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Warsaw School
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Energy Economics

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RESEARCH CONFERENCE

Consequences of energy and geopolitical crisis for Polish energy sector - combining energy transition with energy security

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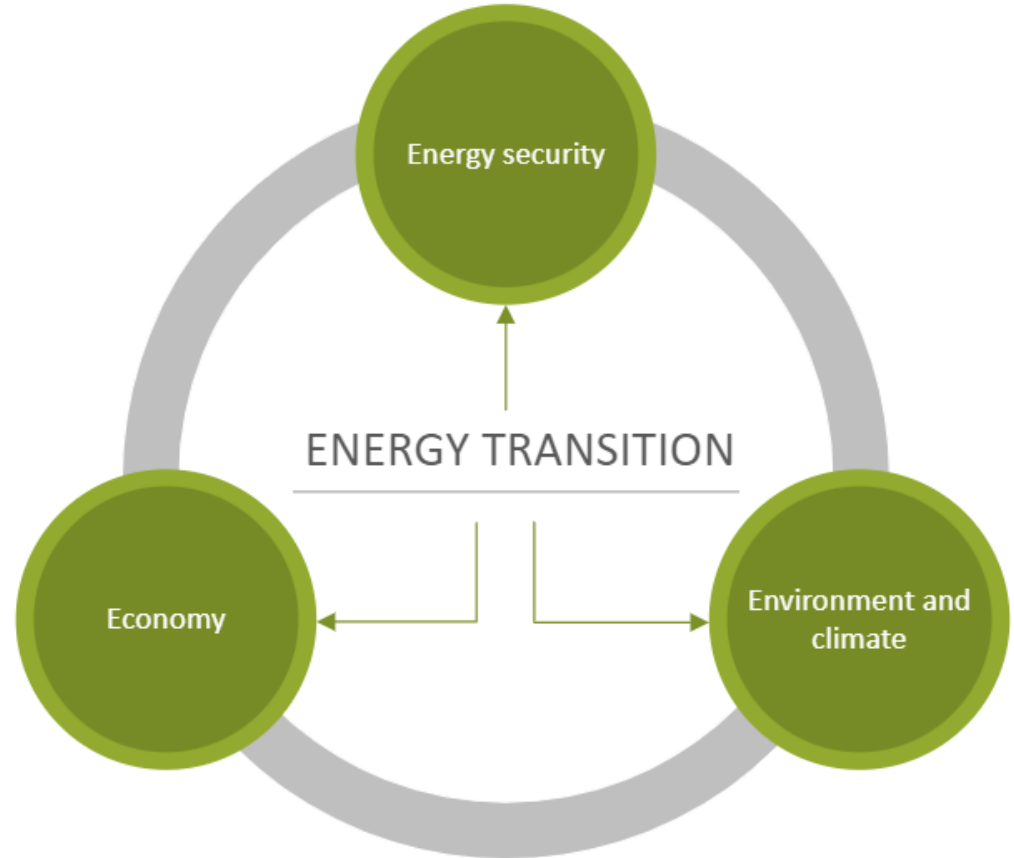
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Oxford, 20th September 2023

Energy Transition and Energy Trilemma

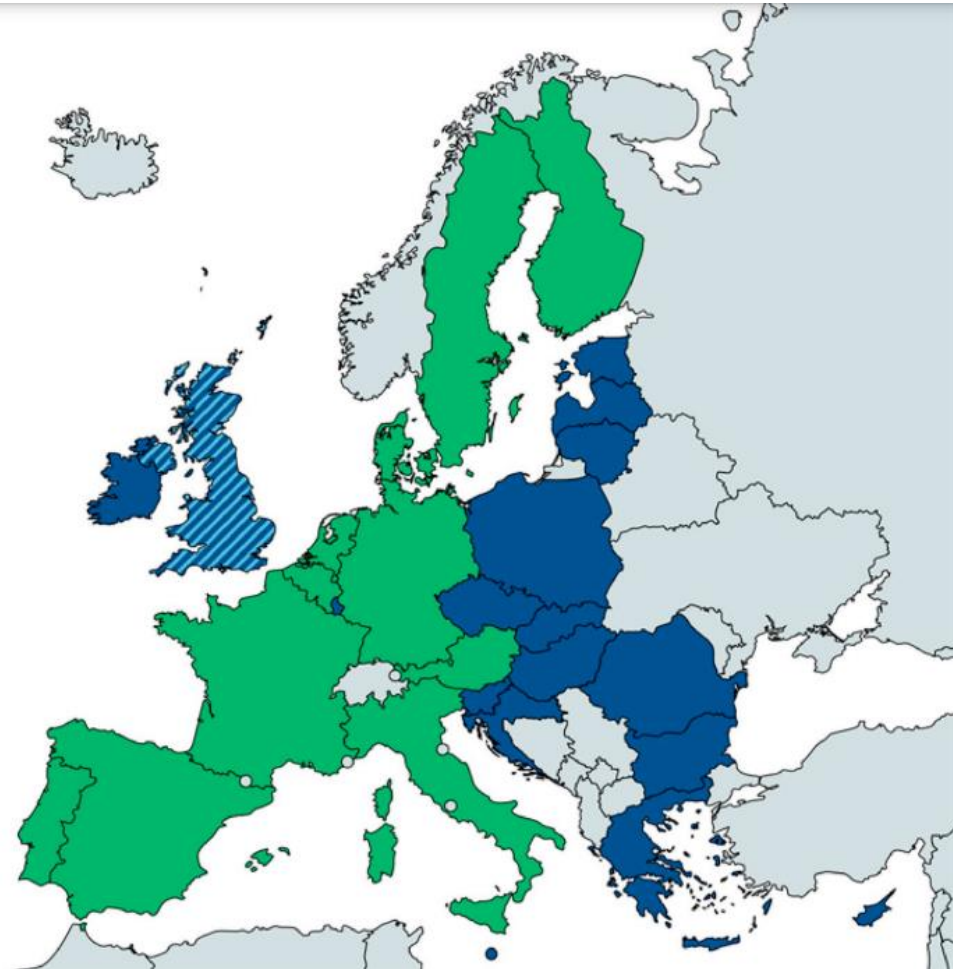
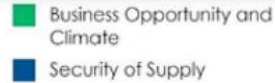
The lack of clarity of the concept of **energy transition** has led to the emergence in the literature of the concept of the **energy trilemma** (Khan et. al., 2021)



- Perez et al., **2019**

Two clusters within EU: energy import dependency together with supplier concentration – with special attention to Russia and second, macroeconomic benefits of increased renewable energy penetration – in terms of electricity prices, low-carbon technology patents, market shares and turnover.

