Hydrobalancing Challenges on three levels

The rising shares of intermittent renewable energy in Europe will increase the needs for balancing and storage capacity, and Norwegian hydrobalancing is interesting in this regard. The project assessed the non-technical drivers and barriers influencing further development of large-scale balancing and storage from Norwegian hydropower to the European market on three levels; within EU, on the national level and local-community level. The main findings are:

- Norway will to a large extent depend on the EU development of a system for exchanging and valuing balancing services.
- There is a need of political strategies and necessary measures to realize hydrobalancing.
- Community compensation and early involvement of stakeholders may sufficiently enhance community acceptance.

Figure 1:
Illustration of scales and the main challenges for large- scale storage and balancing hydropower from Norway to Europe on EU-, National-, and community level.

Need of a coherent planning framework

Potential hydrobalancing projects have to be seen in connection with grid development, both nationally, regionally – and probably also at a local grid level. Energy infrastructures have to be realized within local settings, implying the need for appropriately addressing stakeholders and affected inhabitants. A coherent planning framework concerning the hydrobalancing needs related to the grid is currently not in place at national level, but could make hydrobalancing projects more feasible in practice. Acceptance issues will be crucial in both giving political support for strategic hydrobalancing planning, but also actual realization of concrete projects at a local level.

The national grid is confronted with substantial needs for expansion and upgrading. One major barrier is the need of coordination of grid development and plans for how hydrobalancing projects could be feasible in practice, both on a regional, national and European levels (**Table 1**).

While the Norwegian government has expressed positive signals towards permitting merchant interconnectors, no formal process has thus far been initiated. The Government also signals an ambition of identifying measures which can alleviate and shorten the time and resources employed in relation to interconnector projects, and the coordination between new energy production and grid development. Politically, however, no amendments to this system have been proposed thus far in order to accommodate eventually more interconnector projects and a larger degree of hydrobalancing from Norway.

Table 1. *Drivers and barriers at the national level*

	Drivers	Barriers	Consequence
Hydropower Regulations	Many suitable hydropower reservoirs	• No clear statement or objective on the realization of the potential • Lacking coordination of grid development and increased hydro power production	• Potential for value creation • Need for reinforcement of grid
	Permit processes grid and production development	Negative environmental and social consequences	Possible public opposition
Political will	Promoting interconnectors	• Hydrobalancing not a high priority • No strategy on hydrobalancing	Hydrobalancing not a high priority

Informants where:

- National authorities
- Members of Parliament
- Environmental NGO`s
- Energy intensive industry
- Hydro power companies

Topics for the interviews:

- Current legislation
- Infrastructure/grid lines
- Commercial potential
- Societal legitimacy
- Environmental impacts

Hydrobalancing in Norway depends on EU

Realizing hydrobalancing services from Norway will to a large extent depend on the EU development of a system for exchanging and valuing balancing services from renewable sources such as hydro power. Importantly, a major national barrier is the need of political strategies and necessary measures to realize hydrobalancing. The political realization of hydrobalancing development would be more realistic if drivers existed at a national level.

Hydrobalancing or short- traveled energy?

Informants provided socio-political insights into how increased use or developments of balancing services from Norway to Europe are perceived.

We divided the informants into "sceptics" and "supporters" for providing Norwegian hydrobalancing services to Europe (**Table 2**). The supporters generally saw a great potential in developing Norwegian hydrobalancing for Europe, while emphasizing the domestic energy use and export in combination. Amongst the sceptics, the main concerns were increased electricity prices and/or environmental impacts of hydropeaking, pump storage and infrastructure development.

