

Hydropower and Pumped-Storage Hydropower in the European Union

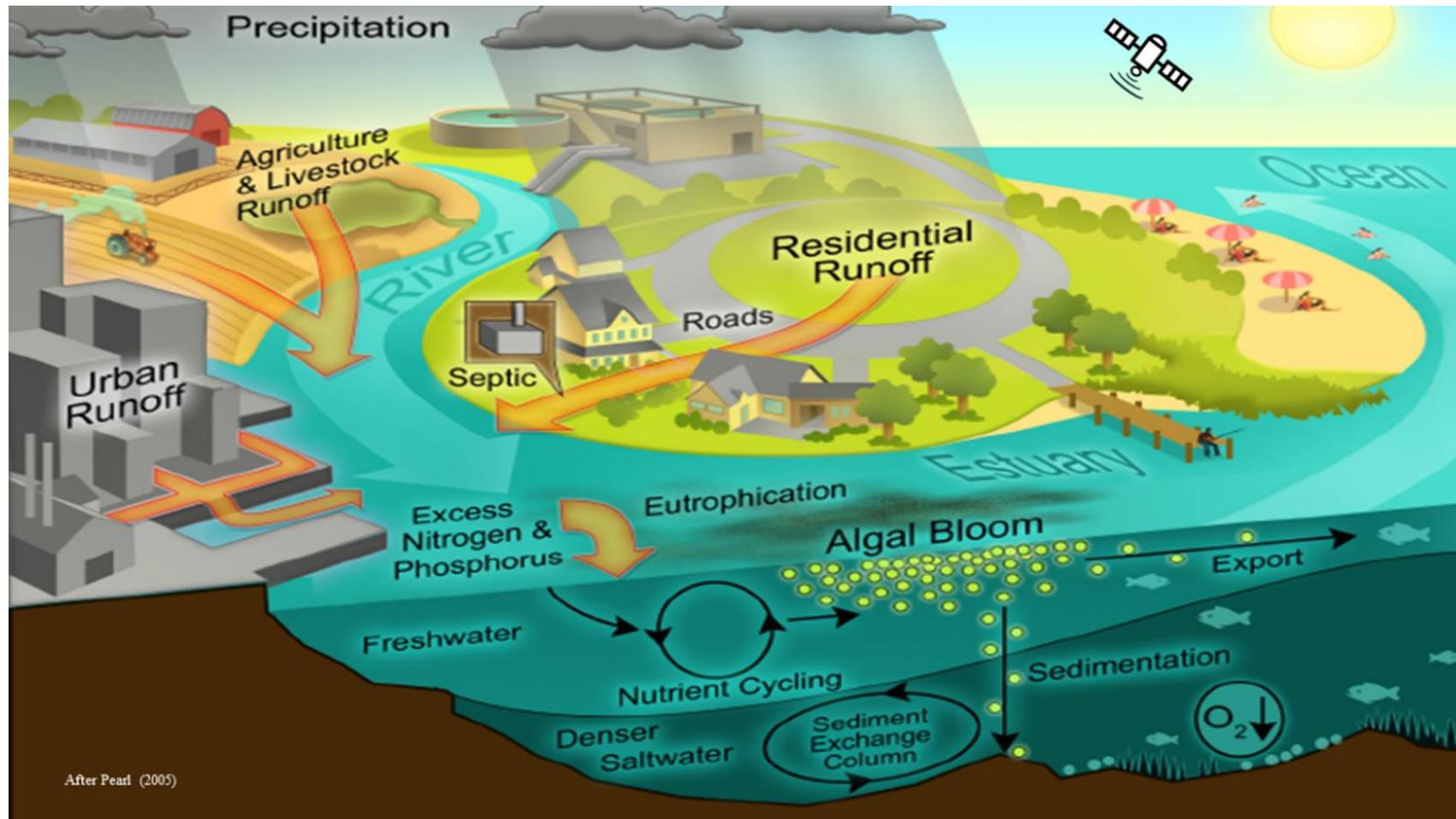
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