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# Electricity system and market 2030

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Energy 2030. New energy for change.

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01

# | Electricity market

# Electricity market

## ⇒ Market should be an essential tool for balancing the system

- Wholesale market (DA/IA) should be a tool for the commercial balancing, which enables market participants to optimise liabilities portfolio resulting from the sale and purchase contracts including the supply of contracted energy to consumers
- Balancing market should be a technical market, which is the essential tool for the TSOs to guarantee a reliable and secure operation of the power system, taking account of the market participants' needs
- On a well-operating market, the TSO's role is limited to the administration of the balancing market and settlements for the market participants' forecasting errors
- European model of the market envisages an active participation by the market players in the balancing of the system.

## ⇒ Modern electricity market has to support the balancing of the system resources through:

- Market allocation of generation and network resources
- Integration of flexible distributed resources from the DSOs' network
- Integration of energy storage systems and other new technologies
- Diversity – energy, power, reserves, inertia, flexibility
- Integration of RES and dispatchable resources on equal terms.

## ⇒ Market rules are to support optimal business decisions of independent entities, it means:

- Limited external interventions into the functioning of the market
- Reduction of subsidies, as they may distort market mechanisms
- Policy makers' activities should be focused on making correct policies.

# 02

## | European electricity market development directions up to 2030

# European electricity market – development directions up to 2030

- ⇒ Final implementation of integrated market and Network Codes.
- ⇒ Evolutionary harmonization, regionalization, optimization efforts.

The key is the integration of energy market's functioning with the principles of physics of the system:

LOCALIZATION SIGNALS

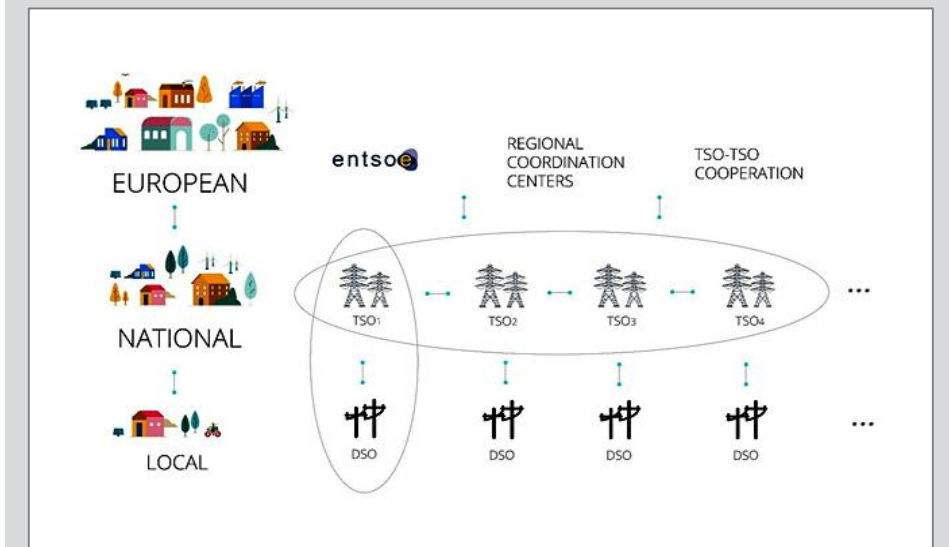
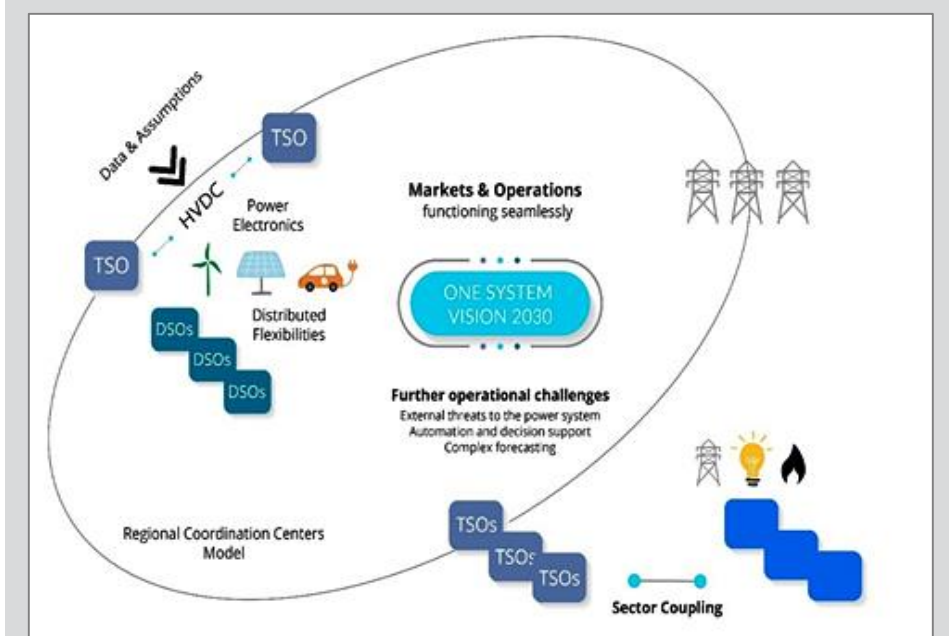
Bidding Zones