Table 2. *Drivers and barriers of hydrobalancing from Norway to Europe. National stakeholders' perceptions.*

Driver/mitigating measure	Barrier (Supporters)	Barrier (Sceptics)
Norwegian balancing services great potential for a green European energy mix	The phrase "green battery" erroneous, concerning Norway's potential contribution towards meeting Europe's energy needs	The phrase "green battery" erroneous, concerning Norway's potential contribution towards meeting Europe's energy needs
Environmental and social consequences in grid and production safeguarded in national regulations	Lack of public acceptance of grid and production development	Short travelled energy prioritized
Important to be connected to EU energy system – export opportunities	Balance with support of domestic energy industry	Unpredictable consequences for domestic energy consumption
EU RES targets	Grid infrastructure insufficient capacity and flexibility	Grid infrastructure insufficient capacity and flexibility.
	Cable ownership	Distribution of costs and benefits (esp. host communities)
		Environmental concerns (not outweighing climate benefits)

Both the sceptics and the supporters were in favor of the two planned interconnectors to Germany and UK, while further ambitions beyond these two cables were rather vague. There was generally a sobriety amongst the informants concerning Norway's potential contribution towards meeting Europe's energy needs, and most had stopped using the metaphor of Norway as a "green battery".

The main barriers mentioned by the supporters against the realization of increased hydrobalancing from Norway were the national and regional grid infrastructure, the distribution of costs and benefits from future interconnectors and the lacking profitability of pump storage projects. The sceptics were divided into environmental NGOs that primarily focused on the possible environmental impacts of projects, and The Federation of Norwegian Industries which was concerned about energy prices and conditions for energy intensive industry. In addition, the absence of long term energy policies both on Norwegian and EU levels were emphasized as important barriers by both the sceptics and the supporters.

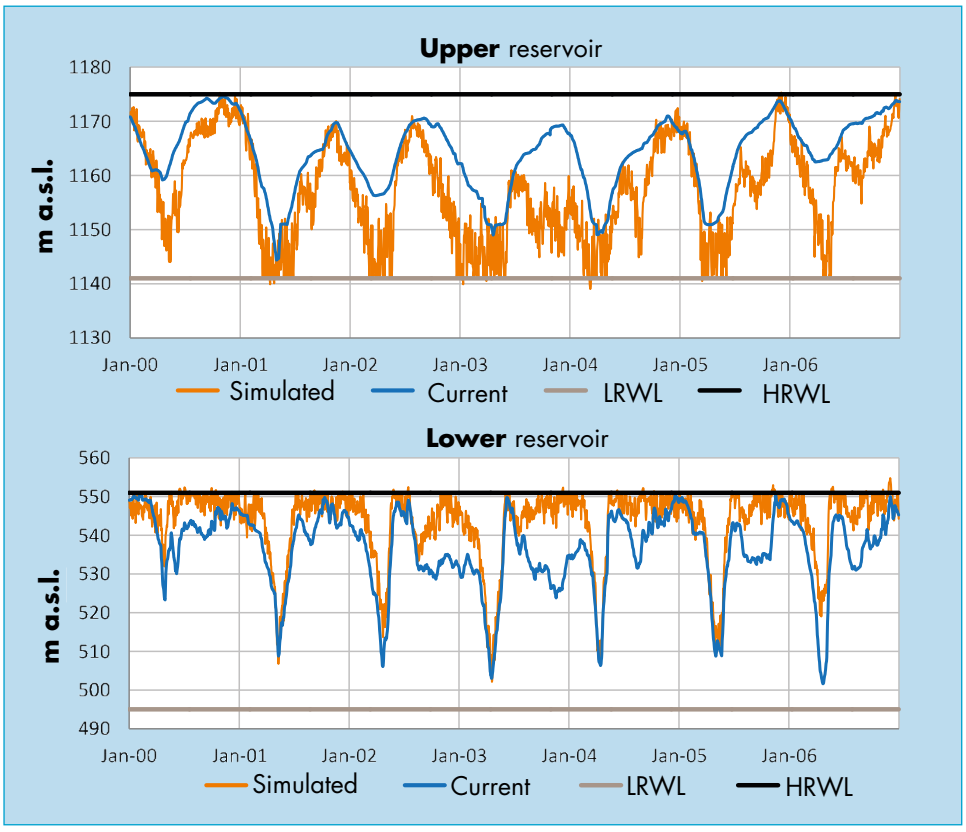
Since both onshore grid development and hydro power development projects are risking negative environmental and social consequences, there is a concern amongst several national stakeholders of increased public opposition if hydrobalancing services are to be developed fully in Norway. A related concern is the sharing of benefits which will not necessarily be of local or regional character but rather serve international climate change mitigation and national value creation, unless compensation towards host communities is ensured.