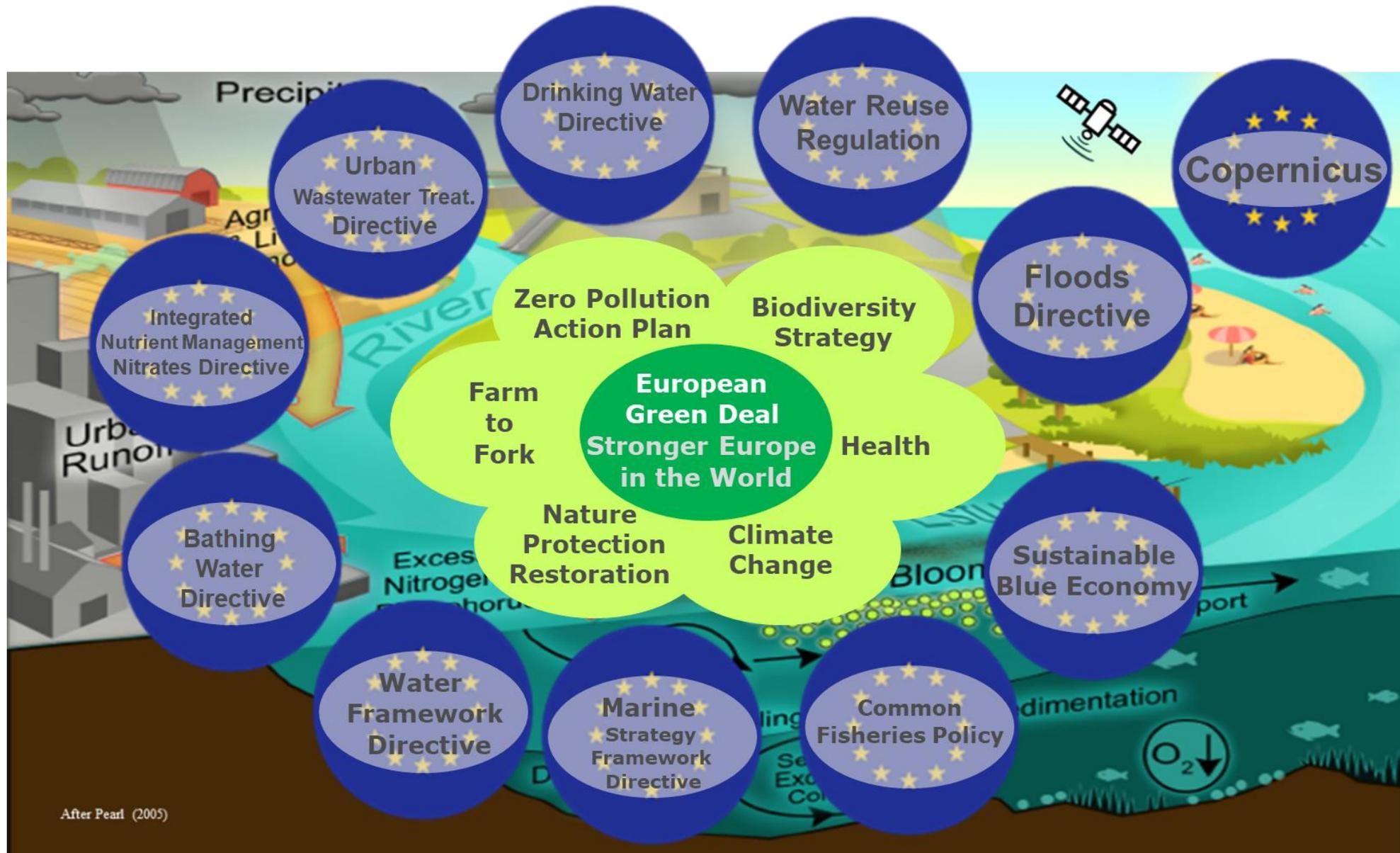
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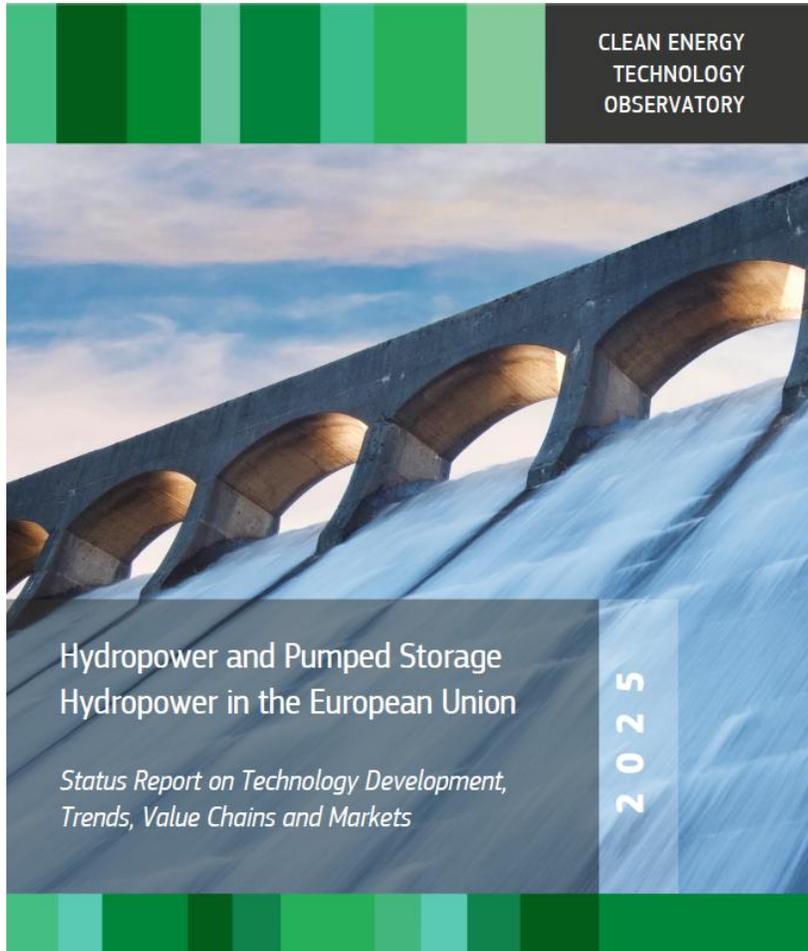
JRC Ocean and Water

