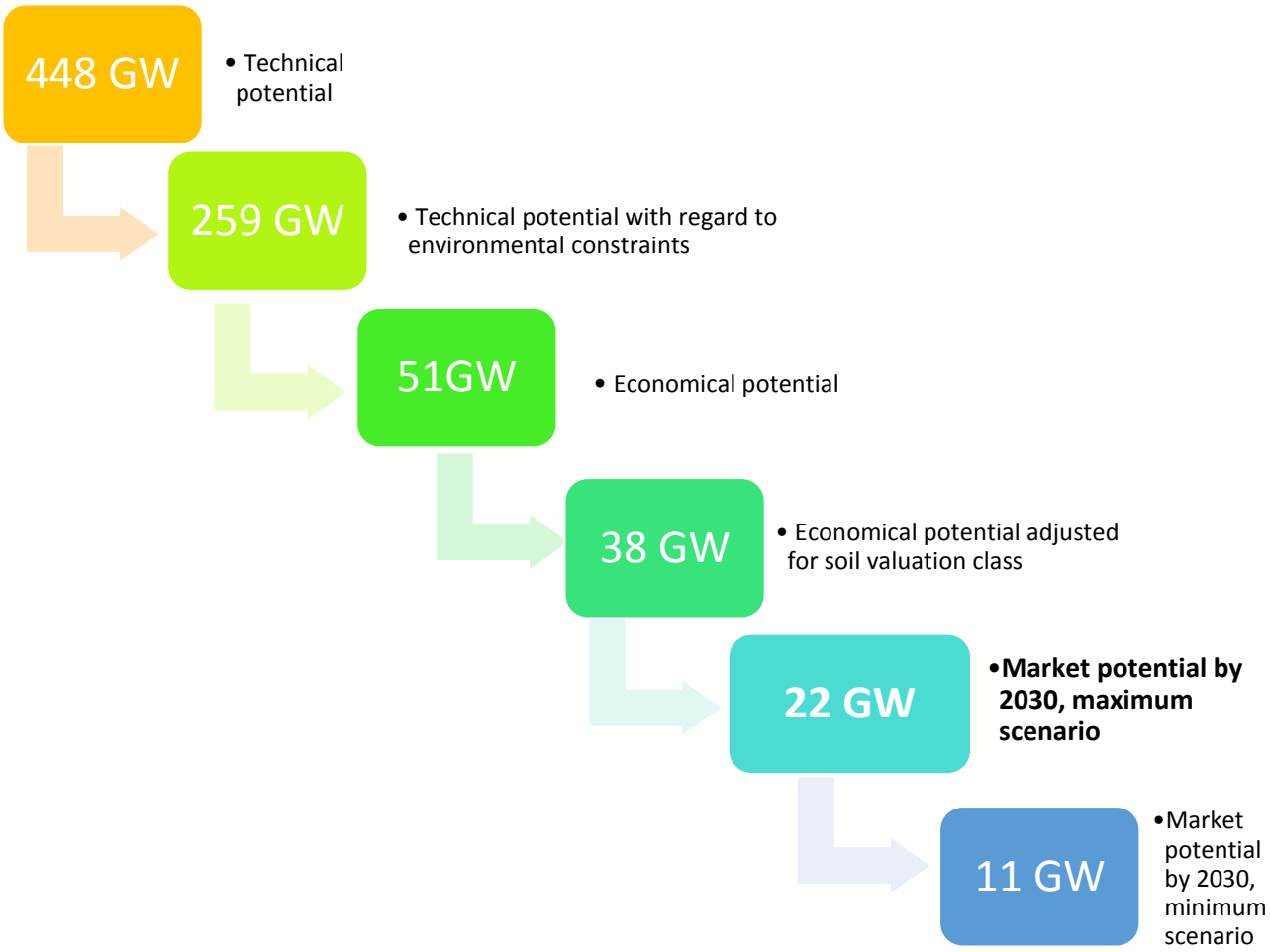

Figure 1. The total onshore wind energy development potential in Poland. Source: Institute for Renewable Energy (IEO)