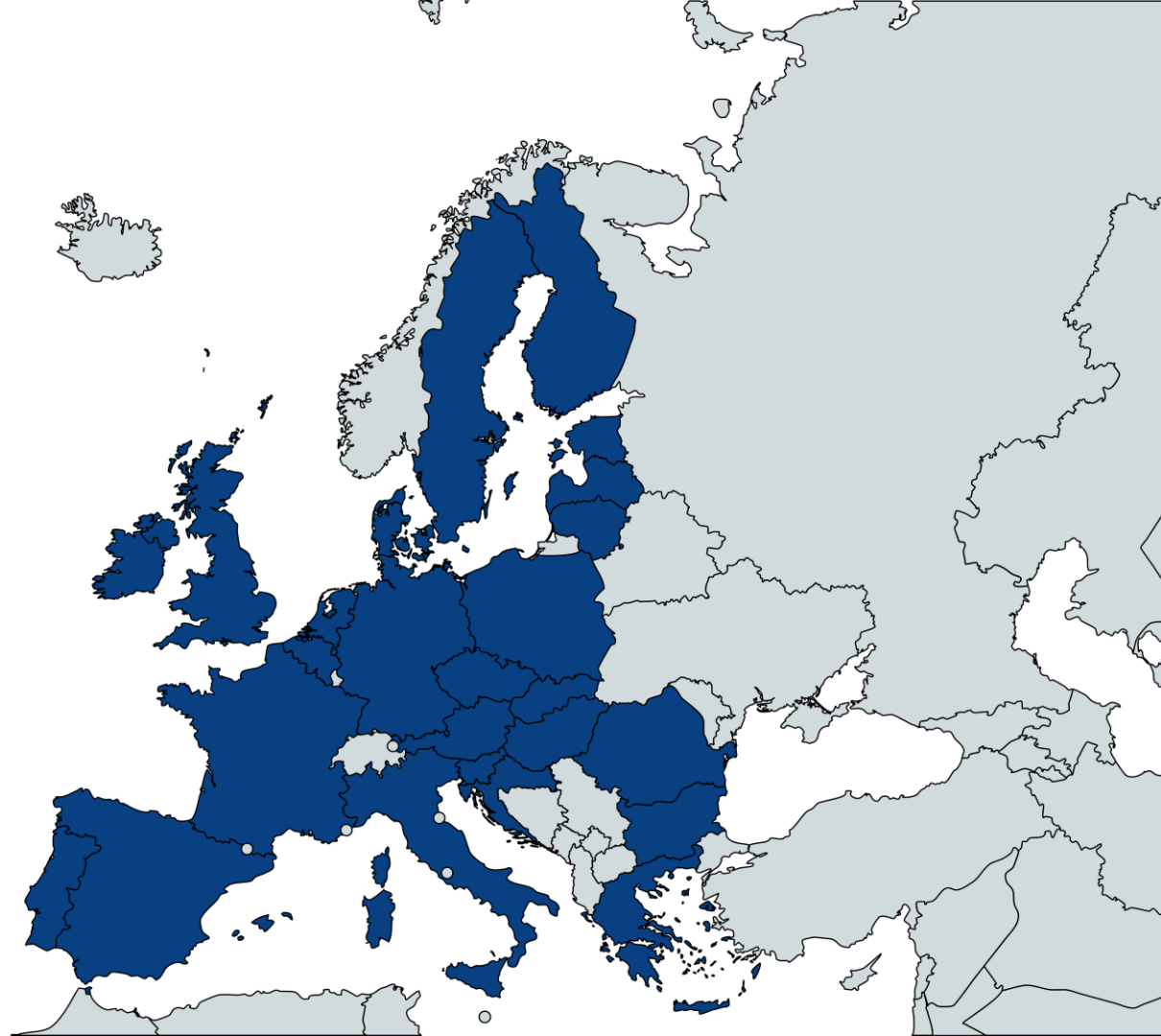
Mata Pérez, M. de la E., Scholten, D., & Smith Stegen, K. (2019). The multi-speed energy transition in Europe: Opportunities and challenges for EU energy security. *Energy Strategy Reviews*, 26(October). <https://doi.org/10.1016/j.esr.2019.100415>



■ Security of supply

2022

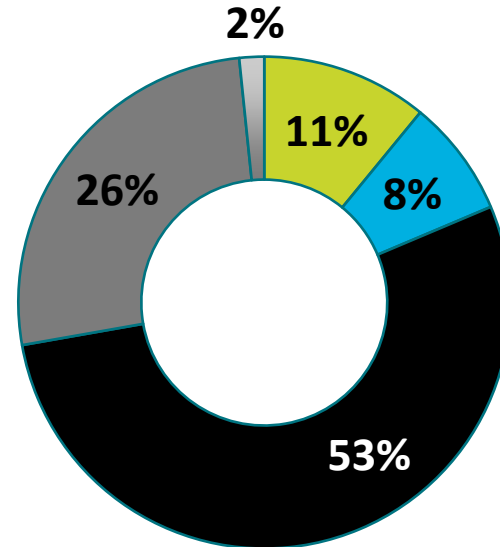
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Energy transition - the case of Poland

- Most dependent on coal
- Non-diversified energy mix
- Lack of nuclear energy
- High exposure on climate risk
- Rapid growth of prosumers' PV

Polish electricity mix
(electricity production in %):



