Fostering changes in energy consumption: a pathway to demand reduction

The need of flexibility in the hydropower sector: a European overview

Prof. Giovanna Cavazzini

Vice-Chair of PEN@HYDROPOWER

EERA
European Energy Research Alliance
clean Energy tranSition for Sustainable Society (e3s)

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COST ACTION FOCUSED ON HYDROPOWER IN EUROPE

PEN@ HYDRO POWER
CA21104

PEN@Hydropower is an action to establish a Pan-European network for a sustainable, digitalised Hydropower contributing to the Clean Energy Transition (CET).

A united network of researchers, engineers, scholars to facilitate close collaboration among European research groups through projects supporting sustainable Hydropower.

Promotes cross-disciplinary activities with the aim of knowledge sharing, boost new interlinked collaborations and put the basis for holistic solutions to the complex challenges of building a sustainable hydropower.

Promote the onset of a new generation of Hydropower experts, naturally educated for crosscutting and interlinked research projects with the final aim of building sustainable and flexible Hydropower.

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MANAGEMENT COMMITTEE & KEY INDIVIDUALS

Dr. Eduard DOUJAK
Action Chair

Prof. Giovanna CAVAZZINI
Vice Chair

WG 1	WG 2	WG 3	WG 4	WG 5
 Elena, **ECI**, *Switzerland*	 Dogan, **ECI**, *Turkiye*	 Elena, **ECI**, *Norway*	 Egidijus, **ECI**, *Lithuania*	 Marina, **ECI**, *Latvia*
 Mentor: Ioannis, *Greece*	 Mentor: Pavel, *Czech Rep.*	 Mentor: David, *Iceland*	 Mentor: Ewa, *Poland*	 Mentor: Barbara, *Austria*

Grant Awarding Coordinator	Science Communication Coordinator	Capacity Building Coordinator
 Marko, *Slovenia*	 Steven, *Malta*	 Sebastian, *Romania*

34 member countries

21 members of Inclusiveness Target Countries (ITC)

Research Areas

WG1 Evaluation and highlighting of the new role for Hydropower (HP) and Pumped Hydro Storage (PHS) **considering the flexibility and energy storage needs** of the future renewable energy sources dominated electricity systems, along with water hydraulics and ecology issues.

WG2 Establish a scientific framework for HP producers/investors to improve the performance and competitiveness of existing and new HP and PHS plants within the European electricity system. **Technological innovations to enhance flexibility and efficiency and promote digitalization** and predictive monitoring.

WG3 Develop a holistic assessment and new approaches to support **sustainable development and adaptation of the EU hydropower potentia**l, considering the resilient infrastructure needs, the environmental and societal conditions, and the climate change forecasts.

WG4 **Mapping the current EU legislative and market framework, the CET scenarios, and identification of policy gaps** to promote the new role of hydropower in the changing energy and market needs.

WG5 **Development of a holistic scientific strategy** based on consideration of digitalisation, climate change adaptation, a balance between production, industrial demands (WEF nexus), and environmental impacts of increased flexibility.