Holistic and integrated support: freshwater - coast - sea



The EU Water Acquis





The *technology state-of-the-art and future developments and trends* section builds on the:

- technology readiness level
- Installed capacity and electricity production
- Technology costs
- Public and private R&I funding
- Patenting trends
- Scientific publication trends
- Impact of EU R&I

The *value chain analysis* maps the situation of the technology with regard to the:

- Turnover
- Gross Value Added
- Environmental and socio-economic sustainability
- EU companies
- Employment
- Energy intensity and labour productivity
- EU production

The *EU position and global competitiveness* analyses the EU position in the global market according to the:

- Global and EU market leaders
- Trade, imports and exports
- Resources efficiency and dependence

Summary

1. Key numbers of hydropower in the EU
2. Energy and flexibility
3. Competitiveness and market data



Key numbers of hydropower in the EU



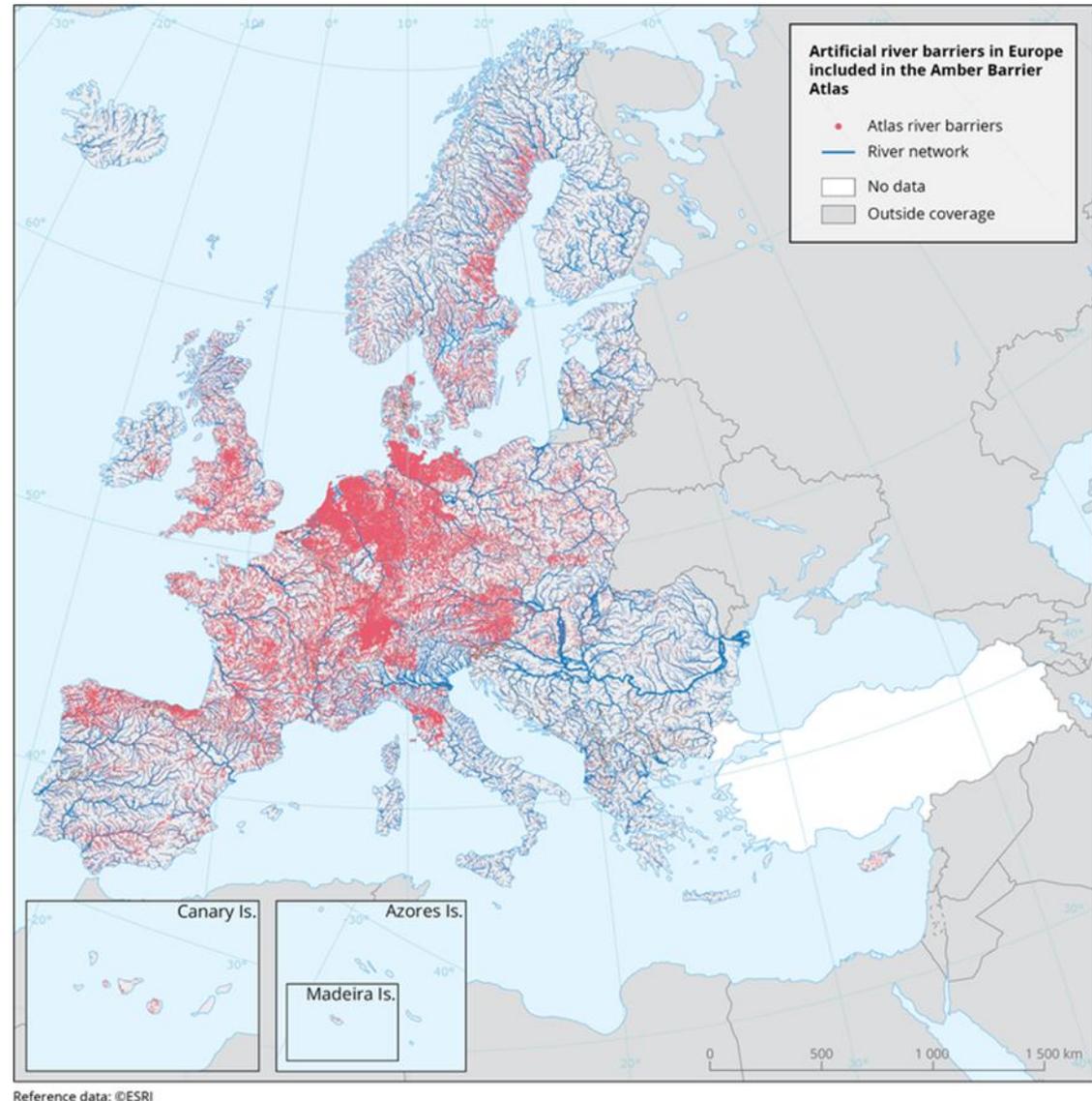
Numbers and river fragmentation in the EU

450,000 barriers in EU's rivers (AMBER project, 630,000 in Europe)

225,000 are weirs and dams

25,000 hydropower plants (JRC estimate)

23,000 SHP plants (< 10 MW),
With installed power 10% of the total hydropower capacity



Hidden hydropower



(a)



(b)



(c)



(d)



Dams in the EU

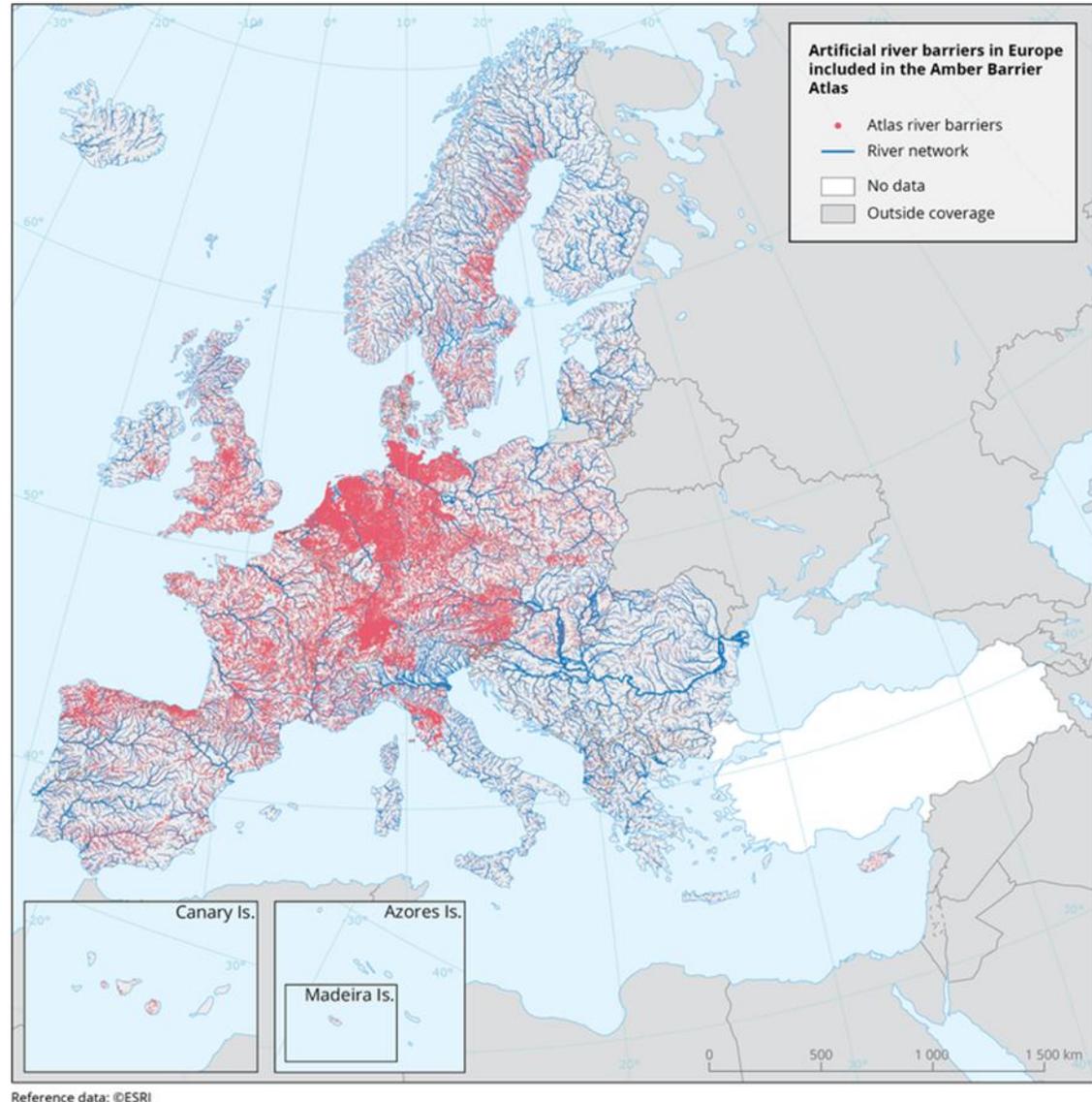
225,000 are weirs and dams

60,000 dams in EU's rivers
(AMBER project)

