



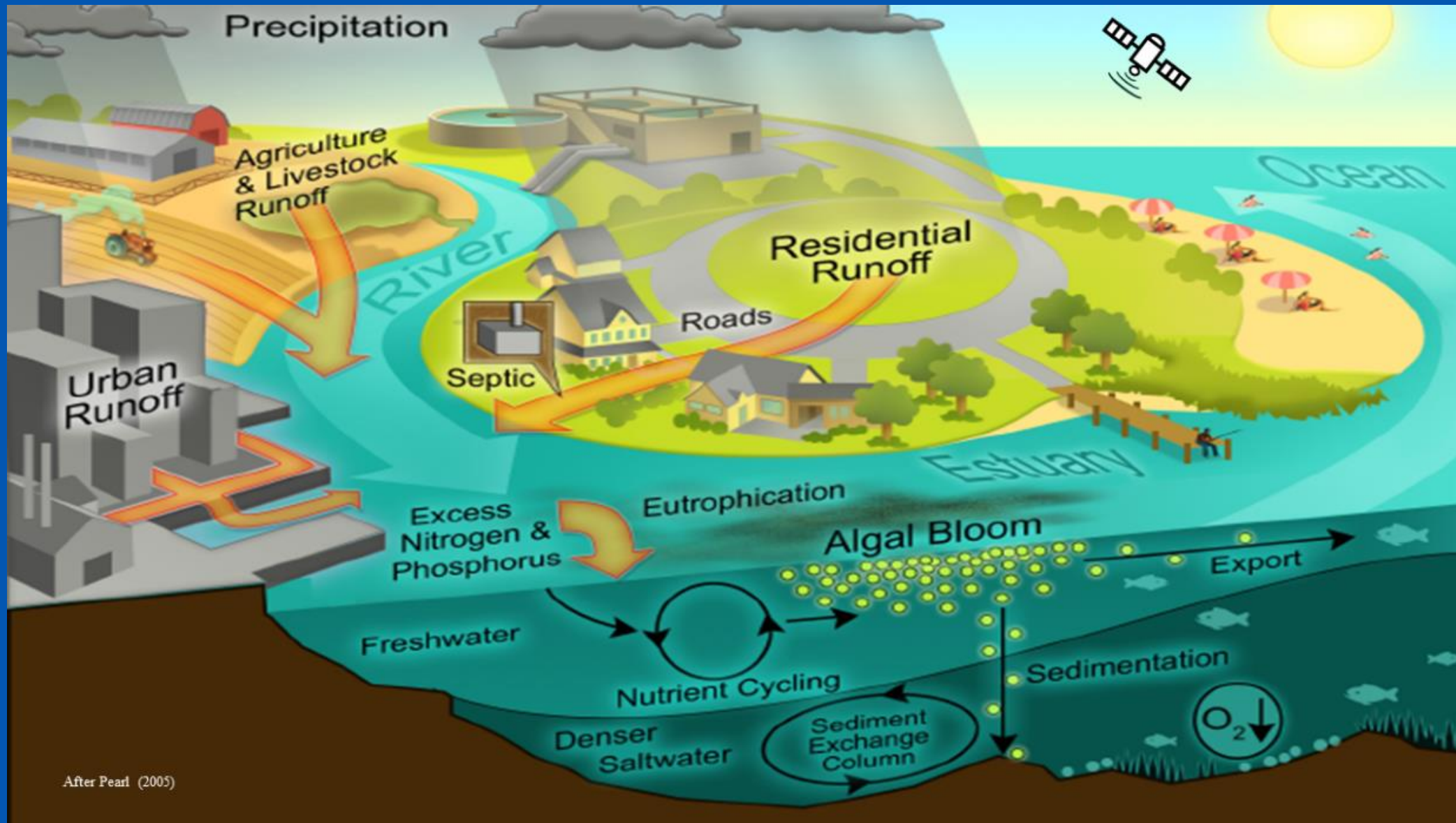
Hydropower research activities at the JRC on hydropower, EU funded projects and impacts on the industrial sector

Emanuele Quaranta, European Commission, Joint Research Centre (JRC), Ispra, Italy.
Emanuele.quaranta@ec.europa.eu
D.2. Ocean and Water



