HOW TO FILL THE COAL GAP

43% RES IN 2030

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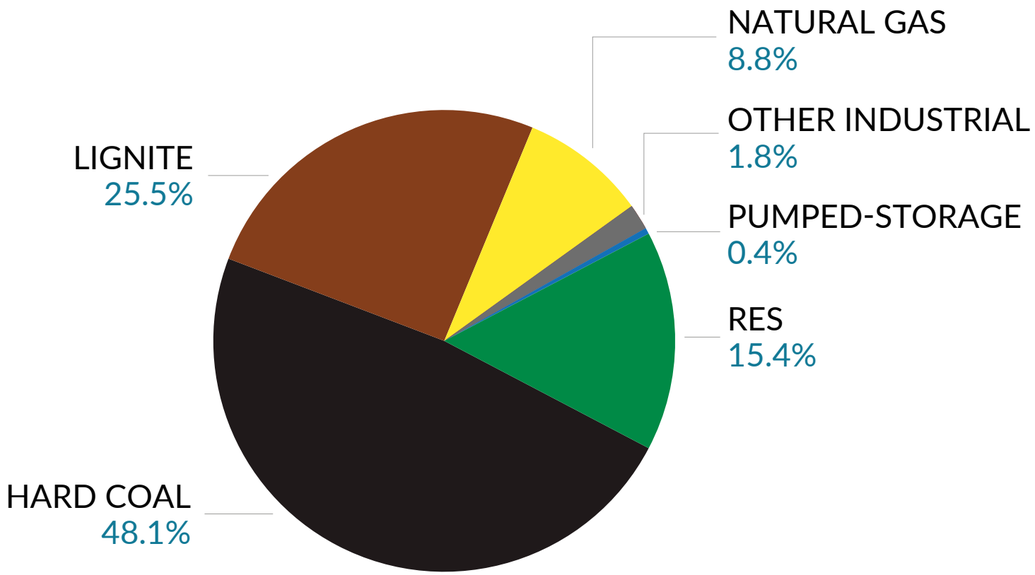
Background

- In 2019 the share of RES in electricity production was only **15.4%,**
- Target for 2020 **19%**
- Target for 2030 **32%**



Source: based on data of ARE

Challenge

End of the capacity market for coal + rising CO_2 allowance prices. Increasing competitiveness of RES.

Pressure for energy transition.

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Withdrawal (faster than assumed by NECP) of coal units. Concerns about the "variability" of RES.

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Generation gap in the national power system

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Availability of options in the 2030 perspective.

Objective of the analysis

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- **Objective 1:** How much RES in the power system until 2030. Assumed high level of security of supply
- **Objective 2:** How much gas/new conventional units we do need by 2030 ?

