Renewal of consessions– total impact on the hydropower system

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SINTEF Energi

Energi Norge
Hele Norge på strom

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Background

- EU water framework directive
- Issued in Norway as The Water Regulation
- Many concessions will be revised the next years
- Requirements for increased minimum flow of water and less flexibility in regulation of reservoirs are expected

About the project

- IPN
- Project period: 2020-2023
- Project responsible: Energi Norge, Project Manager: Solgun Furnes
- Partners: Energi Norge, Statkraft Energi, Agder Energi Vannkraft, Hydro Energi, Hafslund-E-CO, BKK Produksjon, Energiforsk, Energiforetagen, SFE Produksjon, Sira-Kvina Kraftselskap, Trønderenergi, Skagerak Kraft, NTE Energi, Statnett, NVE

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Aim

- Develop new knowledge about the total impacts from new environmental restrictions on the hydropower production for 2015 and 2030.
- Contribute to use of the knowledge by power producers, TSO and Regulator
- Contribute to the public debate in Norway
- Use, verify and improve state-of-the-art power market models developed by SINTEF Energy Research

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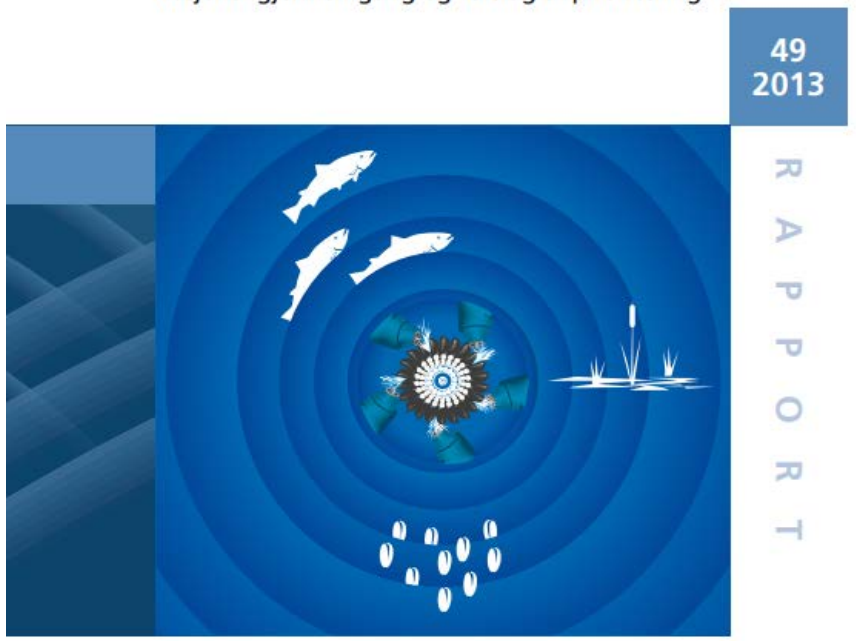
Environmental restrictions

- Q95
  - Power plants identified by NVE 49:2013 + river systems that may get new restrictions after 2022.
  - Geographical location identified by SINTEF
  - Flow before regulation is calculated by NEVINA (by NVE)
  - One value for the summer period and one value for the winter period
- Alternative method for calculation of minimum bypass constraints
  - Hight differences, gradient, national salmon river and other conditions
  - Experiences from completed revisions of concessions
- Restrictions on reservoir operation
  - All inflow shall be used for filling up the reservoirs in the summer period



Previous work

Studies

- NVE/Miljødirektoratet 2013
- Multiconsult for Energi Norge 2016
- Statkraft 2018/2019

Some results

- Lost energy
- Challenges for the security of the system in March
- Increased probability for floods
- Increased and more volatile power prices

Recommendation about further work

Method

Detailed modelling of each river system, new environmental restrictions

Historical time series: inflow, wind, radiation, temperature

Grid data

Other power system data

Dialog with user partners

FANSI analyses of the spot market in Northern Europe with a particular focus on the Nordic hydro power production (1-3 hourly resolution)