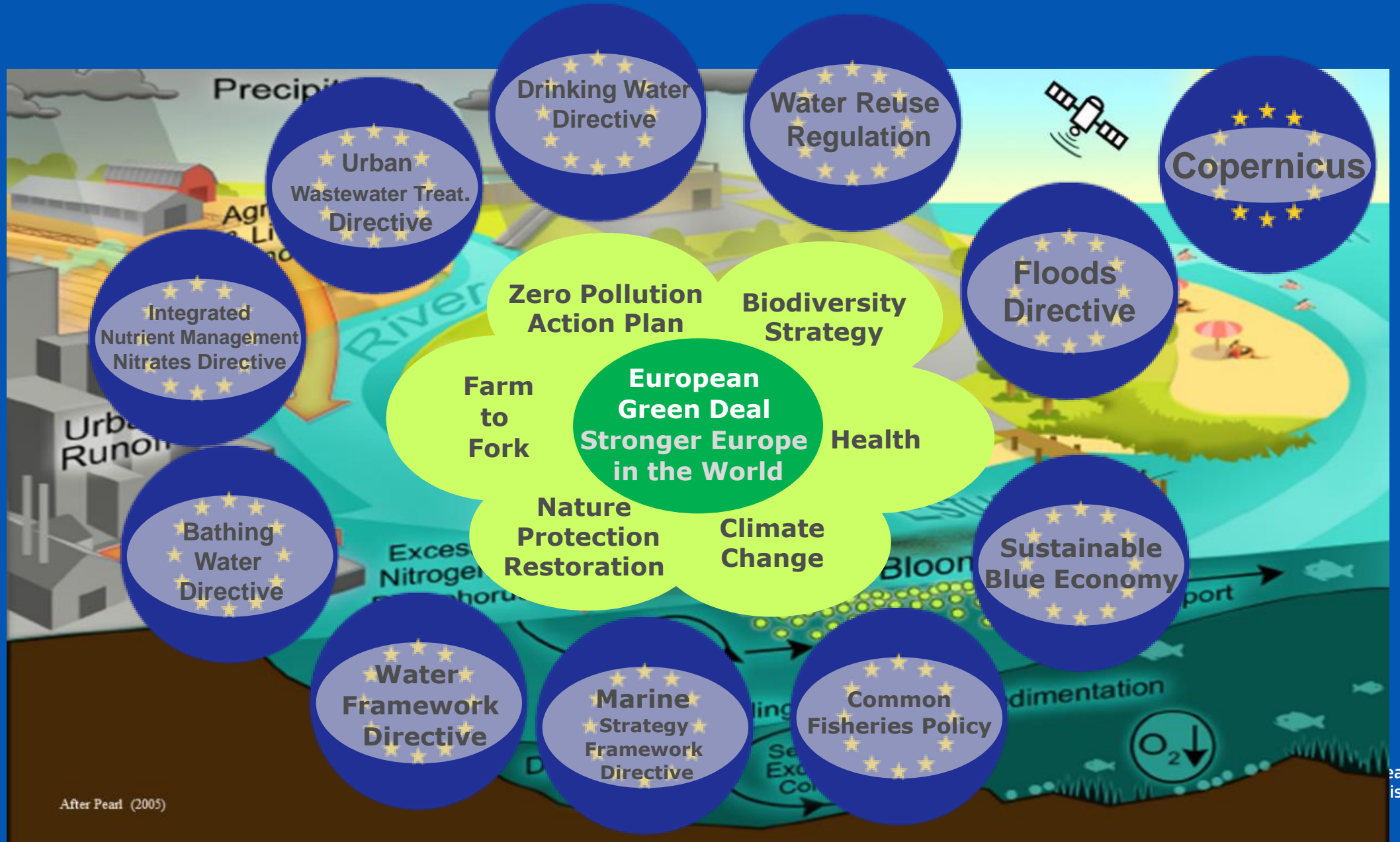
JRC Ocean and Water

Holistic and integrated support: freshwater - coast - sea



After Pearl (2005)

The EU Water Acquis



Some activities

1. SustHydro exploratory activity: assessing the EU potential of sustainable hydropower (and hidden hydro) and novel technologies for sustainable hydropower development, including digitalisation
2. Water&energy storage and PSH: first paper on PSH published
3. CETO: Clean Energy Technology Observatory (annual report, just released)

Sustainable hydropower opportunities in the EU.

Focus: large-scale assessments without new barriers (e.g., weirs, dams,..)


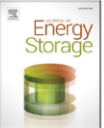
1. Refurbishment/modernisation (+10% of electricity generation)
2. historical and non-obsolete NPB (non-powered barriers, water mills, + 9 TWh/y)
3. hydrokinetic turbines (< 1 TWh/y)
4. hidden hydropower in WDNs and WWTPs (3 TWh/y)

Energy storage




- GWh of energy stored, electricity that could be generated in one emptying cycle
- Different sources with different data
- Definition: theoretical and technical
- Cascade effect or stand-alone operation

Contents lists available at [ScienceDirect](#)

 **Journal of Energy Storage** 

journal homepage: www.elsevier.com/locate/est

Research papers

Considerations on the existing capacity and future potential for energy storage in the European Union's hydropower reservoirs and pumped-storage hydropower 

Emanuele Quaranta^{a,*}, Robert M. Boes^c, Julian David Hunt^d, Sandor Szabó^a, Jacopo Tattini^b, Alberto Pistocchi^a