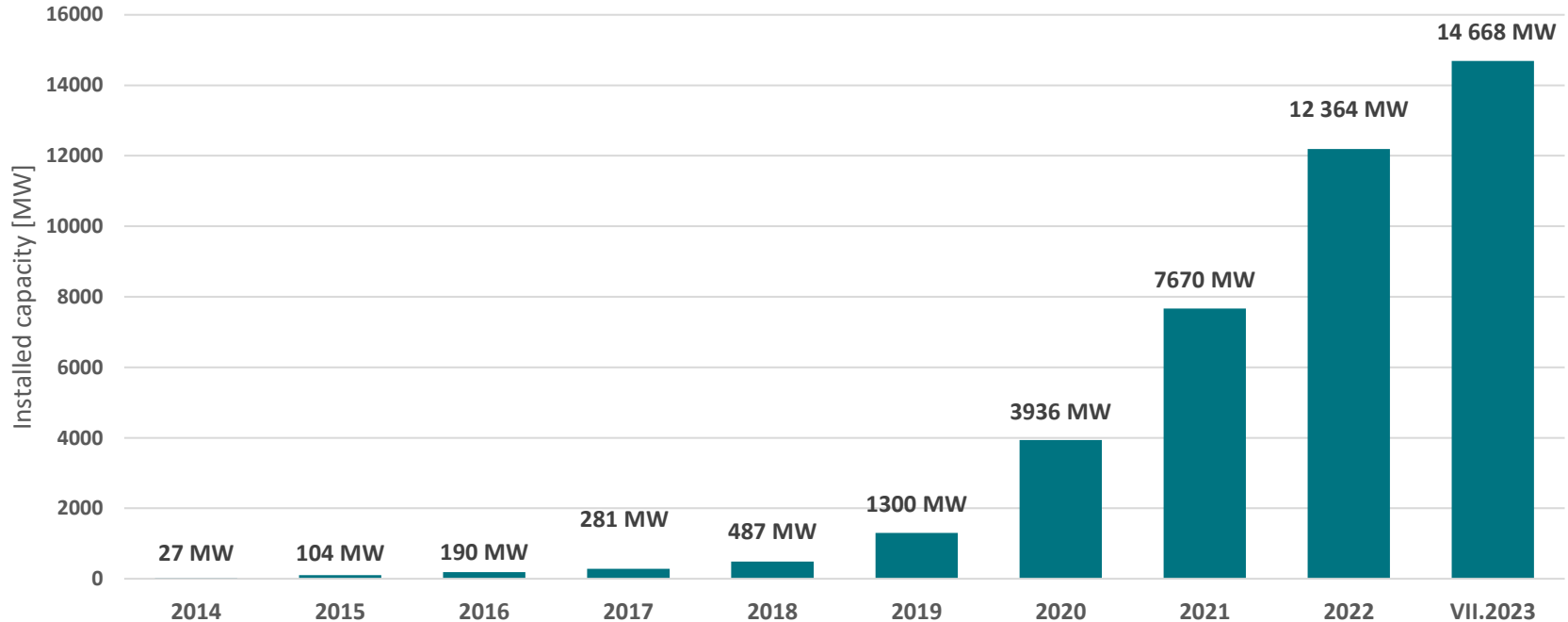
■ Renewables ■ Gas ■ Hard Coal ■ Lignite ■ Hydro

Climate risk exposure and affected energy sectors

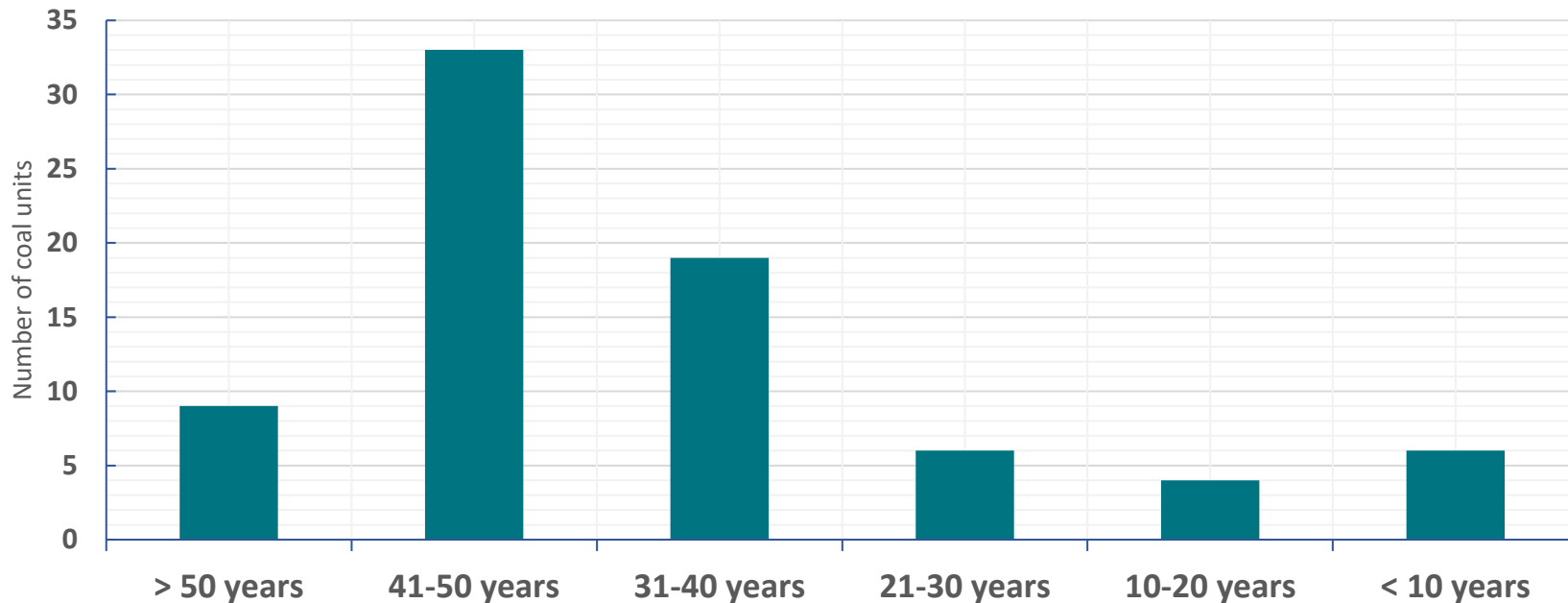
Type of risk	Risk exposure	Affected energy sectors
Financial risk	Severe	Whole energy sector
Regulatory and environmental risk	Very high	Whole energy sector
EU ETS	Very high	Electricity and heat generation, coal mining
Climate anomalies and natural disasters	Moderate	Electricity and heat generation, transmission and distribution of electric energy, energy trading
Social risk	Moderate	Electricity and heat generation, transmission of electric energy, energy trading

