EUROPEAN POWER MARKET INTEGRATION IMPLICATIONS

Presentation of the study results

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On behalf of Polish Wind Energy Association and Heinrich-Böll Foundation (Poland)

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AGENDA

A Introduction

B The Polish Electricity Sector

C The Scenarios

D The Summary

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GOAL & PROCESS OF THE STUDY

Goal Research Impact of German Energiewende and Market Design change on the competitiveness of the Polish energy market

11 days* each year till 2020 w/t electricity

Finding Polish market is not able to meet demand. Impact modelling not possible!

⇒ Immediate national measures required!

Approach Develop a 3-phased approach with security of supply focus which:

A) Maximizes interconnection & integration

B) Provides sufficient generation capacity in Poland by:

1. Using technologies with short project cycle time (time req. to generate 1st kWh)
2. Using technologies with low cost, high efficiency, low carbon

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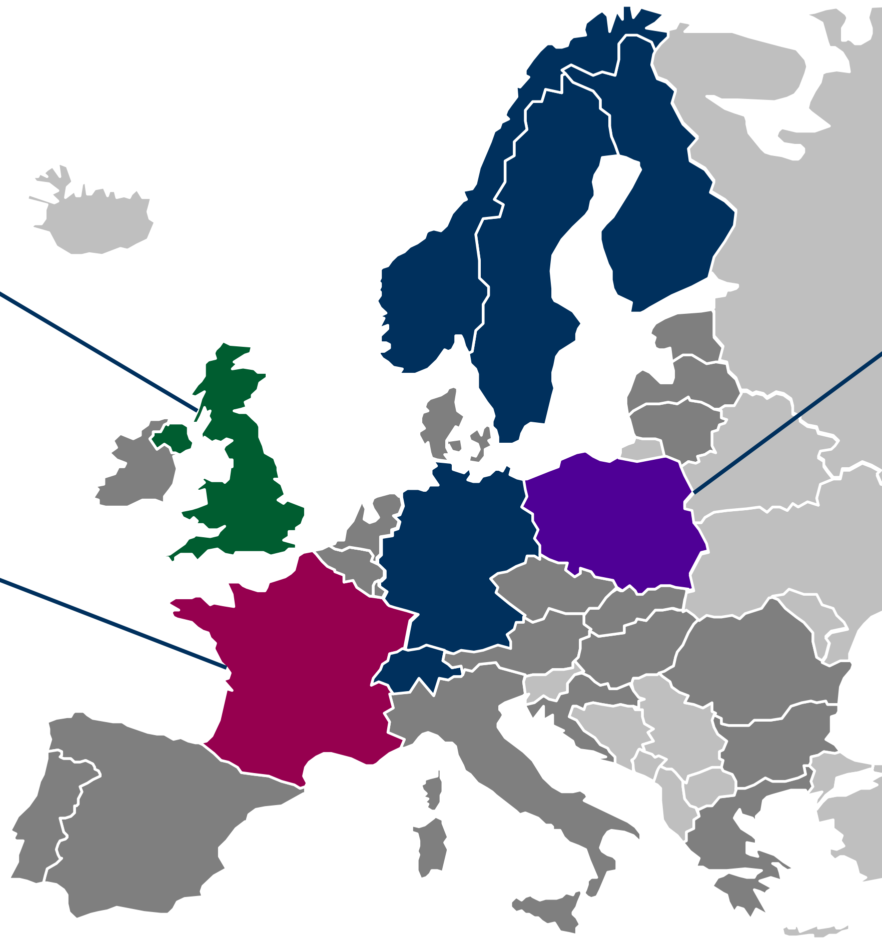
STUDIES FOR FUTURE DEVELOPMENTS IN EUROPE USED

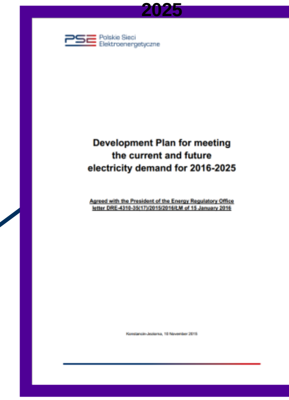
National Grid – Future Energy Scenarios 2015