Energy storage

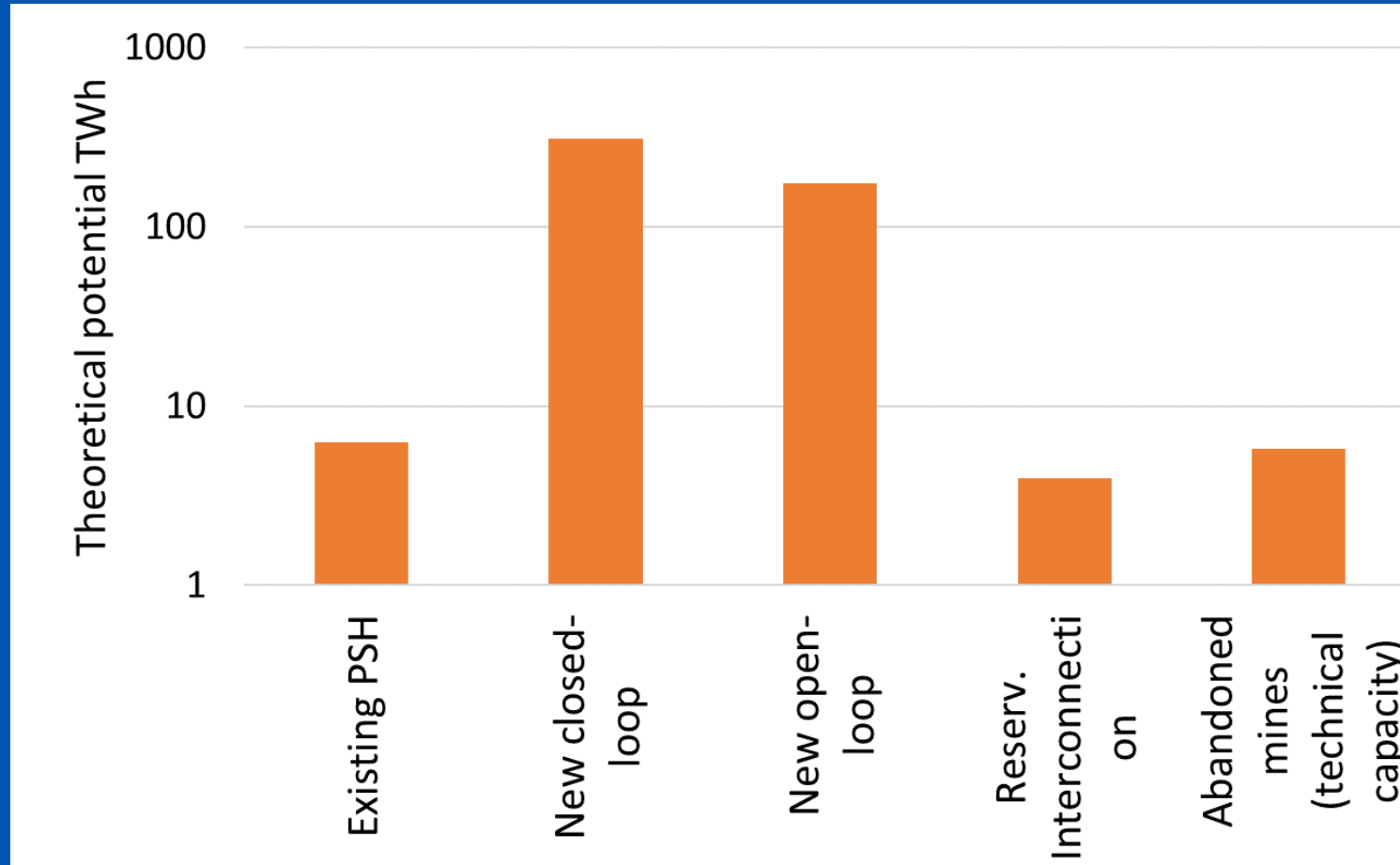
$$E_{s,th,i} = \rho g H V$$

$$E_{s,te,i} = E_{s,th,i} \cdot C_v C_d C_h C_\eta$$

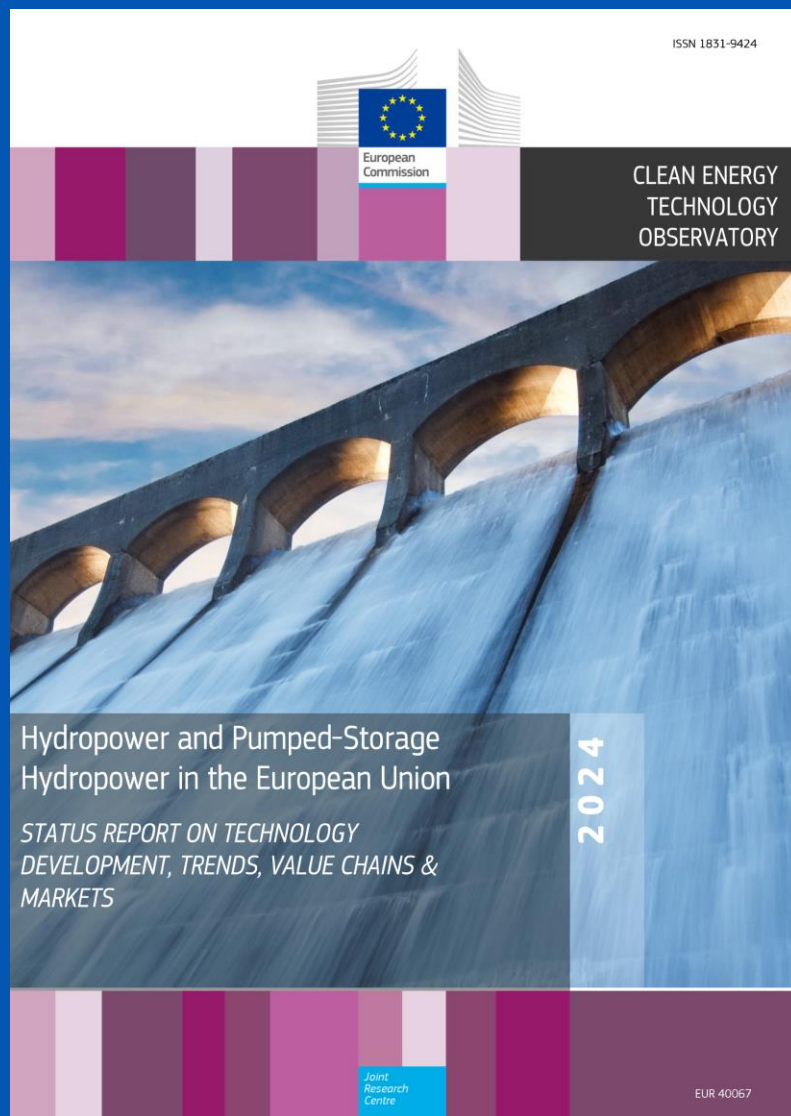
Hydropower type	Theoretical energy storage (TWh)	Technical energy storage (TWh)	Reported energy storage (TWh)
PSH	6.6	2.2	1.3 (IHA)
RHP	54.7	23.8	70.8 (ENTSO-E)