Approach

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Methodology

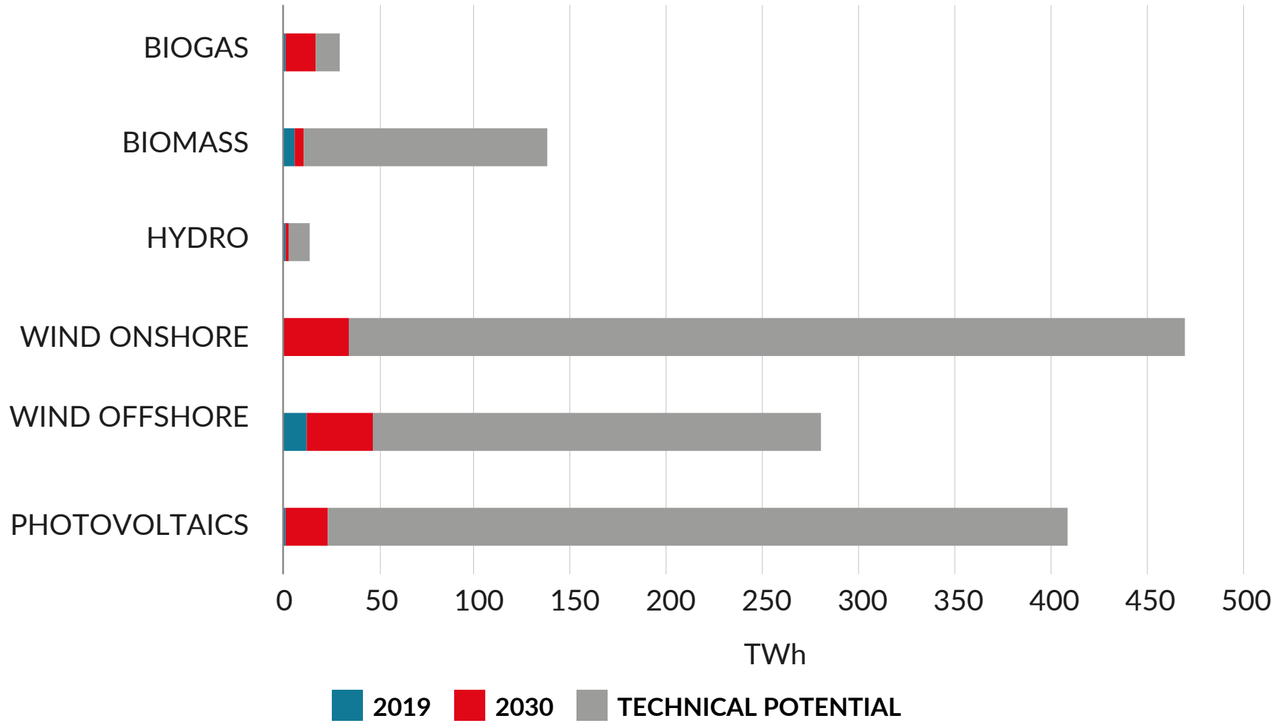
- Different power mixes of different technologies have been modelled to ensure that demand is adequatly covered.
- Determined dispatchable capacities in 2030.
  - Hard coal: **12.9 GW**, lignite: **4.1 GW**, gas: **4.4 GW**
  - Optimisation of production from RES

Assumptions

- High level of security of supply (reliance on national sources, appropriate level of reserves, "must run" dispatschable capacities)
- Maximising RES production
- Minimising installed capacity of new conventional units
- Maximum use of regulatory resources for balancing
- Conservative approach

RES potential by 2030

- Photovoltaics - **17 GW**
- Onshore wind power - **18 GW**
- Offshore wind energy - **7.7 GW**
- Hydropower (without pumped storage power plants) - **1,15 GW**
- Solid biomass - **1.5 GW**
- Biogas - **2,25 GW**



Current and projected use of renewable fuels in 2030 against the technical potential
Source: IEn Gdańsk.

The role of flexibility

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- System with a high share of RES can not rely solely on generation sources.
- It must make use of the potential of such sources of flexibility as DSR, heat pumps and electric cars.

- **Assumed levels of ancillary services**
  - Heat pumps - up to 1 million: **2.57 GW**
  - Electric vehicles - **680 000; 90-200 kWh/piece**
  - Energy storage - **5 GW** including pumped storage
  - Power to heat - **3.2 GW**
  - DSR - **2,8 GW**
  - Cross-border connections - **2.36 GW**

Results

Optimal generation structure in 2030

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- **43% of electricity from RES** in 2030 is achievable.
- Security of supply will be assured
- Wind and solar energy - approx. **32 - 33%**
- Costs **136 - 168 bilion PLN**

Renewable capacity

Installed capacity	Offshore wind farms	Existing onshore wind farms	Onshore wind farms new	Photovoltaics	Biogas	Hydro	Biomass
Min 32 GW	5.2	5.9	4.2	12.5	2.1	0.95	1.2
Max 37 GW	6.3		5.3	14.5	2.2	1.1	1.5