Substantial wind energy potential is also demonstrated by analyses performed with the LIFE Climate CAKE PL project prepared by the National Centre for Emissions Management (KOBiZE), being part of the Environmental Protection Institute — State Research Institute. Depending on scenario, the results of the CAKE project demonstrate onshore wind potential of approximately **26 GW in 2040 and approximately 21-23 GW in 2030.** Therefore, they are consistent with the IEO report.

d. It is a common belief that the increase in installed capacity of variable RES (such as wind or PV) will require increased flexibility of baseload generation and constraints in RES output. However, it has to be stressed that such events will be very short-lived. According to current analyses, the total number of hours requiring constrained RES generation would amount to less than 300 in 2030, assuming that baseload generation (network-constrained generation) cannot be lower than 5,000 MW. However, **the number of hours in the future when it may be necessary to operate below the now-assumed minimum safe output allows for a compromise between the potential curtailment of variable generation and increase in flexibility of conventional sources**. This will result in a substantial increase in wind capacity. It is worth noting that strategies of power utilities provide for a substantial share of gas units in conventional

generation. The assumptions concerning electricity produced from gas generation allow for a statement that these units will use their peak capacity over a short period of time (approximately 3,500 hours per year). **This entails their high availability and control capacity, which would affect the decrease in the minimum safe output of the system and the capacity to absorb electricity from variable wind generation in off-peak periods.**

e. **Onshore wind farm development will also enable conclusion of cPPAs — direct power purchase agreements for electricity produced in RES systems, concluded between the vendor of electricity produced, for instance, from wind, and a customer — usually a production facility.** This electricity sales formula becomes increasingly popular as customers, in particular energy-intensive customers, are seeking to purchase inexpensive electricity from renewable sources to limit costs. At the beginning of 2019, 85% of transactions among 4.7 GW of RES installations in Europe that sold electricity under cPPAs were concluded in the wind energy sector. In the record-breaking 2018 the volume of wind cPPAs amounted to 1.5 GW. Entrepreneurs want to have the opportunity to use RES electricity, unburdened by CO_2 emission allowance costs. They seek such opportunities among others by investing in RES located in the vicinity of production plants or by concluding long-term cPPAs directly with renewable energy producers located close to their plants. **Elimination of barriers to onshore wind energy development, allowing for the use of the latest, much more efficient turbines and enabling the construction of a direct connection between the producer and the customer will further boost cPPA development.** More information is to be found in *Schedule 3*.

f. The increase in the share of RES electricity by 2030, in **particular onshore wind, will decrease wholesale electricity prices**. The results of the IEO analysis demonstrate that the additional volume of RES electricity in 2030 requiring an additional 2.5 GW of capacity will enable safe operation of the power system in the period of decommissioning of ineffective hard coal- and lignite-based units. The highest difference in electricity prices is apparent in the second half of the next decade. The strong trend, limiting electricity costs in the system in the order of 2.5% per year in 2020-2025 also brings positive effects (by limiting the relative increases by 1% per year) in the 2025-2030 period. Compared to the forecast presented in the NECP, implementation of assumptions to the baseline onshore wind energy scenario results in PLN 170 billion in 2020-2040 (PLN'2018).For wind energy technologies, additional investments will amount to approximately PLN 12 billion, however due to decreasing renewable energy source costs this will not adversely affect average electricity prices. To the contrary, RES investments are expected to decrease the growth rate of electricity prices, driven by increasing emission and fuel costs, what would positively translate into prices paid by final customers.