PSH = pumped storage hydropower
RHP= reservoir hydropower

Energy storage: PSH potential in the EU



CETO report



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

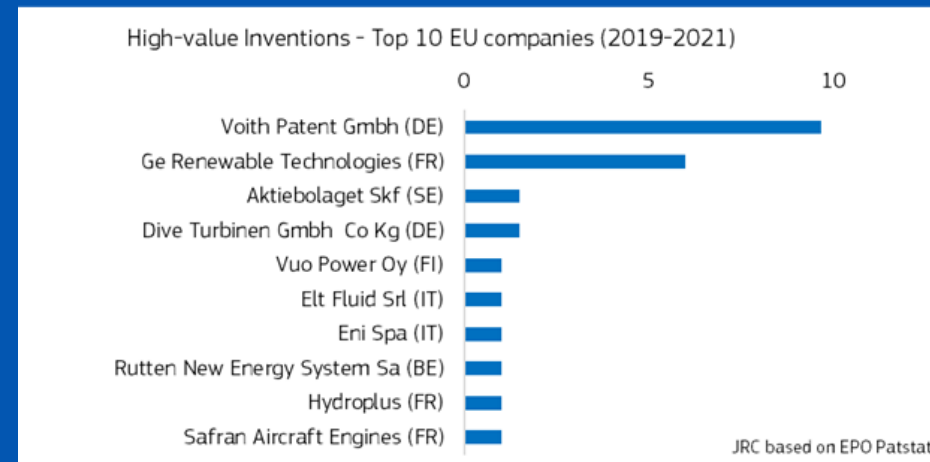
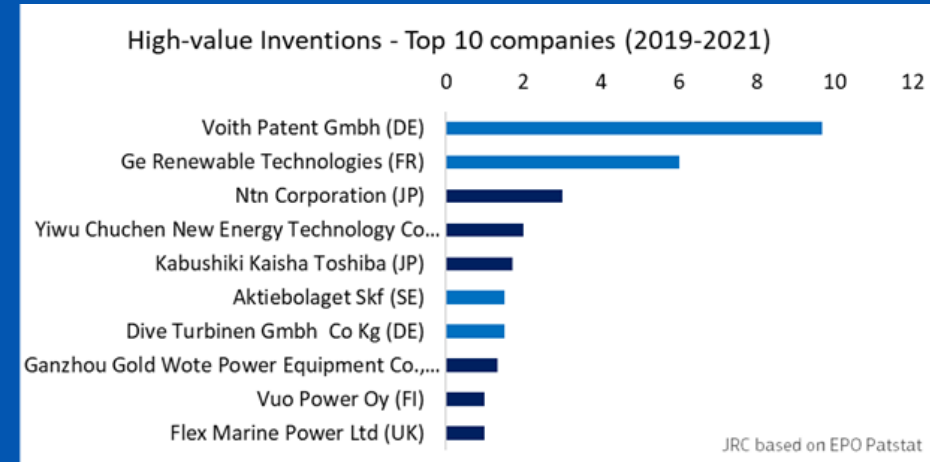
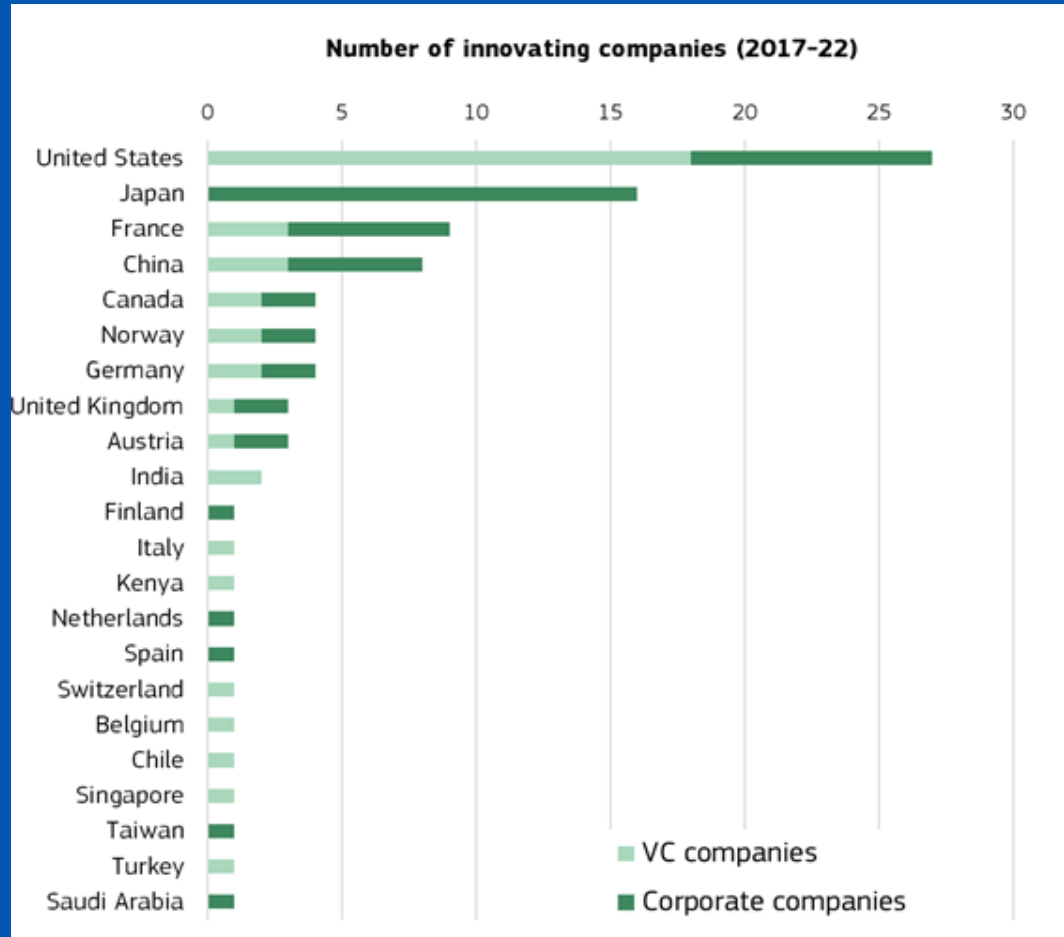
The *value chain analysis* maps the situation of the technology with regard to the:

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

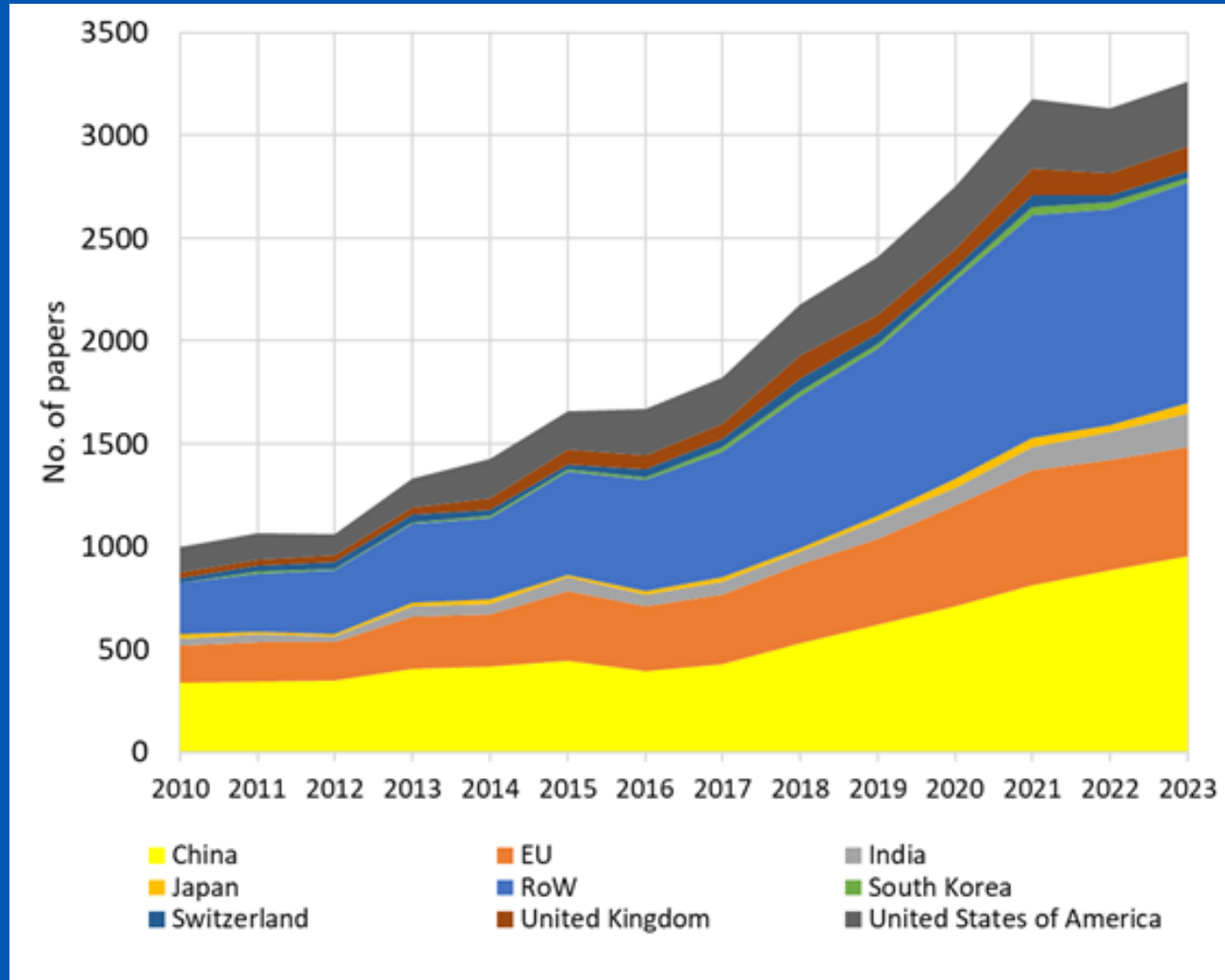
The *EU position and global competitiveness* analyses the EU position in the global market according to the:

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

Innovations



Scientific Publications



Trade: Export & Import of hydro equipment

EU share in Global Export
(2021-2023)

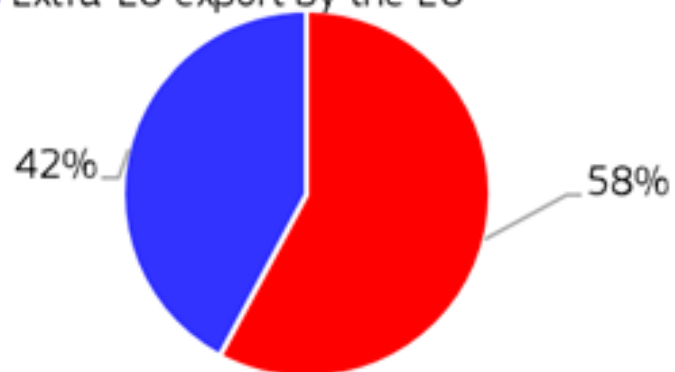
■ RoW exports ■ EU



JRC based on UN Comtrade data

Extra-EU share in Global Export
(2021-2023)

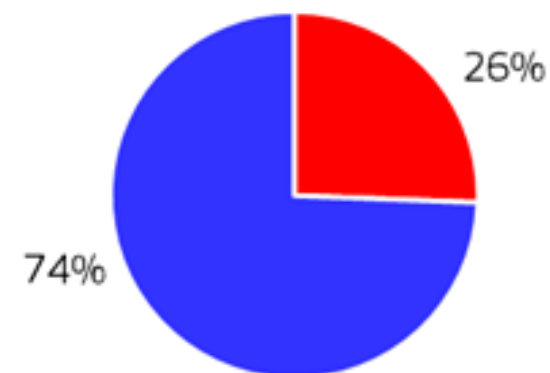
■ RoW export to extra EU countries
■ Extra-EU export by the EU



JRC based on Comtrade and COMEXT data

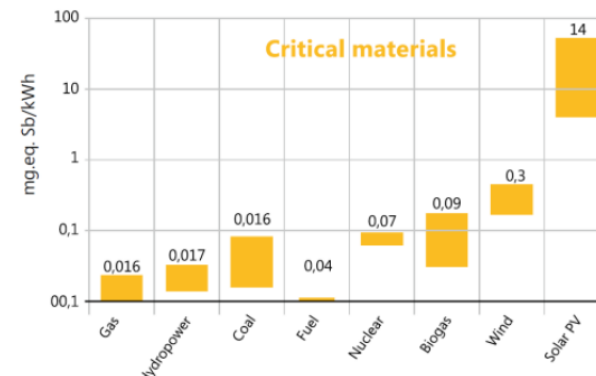
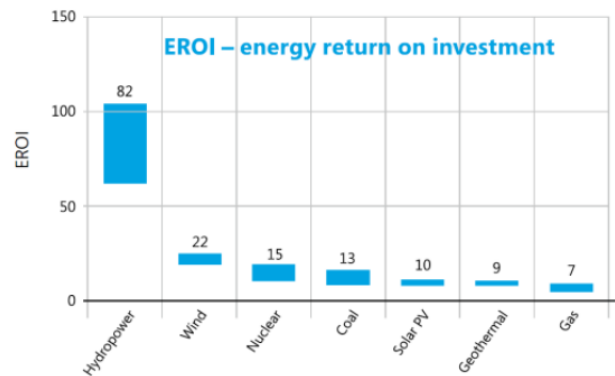
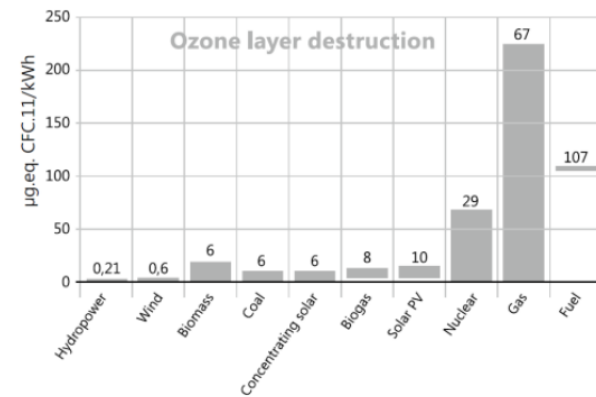
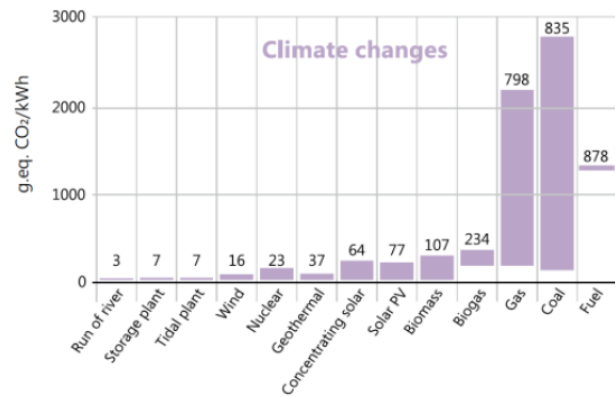
EU MS Imports (2021-2023)

