



University of St.Gallen

Institute for Economy and the Environment

Geopolitical challenges of energy transition: a case of Ukraine

St.Gallen, 27 February 2025

Dr. Nadiya Kostyuchenko

Agenda

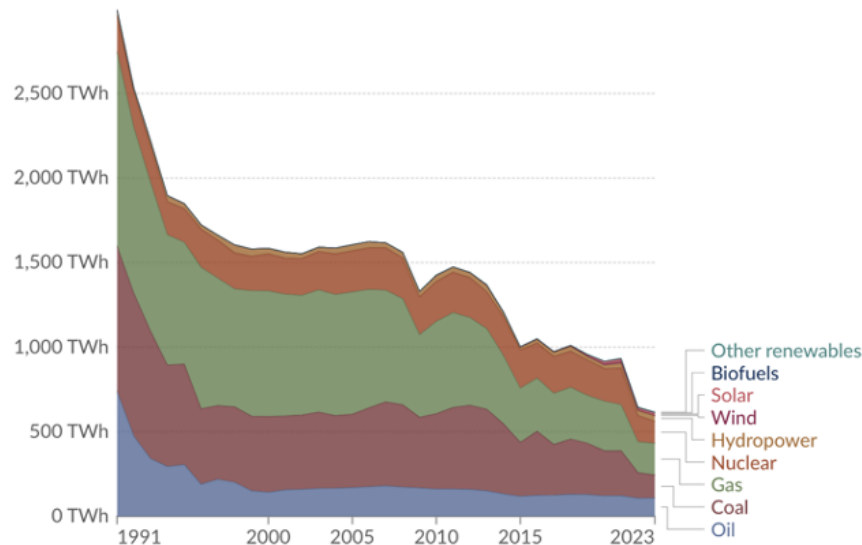
1. Background
2. Ukrainian energy sector overview
3. Ukraine's energy legislative provisions:
“brown” vs “green” energy priorities
4. Can the war be a catalyser for the energy transition?
5. Energy sector forecasting scenarios
6. Questions & Answers

Background:

- ❖ The energy-intensive nature of Ukrainian industrial infrastructure since USSR period
- ❖ Historical heavy energy dependency on Russian fossil fuels imports
- ❖ A severe economic crisis marked by a real GDP drop cumulatively by over 62 % (1991-1998), hyperinflation (1992-1994) and mounting energy-related debt to Russia
- ❖ Artificially low domestic energy prices relative to global market rates throughout the 1990s
- ❖ The gas crises of 2006 and 2009
- ❖ Energy sector reforms

