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Policy brief: making climate services impactful on hydropower reservoir optimization

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The challenges

- Changes and increased variability in climate drivers have been putting pressure on the hydropower (HP) sector to **guarantee energy security** and meet emerging **energy and climate commitments** for the future.
- The pressing needs for sharing the water stored in reservoirs with other water uses, and mitigating potential conflicts, intensifies the urgency to **make the best out of available climate information** to efficiently manage water resources and optimize electricity production.
- The increased availability of weather and climate services prompts questions about how these services can actually **meet the sector's needs and expectations**, and be incorporated in current HP practices.

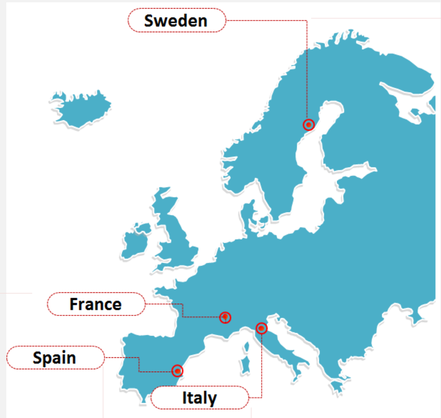
Lessons learnt from case studies

- Given the presence of multiple temporal dynamics in HP systems, tailoring information to the level of scale and detail needed is crucial to move from the stage of having predictions issued by a model to **having predictions fully integrated in decision-making** and economically impactful.
- Systematically overestimating reservoirs inflows can lead to large economic losses on hydropower revenue: flow predictions that systematically take on extreme values that are not actually observed will negatively impact the **optimal daily management of a reservoir**.
- When decisions are optimized based on future meteorological conditions and energy prices, **hydropower revenue** associated with interannual reservoir storage can increase by 3% to 8%, when seasonal predictions from climate and hydrological models are used.

Our case studies: a variety of conditions in Europe for the management of reservoir-based hydropower production

A set of typical mountainous river basins, where 7-day to monthly inflow forecasts are operationally used to inform decision-making:

south-eastern basins in France



A typical north European basin, highly influenced by snowmelt runoff and volumes for planning the hydropower production for the current and next winter seasons:

the upper part of the River Umeälven in Sweden

A typical south Mediterranean basin, with a large share of water for irrigated agriculture:

the Jucar River basin in Spain

A typical snow-dominated Alpine basin, representing a large socioeconomic system where multiple, conflicting water-dependent activities coexist:

the Lake Como in Italy

Policy recommendations

- A range of actors is involved in climate-dependent HP production, management and planning: hydrologists, power plant operators and energy traders. Depending on their role, they may have **different needs for information**.
- A survey involving 28 respondents from 10 different countries indicated that hydrologists, meteorologists and climatologists in HP companies have to deal with **climate and river flow information from different sources**, provided by in-house or external services and **at different scales**: from short to long ranges in time and from local to regional and catchment-based scales in space.
- In their efforts to make the best out of this information, the HP sector should:

1. Ensure that **strategic planning** on the medium- (weekly) to long- (monthly to seasonal) term, which is mostly driven by climate and hydrology at the local scale, **is aligned** with daily and sub-daily decisions, which are mostly driven by the energy market.
2. Continue to explore weather, climate and water services' capability of **anticipating extreme events over different temporal scales**: when HP systems are at critical states (e.g., reservoir water levels too low or too high), knowledge of future conditions facilitates interactions between water users and brings economic value (gain in production and in revenues) to the hydroelectric power industry.
3. Encourage the **involvement of HP operational forecasters and service developers in research** and innovation projects: this can be an asset to optimize the efforts needed to adapt HP operations to state-of-the-art forecast products made available by service providers.

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