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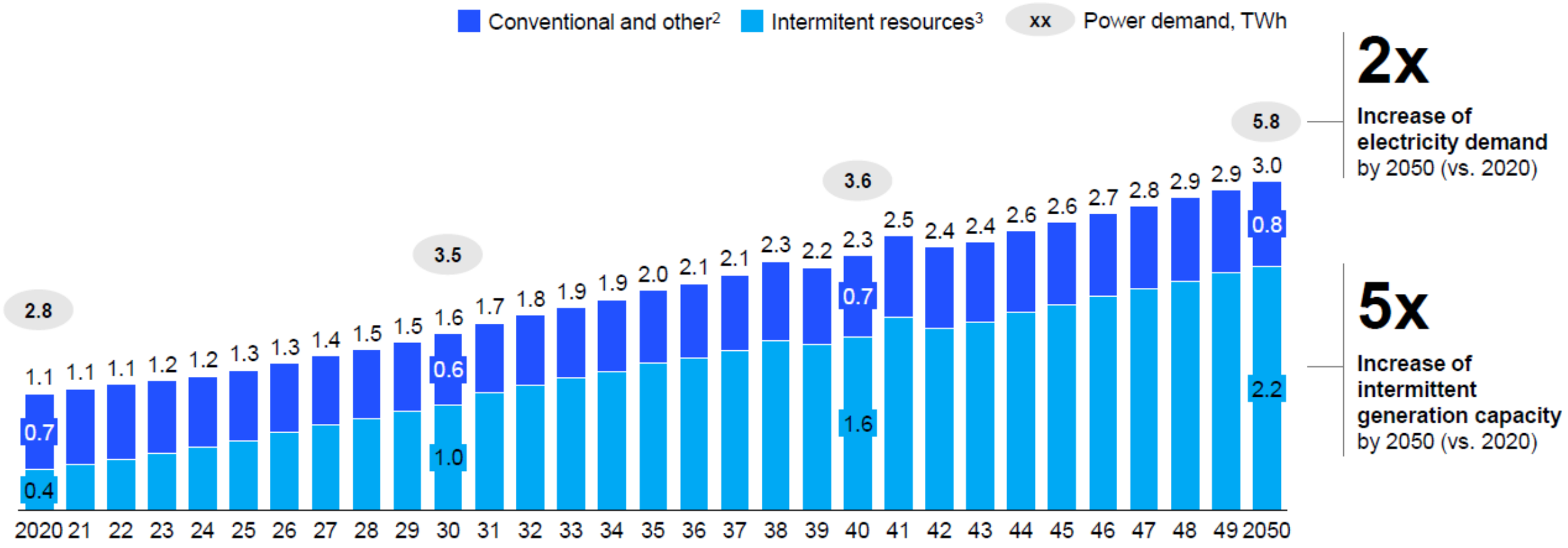
The need of flexibility at EU level

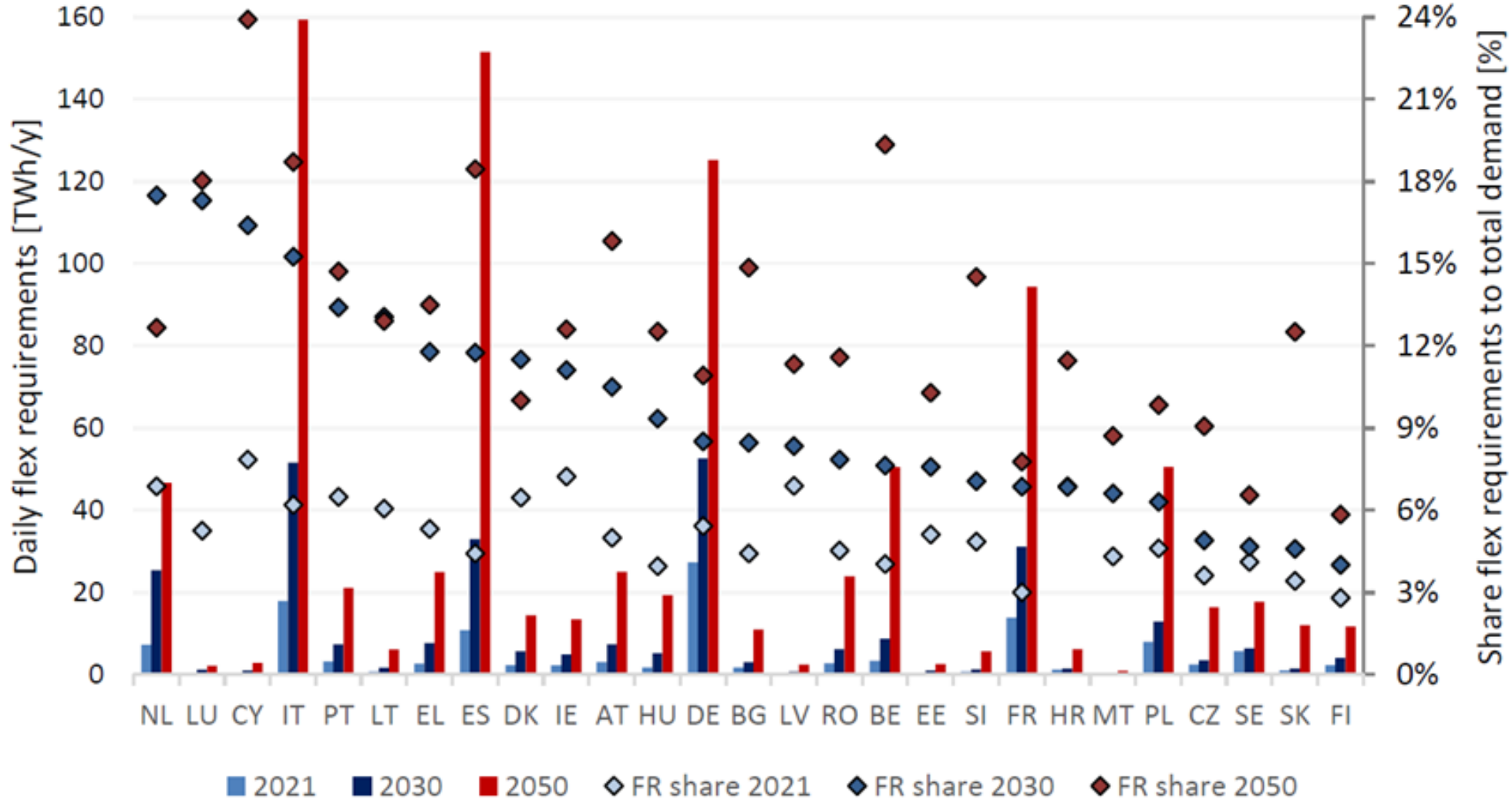
European power installed capacity[1],
TW