Water values per reservoir

PRIMOD analyses for reservation and activation of reserves for selected weeks (15 minutes resolution)

Start costs
Requirements for up/down periods thermal plants

Spot price per time step, hydro power production, income for hydropower producers, energy balances, floods and socio economic surplus

Power prices (spot, reservation and activation of reserves) per time step, hydro power production, income for hydro power producers, power balances, available reserves in the hydro power system, floods and socio economic surplus

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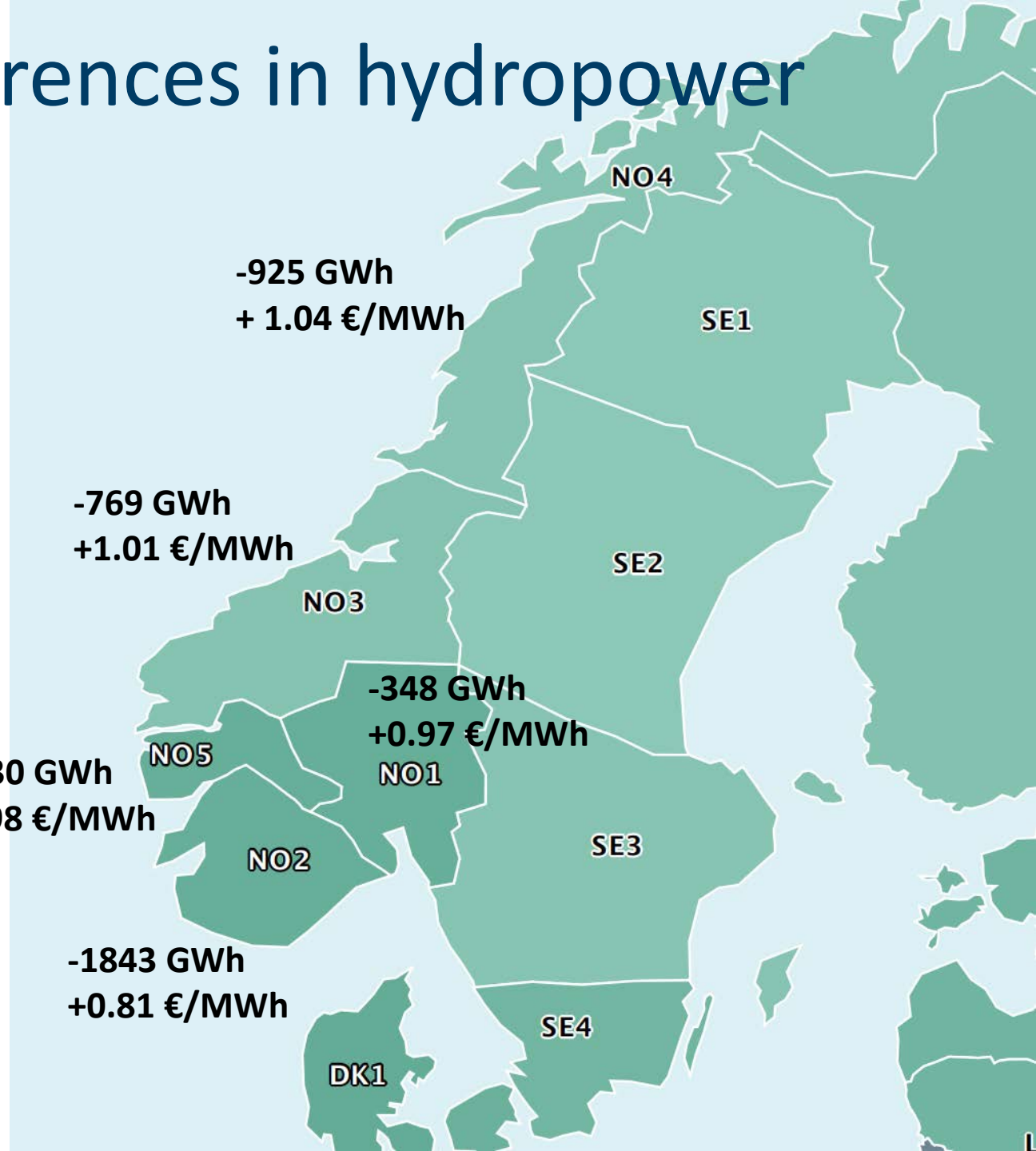
Average spot prices Norway