Soaring PV's installed capacity

PV's capacity factor:
12,3%

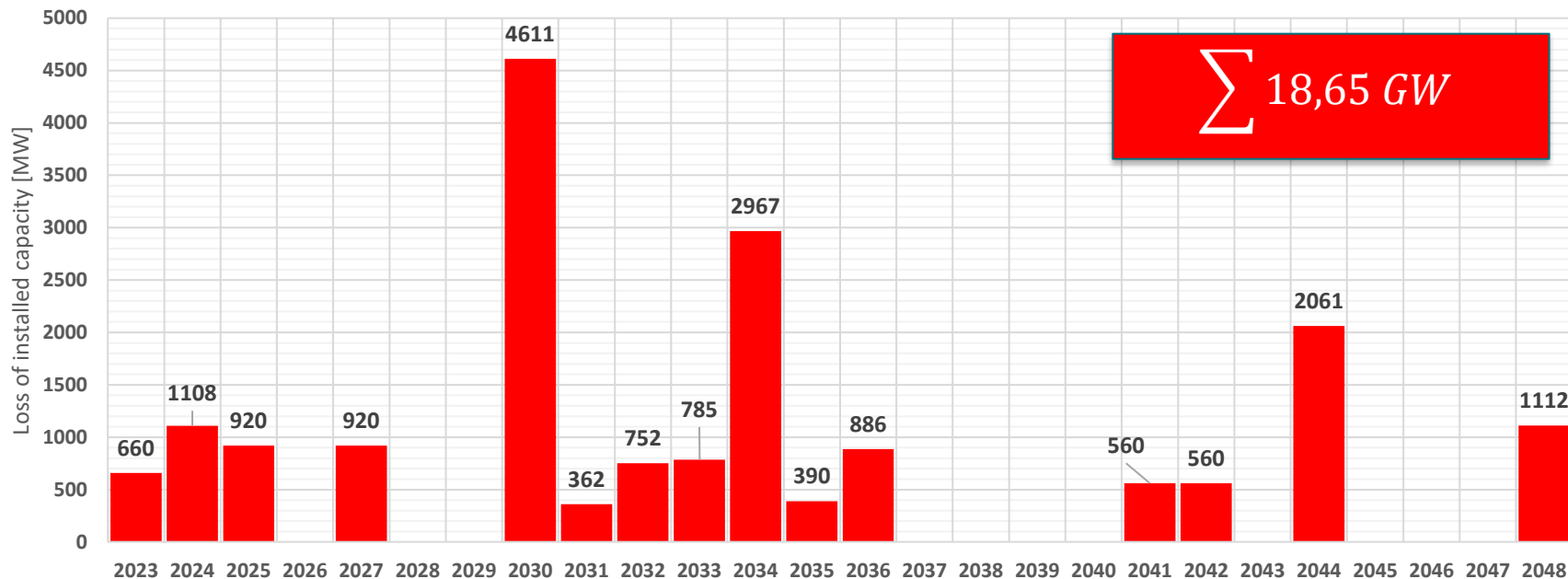


Investment gap in the Polish energy sector



Age structure of coal units in Poland - number of coal units put into operation in a certain period of time (as at 2022).

Phasing out coal units between 2023 and 2048 and the problem of missing capacity



Carbon risk related with EU ETS results in financial risk

EU Carbon Permits



source: tradingeconomics.com

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SRMC analysis of Polish power plants - 2021

- **Hard coal:**

$$SRMC_{Hard\ coal} = C_{Fuel} + C_{Transportation} + C_{EU\ ETS}$$

- **Lignite:**

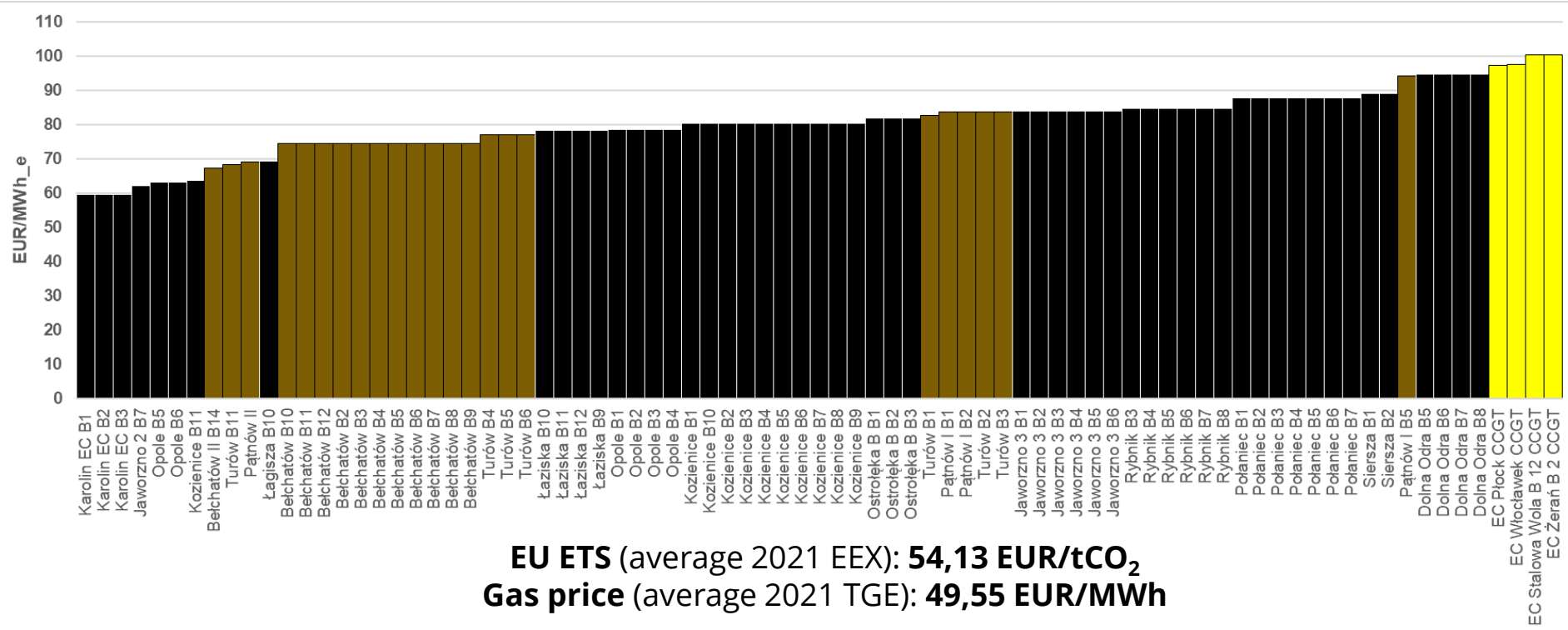
$$SRMC_{Lignite} = C_{Fuel} + C_{EU\ ETS}$$