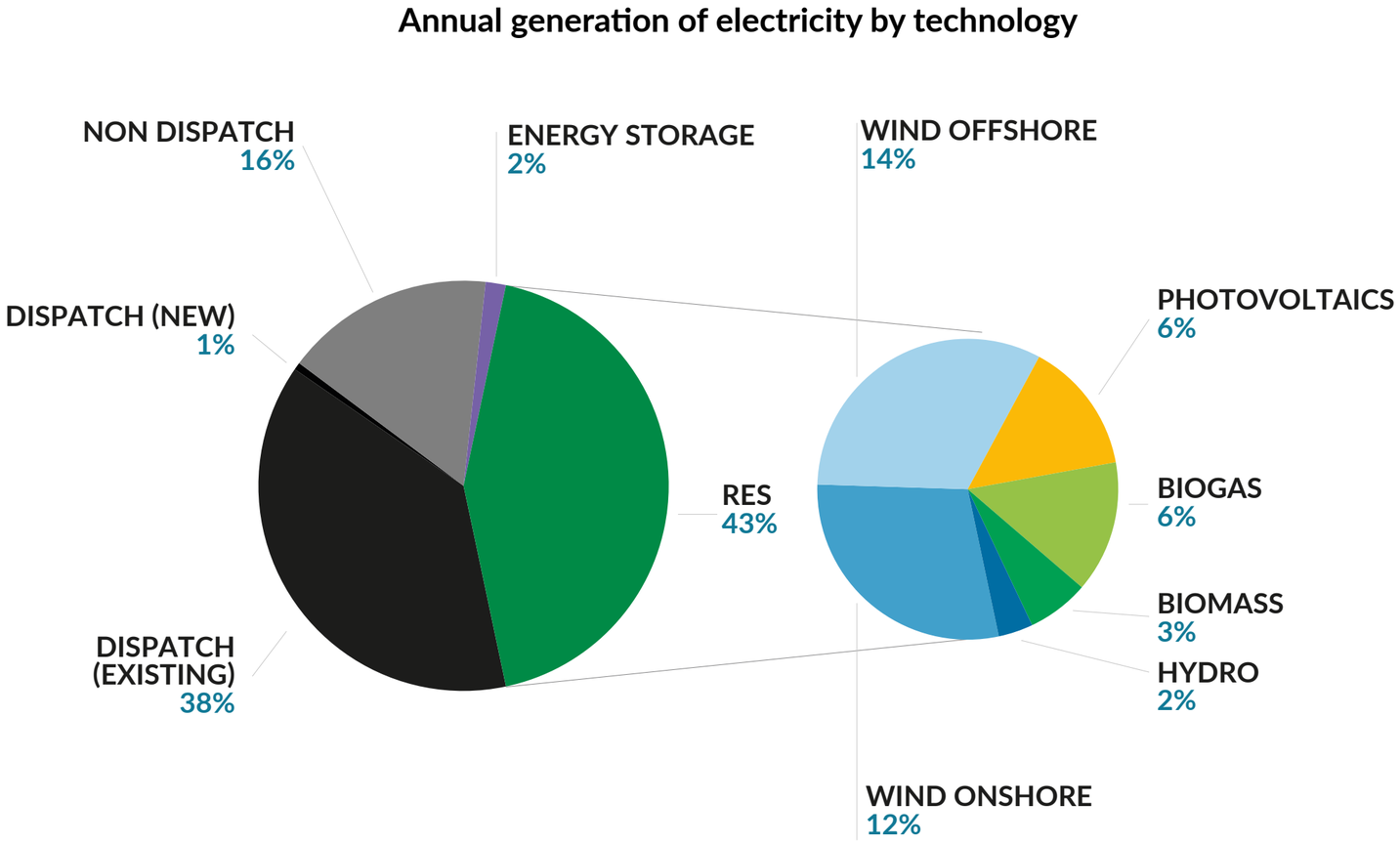
Conventional capacities

Installed capacity	Hard coal	Lignite	Existing CCGTs	New OCGTs
23.4 GW	12.9	4.1	4.4	2
Max 24.4 GW				3

RES share in 2030

Installed RES capacities

- Photovoltaics - **13.2 GW**
- Onshore wind power - **10.6 GW**
- Offshore wind energy - **5.2 GW**
- Hydropower - **1.1 GW**
- Solid biomass - **1.4 GW**
- Biogas - **2,25 GW**

