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EU Hydropower:
Ensuring security of supply by providing flexibility on a large scale

Flexibility demand will increase significantly

The EU power sector is making significant strides in decarbonisation, continuously increasing the share of renewables in the system with a projected 69% of power generation by 2030[1] and a potential increase to 87% by 2040 [2]. As variable sources such as wind and solar photovoltaics (PV) become predominant, the need for flexibility to ensure an efficient utilisation and security of supply must see substantial growth.

A recent study conducted by the European Commission's Joint Research Centre[3] indicates that we are approaching a tipping point where flexibility needs are expected to increase exponentially, reaching up to 30% of the total electricity demand. Based on the latest demand projections for 2040[2], this flexibility requirement could amount to nearly 1,000 TWh per year. Addressing these needs necessitates a concerted effort towards enhancing the electricity network infrastructure and bolstering flexible supply and demand.

Hydropower, as a renewable energy source, assumes a pivotal role in this context by providing flexible electricity generation and storage capacity on a large scale through three distinct power plant types.

3 main hydropower plant types

Run-of-river hydropower:

Channel the water of a river through turbines, and thus, supply a continuous amount of electricity linked to the river's discharge. However, these plants can provide flexibility services to cover short-term up to daily fluctuations in demand by adjusting their operation parameters in a certain range.

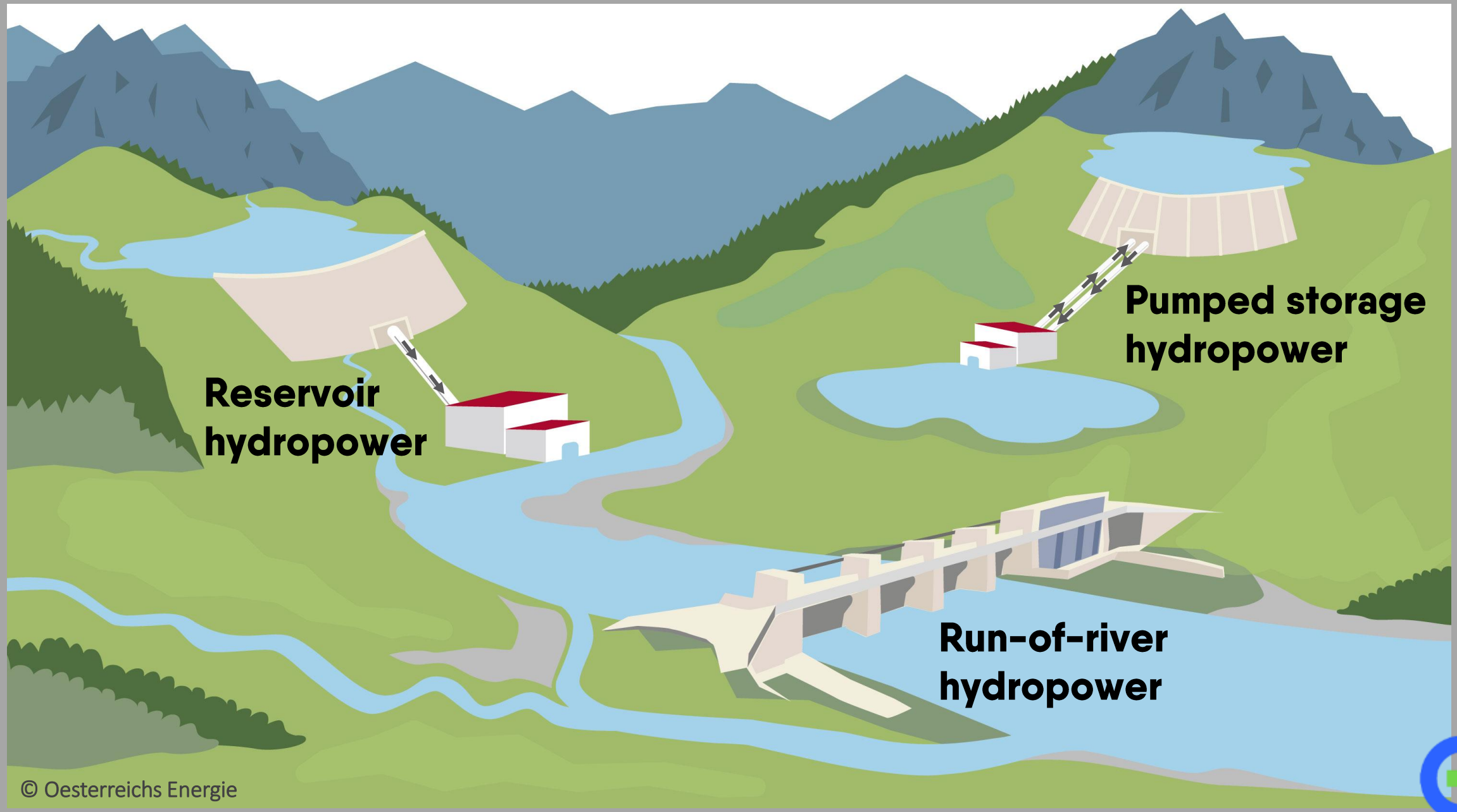
Reservoir hydropower:

Accumulate water during periods of abundance. These strategic water reserves enable optimised operation for durations ranging from weeks up to a year, irrespective of prevailing natural discharge conditions. Consequently, reservoir hydropower stands as the predominant renewable source of flexible power generation, addressing short, medium, and long-term flexibility requirements.

Pumped storage hydropower:

Provide electricity storage by utilising water which is cycled between a lower and upper reservoir. During periods of surplus power, pumps act as flexible absorbers, lifting water to the upper reservoir. Conversely, when electricity demand peaks, water is released from the upper reservoir, facilitating flexible electricity generation. The storage capacity varies depending on the system's size, ranging from short-term to long-term, potentially spanning several months.

In many hydropower schemes these different plant types are strategically combined and operated to harness the maximum energy output from the available water while keeping the environmental impact to a minimum.


Reservoir hydropower
Pumped storage hydropower
Run-of-river hydropower
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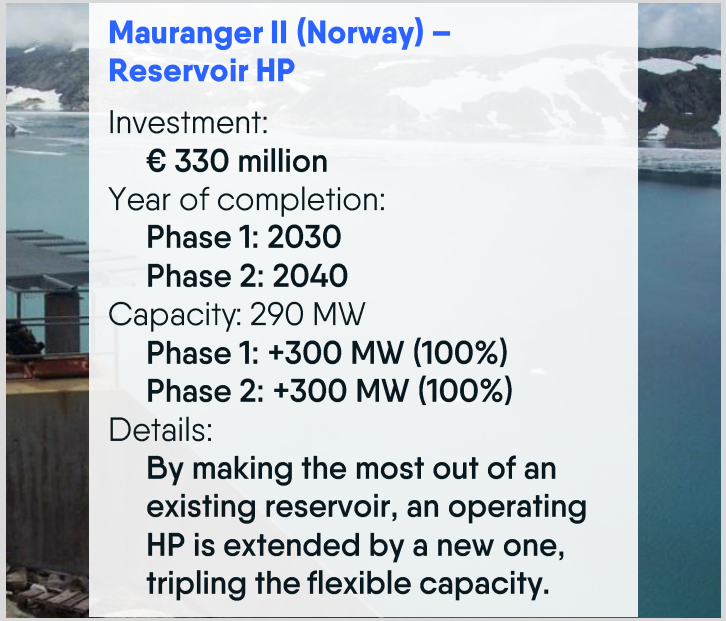
Flexible generation and storage capacity is increasing all over Europe