RTE – Adequacy Report 2015

EU Energy, Transport and GHG Emissions Trends to 2050



Development Plan for meeting the current and future electricity demand for 2016-2025



Energy Brainpool Experts

UNDERLYING STUDIES

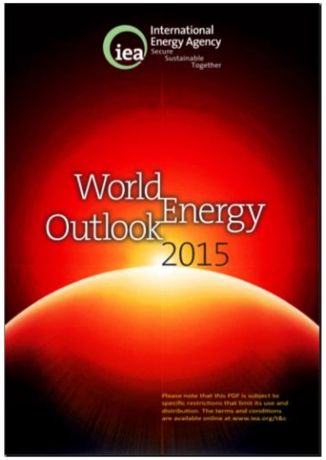
„EU Energy, Transport and GHG Emissions Trends to 2050“

Study written on behalf of the European Commission about the energy specific development of the member states of the European Union. The "Reference Scenario" has one trend path to 2050 adapted to the country and to the European Union taking into account the specific initial conditions of every country in the EU 28. Utilized scenario: "**Reference Scenario**"

Assumptions used in the scenarios:

Trends for the major country specific parameters of the power sector:

- Installed capacity for nuclear, coal, natural gas, oil, wind and solar power plants
- Electricity demand, network losses and own consumption
- Power generation from fossil and renewable energy sources
- Emissions of non-power-generating sectors



„World Energy Outlook 2015“

Annual trend forecast until 2040 for the world energy market, published by the International Energy Agency (IEA). Various scenarios allow the analysis of future trends with different price movements for the energy commodities. Utilized scenario: **„450 Scenario“**

Assumptions used in the scenarios:

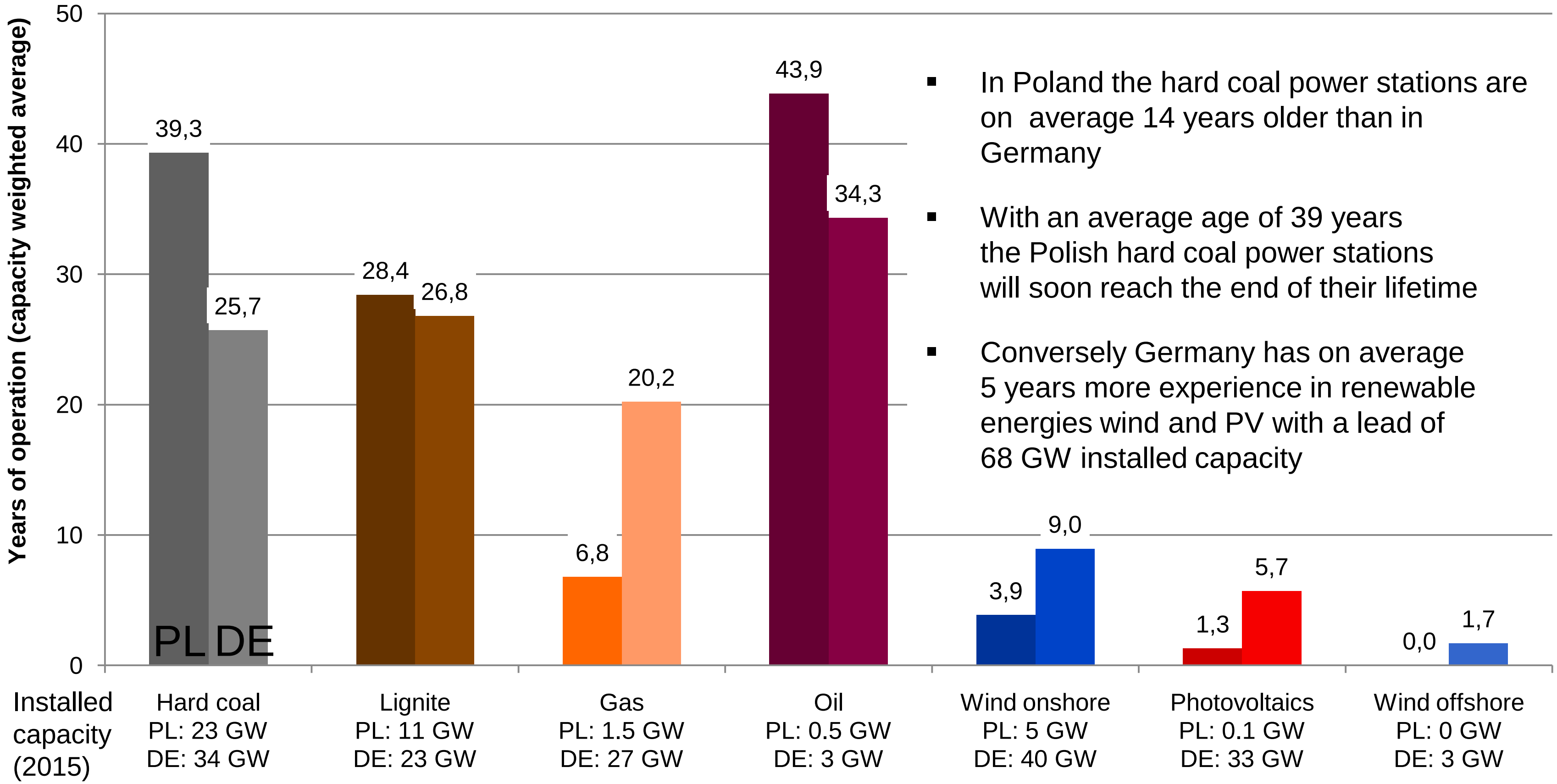
Price trends in Europe for the following fuels:

- Natural gas
- Hard coal
- Crude Oil
- CO_2-Certificates of EU ETS*

*European Emission Trading System

THE POLISH POWER GENERATION SECTOR

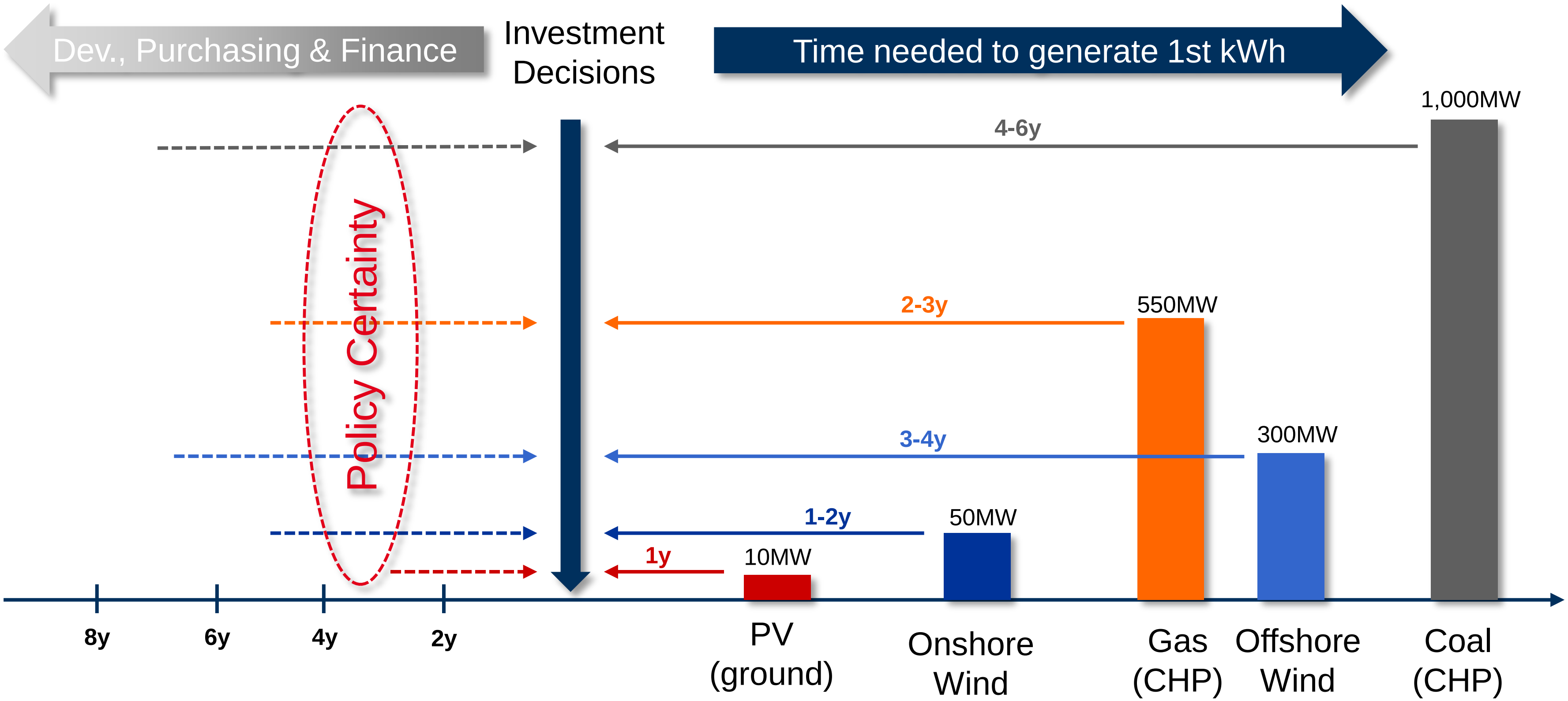
Average age of power stations in Poland



- In Poland the hard coal power stations are on average 14 years older than in Germany
- With an average age of 39 years the Polish hard coal power stations will soon reach the end of their lifetime
- Conversely Germany has on average 5 years more experience in renewable energies wind and PV with a lead of 68 GW installed capacity