- Q95 and restrictions related to reservoirs increase the average spot price in Norway in all prices regions with about 1 €/MWh

Price area	Spot price without restrictions [EUR/MWh]	Spot price with restrictions [EUR/MWh]
NO1	41.86	42.82
NO2	40.68	41.49
NO3	40.83	41.84
NO4	39.87	40.93
NO5	40.72	41.70

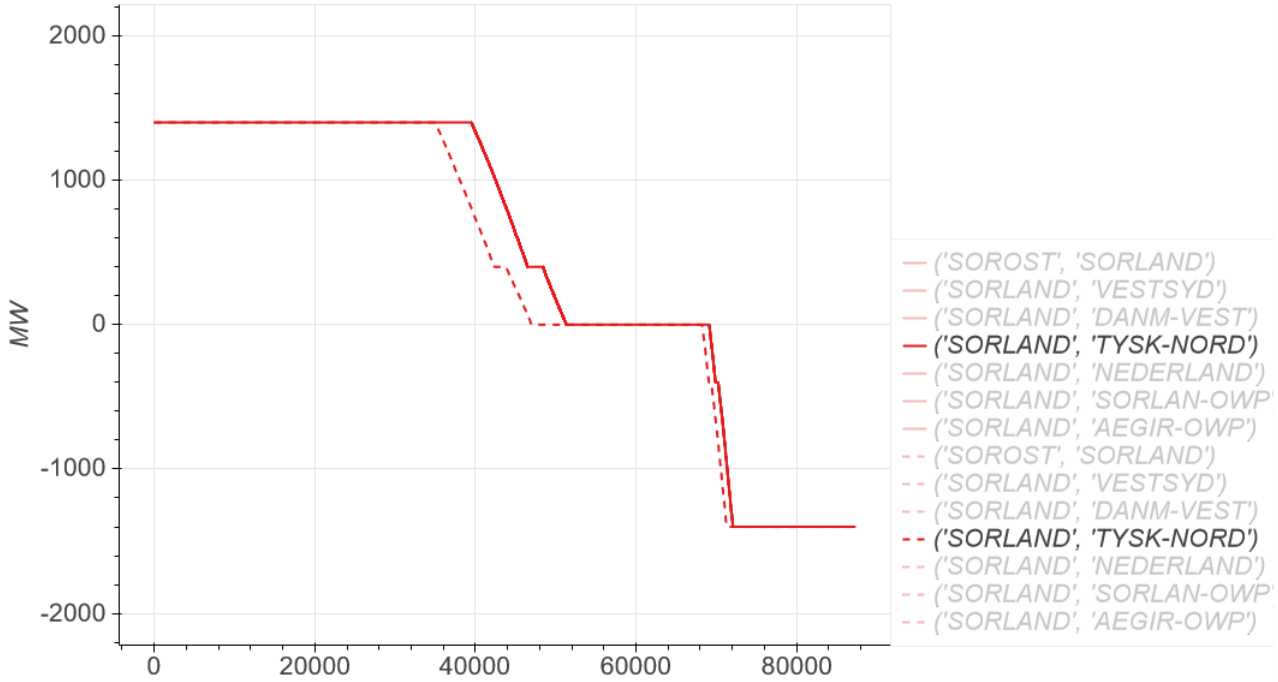
Preliminary results- Differences in hydropower production and prices