1. EU27+UK, 2022 Current Trajectory scenario
2. Gas, nuclear, oil, coal, biomass, hydrogen, geothermal, storage
3. Solar PV, CSP, wind onshore and offshore

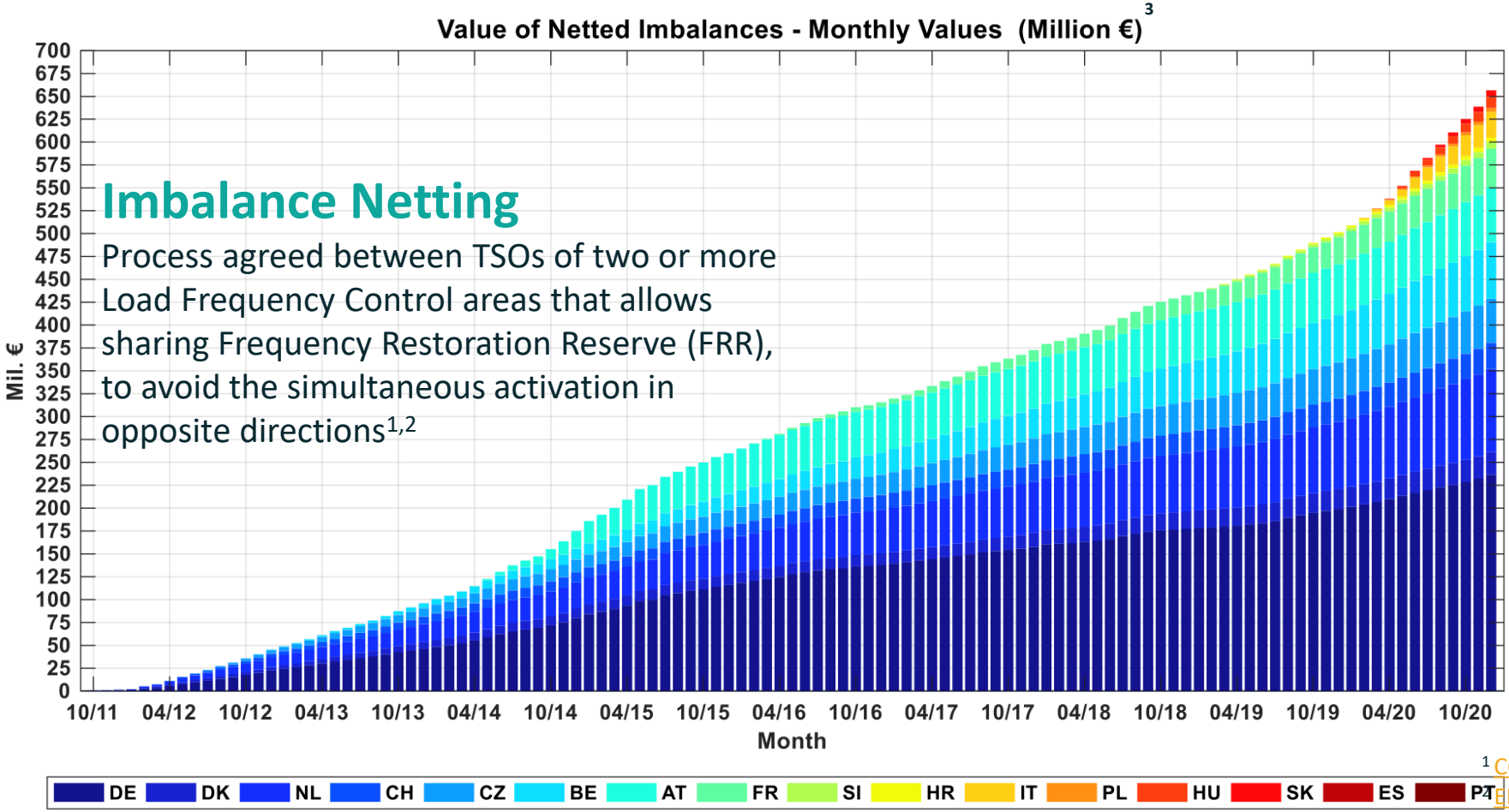
Endorsement of flexibility and **reliability** from dispatchable energy sources is necessary