*Source: Energy Brainpool European Power plant database

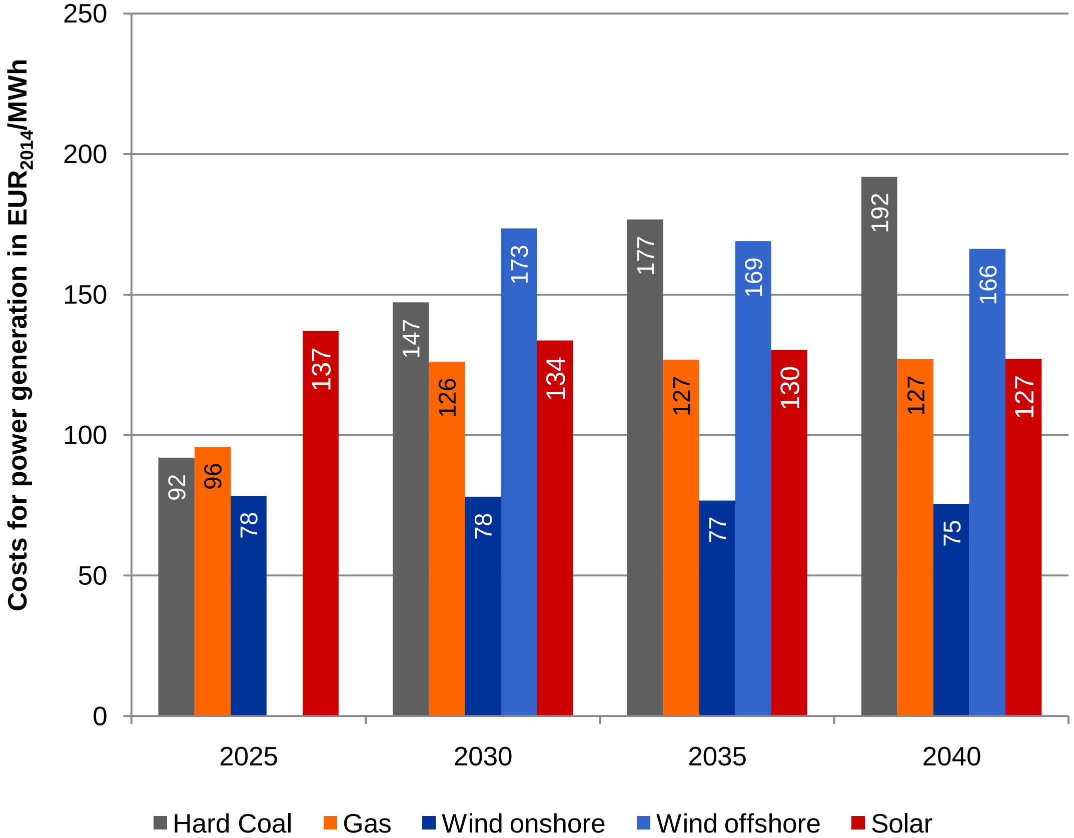
ENERGY PROJECT CYCLE



Investment certainty requires policy up to 10 years before investments are completed.

ANNUAL INVESTMENT COSTS OF NEW POWER STATIONS

Levelized Costs of Electricity: (CAPEX + OPEX + SRMC) / Generated Power



- The “Levelized Costs of Electricity” showing the price of electricity power generation based on the total costs of the technology
- The costs contains: CAPEX, OPEX and Short run marginal costs (SRMC) divided by the amount of generated power
- In the scenario, the commodity prices are increasing based on the “450 Scenario” of the “World Energy Outlook 2015”.

⇒ Impact: costs for gas and coal are increasing

- Wind and Solar are getting more efficient in the future (higher full load hours) and with that the costs per generated MWh power are decreasing