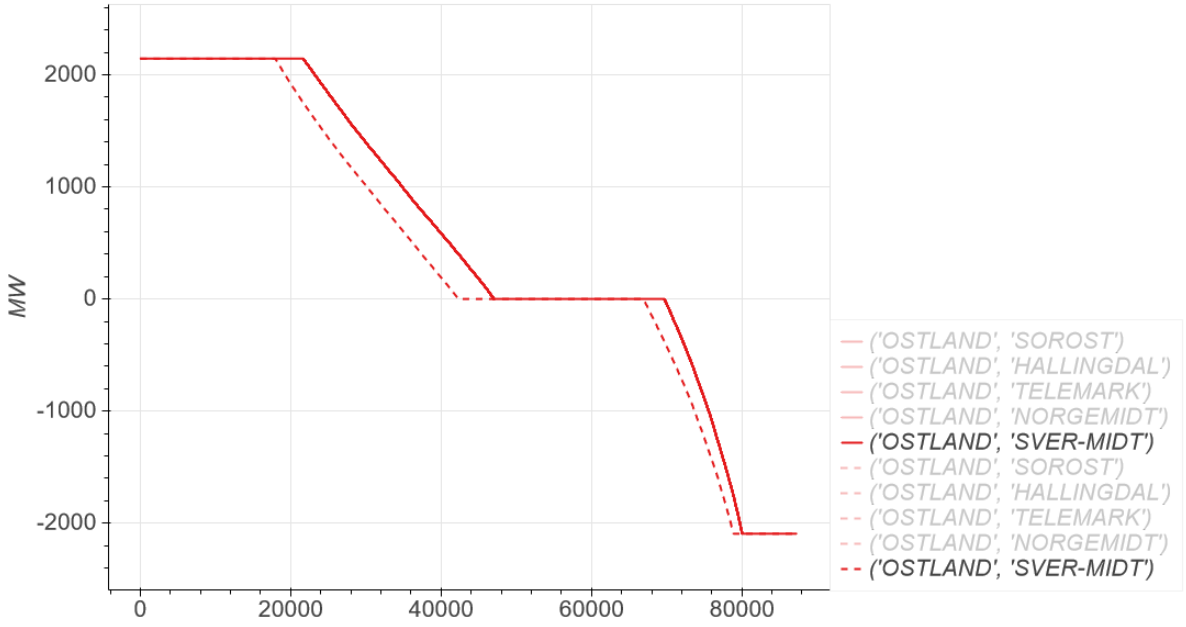
- Differences are «with restrictions» - «without restrictions»
- In average the production in Norway is reduced with 5.5 TWh/y
- The prices differences vary between ca – 0.3 €/MWh (1994) and +10.8 €/MWh (1985).
  - Largest difference in dry years