The need of flexibility at EU level



Joint Research Centre, 2022, Flexibility requirements and the role of storage in the future European power system

Role of Hydropower Flexibility - What's the issue?



Imbalance Netting

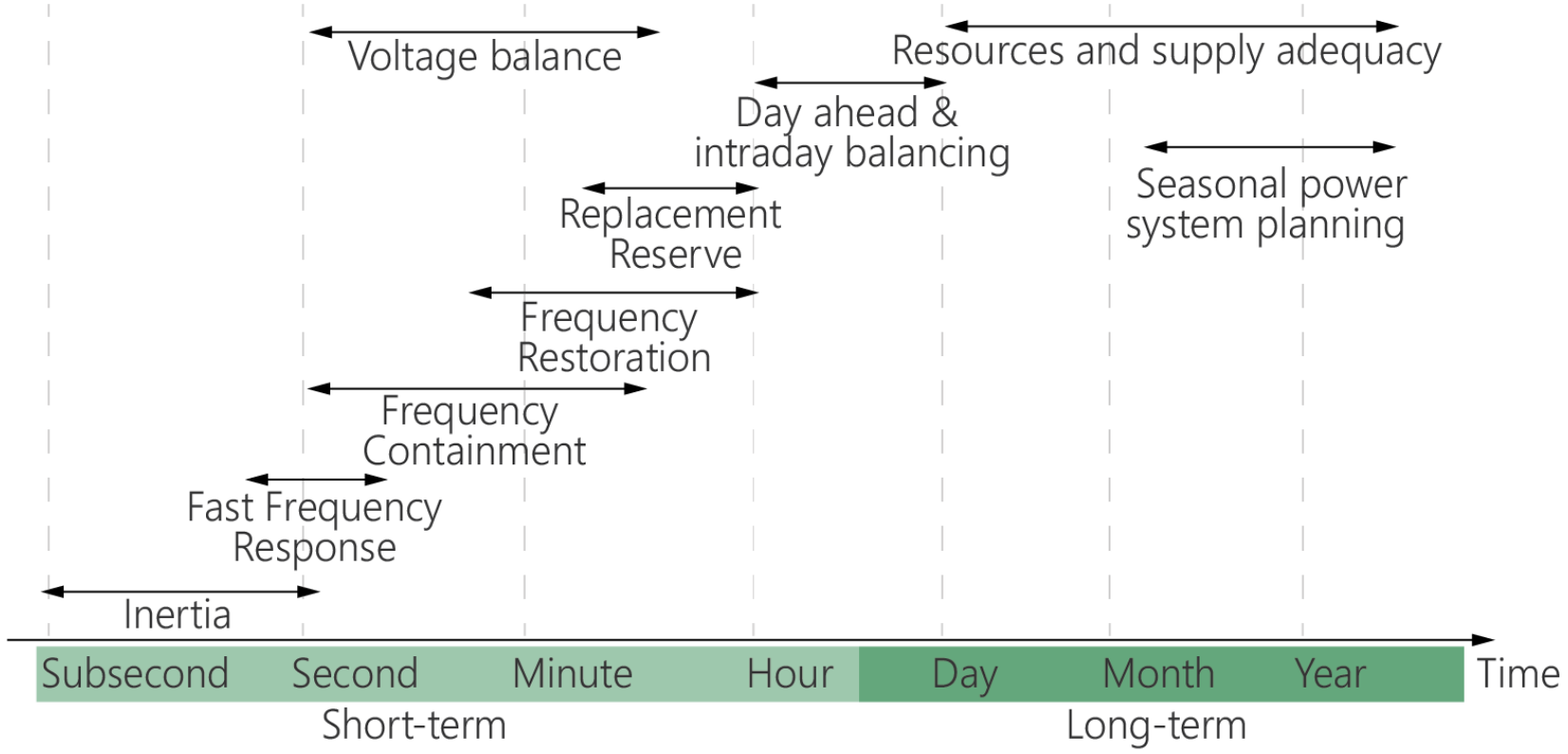
Process agreed between TSOs of two or more Load Frequency Control areas that allows sharing Frequency Restoration Reserve (FRR), to avoid the simultaneous activation in opposite directions[1,2]