- The CAPEX and OPEX costs are based on current values
- Because of the high prices for CO_2-certificates, the generation from gas power stations is cheaper than the generation from coal.
- As coal is replaced by gas, wind, solar and imports, the power stations can produce less amount of power and the costs per produced MWh is increasing.

⇒ the increase of gas and CO_2-prices is balanced by the higher full load hours of gas power stations

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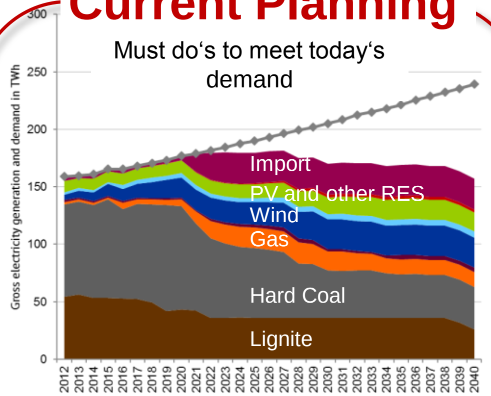
STUDY SCENARIOS

Current Planning

Must do's to meet today's demand



<u>Meassure</u>:
- German interconnection ↑
- Critical plants life ↑
- Renewable build out ↑

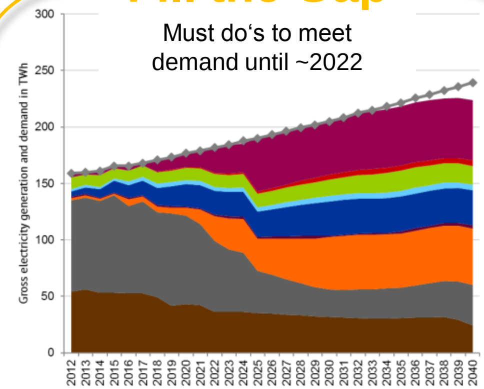
<u>Policy emergency rec.:</u>
- Reject closures of specific plants (for lim. period)
- Wind auction in Q3/Q4 16