■ From RoW ■ Intra-EU



JRC based on COMEXT data

Some environmental indicators

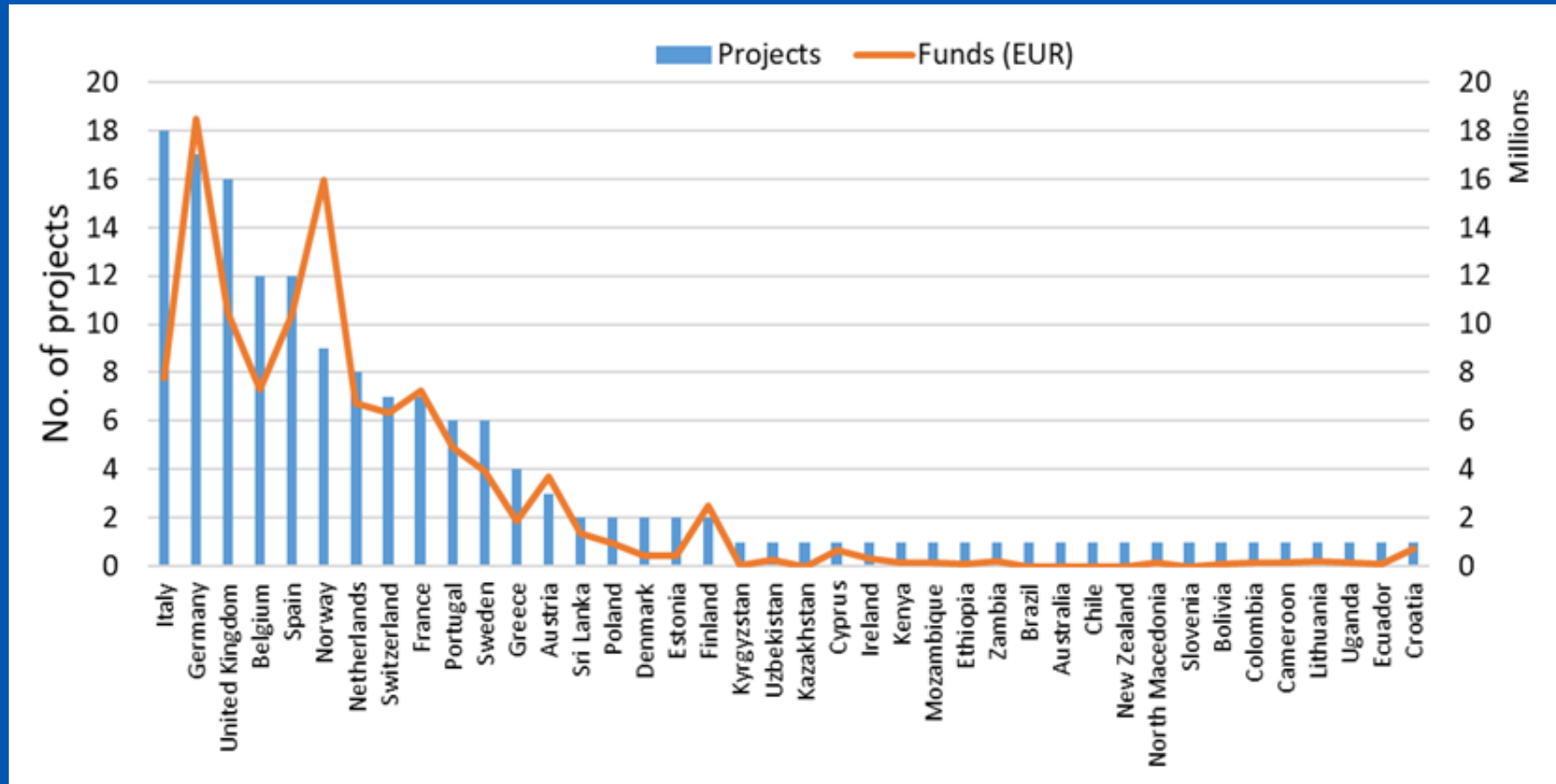


kilograms of antimony equivalent (kgeq.Sb)