[1] COMMISSION REGULATION (EU) 2017/ 2195 ENTSO-E Network Code, Imbalance Netting

[3] ENTSOE - IGCC Regular Report on Social Welfare

Role of Hydropower Flexibility - What's the issue?

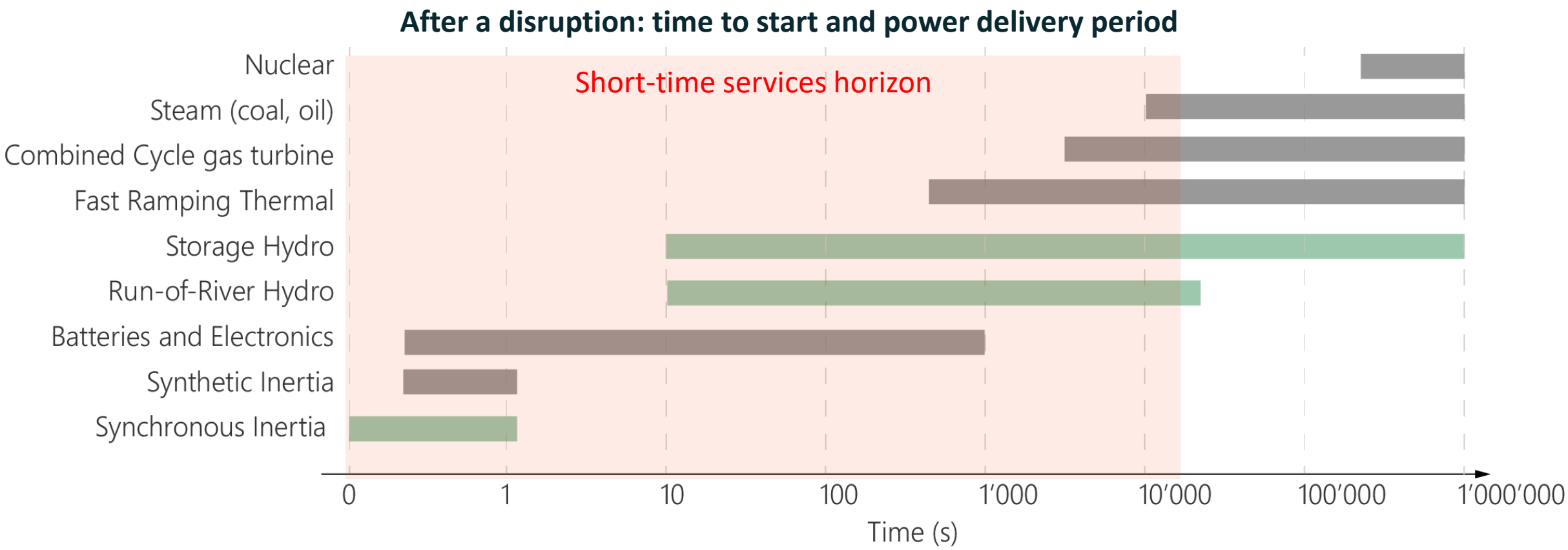
Flexibility services from short-term to seasonal:



(1) FLEXIBILITY, TECHNOLOGIES AND SCENARIOS FOR HYDROPOWER REPORT, XFLEX HYDRO, 2021

(2) Valuing Flexibility in Evolving Electricity Markets: Current Status and Future Outlook for Hydropower, IEA Hydropower, 2021

Role of Hydropower Flexibility - What's the issue?