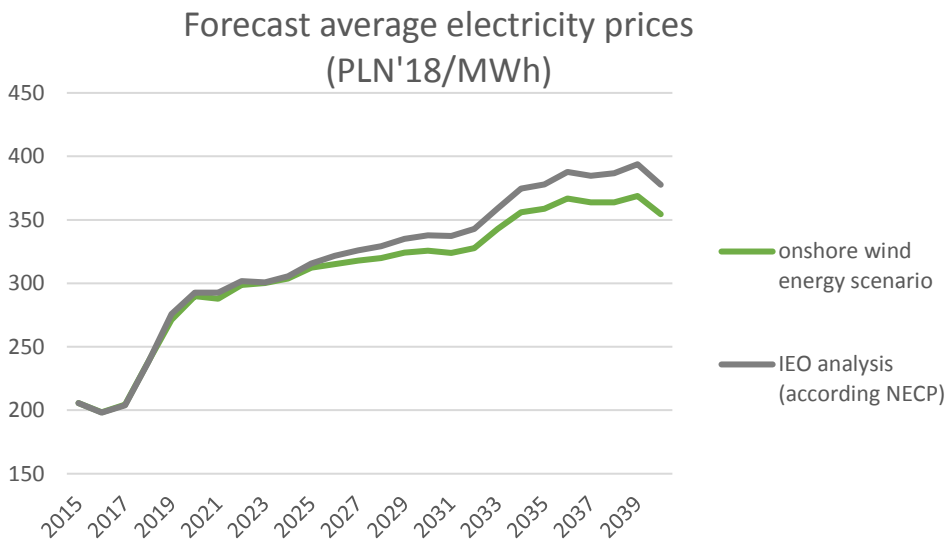

Figure 2. Forecast of electricity prices. Source: INSTITUTE FOR RENEWABLE ENERGY (IEO)

g. **Onshore wind development may create tens of thousands jobs in Poland**. This will aid transformation of regions dependent on traditional power generation, such as Silesia. Compared to conventional power plants, onshore wind features several times higher local content over its lifecycle. Currently, it exceeds 50%; with favourable industry environment in Poland it may reach 65%. In accordance with WiseEuropa forecasts it is estimated that wind energy development may bring up to 42 thousand new jobs in 2040, of which 31 thousand indirect and 11 thousand direct jobs. The increase in the number of onshore wind dependant jobs is accompanied by the increase in local content in the supply chain and consolidation of the position of Polish plants on the international market. The analysis of onshore wind energy development constitutes *Schedule 4*.

2. **Restoration of provisions on the target offshore wind potential at the level of at least 10.3 GW in the 2040 perspective, laid down in the previous version of the draft EPP 2040.** Below we present the key arguments for the strong support of offshore wind farm development:
   a. Predictable output is the key advantage of offshore wind. **Capacity factor for offshore wind farms amounts to 50% and may reach as much as 60% in the future.** This means that offshore wind farms are the most efficient renewable energy source. 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.
   b. On the basis of a survey carried out among its members PWEA prepared a forecast of offshore capacity growth. It demonstrates that offshore wind farm potential amounts to 7.5 GW by 2030 and at least 14 GW by 2040. This is much more than in the current version of EPP 2040, where only 3.6 GW is expected in 2030. Establishment of ambitious targets is crucial for suppliers and sub-suppliers of offshore wind farm components, who need a precise project schedule to make the necessary investments in their production facilities. Decreasing the target would send a wrong or even alarming message to representatives of investors and suppliers comprising the supply

chain. Therefore, we recommend to increase the target to at least **10 GW (i.e. to restore the level from the previous version of the EPP) in 2040**.