4,500 are large dams (>15 m OR >
3 Mm³)

1,500 single purpose hydropower
In general, hydropower reservoirs
are larger than those for other uses

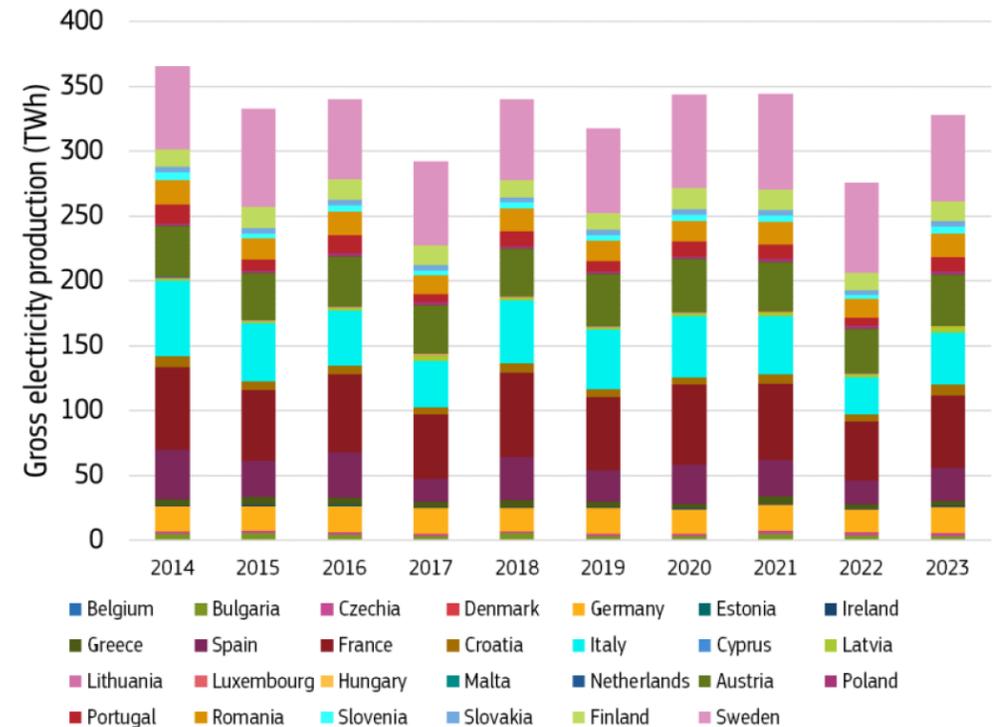
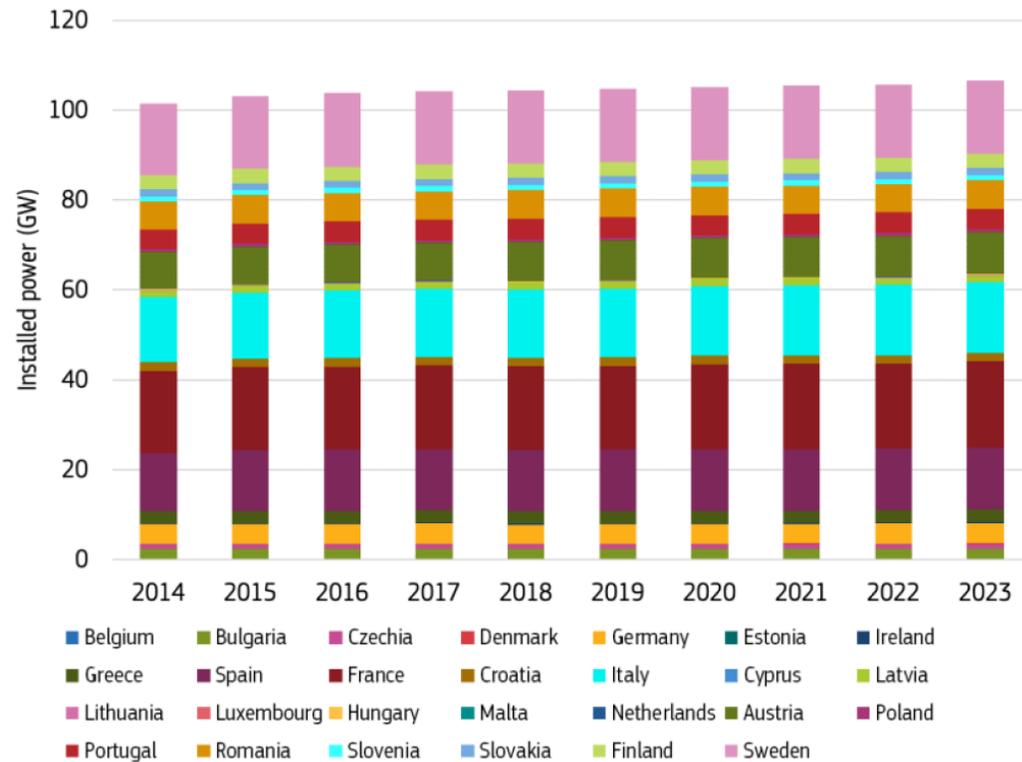
(NB: there are unrecognized uses!)