Energy Sector Overview

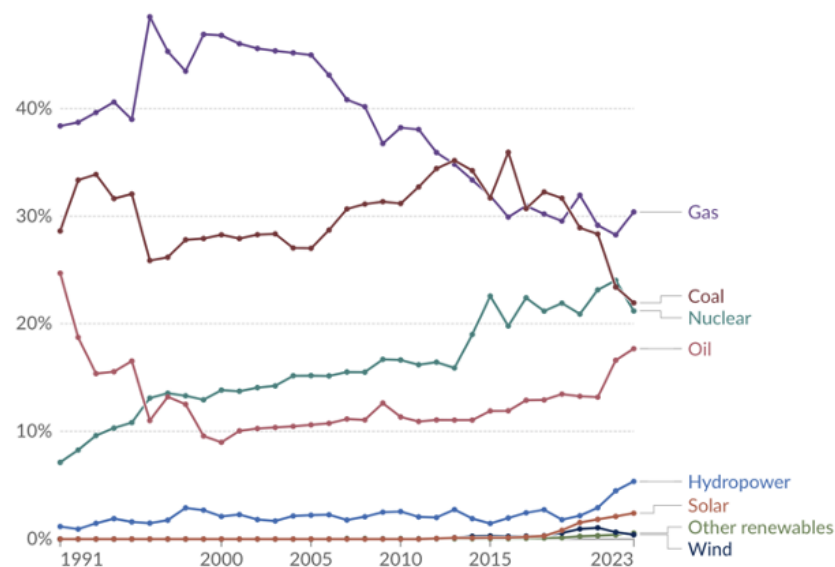
Ukraine's energy consumption by sources



Energy consumption by sources, Ukraine, TWh

Measured in terms of primary energy using the substitution method

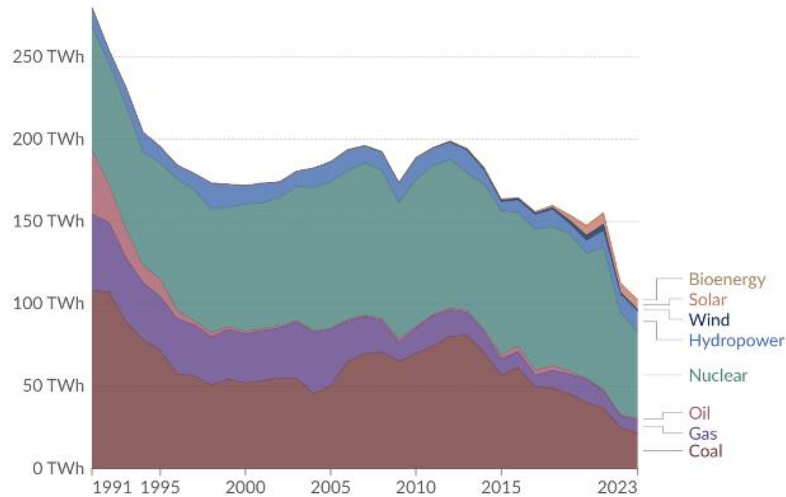
Source: <https://ourworldindata.org/energy/country/ukraine>



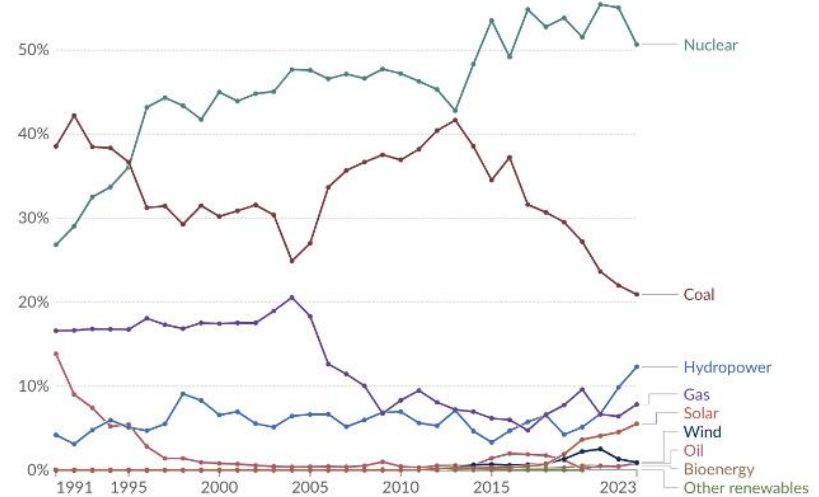
Share of energy consumption by sources, Ukraine, %

Measured as a percentage of primary energy, using the substitution method

Ukraine's electricity production by sources



Electricity production by sources, Ukraine, TWh



Share of electricity production by sources, Ukraine, %

Source: <https://ourworldindata.org/energy/country/ukraine>

Ukraine's energy market in 2021: installed capacity

Total energy capacity & number of power plants

Fuel type	Number of Plants	Total Capacity (MW) ▾
Coal	21	23,793
Nuclear	12	10,835
Gas	44	10,631
Hydro	30	8,763
Solar PV	570	5,777
Onshore	41	2,661
Biopower	24	146
Oil	1	18