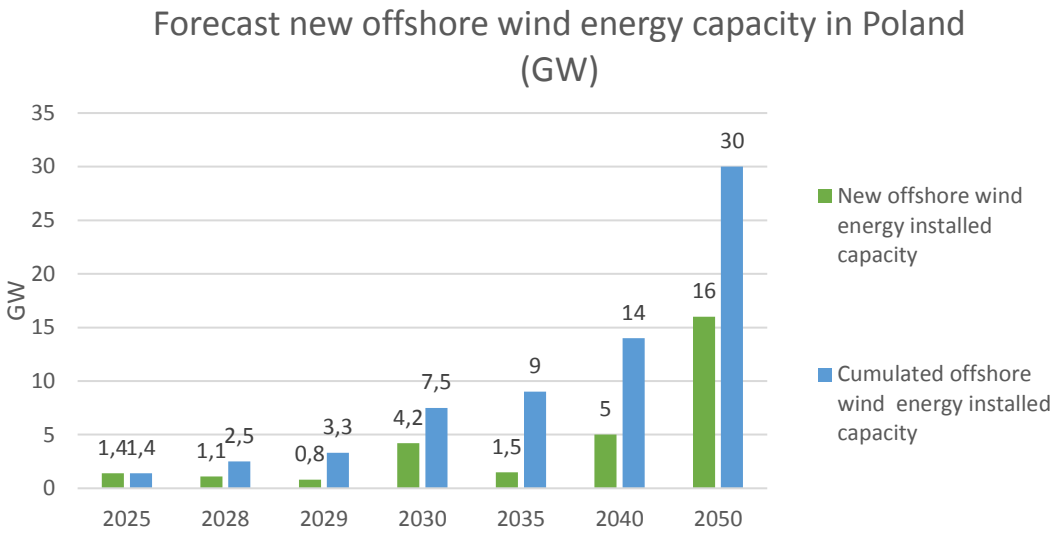

Figure 3. Forecast offshore wind farm development in accordance with PWEA. Source: PWEA on the basis of data from member companies

Below we present offshore wind farm investments. The figures were obtained from interconnection agreements and issued connection conditions.

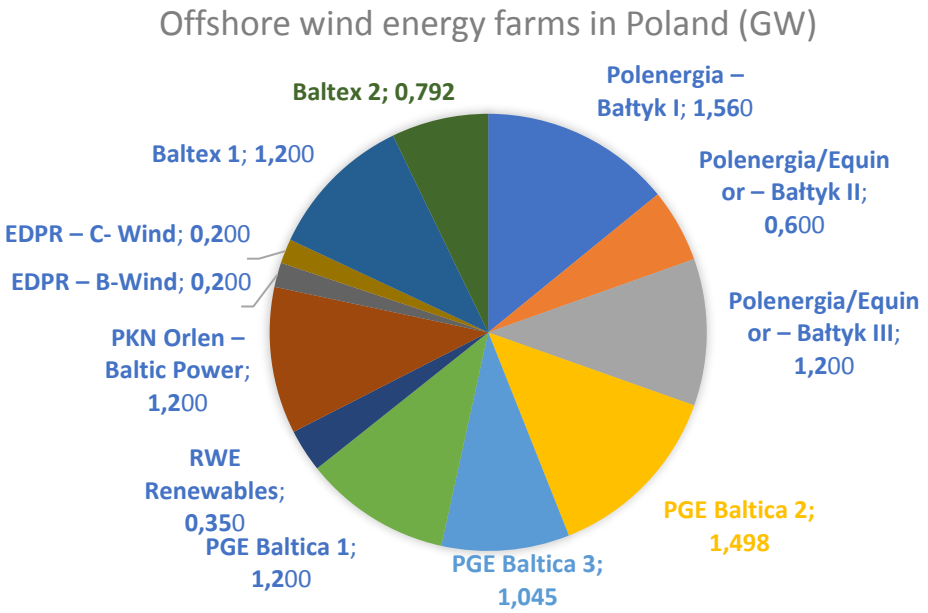

Figure 4. Offshore wind farm projects in the Baltic Sea: Polish investors' projects (GW)

Moreover, the **WindEurope's** „Our energy, our future – How offshore wind will help Europe go carbon-neutral" report confirms the importance of offshore wind in the strive to achieve climate-neutral economy in the European Union by 2050.