FLEXIBILITY

Grid and Generation

INTERFACES

TSO-DSO, Power-to-X



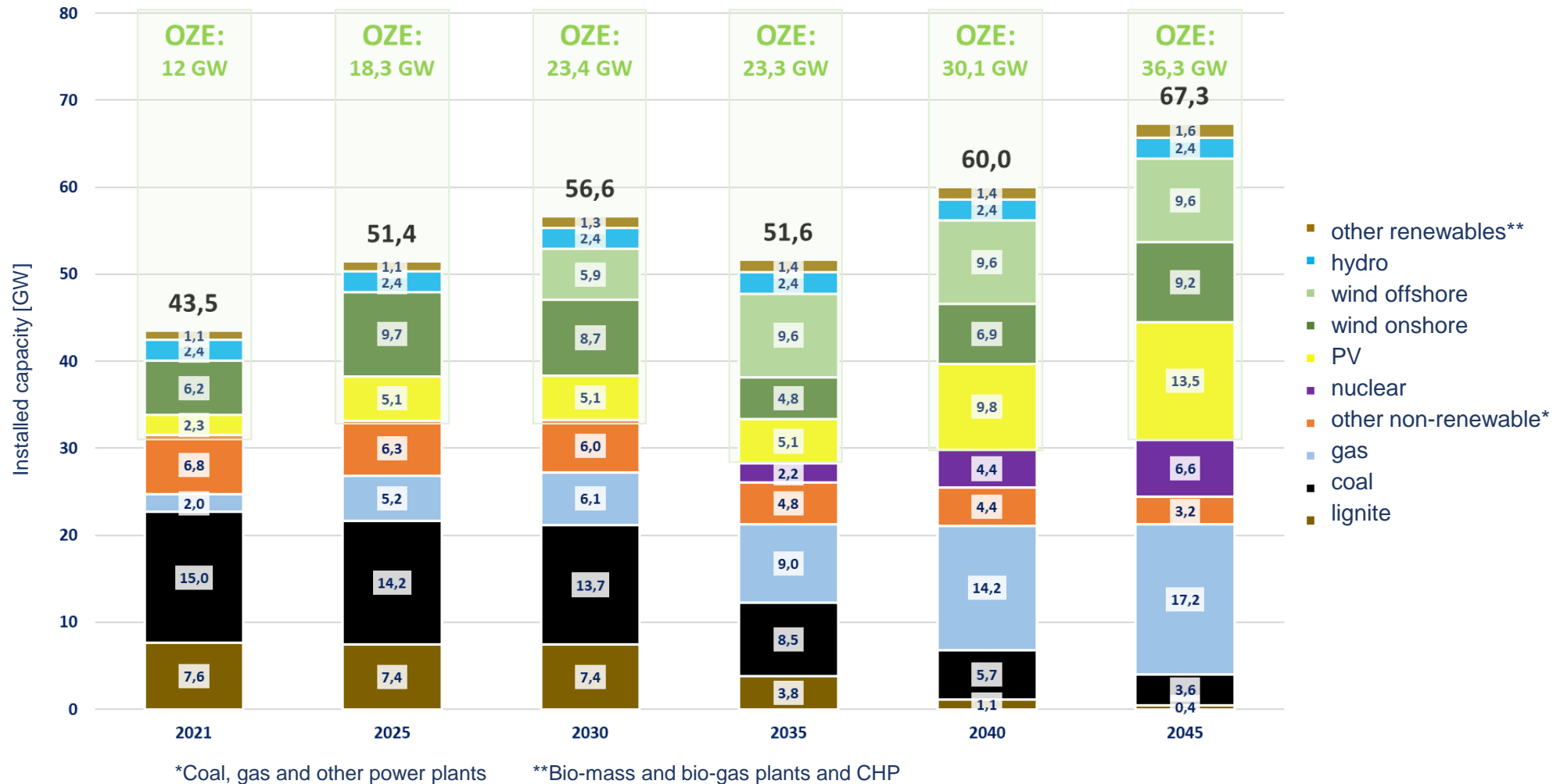
Source: ENTSO-E 2020 Vision

# 03

## | The structure of the installed capacity of the Polish Power System 2021-2045

# The structure of the installed capacity in the PPS 2021-2045

The energy mix according to the Polish nuclear energy program (Scenario II – strategic option, total cost model) adopted by the Polish Council of Ministers on 9 October 2020