- **Natural gas:**

$$SRMC_{Natural\ gas} = C_{Fuel} + C_{EU\ ETS}$$


- Total installed capacity in the model: 26,6 GW
- The model includes only centrally dispatched capacities, not CHP units

SRMC analysis of Polish power plants - 2021

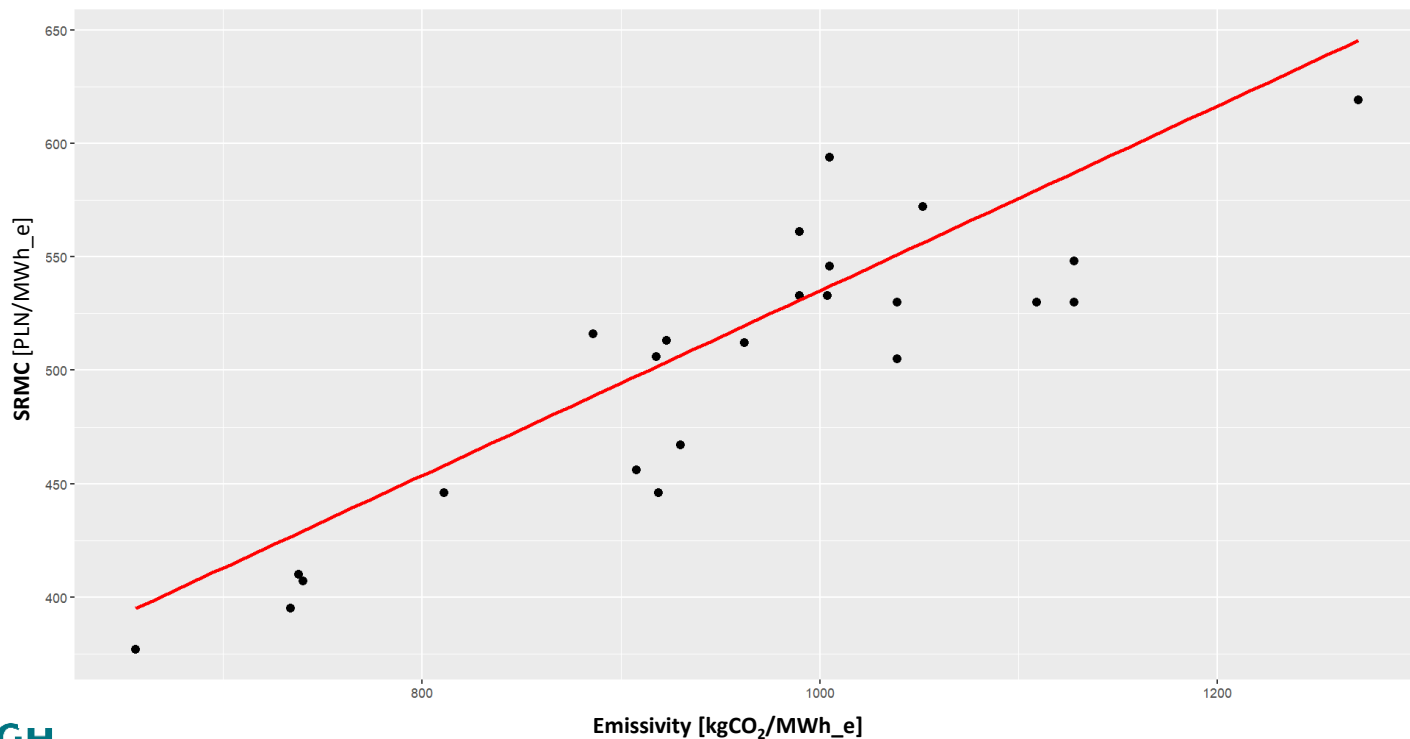


 Hard coal

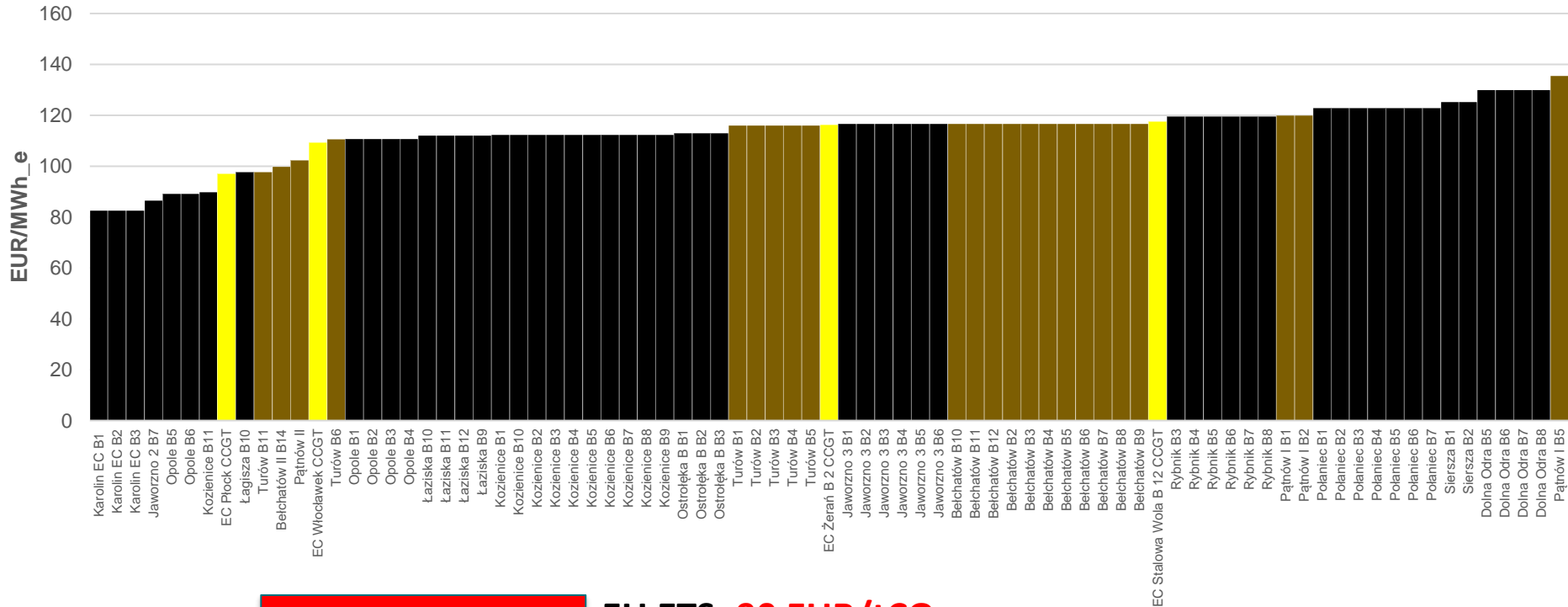
 Lignite

 Natural gas

Dependence of SRMC on the emissivity of coal blocks (hard coal) in 2021