Energy and flexibility



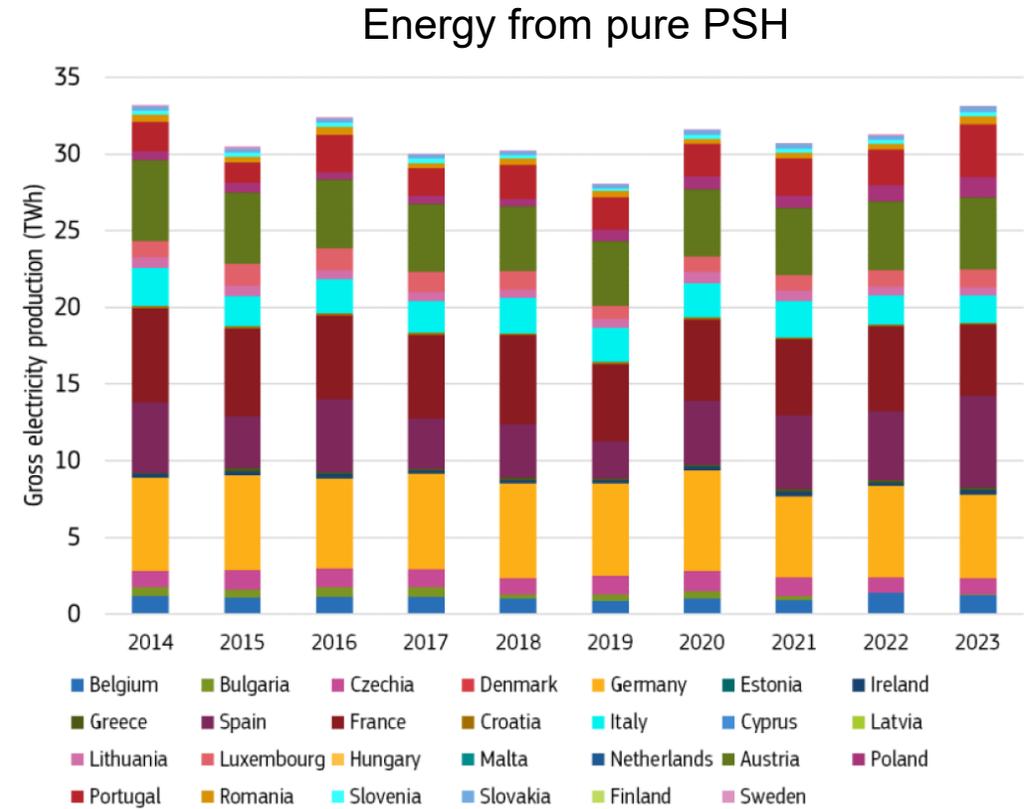
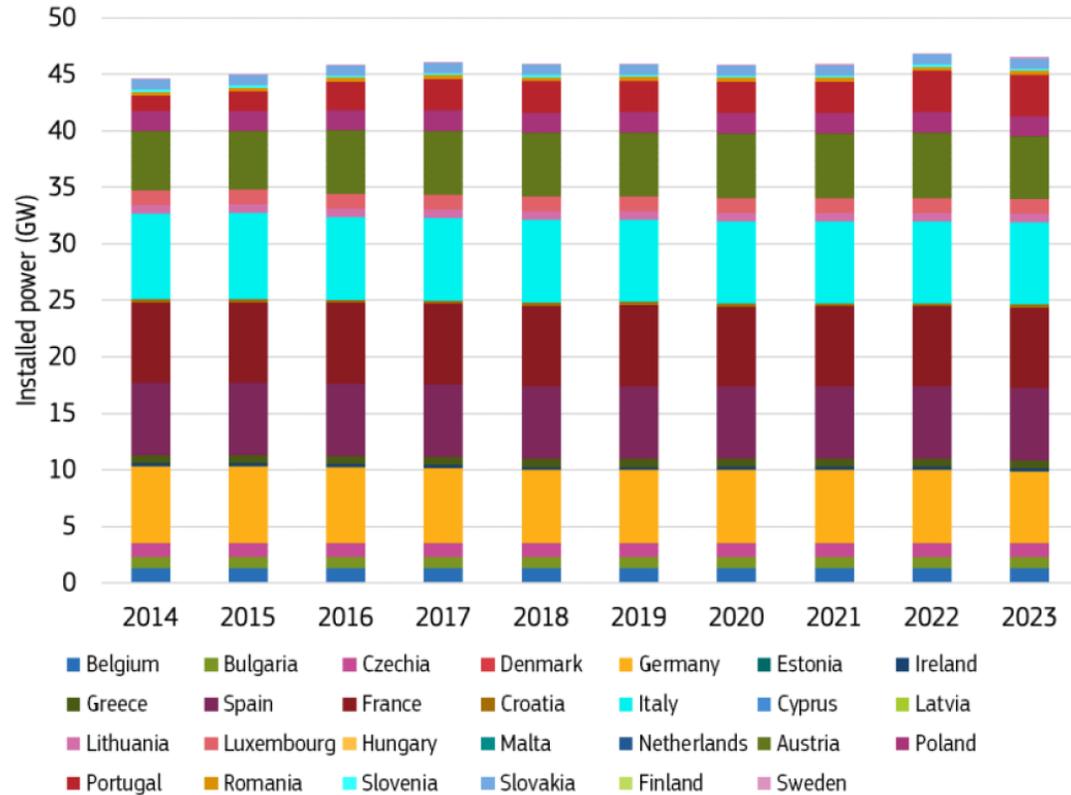
Traditional hydropower: power and energy



Additional capacity over the last 10 years: + 5 GW, but additional 10 GW are estimated to have been refurbished