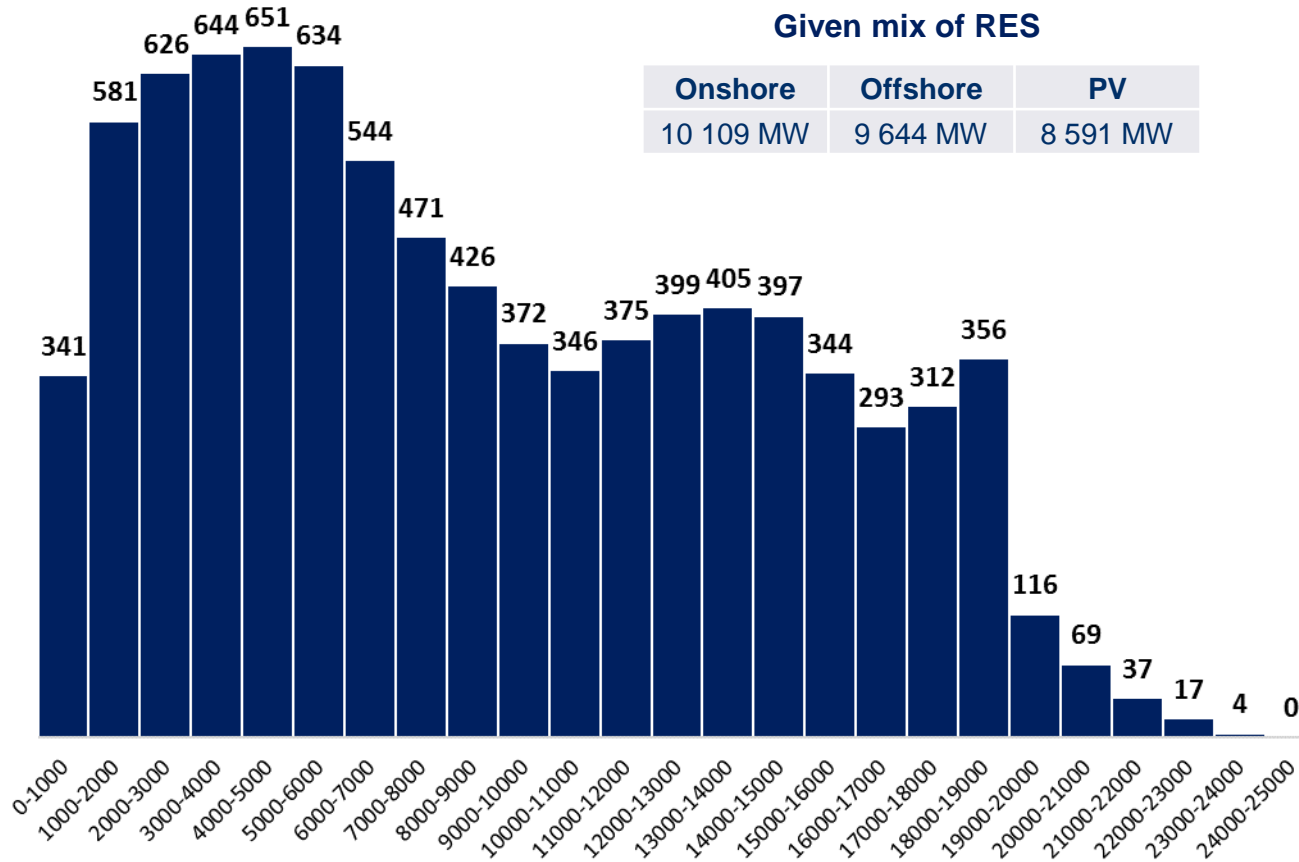
# 04

| What is the limit of RES from the perspective of power adequacy in the Polish Power System?



# What is the limit of RES from the perspective of overall power balance stability in the Polish Power System?

Probability distribution of simultaneous generation for a given mix of RES (circa 10 GW + 10 GW + 10 GW)