SRMC analysis of Polish power plants - 2021



Theoretical simulation

EU ETS: 90 EUR/tCO₂

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Hard coal



Lignite

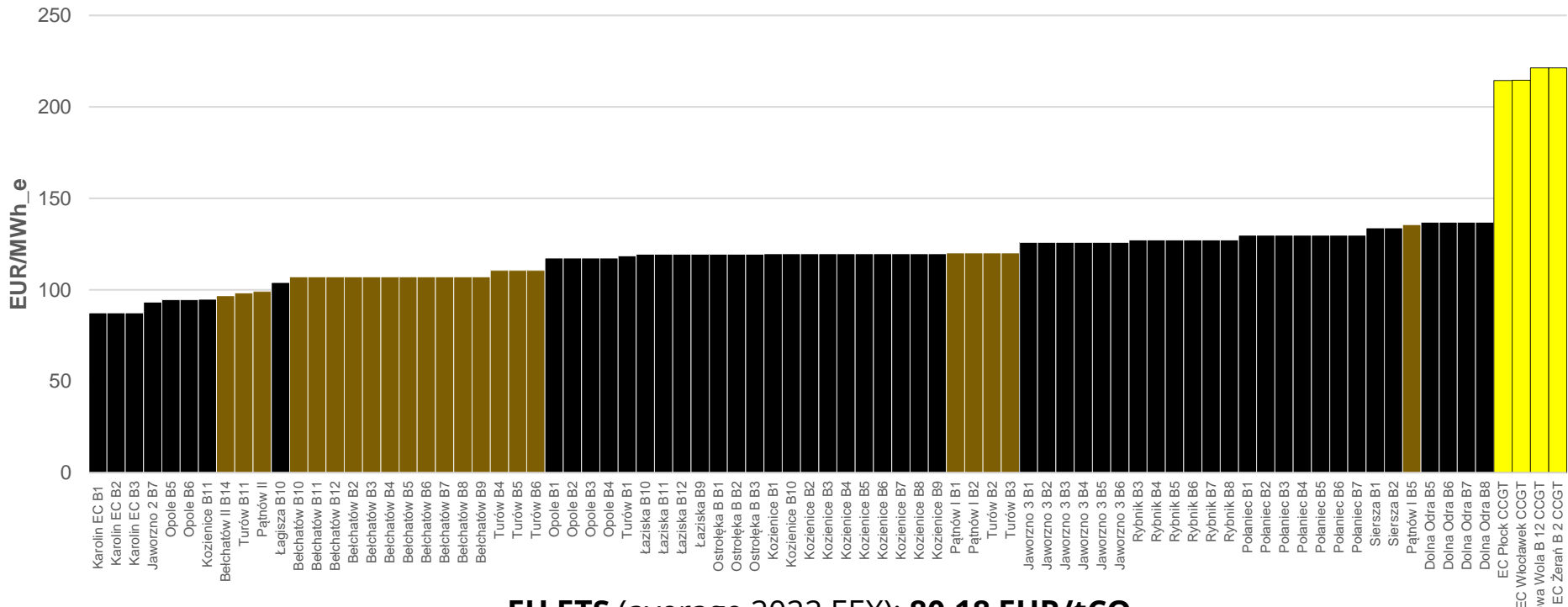


Natural gas

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Source: Own research, data for 2021

SRMC analysis of Polish power plants - 2022



EU ETS (average 2022 EEX): 80,18 EUR/tCO₂
Gas price (average 2022 TGE): 116,86 EUR/MWh