Hydropower is the only highly-controllable low carbon generation to provide flexibility services over all time scales

Hydropower at EU level: a survey

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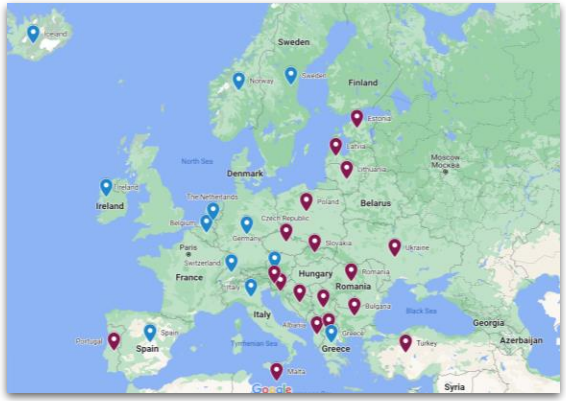
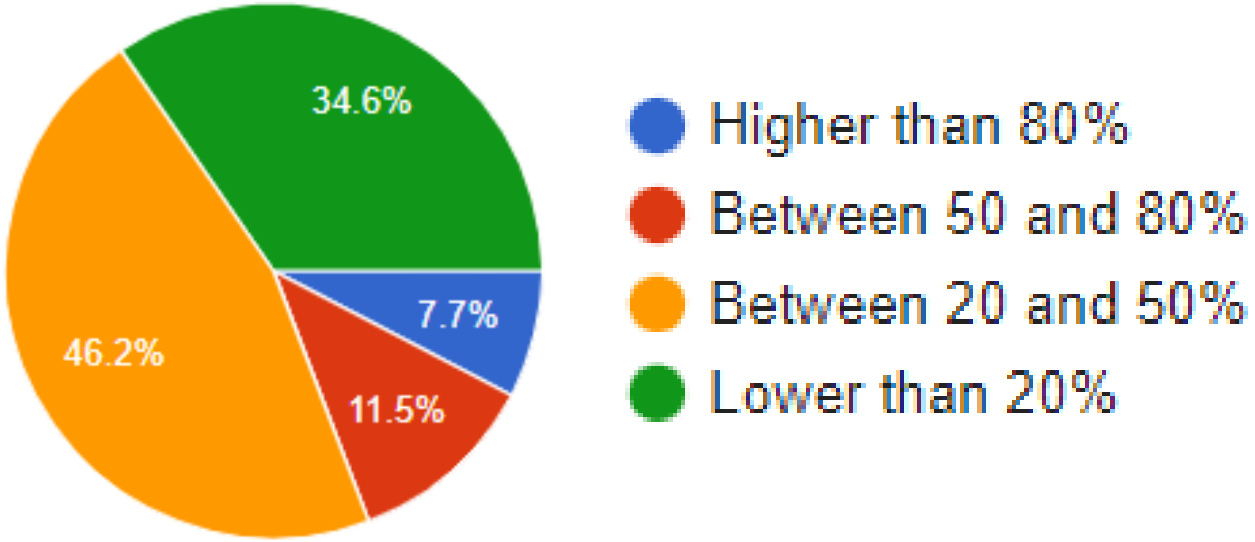


What's the share of hydropower generation in your country?