Source: Global Data

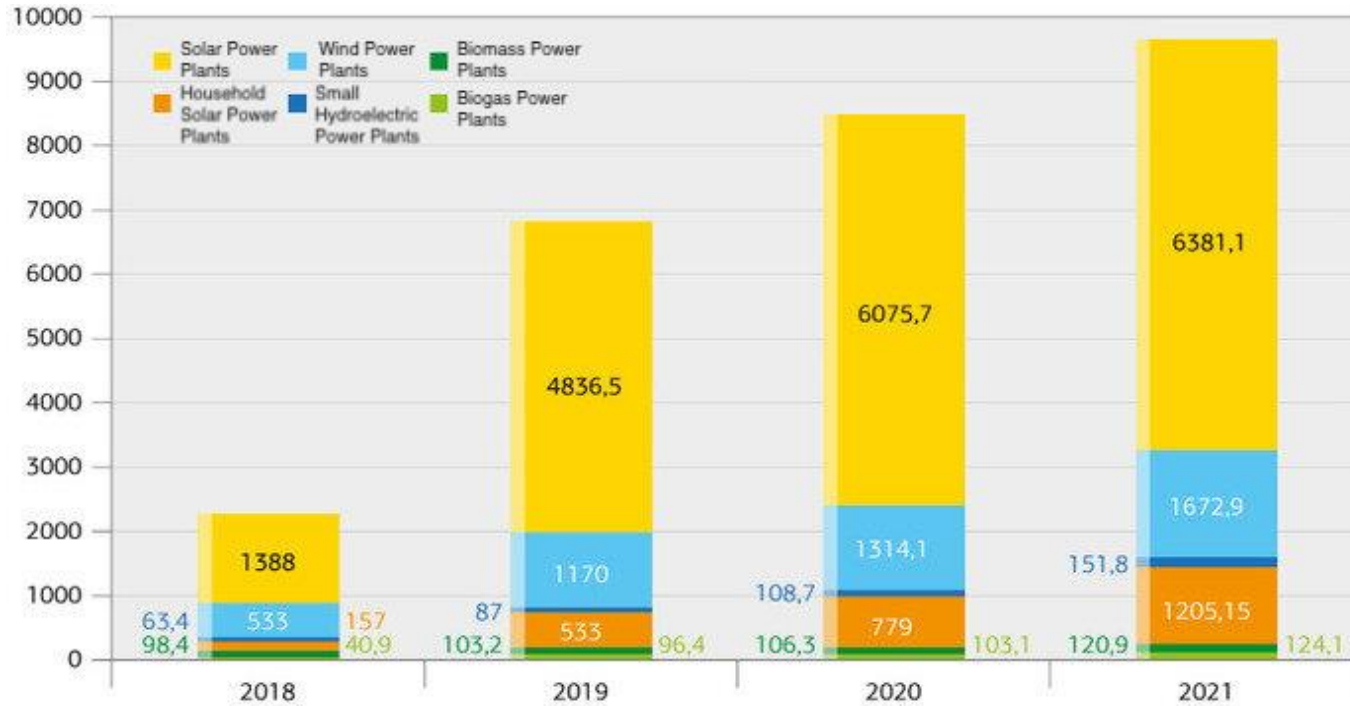
Average total capacity of power plants, MW



Source: Global Data

<https://www.power-technology.com/features/ukraine-power-plants/?cf-view>

Ukraine's installed capacity of RES facilities operating under the “green” tariff, MW



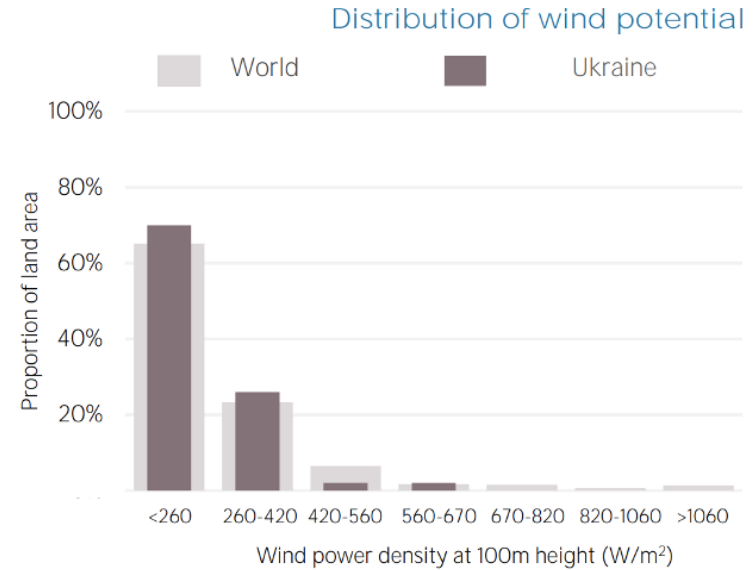
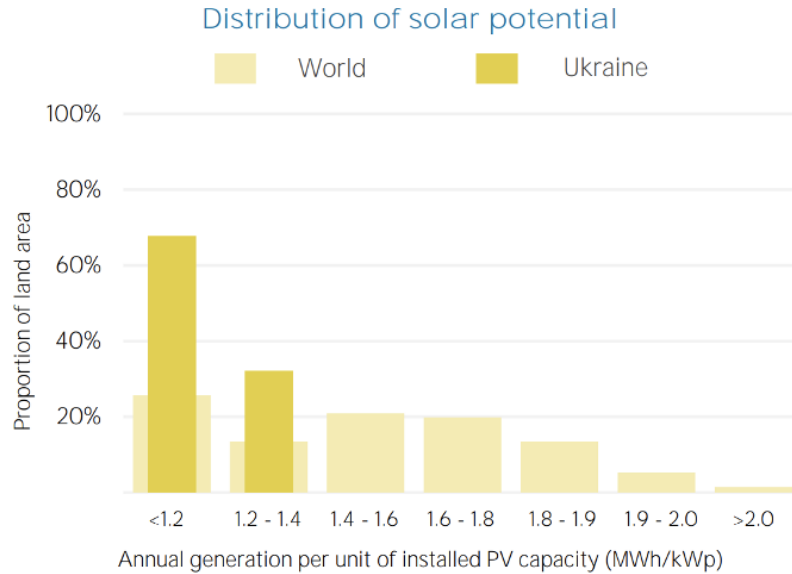
Source: UWEA, NERC, 2021