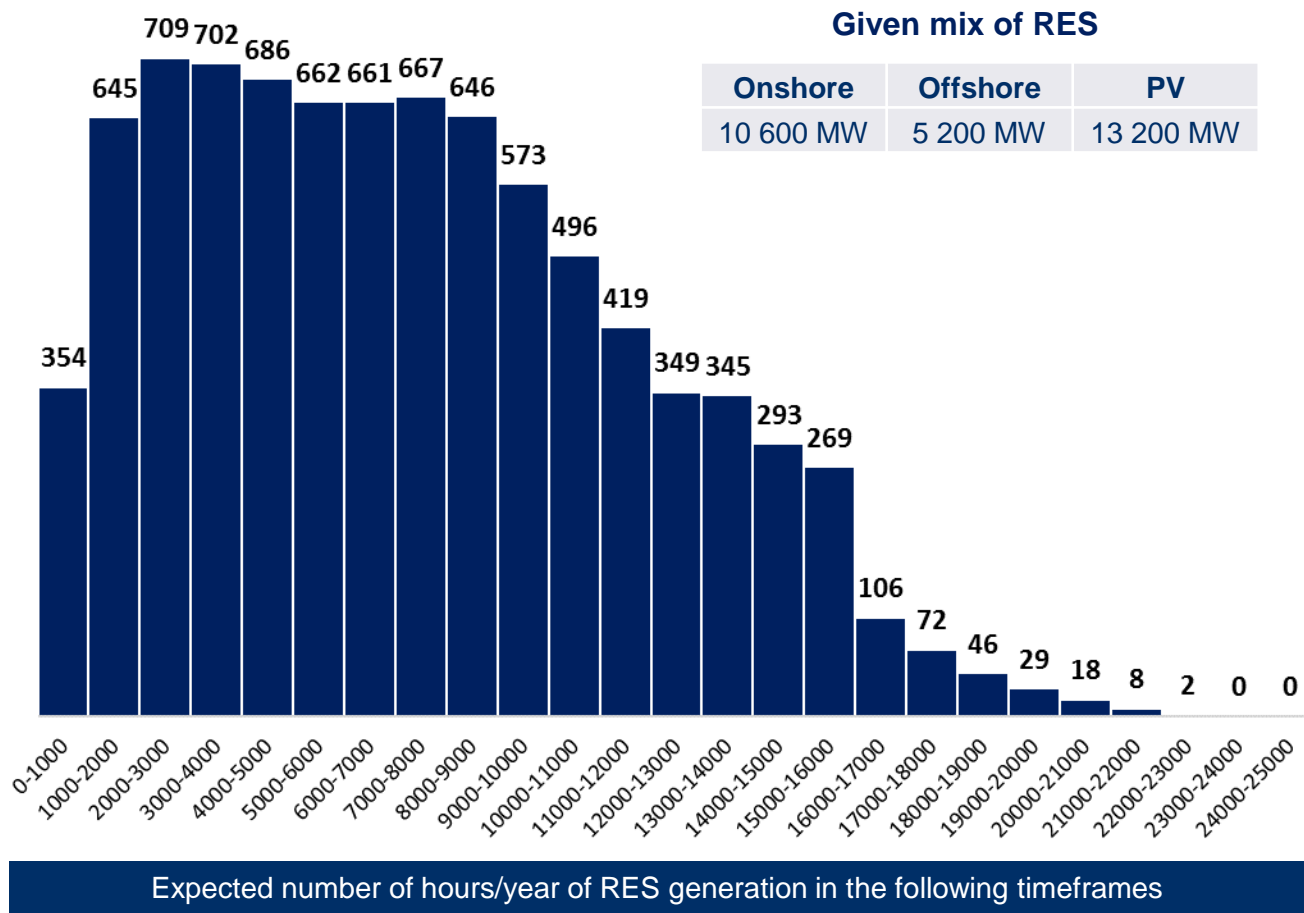


Expected number of hours/year of RES generation in the following timeframes

- Probability distribution of RES has been based on the data of 39 climate years 1982-2019.
- Probability distribution is rather flat. It is due to a significant simultaneous occurrence of wind generation.
- Given mix of RES is diversified enough what according to the common belief should reduce its overall volatility, however it is not.
- There are many hours with generation exceeding power demand in the system, which means a risk for the stability of the Polish power system and the interconnected systems.
- The periods with significantly low generation still exist, mainly when PV sources are unavailable (night, evening) along with low wind conditions.