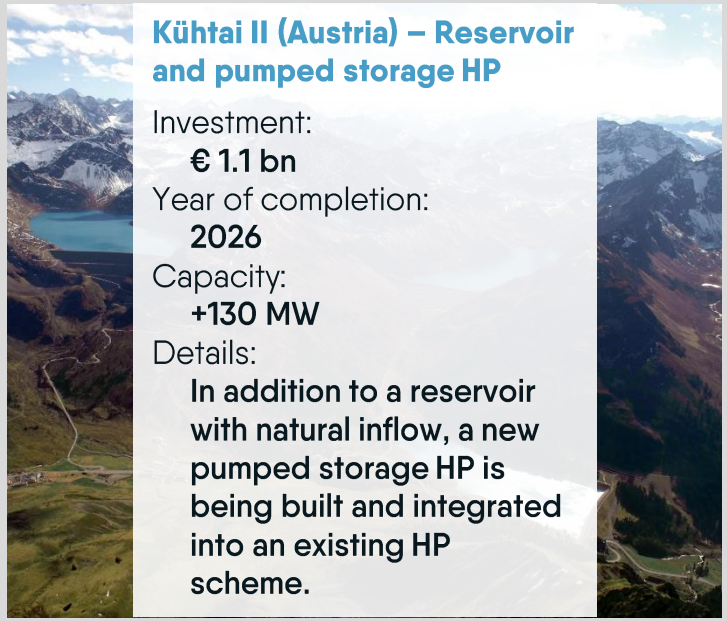


Mauranger II (Norway) – Reservoir HP

Investment:
€ 330 million
Year of completion:
Phase 1: 2030
Phase 2: 2040
Capacity: 290 MW
Phase 1: +300 MW (100%)
Phase 2: +300 MW (100%)
Details:
By making the most out of an existing reservoir, an operating HP is extended by a new one, tripling the flexible capacity.

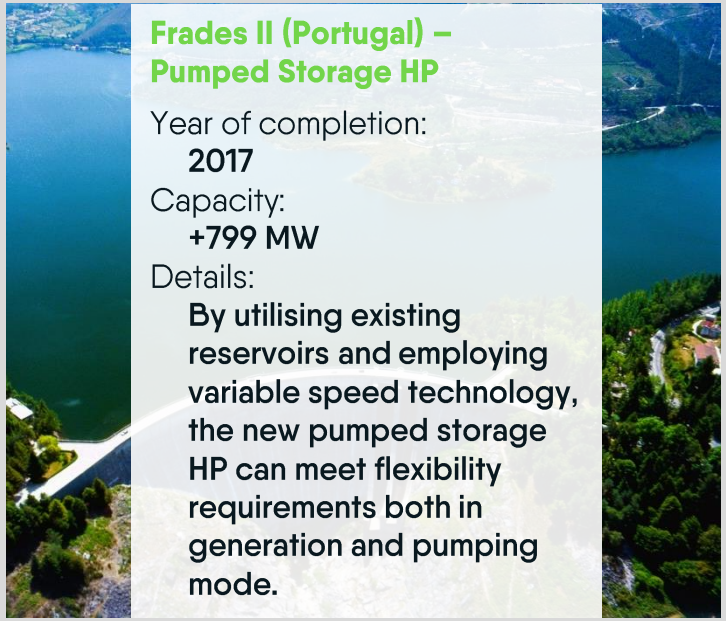
Rengård (Sweden) – Reservoir HP

Investment:
€ 100 million
Year of completion:
2024
Capacity: 36 MW
+35 MW (100%)
Details:
By adding another turbine, the capacity of an existing HP was doubled, resulting in greater flexibility of the plant itself and downstream ones.



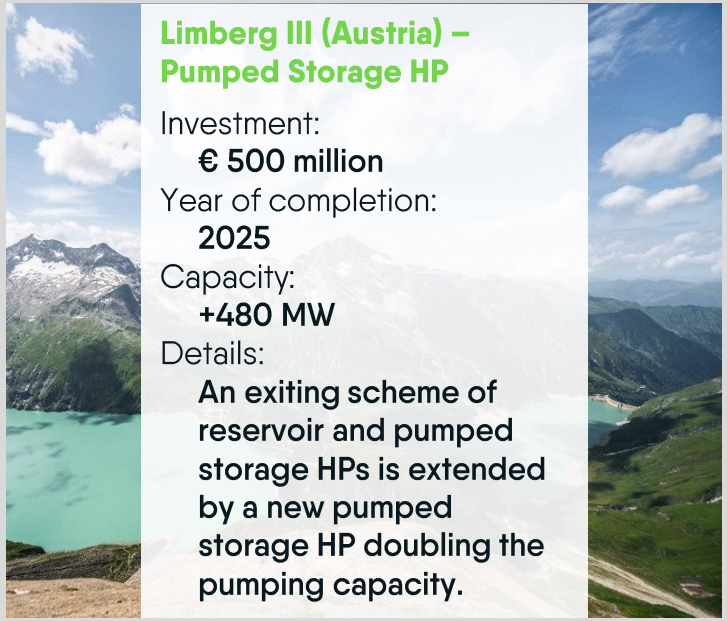
Kühtai II (Austria) – Reservoir and pumped storage HP

Investment:
€ 1.1 bn
Year of completion:
2026
Capacity:
+130 MW
Details:
In addition to a reservoir with natural inflow, a new pumped storage HP is being built and integrated into an existing HP scheme.