<https://razumkov.org.ua/statti/sektor-vidnovlyuvanoyi-energetyky-ukrayiny-do-pid-chas-ta-pislya-viyny>

The background is an abstract composition of overlapping, semi-transparent planes in various shades of gray and white. These planes create a sense of depth and perspective, with some appearing to recede into the distance. In the bottom right corner, a portion of a light-colored wooden floor with a herringbone pattern is visible, suggesting a physical space. The overall aesthetic is modern and architectural.

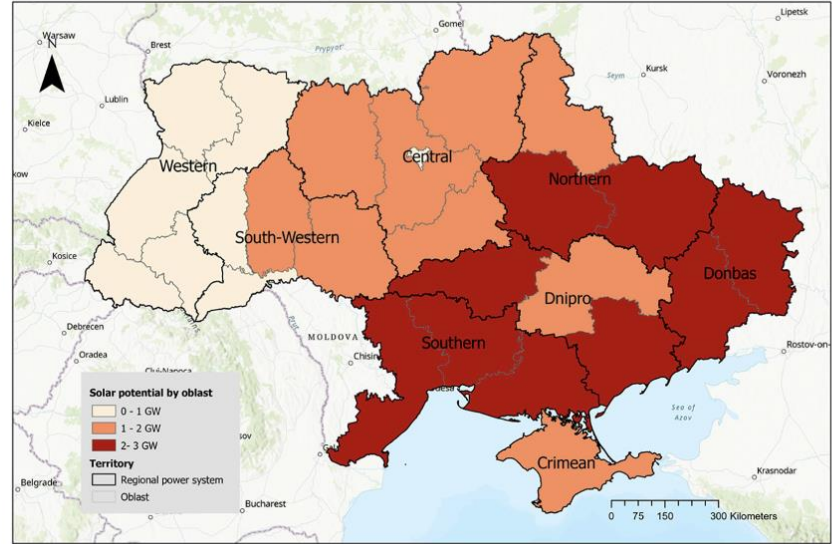
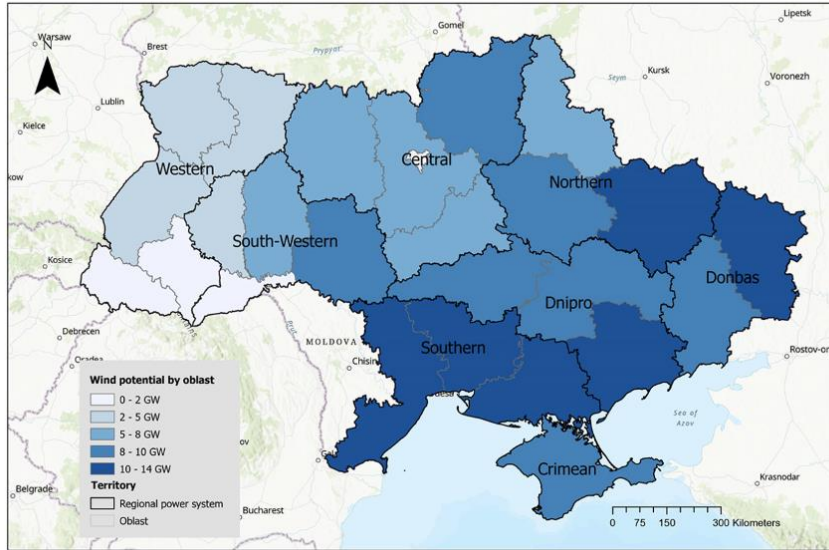
Perspectives