Hydropower at EU level: a survey

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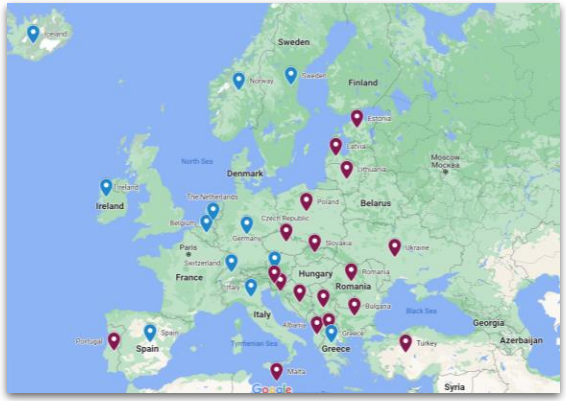
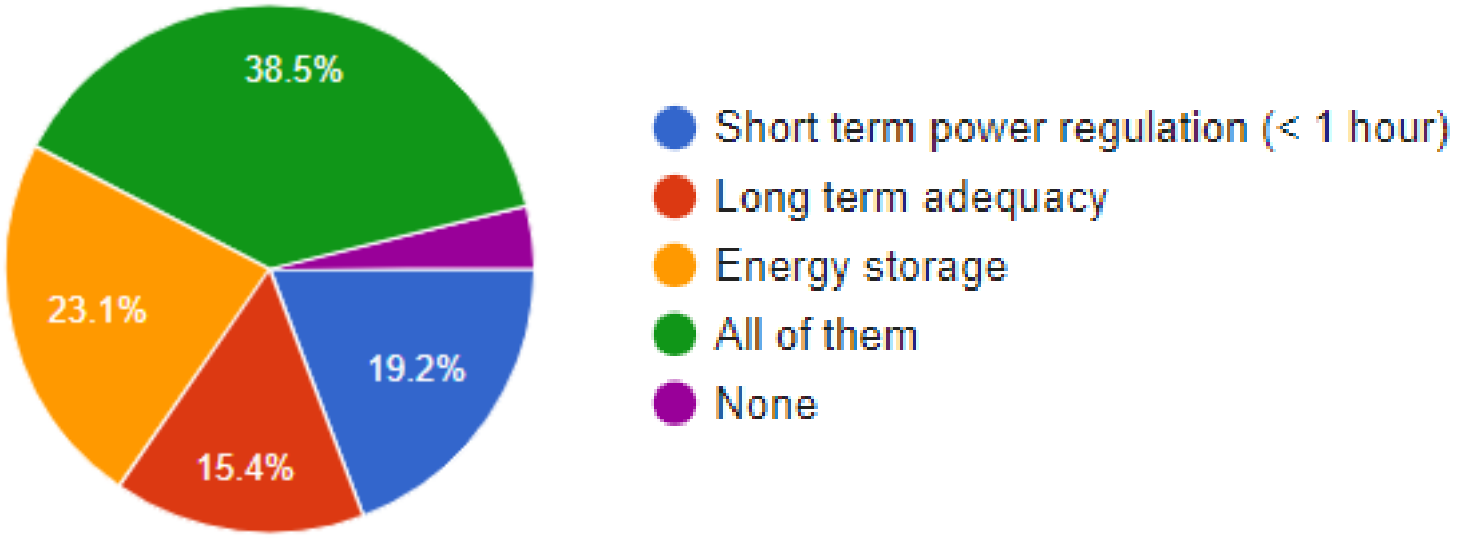


To which flexibility aspects hydropower contributes in your country?



What's one of the main issue for hydropower?

Wear and performance of the equipment

- **Variable Speed**

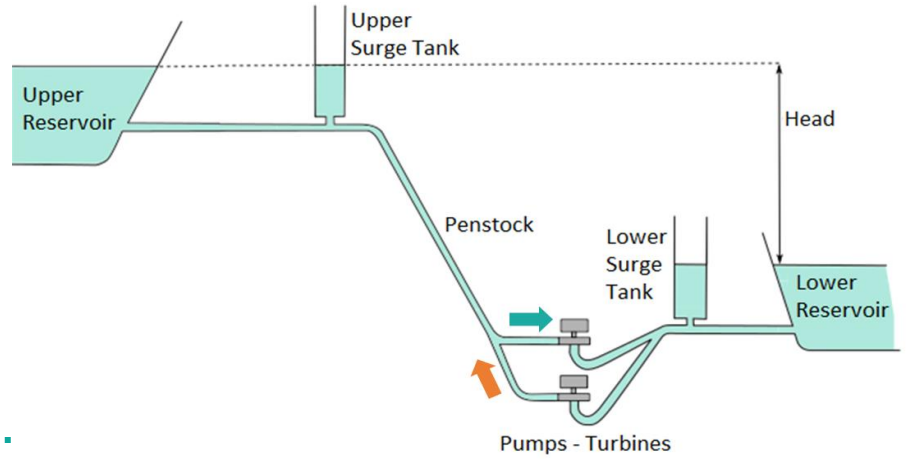
Capability of hydroelectric units to produce power at grid frequency regardless of the turbine's rotational speed.