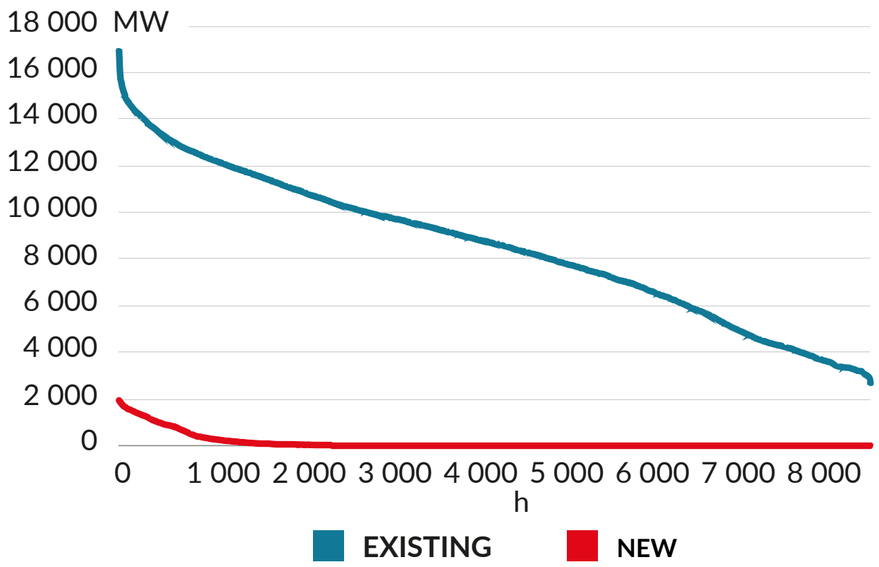


Source: IEn Gdańsk.

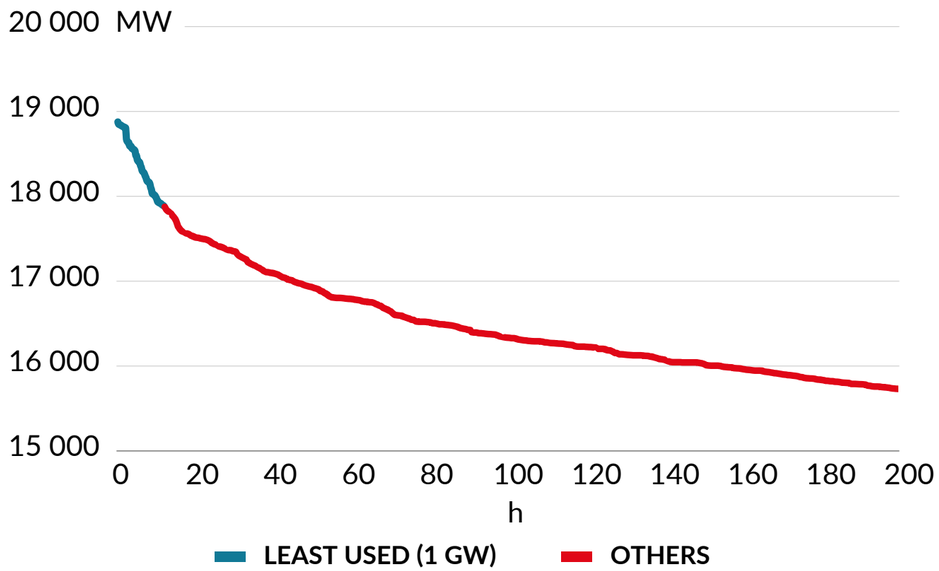
Gas demand

- Maximum 3 GW of new gas generation capacity - OCGT
- The last, third GW of capacity, will work about several hours per year on average

Annual power demand dispatchable generation



Annual demand dispatchable generation (new and existing)



Source: IEn Gdańsk.