# What is the limit of RES from the perspective of overall power balance stability in the Polish Power System?

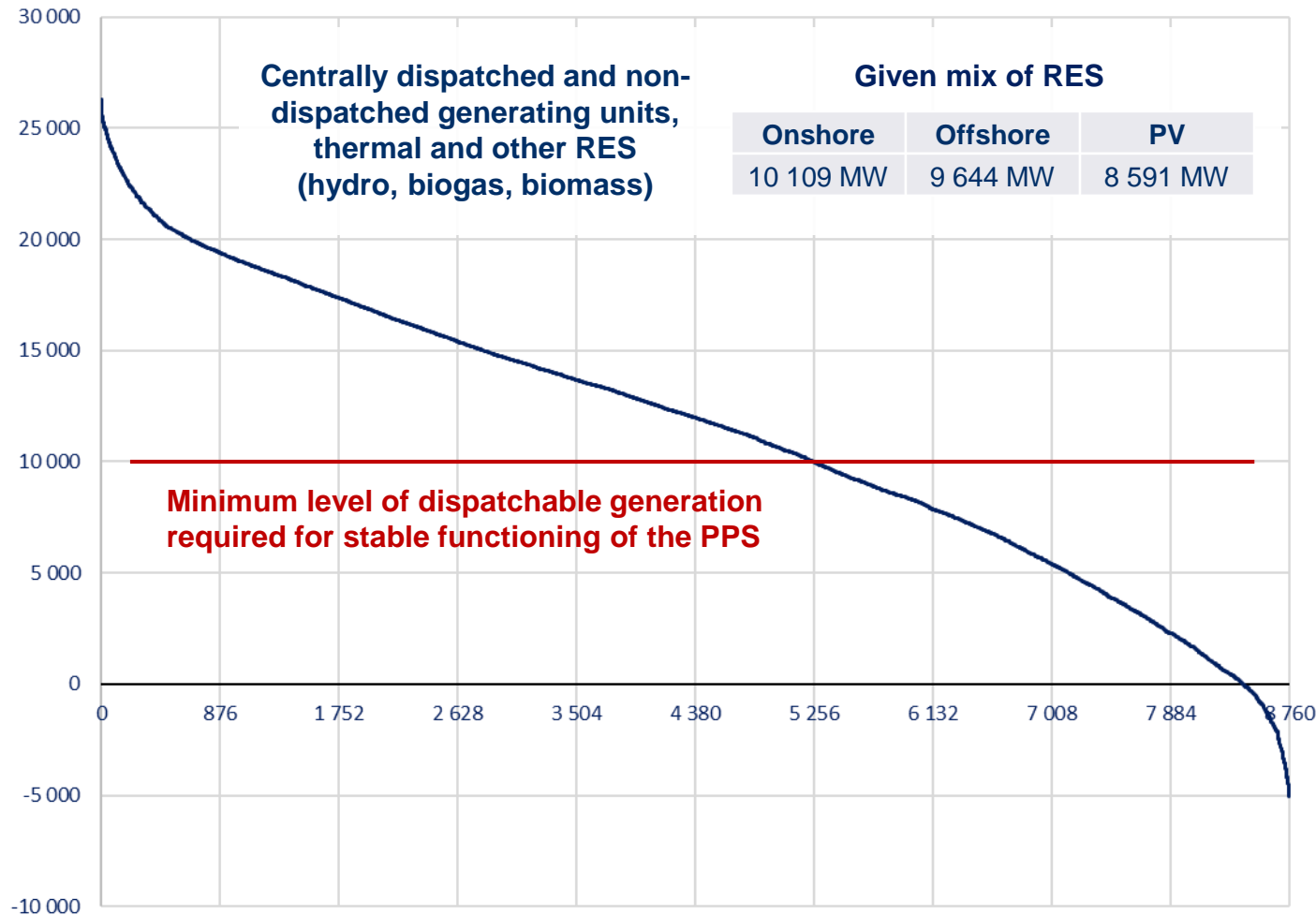
Probability distribution of simultaneous generation for the mix of RES postulated in the analysis by Forum Energii



- The change in the mix of RES affects the available capacity of these units, however the form of the distribution of generation is maintained with a significant number of hours with high total generation of RES.
- The draft of the RES law includes higher power capacity (>10GW), so even if some of the planned investments are not implemented by 2030, the problem will materialise few years later.
- Still there are long periods with significantly low generation...

# What is the limit of RES from the perspective of overall power balance stability in the Polish Power System?

Ordered chart of capacity volume to be covered by sources other than variable RES (VER) in 2030 (for climate year 2015)



- Assuming that 2030 would be similar to for example 2015 from the point of view of climate, PPS needs the capacity to cover the demand at the level of 26 GW net (peak net demand in 2019 was at 23.5-24 GW).
- At the same time, there is a very large number of hours during which the demand to be covered by units other than RES (off/onshore, PV) falls below the safety level for the operation of the PPS.
- In other climate years, the effect may be even greater.
- Such operation of the system will result in a large number of hours with very low (or negative) energy price, pushing the dispatchable sources out of the market. At the same time, without these units it is impossible to guarantee the security of the system.
- RES integration on a massive scale requires structural, long-term, and coordinated actions, both in infrastructure and market rules (diversity – energy, power, flexibility).

# 05

| What are the possible remedial actions?  
And are they enough?