<u>Cost:</u>
Marginal

Prevent immediate Brown Outs

Fill the Gap

Must do's to meet demand until ~2022



<u>Meassure</u>:
- Neighbour interconnection ↑
- Wind & PV build out ↑
- Gas comb. heat & power ↑

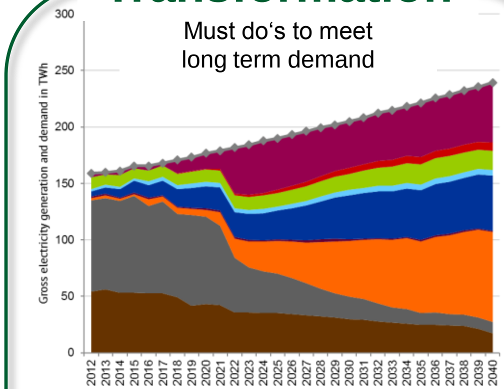
<u>Policy Recommendation:</u>
- Policy alignment with Neighbours
- Continue Wind & start up PV
- Dev. Gas-based CHP policy

<u>Negative Cashflow</u>:
Up to € 0.4 bln p.a. (2021)

Prevent ~'22 Brown Out

Transformation

Must do's to meet long term demand



<u>Meassures</u>:
- Further Interconnection ↑
- Wind & PV & Offshore
- Gas Comb. Heat & Power

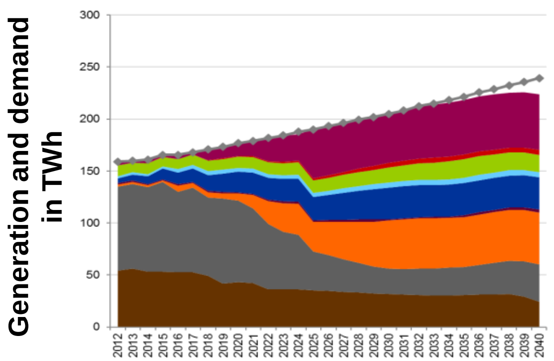
<u>Policy Recommendation:</u>
- Regional Energy Policy – BEMIP – Joint Offshore
- Continue Wind & PV policy
- Gas infrastructure

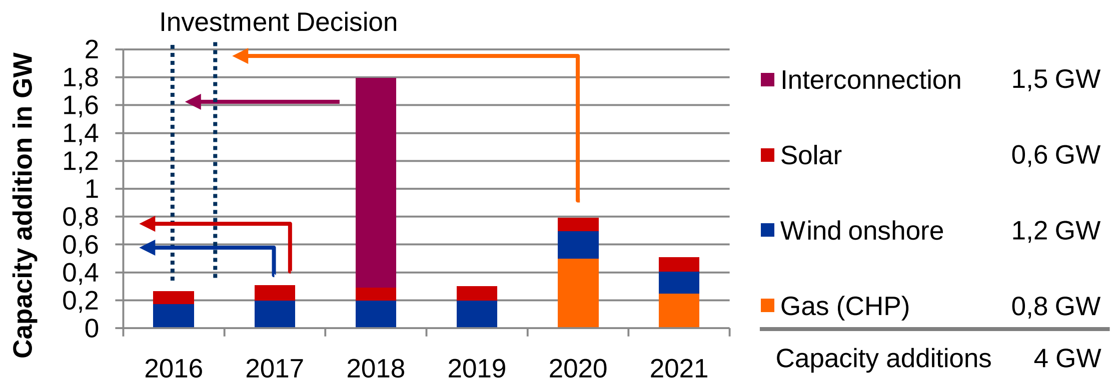
<u>Negative Cashflow</u>:
Up to € 2.3 bln p.a. (2040)

