

HydroBalance Project: Large-Scale Energy Balancing and Storage from Norwegian Hydropower

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With increasing shares of variable renewable energy sources (RES) the need for flexible power generation and energy storage in Europe is growing. Hydro storage and pumped storage offer an efficient and renewable way of storing energy, and at present, these are the only economically viable storage technologies at large scale. The HydroBalance Project develops a roadmap for the potential use of the Norwegian hydropower system for providing flexible generation and energy storage in the European power market. The interdisciplinary project includes analyses, case studies and model simulations addressing key challenges between the poles of technology, economy, society and environment.



Regulated Govda (left) and natural Cazajavri lake (right). Photo: A. Eloranta

Scenario building

- Which role can energy balancing and storage from Norwegian hydropower play in the European electricity market in the year 2050?
- Four scenarios with varying amount and time horizon of energy balancing

Hydropower in Norway

Installed capacity31 GWMean annual generation130 TWhStorage capacity84 TWh

Additional potential using existing reservoirs and dams: at least 20 GW



Scenarios A – Small battery B – Big battery C – Niche battery D – Nordic battery





Small

Balancing and storage needs

- Establish data models with sufficient temporal and spatial resolution
- Analyse the need for storage at different time horizons in a multiple coupled market environment
- Model interaction between day-ahead, intra-day and balancing markets
- Compare alternative solutions for storage

Environmental impacts

- Analyse impacts of frequent, rapid water level fluctuations in reservoirs on abiotic and biotic environment
- Compare ecological effects on fish communities and food webs in reservoirs

Business models

- Investigate where and how energy balancing and storage as a service may enter the markets, and assess economic opportunities
- Identify markets, assess business models and analyse expected payback for investors
- Simulate operation and revenue of hydro storage and pumped storage plants

Regulatory framework and public

acceptance

- Identify the main non-technical challenges
- Assess how increased use of energy balancing is perceived among stakeholders at national, regional and
- Model hydro-dynamics for different reservoir types
- Develop operational guidelines for mitigation of impacts

local level

• Determine regulatory and policy drivers and limitations

Roadmap

- Draw time lines and development steps for alternative options to use hydro storage and pumped storage for providing energy balancing and storage
- Address requirements, recommendations and limitations in relation to the regulatory framework, environmental regulations, public acceptance, business models and investment needs



The HydroBalance project is part of the research centre CEDREN (Centre for Environmental Design of Renewable Energy, http://www.cedren.no). It is a four year project funded to two thirds by the Research Council of Norway. Private sector partners and public authorities provide the rest of the funding. HydroBalance industry partners are: Statkraft, Statnett, Eon, EDF, Sira Kvina, Agder Energi, BKK, Energi Norge and Listerrådet.