# What are the possible remedial actions? And are they enough?

We need the capacity to cover 26 GW of demand without RES, and to manage up to 15 GW of surplus of RES

## ➔ Cross-border exchange?

- The generation of RES is significantly geographically correlated across Europe.
- Probably, when there is a surplus of RES in Poland, other countries will also have a surplus.
- Similarly, in the case of demand for dispatchable power in PL, this power will also be needed in other systems.

Correlation between RES in selected EU countries based on the ENTSO-E database

PV	PL	DE	DK	NL
PL		0,95	0,92	0,90
DE	0,95		0,95	0,95
DK	0,92	0,95		0,94
NL	0,90	0,95	0,94	

**Strong correlation**

Onshore	PL	DE	DK	NL
PL		0,65	0,52	0,42
DE	0,65		0,65	0,82
DK	0,52	0,65		0,59
NL	0,42	0,82	0,59	

**Important correlation**

Offshore	PL	DE	DK	NL
PL		0,32	0,46	0,24
DE	0,32		0,76	0,91
DK	0,46	0,76		0,59
NL	0,24	0,76	0,59	

**Important correlation**

Between DE and PL **it will be higher** in case of larger than initially planned development of the Baltic Sea in relation to the North Sea

# What are the possible remedial actions? And are they enough?

We need the capacity to cover 26 GW of demand without RES, and to manage up to 15 GW of surplus of RES

## ⇒ Conventional sources?

- **New capacities** - who will take the investment risk and on what terms? What are the possibilities and possible costs of flexibility of natural gas fuel supply (including gas storage and gas transmission capacities)?
- **Existing dispatchable capacities** - technically unadapted to such a dynamic nature of operation. How will these conditions affect the market and price formation?

## ⇒ Energy storage?

- **New large-scale storage** - there is no commercialised technology capable of providing the required capacity by 2030.
- **New distributed storage** - how to manage thousands of distributed units (central vs self dispatch) in 2030 perspective? If self-dispatch – how to guarantee their desired behaviour? If central-dispatch – will they still be attractive to their owners?
- What is the guarantee that new energy storage facilities will be built along with the development of subsidised RES?

## ⇒ Increase of demand?

- **Industrial power-to-heat** – large heat storages are desirable, but their potential is limited to the largest heating systems, some of them already have storage facilities.
- **Small power-to-heat/air conditioning** – similarly to decentralised storage, a guarantee of their desired behaviour is required.
- **Electrification of heat** - it must win the price competition with other forms of heat production.

## ⇒ Reduction of RES?

- **Reduction as part of short-term planning** - who is to bear the costs - RES consumers or producers?
- **Optimizing strategic and long-term planning** – decisions on support systems and RES volumes must **take into account the technical feasibility** and the realistically achievable level of remedial measures available in individual time perspectives, including the level of commercialisation of energy storage technologies.

# 06

| Making energy policy must be based on real foundations



# Making energy policy must be based on real foundations



- ⌚ Power system and energy market will not (profoundly) change by 2030.
- ⌚ Decarbonisation pathway will depend on the pace of technology development and the ability to ensure the security of the system operation and the continuity of energy supplies to consumers.
- ⌚ Stable operation of the power system with a very large share of RES is impossible without a technological breakthrough in the energy storage technologies – this will not happen before 2030.
- ⌚ Fundamental changes to the energy infrastructure require years and massive financial outlays.
- ⌚ Interconnectors are not a miracle solution to answer problems with balancing RES.



# Making energy policy must be based on real foundations



⇒ Stability and security of electricity supply for households and business is and will be basis for political and investment assessment of power systems.

⇒ System flexibility is a very valuable resource, but it is not a source of electricity.

⇒ Hydrogen value chain, industry and economy of tomorrow is still on Power Point.



May 6, 1937



The power system evolves, changes with the development of new technologies, and so do the needs of consumers.

Changing the energy mix and reducing the sector's impact on the environment are one of the most important goals of the energy policy of Poland and the EU.

**PSE is determined to be a leader in shaping a modern power system that meets the needs of electricity consumers.**



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