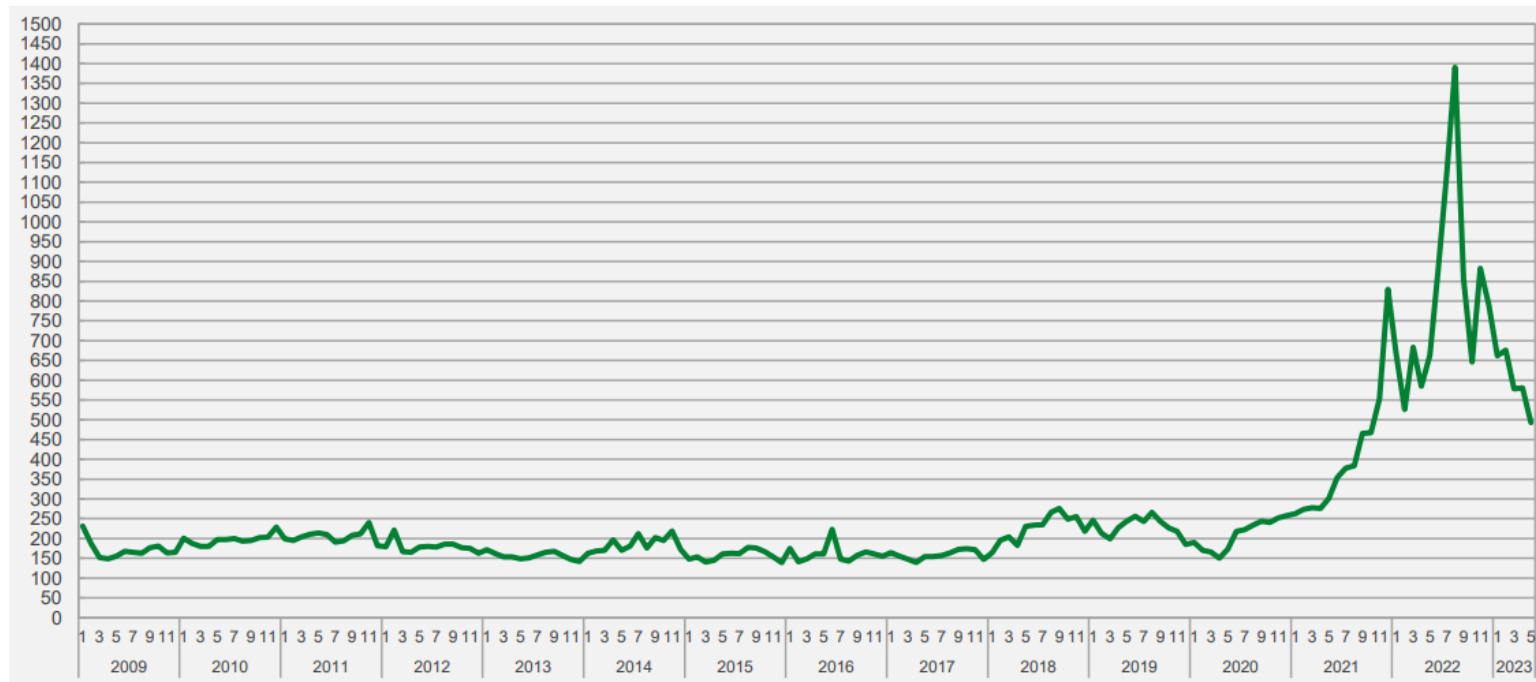


 Hard coal

 Lignite

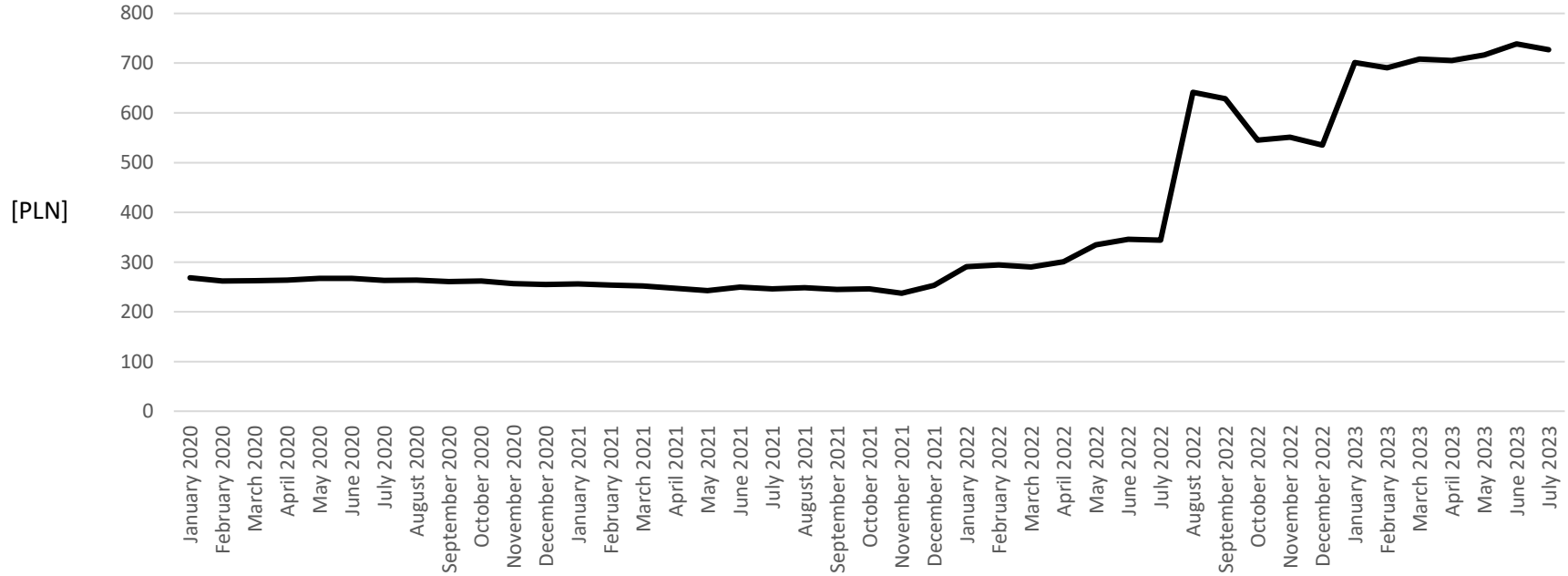
 Natural gas

Monthly weighted average energy prices in Poland

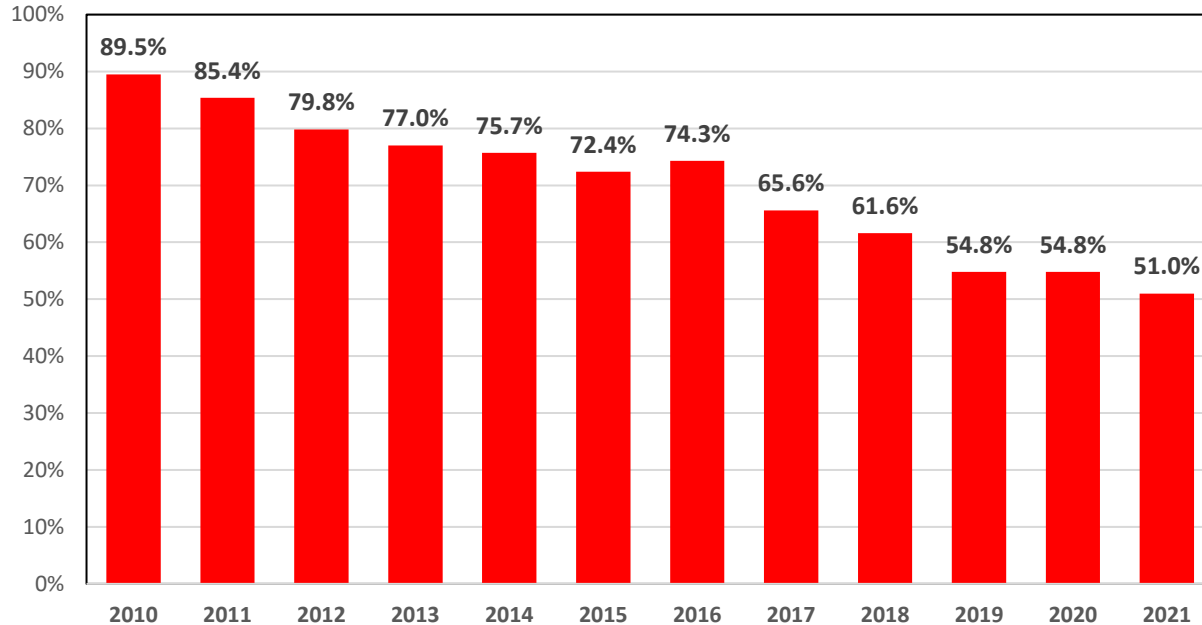


Source: TGE monthly report 05/23, Day-Ahead market

PSCMI1 – Polish Steam Coal Market Index



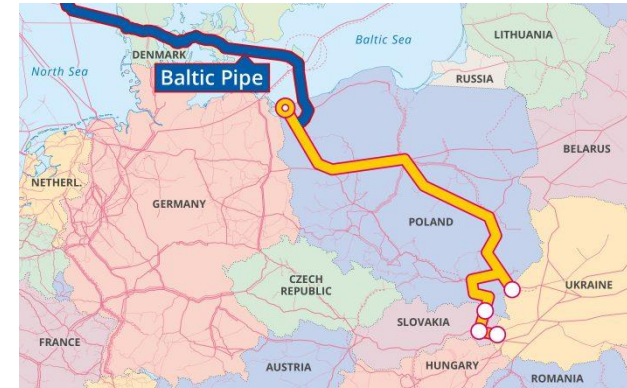
From being addicted to Russia's gas to being a gas hub in the CEE region



Poland's dependence on gas imports from Russia

Source: Own research based on data from Eurostat and Polish Ministry of Climate and Environment

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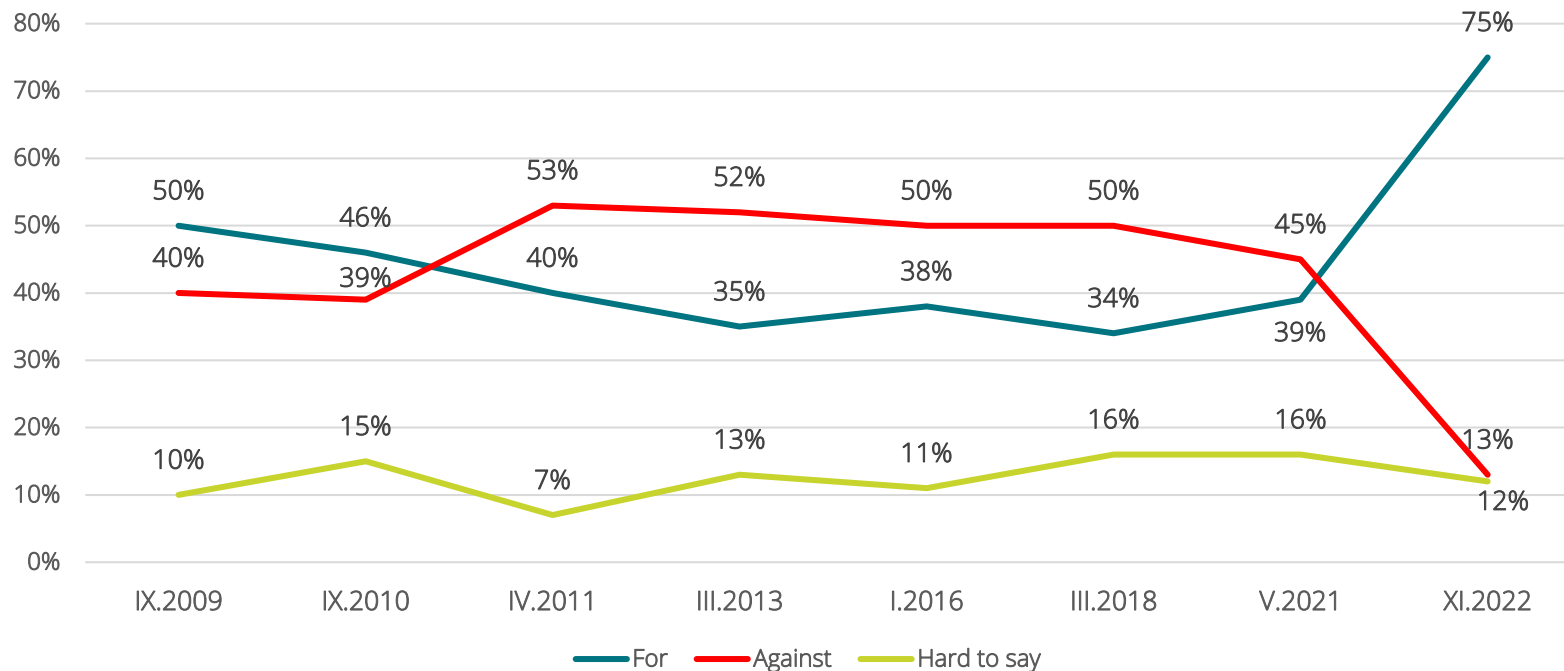
Baltic Pipe and gas transmission to Ukraine

Source: Gas Transmission System Operator of Ukraine

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Investment in nuclear energy

Planned 6-9 GW



Summary

- **Russia's invasion in Ukraine** affected **energy security** in the EU
- **Dependence on fossil fuels** triggered dynamic growth in energy prices due to **merit order** and the soaring **gas prices**
- Extreme high gas prices are seen as **temporary**
- **Coal assets are treated as toxic assets** and worsen the possibilities of rising capital
- Phasing-out fossil fuels will **reduce exposure to energy crises** in the future
- ETS development accelerates need for **decarbonisation**, but **substitution** of energy sources is necessary
- **Energy security** plays a crucial role in the Polish energy transition, particularly during the **war in Ukraine**

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