Renewable & Low carbon

SCENARIO DETAILS AND KEY RESULTS

Fill the Gap till 2022





Findings & Implications

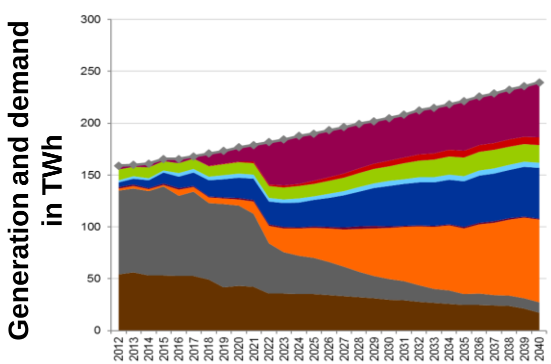
- Fossil fired power plant capacities decreasing by 6.5 GW until 2022 because of the end of lifetime
- With additional 4 GW capacity additions supply can meet demand till 2021
- Between 2022 and 2025 and then beginning from 2028 shortages occur
- Negative cash flow for power producer: € 0.3 to 0.4 bln per year in 2020 and 2021

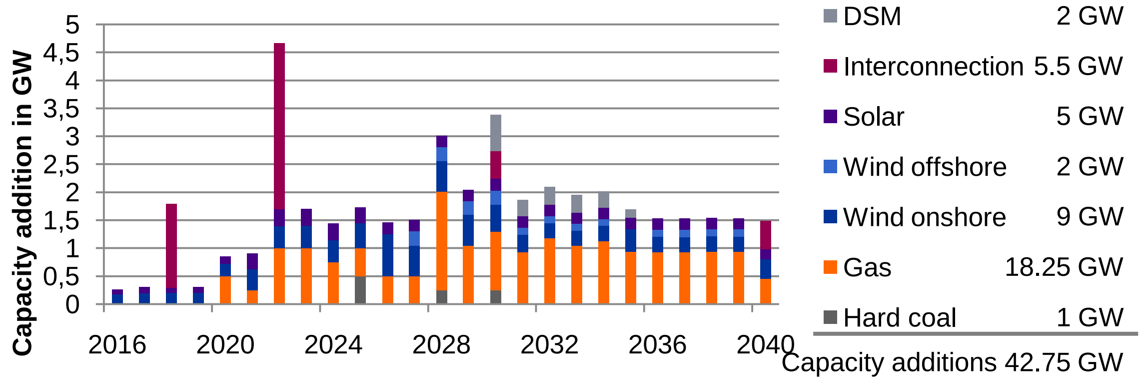
Impact

- Brown out & black out ↓ (no brown-/blackout till 2021)
- Security of supply ↑
- Decreasing CO_2 emissions by replacing coal power plants with imports, gas and renewables
- Integrating Poland in the European power market

SCENARIO DETAILS AND KEY RESULTS

Transformation





Findings & Implications

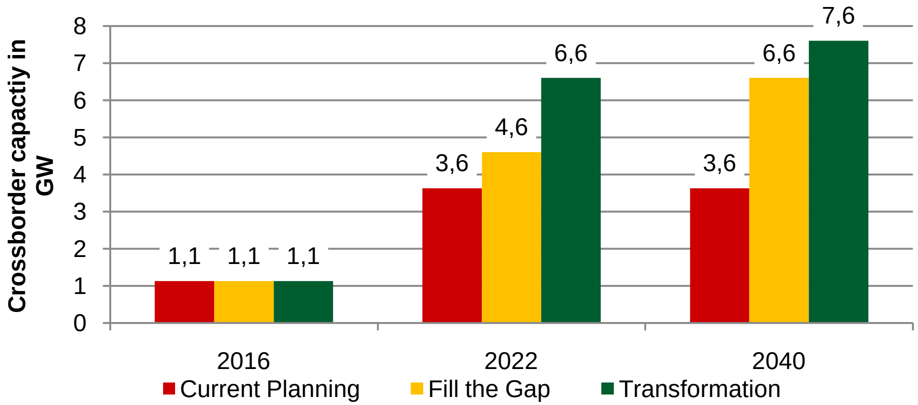
- Fossil fired power plant capacities decreasing by 17 GW until 2040 because of the end of lifetime
- With additional 43 GW capacity additions supply can meet increasing demand till 2040
- Long term alternative to coal power stations are gas fired stations
- Negative cash flow for power producer: € 0.3 to 2.3 bln per year from 2020 to 2040