Renewable energy resource potential



Source: IRENA

Suitability of local conditions for the development of solar and wind energy

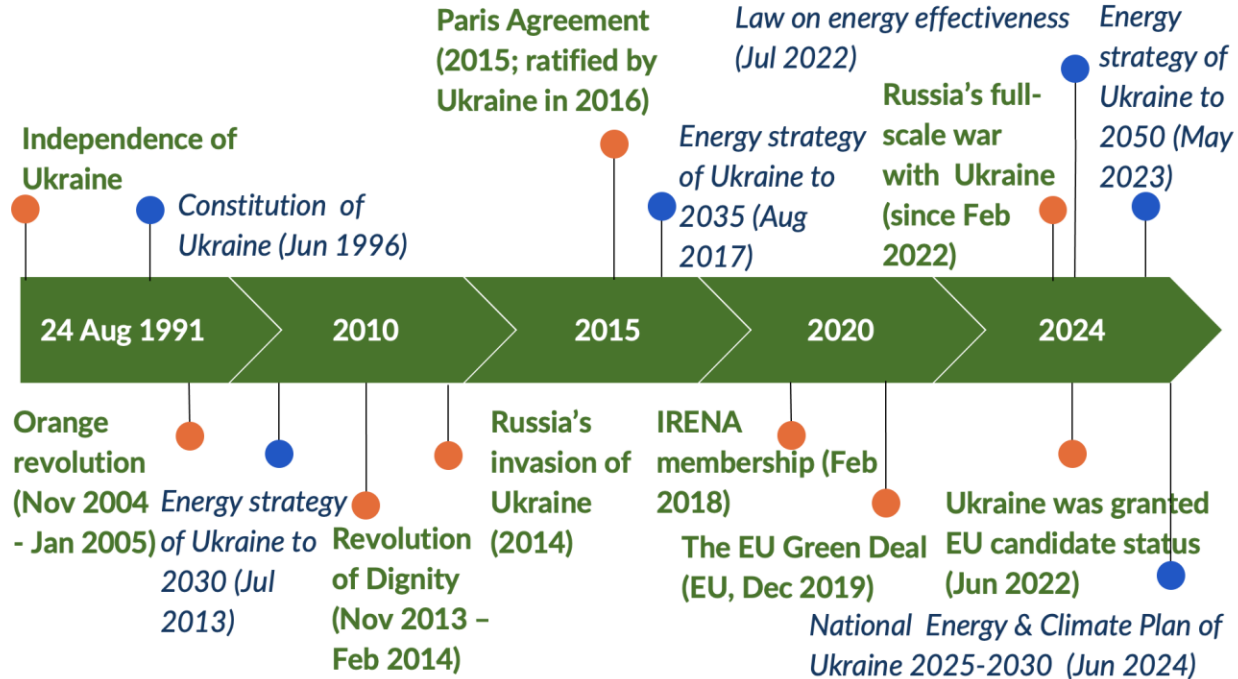


Source: ETH Zurich / Cell Press

<https://plus.ethz.ch/plus-news/2024/09/how-ukraine-can-rebuild-its-energy-system.html>