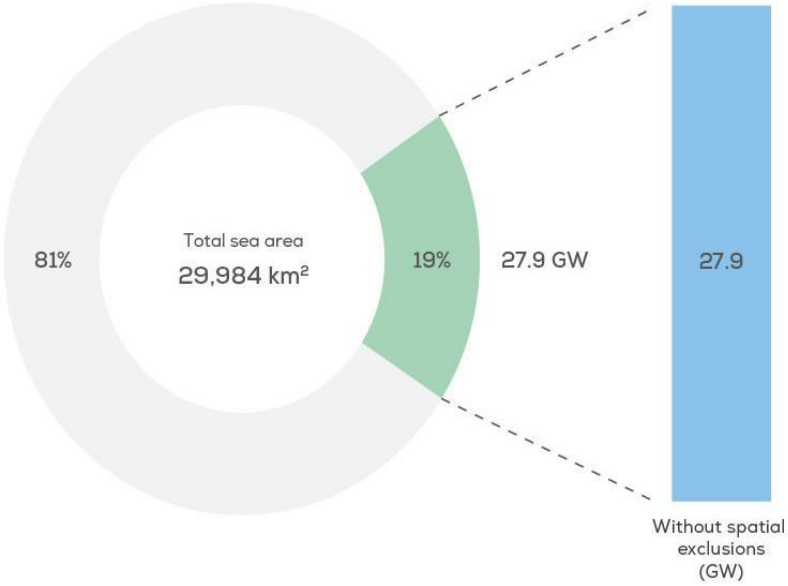

Figure 5. Offshore wind farm capacity in Poland forecast by WindEurope

The Polish share in the total offshore wind farm capacity in 2050 forecast by WindEurope amounts to 28 GW. Therefore, Poland may become the offshore wind leader in the Baltic Sea, with potential for one-third of capacity that could be installed in the area. The full version of the report is presented in *Schedule 5*.

c. PWEA estimates that offshore wind development will become the driver of the Polish economy in the decades to come. Completion of the first 6 GW will increase the country's GDP by as much as PLN 60 billion. Additionally, the state and local governments' budget will receive addtional PLN 15 billion in taxes. The sector may create **77 thousand jobs by 2030 and create new employment opportunities in the entire country**, in particular on the Baltic Sea coast. Poland already has an extensive chain of suppliers and sub-suppliers for offshore wind farms developed in areas controlled by other states. PWEA identified more than 100 such entities that could deliver up to 50 percent of components required to build domestic projects. 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. Subsequent companies could join the development, construction and operation of wind farms in the Polish Baltic Sea. 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. 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. Key beneficiaries of offshore wind development include the smelting, steel and cable industry. Construction of wind turbines in the Baltic Sea may become the most steel-intensive economic programme in the history of Poland. A typical offshore wind turbine tower requires 300–

400 tonnes of steel, with further 750–1200 tonnes for its supporting structure. This means that construction of the first 6 GW in the Baltic Sea would consume 1.1–1.2 million tonnes of steel in the next decade. Offshore wind energy development will also be a strong 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. Moreover, another beneficiary of of offshore wind development could be Silesia, where Polish Wind Energy Association is planning to build a training centre that would become the development centre for RES personnel, giving engineers and experts an opportunity to gain competitive advantage on the labour market, and giving economic operators involved in RES development access to qualified personnel.

d. Public opinion polls carried out by Indicator in December 2018 demonstrate that offshore wind enjoys broad public support. As much as **2/3 of Polish citizens selected offshore wind as the preferred source of supply for their homes**. Offshore wind farms do not lead to social protests, for they have been planned at a distance not less than 22 km from the shore, in the Exclusive Economic Zone — i.e. outside the territorial sea — invisible for residents of coastal towns and tourists resting on the beaches.

e. Offshore wind development is an opportunity for energy transformation in Poland and for an increase in RES share **to 25% in 2030 in accordance with the European Commission's recommendations from June 2019**. Currently, the 21% target laid down in EPP 2040 or the conditional 23% target is insufficient to ensure appropriate economic growth in Poland. In accordance with PEWA analyses, by increasing the RES target to 25% in 2030 and the share of offshore wind energy to 10 GW in 2040 we may achieve **lower electricity costs and lower CO_2 emission factor**. PWEA analyses demonstrate that an increase in the RES target to 25% in 2040 may enable the average electricity production cost to fall by 10 PLN/MWh compared to the EPP 2040 scenario, i.e. to 360 PLN/MWh.