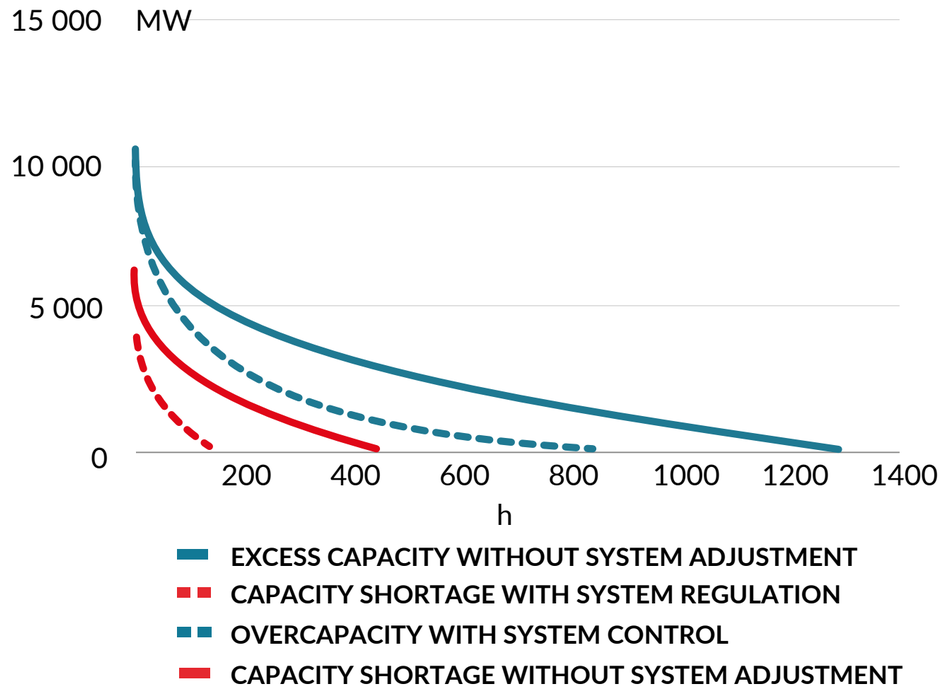
The balancing challenge

Oversupply

- approx. 1 300 h per year

Deficit

- approx. 430 h per year
  (maximum 6 GW)
- 30 h - deficit of covering the demand
  (approx. 20 GWh per year)
  and reserve
- 400 h – missing



Source: IEn Gdańsk.

Adjustment of the system with excess generation (1)

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Step 1: Supply and demand control

- Maximise capacity demand in hours with advantage of supply over demand
- Minimising hours with capacity shortage

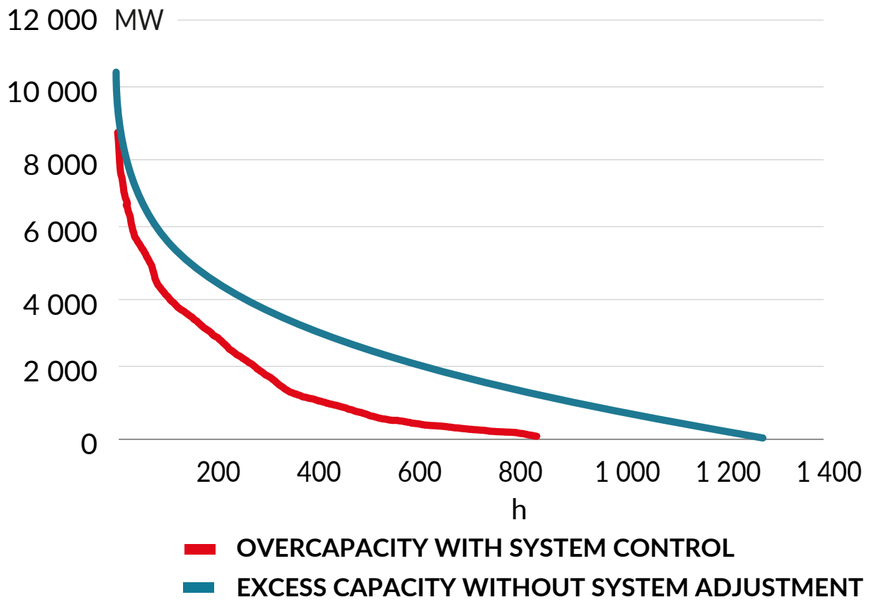
Measures

- Electric cars
- Heat pumps
- Energy storage

The result:

- The number of hours with excess capacity dropped from 1.3 to 0.8 GW
- Maximum demand fells by 1.5 GW

Excess capacity in the system before and after regulation



Source: IEn Gdańsk.

Adjustment of the system with excess generation (2)