Legislative Provisions

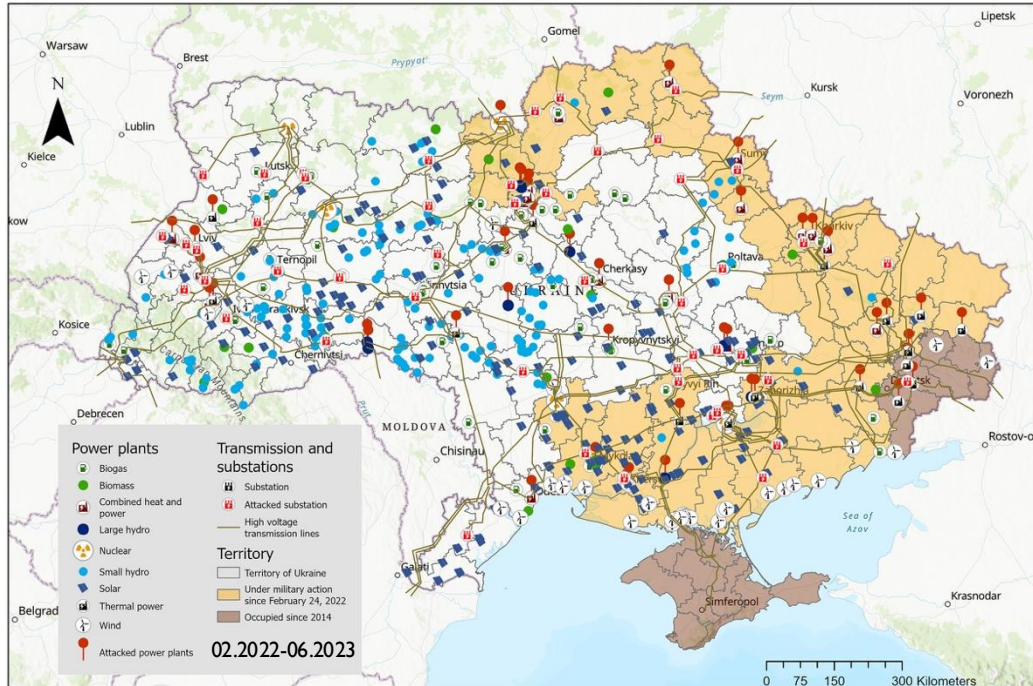
Principal legislative provisions and milestones in energy policy of Ukraine: from independence till today



Source: own elaboration

Consequences of the Russia's invasion of Ukraine

Military attacks on Ukrainian energy infrastructure



Source: ETH Zurich, ISTP, PLUS / Cell Press
<https://plus.ethz.ch/plus-news/2024/09/how-ukraine-can-rebuild-its-energy-system.html>



Source: Texty.org.ua

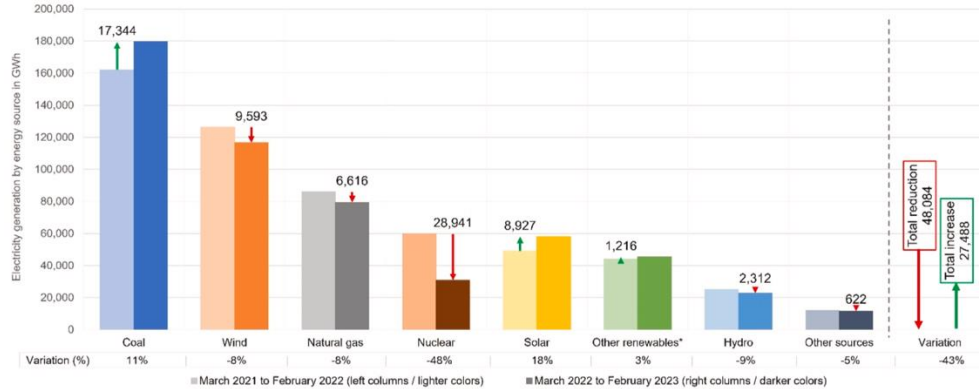
Main gas pipelines across Europe



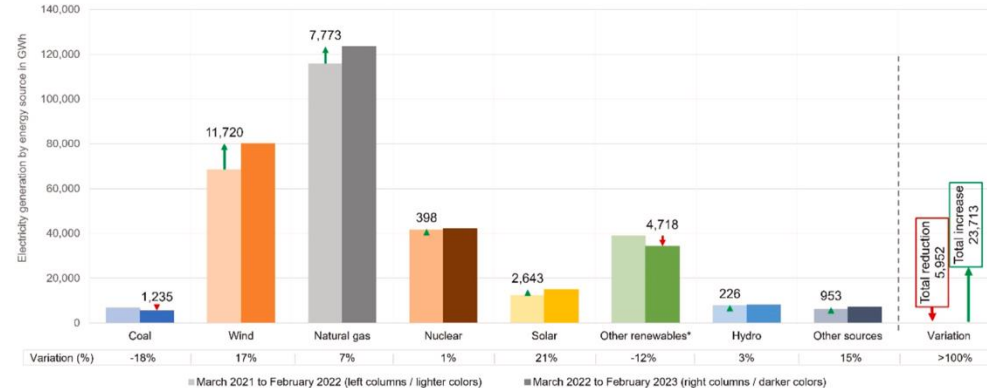
Source: European Network of Transmission System Operators of Gas, BBC
<https://www.bbc.com/news/articles/c4glyx9m71o>