PSH: power and energy

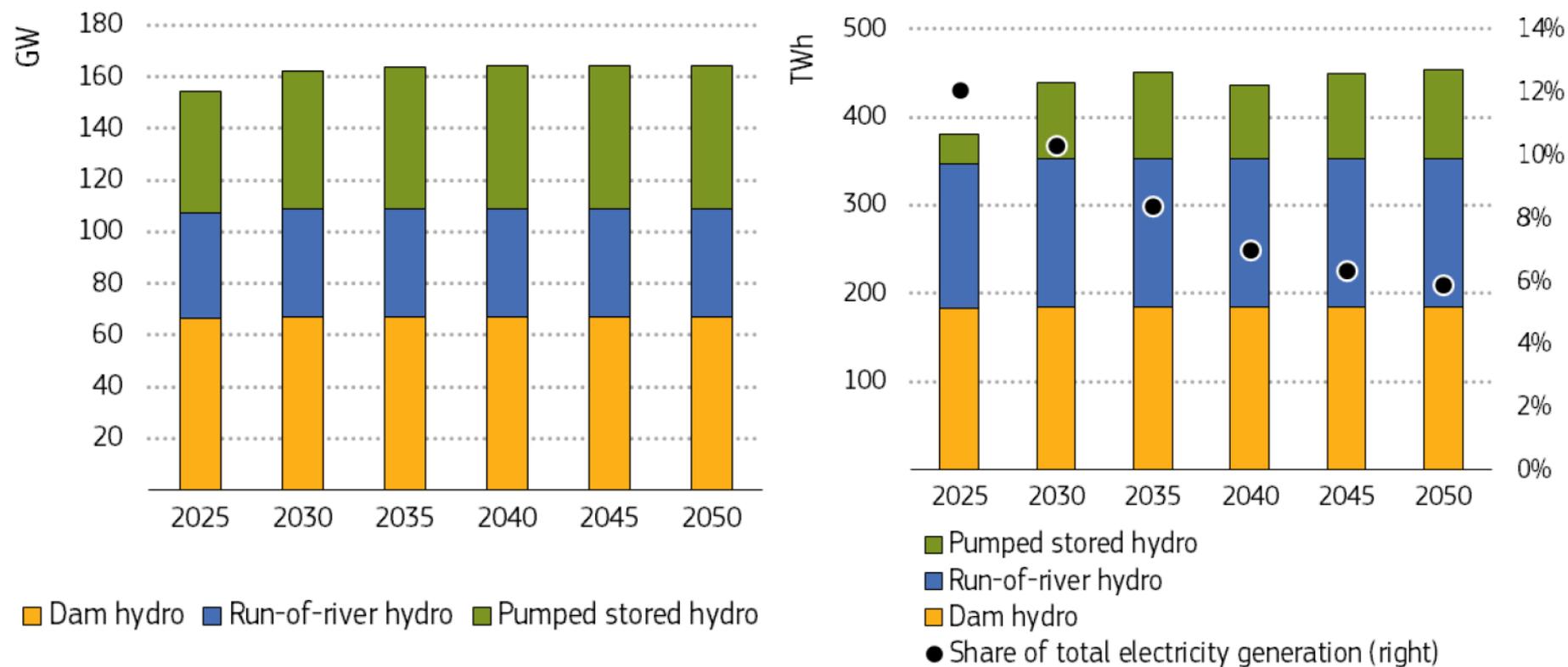


Source: Eurostat, 2025.



Projections

Figure 28. Hydropower installed capacity and electricity generation in the EU, 2025-2050. PSH generation includes closed-loop PSH and that from the pumped water in open-loop PSH.



Potential without new dams: traditional hydro

1. Refurbishment/modernisation by increasing efficiency and flexibility (+10% of electricity generation)
2. Powering non powered large dams (+1%)
3. Historical and non-obsolete small dams/weirs (e.g., water mills, +3%)
4. Hydrokinetic turbines (< 0.1% TWh/y)
5. Hidden hydropower in WDNs and WWTPs (+1%)
6. New reservoir-hydropower in deglaciarized areas (+3%, +0.3% if the most economical sites)
7. Potential of PSH: new closed-loop and abandoned mines, > 100%

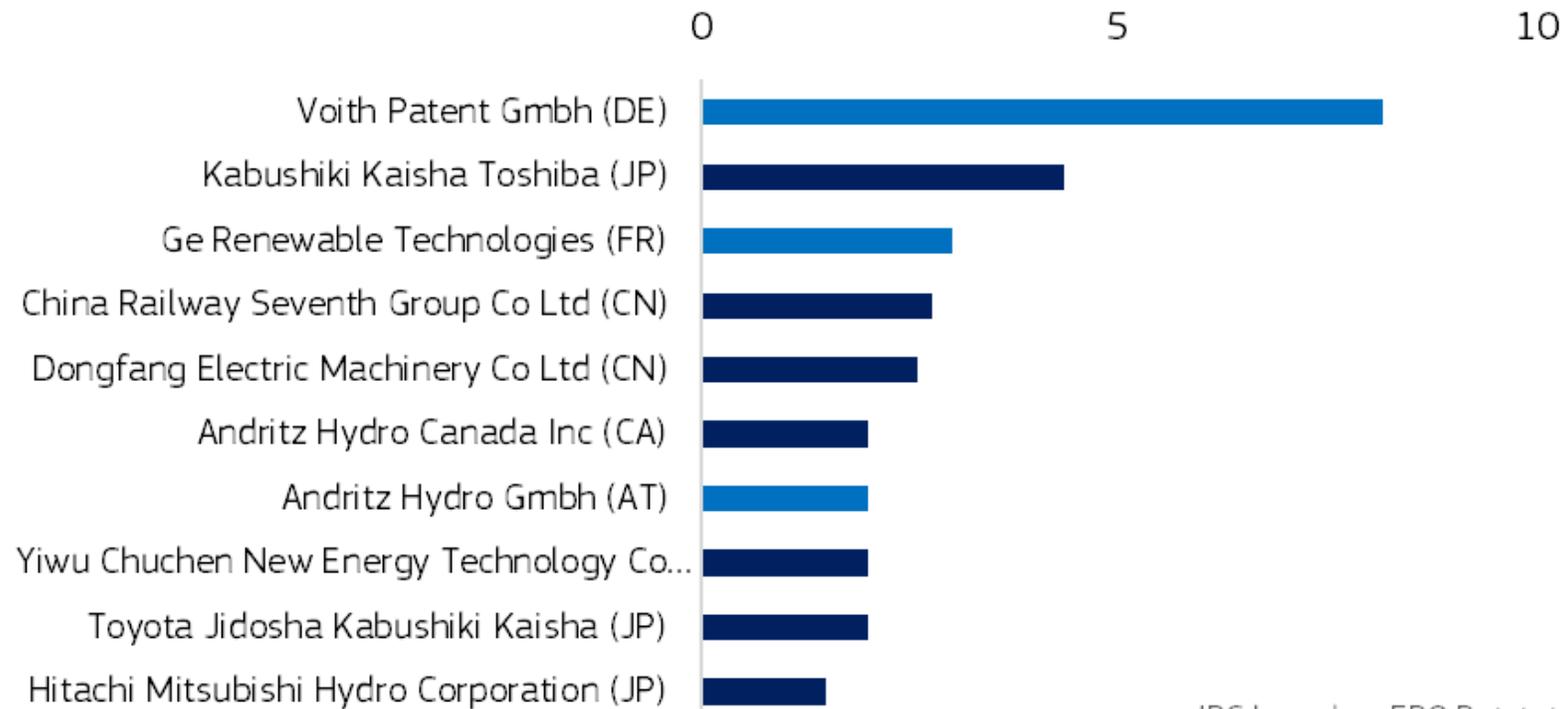


Competitiveness and market data



High-value inventions

High-value Inventions - Top 10 companies (2020-2022)