- ✓ Extended operating range
- ✓ Better efficiency for head and discharge fluctuations
- ✓ Control power in pumping mode

- **Hydraulic Short Circuit**

Simultaneous pumping and generating on different units of the same pumped-storage power plant (PSPP)

- ✓ Extended operating range of the PSPP
- ✓ Continuous variation of the consumption of the plant



- **Hybridization with Battery Energy Storage System**

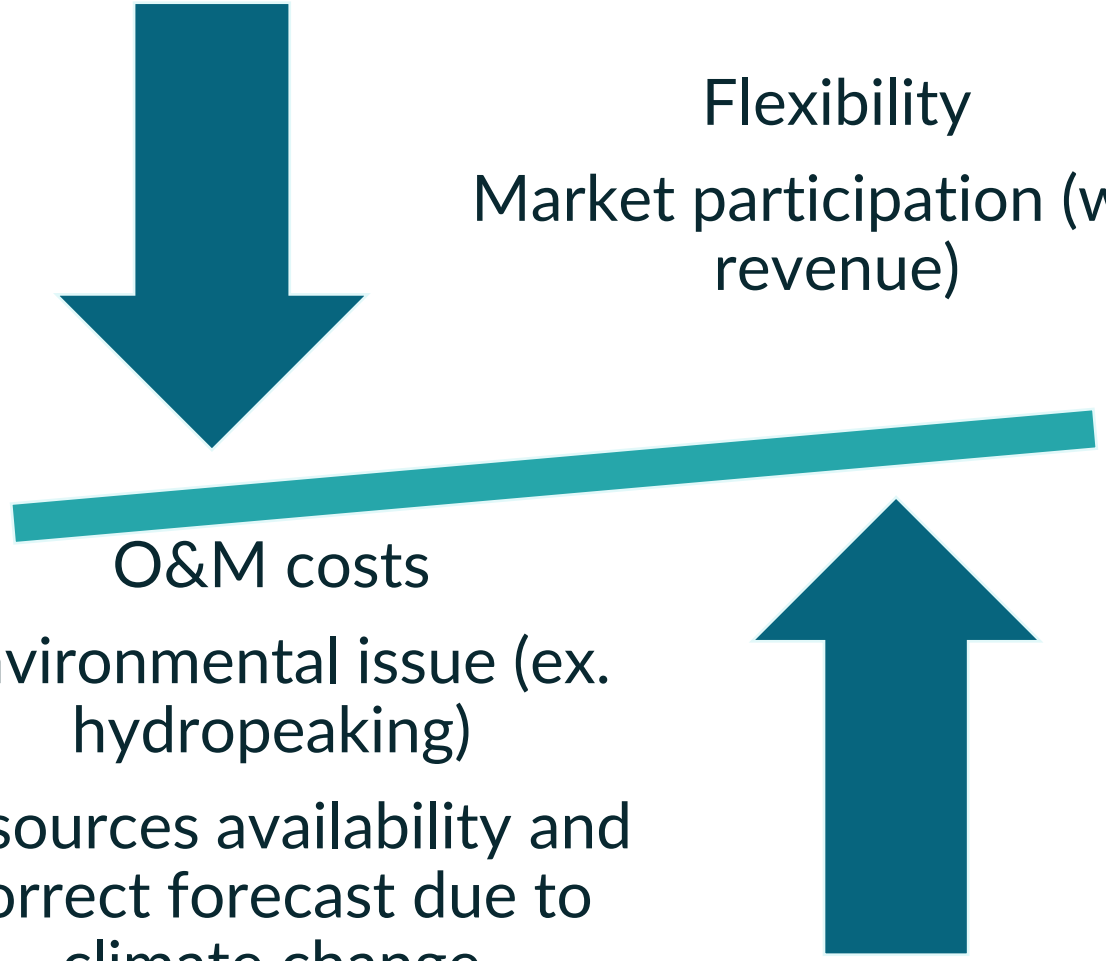
Addition of a grid-connected battery energy storage system in parallel to the hydroelectric unit.

- ✓ Faster response time for frequency control
- ✓ Reduction of the turbine governor maneuvers by significantly reducing mechanical stresses, wear and tear, and consequently maintenances.

What’s the main issue for hydropower?

Flexibility VS others

There is a urgent need of digital tools and models for holistic analyses!!



THANK YOU

CONTACT US FOR MORE INFORMATIONS

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