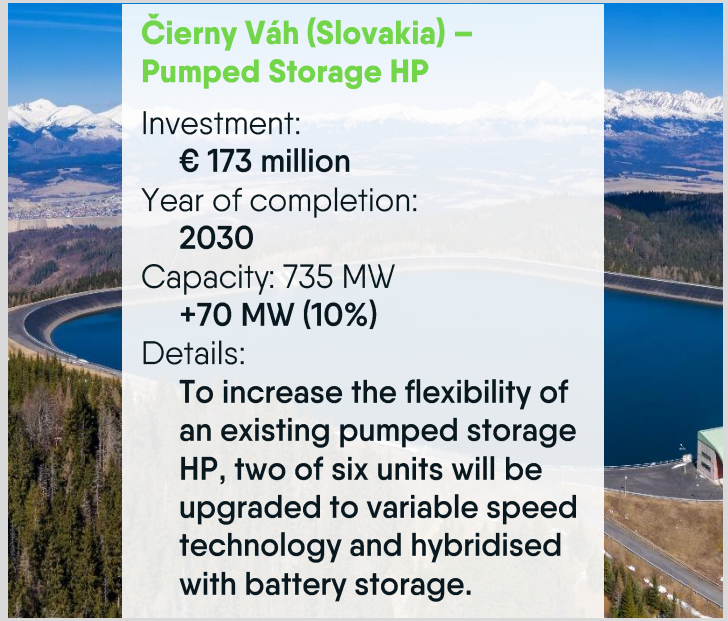
Frades II (Portugal) – Pumped Storage HP

Year of completion:
2017
Capacity:
+799 MW
Details:
By utilising existing reservoirs and employing variable speed technology, the new pumped storage HP can meet flexibility requirements both in generation and pumping mode.



Limberg III (Austria) – Pumped Storage HP

Investment:
€ 500 million
Year of completion:
2025
Capacity:
+480 MW
Details:
An exiting scheme of reservoir and pumped storage HPs is extended by a new pumped storage HP doubling the pumping capacity.



Čierny Váh (Slovakia) – Pumped Storage HP

Investment:
€ 173 million
Year of completion:
2030
Capacity: 735 MW
+70 MW (10%)
Details:
To increase the flexibility of an existing pumped storage HP, two of six units will be upgraded to variable speed technology and hybridised with battery storage.

5 Essential calls to enhance hydropower flexibility

1. **Recognise the diversity of hydropower – run-of-river, reservoir and pumped storage plants – providing flexible renewable electricity generation and storage to ensure an efficient and reliable power system for decades.**

2. **To fully exploit the potential of hydropower, a technology-neutral, stable regulatory environment is needed to strengthen confidence of plant owners, operators and investors.**

3. **It is crucial that future market interventions are avoided, and market principles maintained to enable efficient dispatch and storage of electricity** (i.e., flexible sources are activated when they offer the greatest value to the electricity system).

4. **Swift implementation of the provisions in the Clean Energy Package and Electricity Market Design will contribute to an accurate assessment of different flexibility needs, long-term visibility for investments and incentives to foster more participation of flexibility services.**

5. **While public support mechanisms can provide short-term signals and catalyse essential long-term investments in hydropower, they must align with existing regulations, applying for new and existing assets and allowing flexible plants to maximise their incomes on various markets.**

References:

[1] European Commission, Commission Staff Working Document, Implementing the REPowerEU Action: EUR-Lex - 52022SC0230 - EN - EUR-Lex (europa.eu);
[2] European Commission, Communication on Europe's 2040 climate target and path to climate neutrality by 2050 building a sustainable, just and prosperous society, Impact Assessment Report Part III: https://eur-lex.europa.eu/resource.html?uri=cellar:6c154426-c5a6-11ee-95d9-01aa75ed71a1.0001.02/DOC_3&format=PDF;
[3] European Commission, Joint Research Centre, Koolen, D., De Felice, M., Busch, S., *Flexibility requirements and the role of storage in future European power systems*, Publications Office of the European Union, 2023, https://data.europa.eu/doi/10.2760/384443;

Photo credits:

Graphic hydropower plant types – Oesterreichs Energie
Mauranger II – Statkraft
Frades II - EDP
Rengård – Skellefteå Kraft
Limberg III – VERBUND
Kühtai II – TIWAG
Čierny Váh – Slovenské elektrárne

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