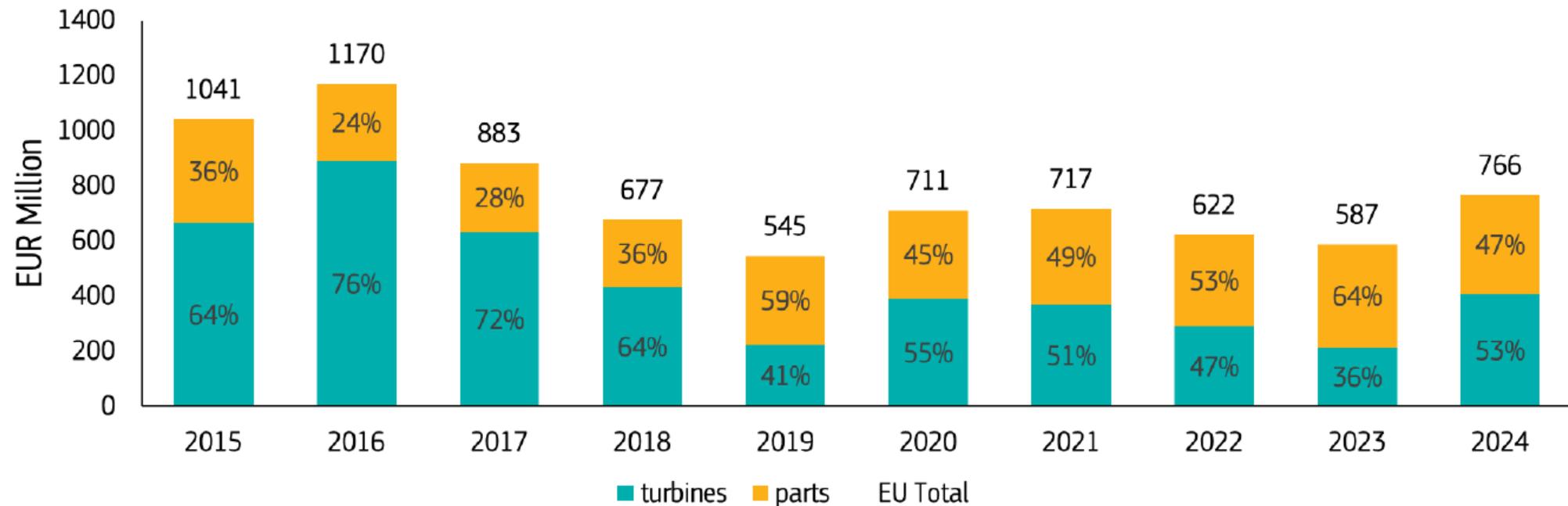


JRC based on EPO Patstat



Production

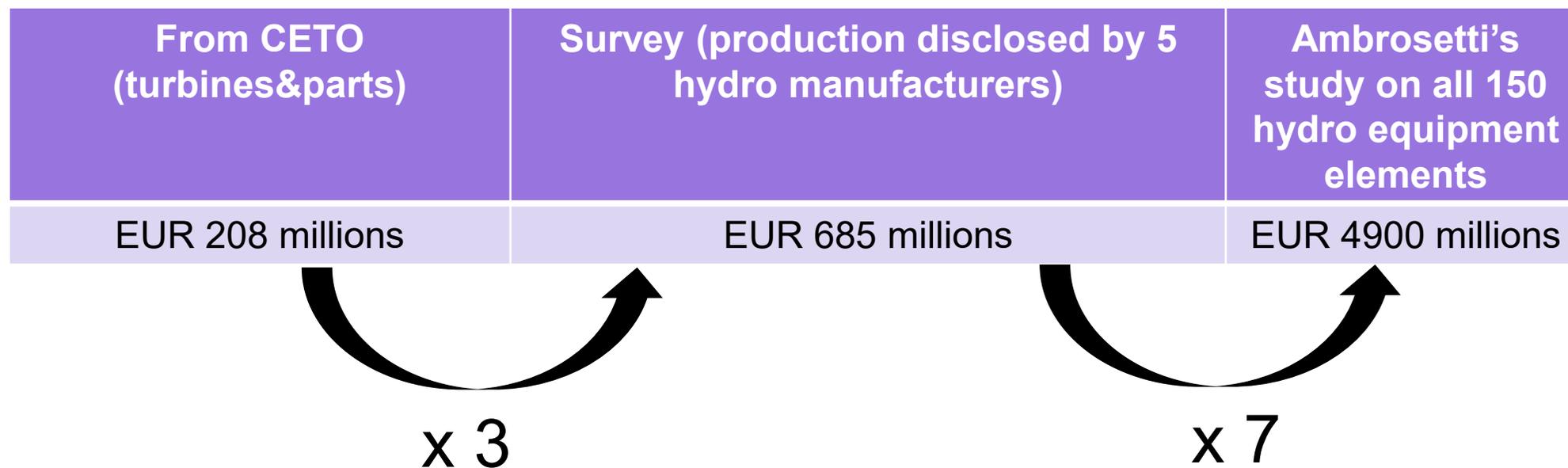
Figure 24. EU production value per commodity [EUR Million].



But turbines and parts are only a small portion of the overall market!