If several of the barriers are to be overcome and the socio-political acceptance increase, it is important to be aware of the difference between a societal acceptance at the national level, and the acceptance of specific projects in concrete local settings.

Community acceptance – reducing local resistance

Tyin was selected as an illustrative case to explore community acceptance as it has a hydropower reservoir with a large balance power potential in addition to extensive user-interests locally. Through interviews and a focus group meeting the informants disussed how a pump-storage scenario (example given in **Figur 2**) would affect their use of the lake and surrounding areas. Informants where representatives from local and regional authorities, tourist businesses, landowners, cabin owners and NGO's.

We found that the local and regional stakeholders in Tyin were critical of carrying the local impacts of moving towards more renewable energy globally. Local resistance amongst Tyin informants was concerns for the local environment and biodiversity, negative impacts on business, recreation and transportation in the area, and safety issues related to rapidly fluctuating water levels. This illustrates the importance of the "need argument" used to legitimize renewable energy technology projects. When the need argument of a project focuses on diffuse benefits elsewhere with few local benefits, it will be challenging to build community acceptance. This is obviously a challenge for grid or production projects that aims at providing hydrobalancing services, where the costs are taken locally while the benefits are



Figur 2. *Example of changes in water levels in a system with the current regulation regime (blue line) and simulations of pumped storage (red line) in upper reservoir and lower reservoir.*

globally or nationally. Much discussed measures to counterbalance non-existing or negative local impacts of renewable energy projects are various forms of local compensation, but not necessarily monetary compensation. As hydrobalancing projects will have few local benefits, community compensation could be a relevant measure to give something back to those carrying the negative impacts.

Early involvement of local stakeholders and procedural justice is of vital importance to ensure community acceptance. Norway has a regulatory system where public consultation is ensured during the planning and licensing processes of renewable energy technology projects, but our study shows that local stakeholders feel ignored and unable to influence the decision-making process.

Conclusions

- Hydrobalancing services from Norway will largely depend on the EU development of a system for exchanging and valuing balancing services from renewable sources such as hydro power.
- The right drivers need to be in place at the Norwegian national level.
- A major barrier is currently the need of comprehensive political strategies and necessary measures to realize increased hydrobalancing from Norway.
- Measures such as community compensation and early involvement may enhance community acceptance.

In sum, it is recommend to formulate a policy strategy that encompass and balance different societal interests. This should be done both at the national and local levels with provisioning of guidelines for coordination of different plans, regulations and interests of relevant water resource and grid development needs. Such a comprehensive strategy should further address the political-, economic-, societal- and technological trends, which will impact upon relevant European countries' demands.

National stakeholders, who potentially could influence the national policies on hydrobalancing, did not at a large scale demand such a development beyond the interconnectors that currently are realized. Given the number of barriers, extensive hydrobalancing from Norway appears to be an unrealistic idea in the near future.

Facts about the HydroBalance project

The project addresses key questions regarding the increasing need for balancing variable generation from renewable energy sources and providing flexibility by the use of Norwegian hydropower including deployment of pumped storage. These key questions are investigated in the research tasks of five work packages. The interdisciplinary project integrates perspectives on the topic according to CEDREN's vision: technology, nature and society:

WP 1 - Roadmap for energy balancing from Norwegian hydropower

WP 2 - Demand for energy balancing and storage

WP 3 - Modelling and analyses to develop business models

WP 4 - Environmental impacts of new operational regimes in reservoirs

WP 5 - Social acceptance and regulatory framework

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