Step2: Utilisation of redundant RES production

- Approximately 800 h - 1.4 TWh

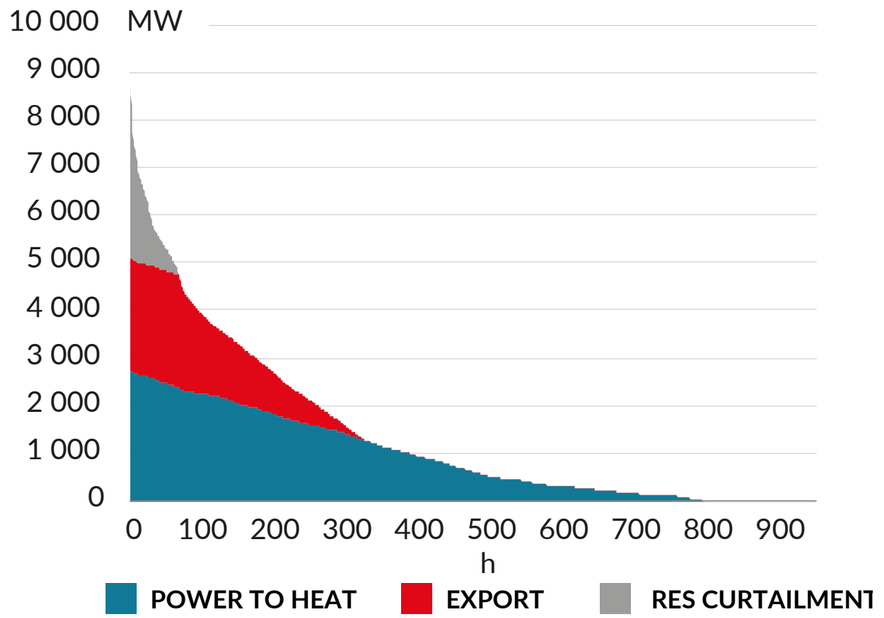
Measures

- Exports
- Green hydrogen
- Power to Heat
- RES curtailment

Reserves

- Reserve allocated to RES for about 1000h
- Possible loss of RES production – curtailment - approx. 15 GWh

The chart shows the order of capacity surplus withing a year, taking into account how they are managed



Source: IEn Gdańsk.

System regulation with generation deficit (1)

Objective: shifting part of the demand to off-peak periods

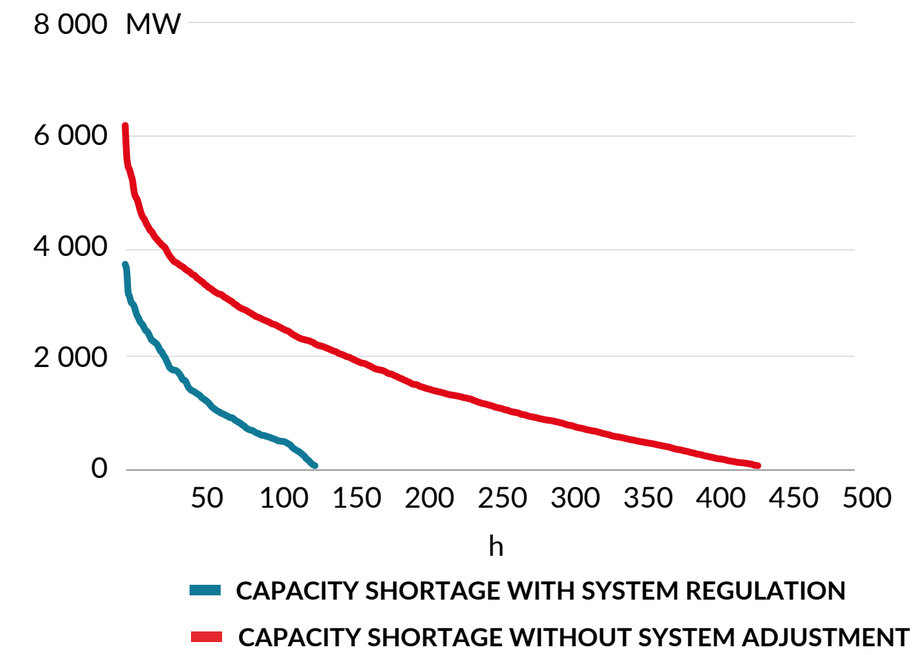
Measures:

- Electric cars
- Heat pumps
- Energy storage facilities

The result:

- Approx. 130 h (maximum 3.7 GW) - reserve deficit
- The deficit may be covered by:
  - 10 h imports (maximum 0,9 GW) and DSR
  - 120 h DSR

Capacity shortage in the system before and after regulation



Source: IEn Gdańsk.

Key results

- RES are the most important resource to fill the coal generation gap in the 2030 perspective.
  - Poland may reach **43% share of RES** in electricity production in 2030 and the system will operate safely.
  - 2 key actions need to be taken:
    - Urgent adoption of a plan that will trigger investments in new RES capacities
    - Electricity market changes that will increase the flexibility of the power system

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THANK YOU FOR YOUR ATTENTION

Dr Joanna
Maćkowiak-Pandera
CEO Forum Energii