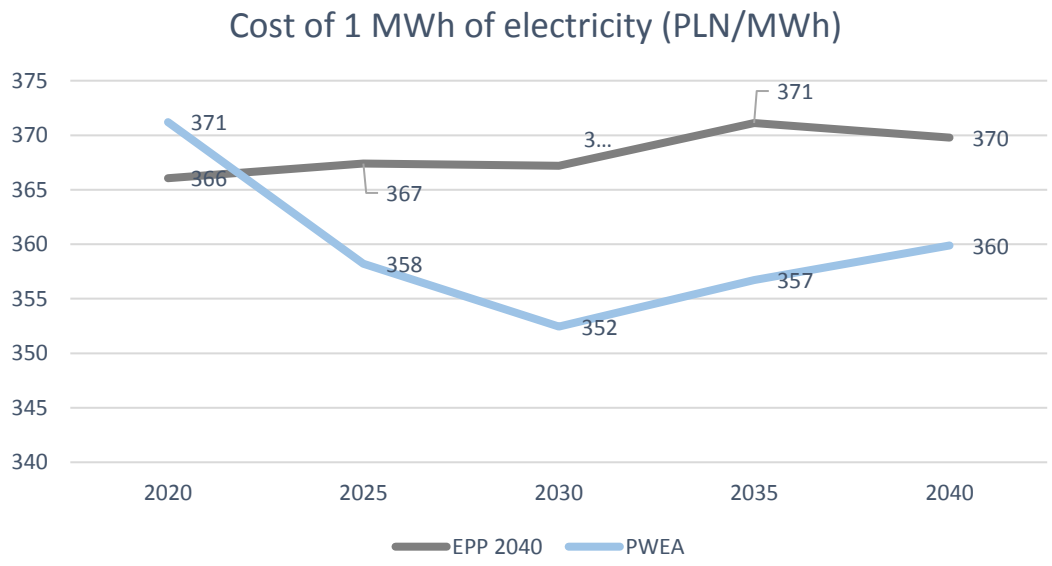

Figure 6. Average electricity production costs (PLN/MWh) in accordance with PWEA analyses

f. **Wind energy may also be an effective tool to improve emission performance of the Polish economy**. As demonstrated by estimates made for PWEA, assuming the 2030

RES target is set at 25 percent, atmospheric carbon dioxide emissions would decrease from the current 125.9 million tonnes per year in 2018 to 109.4 million tonnes in 2030. In further perspective, by 2040 CO_2 emissions would decrease to 66.2 million tonnes per year. Such an emission reduction would enable the achievement of the targets assumed in the so-called winter package, which paves the way for the development of the energy sector in the next decade in the entire European Union. In the PWEA scenario the emissions will decrease from the current 803 kg CO_2 per MWh of produced electricity net (in 2018) to 508 kg CO_2 per MWh in 2040 and 282 kg CO_2 per MWh in 2040. As a result, implementation of the PWEA scenario will enable faster fulfilment of reduction commitments compared to the scenario laid down in the updated draft EPP2040. In 2030 CO_2 emissions amount to 580 kg CO_2/MWh, and in 2040 — to 309 kg CO_2/MWh. The expected decrease in CO_2 emissions is presented below.