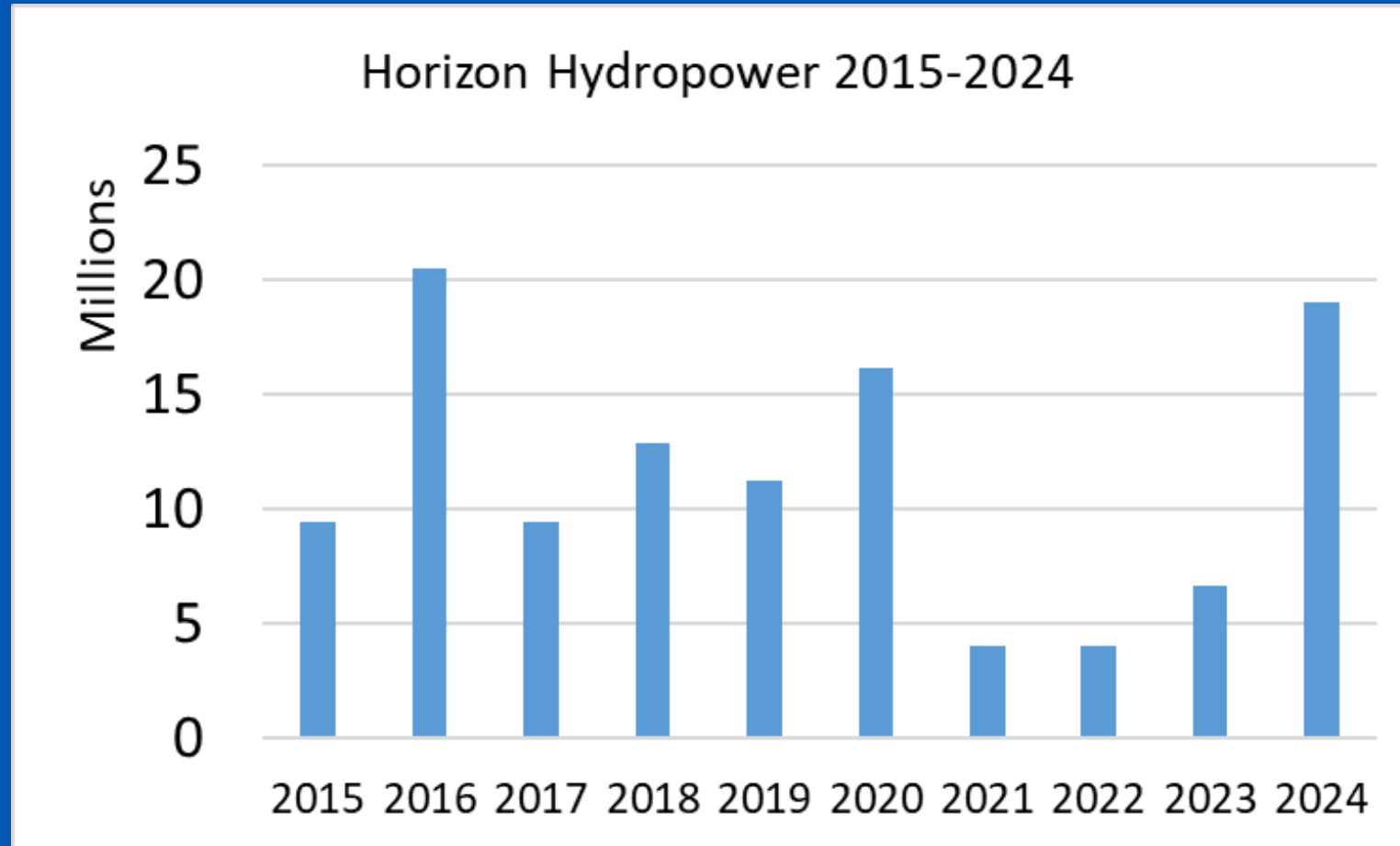
Source: ETIP Hydropower

But not forget other impacts: e.g., fragmentation, impoundment, fish migration, sediment trapping, hydro-morphological alterations

Horizon projects



Horizon projects



Recent Horizon calls

Title
Development of hydropower equipment for improving techno-economic efficiency and equipment resilience in refurbishment situations
<ul style="list-style-type: none">- Demonstration of innovative pumped storage equipment and tools in combination with innovative storage management systems- Development of novel long-term electricity storage technologies
Demonstration of sustainable hydropower refurbishment

Funded Horizon projects

Title
RevHydro: Revolutionary refurbishment for an efficient and eco-friendly hydropower
SHERPA: new Solutions for Hydropower plants to Enhance operational Range, Performance and improve environmental impAct
STOR-HY: Innovative storage technology and operations in hydropower

References

Quaranta, E., Georgakaki, A., Letout, S., Mountraki, A., Ince, E. and Gea Bermudez, J., Clean Energy Technology Observatory: Hydropower and pumped storage hydropower in the European Union - 2024 status report on technology development, trends, value chains and markets, Publications Office of the European Union, Luxembourg, 2024, <https://data.europa.eu/doi/10.2760/8354439>, JRC139225.

https://setis.ec.europa.eu/publications-and-documents/clean-energy-technology-observatory/ceto-reports-2024_en

Quaranta, E., Boes, M. R., Hunt, J., Szabò, S., Tattini, J., Pistocchi, A. (2024). Considerations on the existing capacity and future potential for energy storage in the European Union's hydropower reservoirs and pumped-storage hydropower, *Journal of Energy Storage*, 104(A), 114431.

<https://www.sciencedirect.com/science/article/pii/S2352152X24040179>

Thank you



© European Union, 2024

Unless otherwise noted the reuse of this presentation is authorised under the [CC BY 4.0](https://creativecommons.org/licenses/by/4.0/) license. For any use or reproduction of elements that are not owned by the EU, permission may need to be sought directly from the respective right holders.