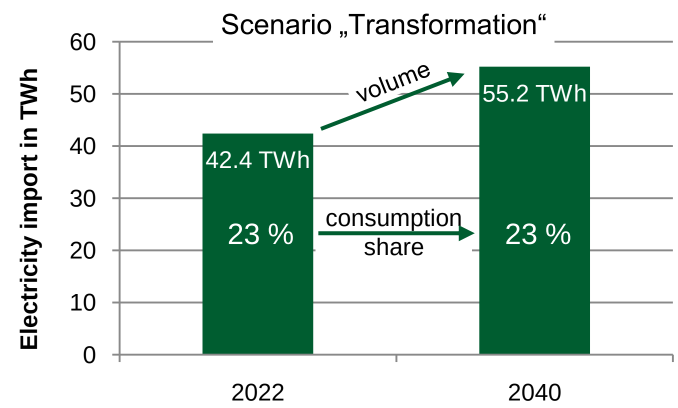
Impact

- Brown out & black out ↓ (no brown-/blackout till 2040)
- Security of supply ↑
- Transition to less CO_2-intensive energy sources like renewables and gas
- Increase of renewable power producing capacities by more than 5 time from current 5 GW to more than 30 GW
- Integrating Poland in the European power market

INTERCONNECTION DEVELOPMENT AND EUROPEAN MARKET IMPLICATIONS

Interconnection to Sweden, Lithuania and Germany/Czech Republic/Slovakia





Costs for imported electricity 2040

€ 4 bln

Power imports **saving € 3 billion** in 2040 compared to new gas power plants

Costs for electricity from new gas power plants 2040

€ 7 bln

- Currently Poland has many interconnections with neighbouring countries that can not be used totally because of the **network restrictions today**
- One of the most important aspects is to solve the network issues and use the interconnections to import /export power as soon as possible
- To be less dependent on electricity imports Poland would need to invest into a lot more power stations
- Import connections are operating **83 % of the year** to secure the Polish electricity system
- Importing power saves up to **€ 3 billion** in 2040 compared to new gas power plants in Poland and **€ 6,5 billion** compared to new coal fired power plants

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KEY INSIGHTS AND RECOMMENDATIONS

Scenario	Target	Action	Implementation
Current Planning	Avoid immediate Brown & Black outs	▪ Lifetime extension ▪ Wind auction ▪ Use exist. Interconnect	“In progress!?”
Fill the gap	Avoid 11 days/year of potential brown out/black outs till 2021	Further capacity incc. ▪ CHP Policy gas & coal ▪ Wind & Solar Policy ▪ Integrate & Interct.	Start “Today”
Transformation	Transform energy market: ▪ Clean and efficient ▪ Flexible and modern ▪ At low cost	▪ Regional Energy Policy – BEMIP, Offshore ▪ Continue Wind & PV ▪ Gas infrastructure	Start “Tomorrow”

Challenging activities required	▪ Built out gas infrastructure (pipeline and LNG) ▪ Review heat infrastructure (no-regret option) ▪ Develop regulatory framework to ensure transformation

KEY INSIGHTS – COST-BENEFIT

Scenario	Cost	Benefit	Implication
Current Planning	Marginal	None	Security of Supply ↓
Fill the gap	Up to € 0.4 bln p.a. or 0,22 Ct/kWh (2021)	20 % RES (2020)	Security of Supply ↑ Energy Independence ↓
Transformation	Up to € 2.3 bln p.a.* or 0,96 Ct/kWh (2040)	33 % RES (2040)	Security of Supply ↑ Energy Independence ↓

*) including power import **savings of € 3 billion**

This study provides market data for the Polish energy market transformation as a quantitative starting point for further sector and technology specific cost-benefit analysis

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