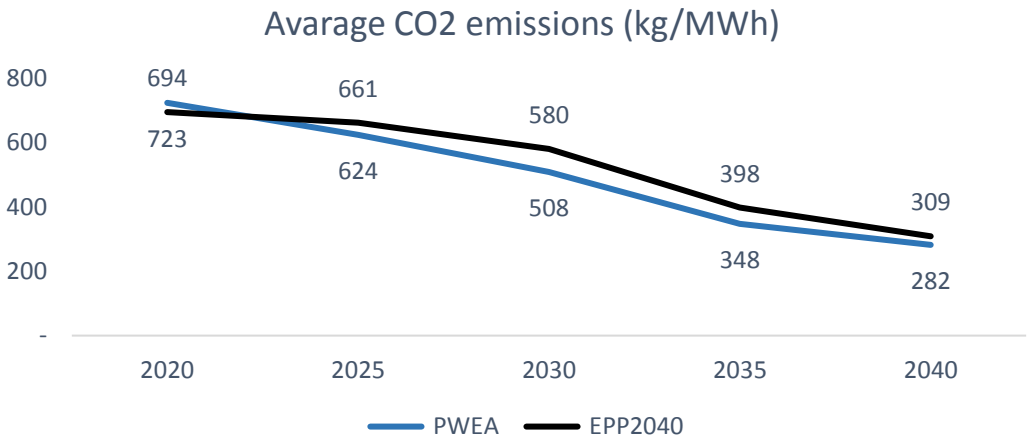

Figure 7. Average CO_2 emissions (kg/MWh) in accordance with PWEA analyses

Decrease in CO_2 emissions by increasing RES share will improve air quality in Poland, in particular assuming development of electro-mobility, which should be powered from renewable sources.

3. Attention shall be paid to appropriate wording. We recommend to change the term "**unstable RES**" to "**variable RES**", for variable energy output depending on the season or hour of the day is a feature of wind or PV installations. Renewable energy sources with variable operational characteristics are not unpredictable/unstable. The development of forecasting tools makes forecasting and assuming electricity production from wind sources increasingly easy. This stems from the fact that a very high accuracy of energy output forecasts has been achieved. Such an accuracy is the result of monitoring of atmospheric conditions and complex mathematic models enabling energy production forecasting 12 hours in advance with accuracy of up to 90%. With the knowledge about the expected instantaneous capacity, it may be controlled by curtailment or — as it happens now — by controlling other generating sources, including conventional sources.

The scenario proposed by PWEA to increase the share of renewable energy sources to the 25% in final energy consumption in 2030 proposed by the European Commission using electricity from both the least expensive onshore wind farms and system-stabilising offshore wind farms will enable safe

operation of the power system in the period of decommissioning of ineffective hard coal- and lignite-based units. This will create an opportunity for the Polish power system to be based on cost-effective, environmentally-friendly and innovative solutions. Our analyses considering development of onshore and offshore wind demonstrate a substantial decrease of electricity prices in 2040 to 360 PLN/MWh, i.e. 10 PLN/MWh less than in the EPP 2040 scenario, and a decrease in CO_2 emissions to 282 kg/MWh, i.e. almost 10 percent less than in the EPP 2040 scenario.

Access to inexpensive and price-stable electricity from RES will be crucial for further growth of the Polish economy and maintained competitiveness of Polish exporters of goods. It will also aid in stabilisation of wholesale electricity prices, which over the years will be subject to a strong pressure of increasing CO_2 emission allowance prices. Therefore, renewable energy sources, including onshore and offshore wind, will be the key to just transformation in Poland.

PWEA is willing to further cooperate with the Ministry responsible for RES development to develop the "Energy Policy of Poland until 2040" and the "National Energy and Climate Plan" which is optimum for further dynamic growth of the national economy and competitiveness of Polish products in foreign markets. We are ready to provide any and all analyses and studies that were used to develop this Position Paper.

Schedules:

1. The use of modern wind turbine models in the wind energy sector
2. Potential of onshore wind energy in Poland
3. Corporate PPAs — wind energy for a competitive industry
4. The contribution of national suppliers to the development of onshore wind and its impact on the polish labour market by 2040
5. WindEurope report entitled „Our energy, our future – How offshore wind will help Europe go carbon-neutral"