Energy transition? European cases

Electricity generation by energy source in Germany



Electricity generation by energy source in the UK



March 2021 to February 2022 (left columns / lighter colors)
March 2022 to February 2023 (right columns / darker colors)

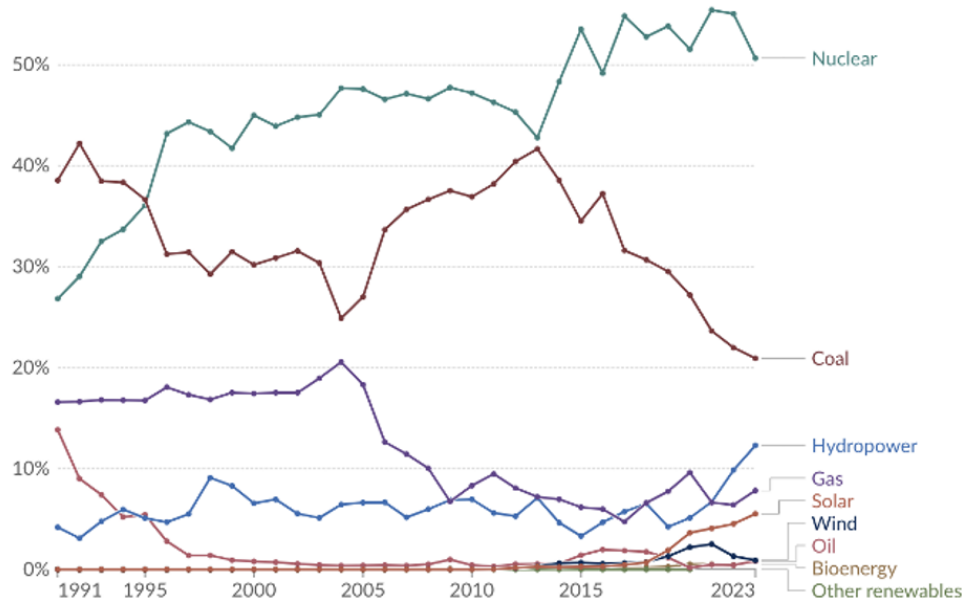
*Other renewables include geothermal energy, biofuels.

Source: IEA, Luschini et al, 2024

Nuclear energy:
a new look at security
issues ?



Share of electricity production by sources in Ukraine, %



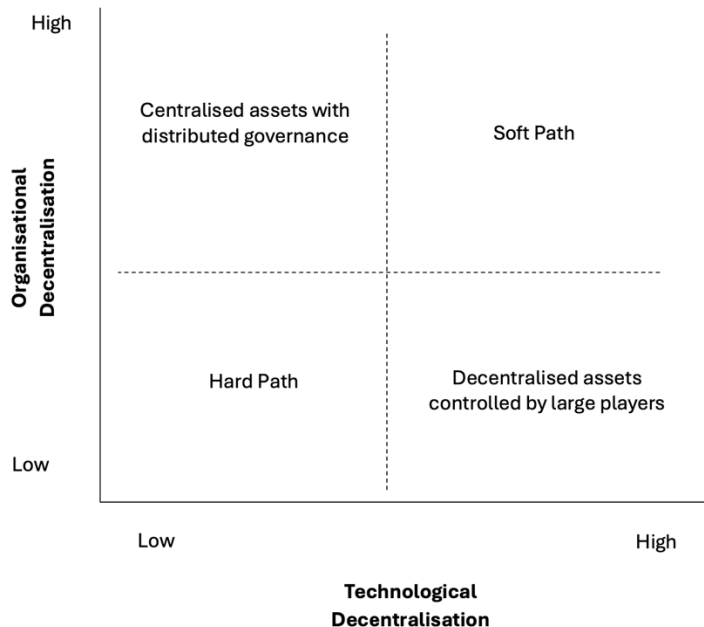
Source: <https://ourworldindata.org/energy/country/ukraine>