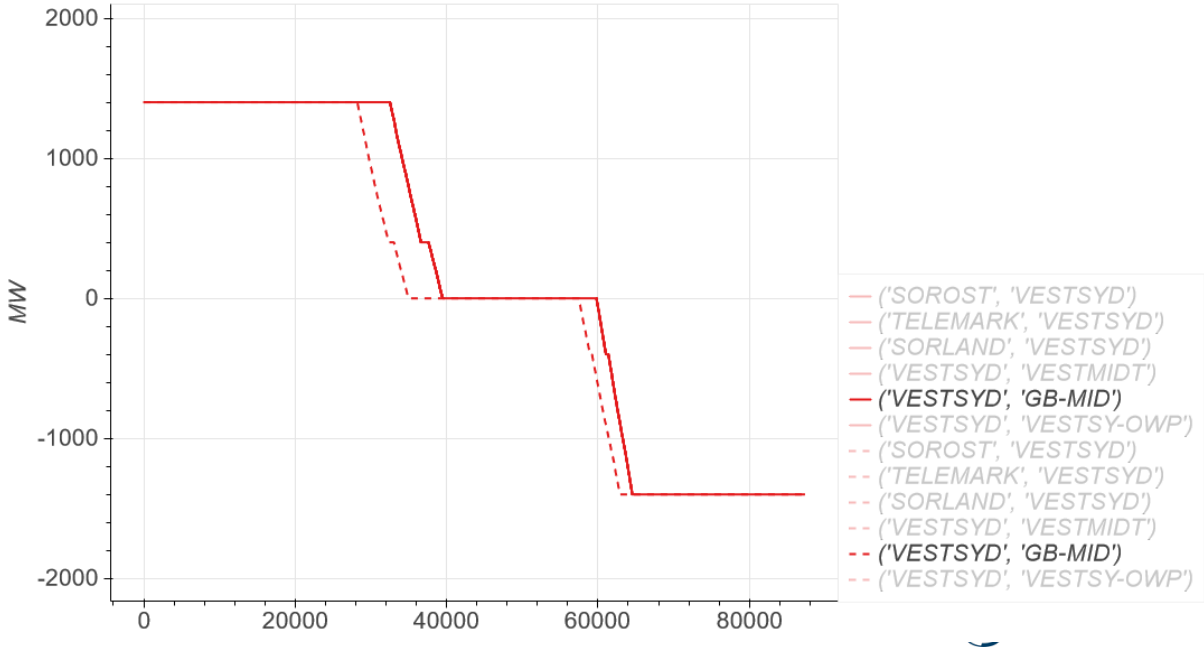


Reduced export from Norway

- Net export from Norway:
  - Without restrictions: 20.9 TWh/y
  - With restrictions: 15.5 TWh/y

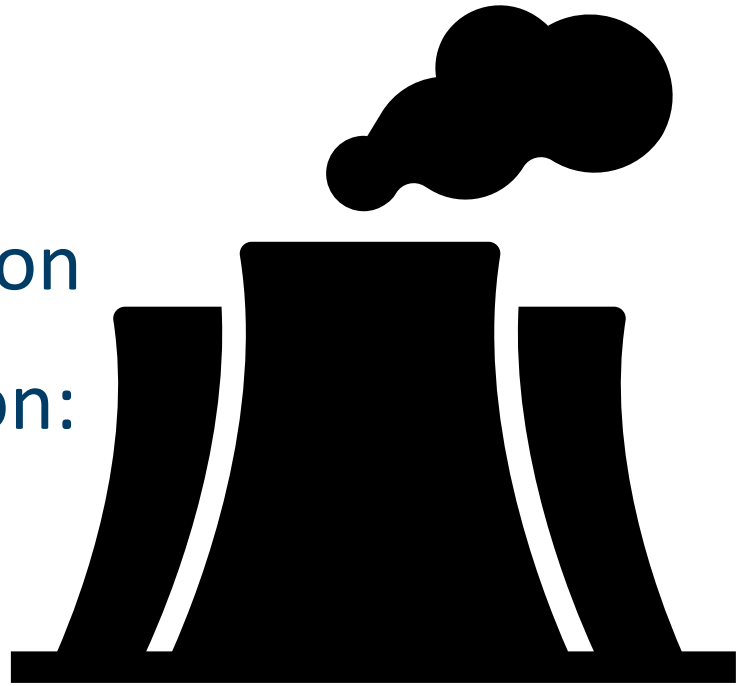






Production increases in other countries

- 3.5 TWh increased gas production
- 0.8 TWh increased coal production
- 0.4 TWh increased nuclear production
- Reduced price-sensitive consumption:
  - 311 GWh/y in Norway
  - 196 GWh/y in Sweden



Further work

- Alternative method for calculation of environmental restrictions
- Consequences for capacity and activation prices (using PRIMOD)
- Including flow based market coupling
- Sensitivity analyses