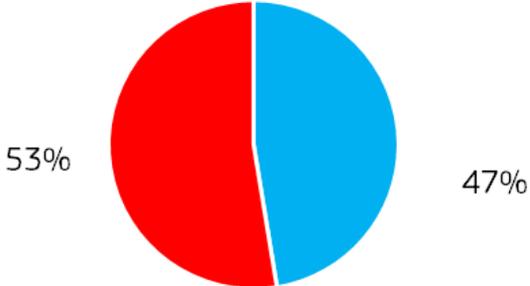
Production: Austrian example



Trade

EU share in Global Export (2022-2024)

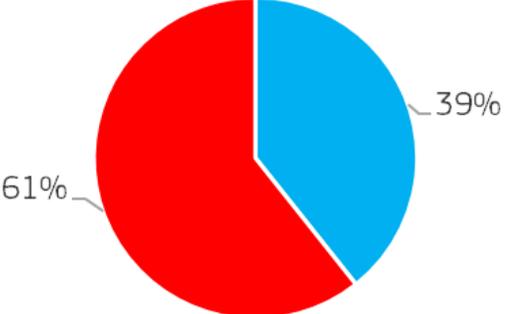
■ EU ■ RoW



JRC based on UN Comtrade data

Extra-EU share in Global Export (2022-2024)

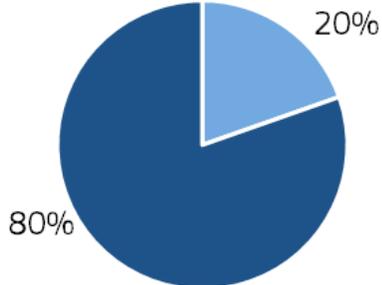
■ Extra-EU from the EU ■ extra EU from RoW



JRC based on Comtrade and COMEXT data

EU MS Imports (2022-2024)

■ From RoW ■ Intra-EU

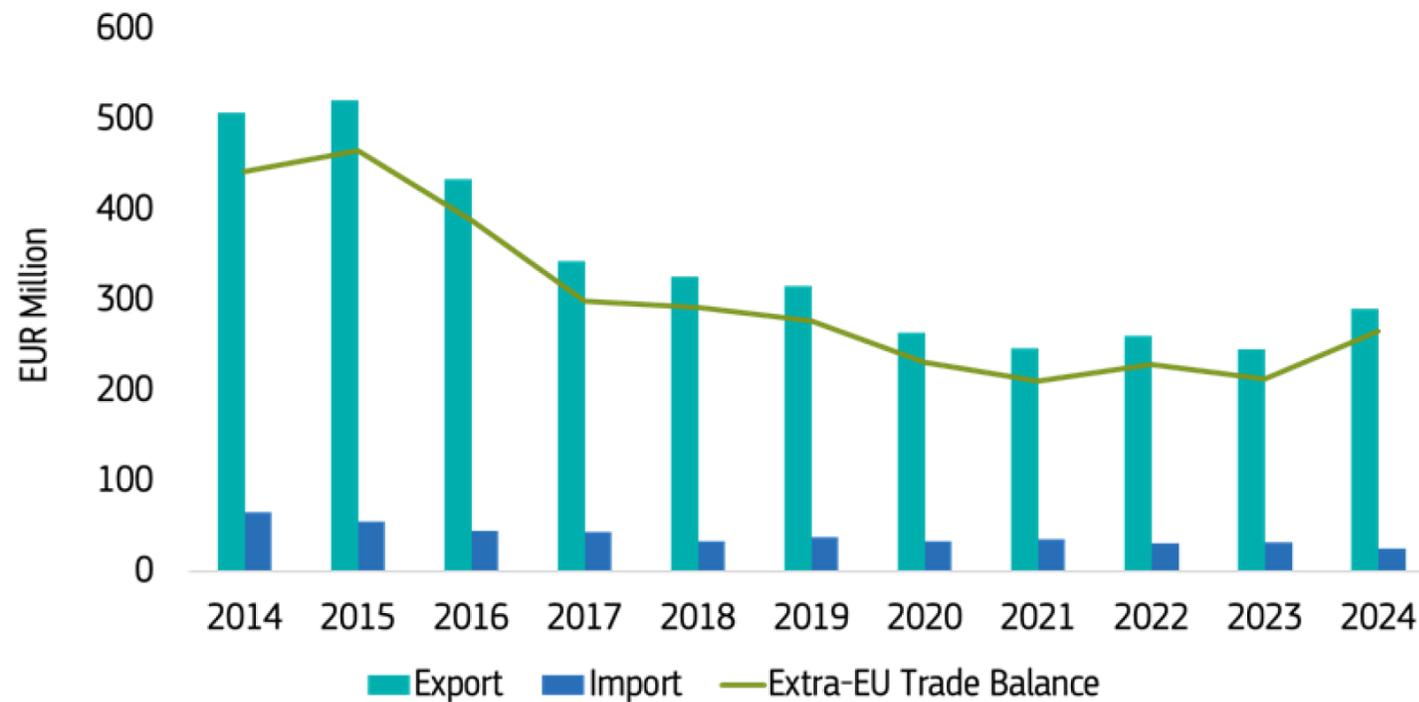


JRC based on COMEXT data



Trade

Figure 31. Extra-EU trade for hydraulic turbines and parts [EUR M]



Source: JRC based on COMEXT data

Employment

Source	Employment	Comment
Prognos	102,000	Not clear if it involves services like environmental, hydrological studies, etc.
EurObserv'ER	80,000	
IRENA	89,000	
EREF	60,000	Only for small hydro



Challenges

1. Keeping the competitiveness on the global market
2. Competing with lower-cost services outside of the EU
3. Recognizing multi-services of hydropower
4. Ancillary services and flexibility
5. Increase resilience to climate changes and volatile market
6. Mitigate environmental impacts in freshwater systems



Horizon projects

Name	Topic
H-HOPE: Hidden Hydro Oscillating Power for Europe	Hidden Hydro and digitalisation, water-energy nexus
HydroFlex: Increasing the value of Hydropower through increased Flexibility	Flexibility, modernisation
AFC4Hydro: Active Flow Control system FOR improving HYDRaulic turbine performances at off-design Operation	Flexibility, modernisation



Link

- CETO reports: https://setis.ec.europa.eu/publications-and-documents/clean-energy-technology-observatory/ceto-reports-2025_en
- Survey for manufacturers: <https://ec.europa.eu/eusurvey/runner/e0f5468a-033d-bcd3-79a9-a880876c2bec>
- Survey for the CETO: https://ec.europa.eu/eusurvey/runner/CETO_hydropower_survey



Thank you

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