Forecasting Scenarios

Soft vs hard energy paths

Conceptual Framework

based on the Amory Lovins' typology of energy paths



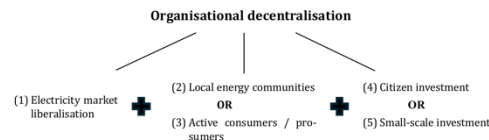
Source: Kostyuchenko et al, 2025 (forthcoming)

Data Collection:

- Official reports focusing on the future of Ukraine's electricity system, as evidenced by their title and/or executive summary
N = 24 reports / 32 scenarios
- Language: English or Ukrainian
- Time frame: published between 2022-2024

Methodology:

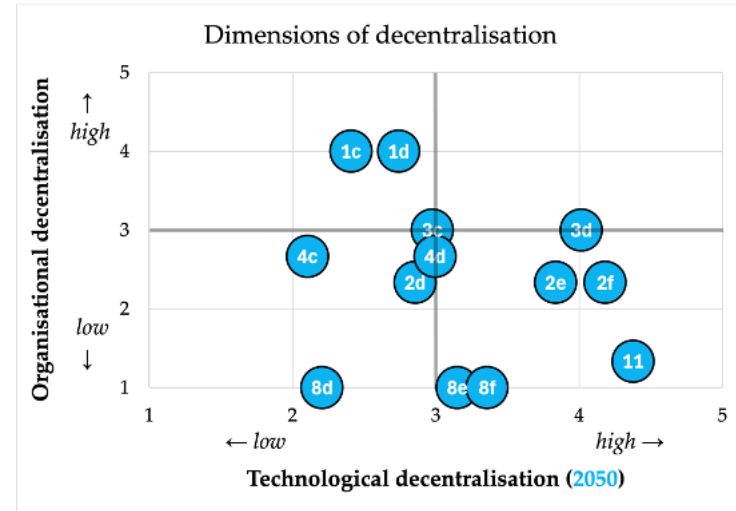
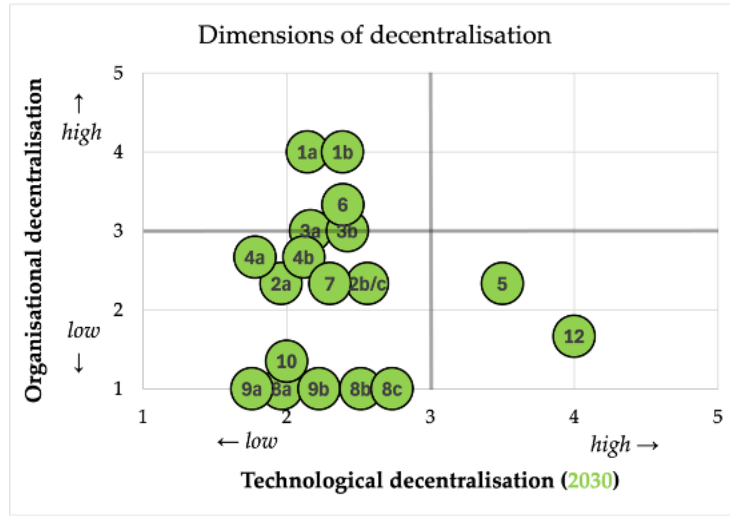
- ❖ **Qualitative** content analysis to examine the level of organisational decentralisation



- ❖ **Quantitative** analysis to measure the level of technological decentralisation (shares of RES, coal, nuclear, other sources)

- Decentralisation score: nuclear = 0, coal & lignite = 0.2, hydro reservoir = 0.2, natural gas = 0.8, run-of-river = 0.9, wind offshore / onshore = 0.7 / 1, PV = 1

Reviewing scenarios of a decentralised post-war electricity system in Ukraine



Source: Kostyuchenko et al, 2025 (forthcoming)

Key Takeaways:

- ❖ Ukraine's energy transition is deeply influenced by the ongoing war and its geopolitical context.
- ❖ Energy independence, security, and green transition goals are interconnected challenges.
- ❖ Ukraine must navigate these complex issues, balancing immediate energy security with long-term sustainability goals.

Thank you for your attention.



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