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Modeling of Environmental Constraints (HydroCen/ProdRisk)

Birger Mo / Arild Helseth



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Norwegian Research Centre for Hydropower Technology

Forskning

Forskningen i senteret er organisert i fire arbeidspakker:

WP 3.4 Miljørestriksjoner og Usikkerhet



Vannkraftkonstruksjoner



Turbiner og generatorer



Marked og tjenester



Miljødesign

User Survey – Environmental Constraints


2018:01435- Unrestricted

Report

Environmental Constraints in Seasonal Hydropower Scheduling

Survey and Feasibility

Author(s)
Arild Helseth
Other authors



Important constraints:

- State-dependent discharge
- Virtual reservoirs
- Ramping constraints



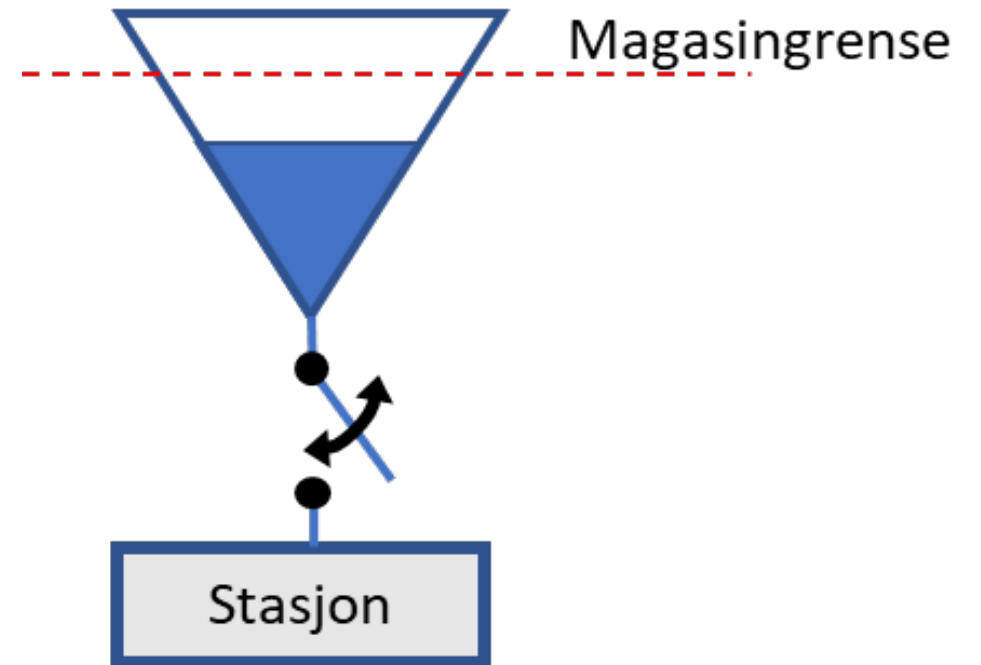
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State-Dependent Discharge

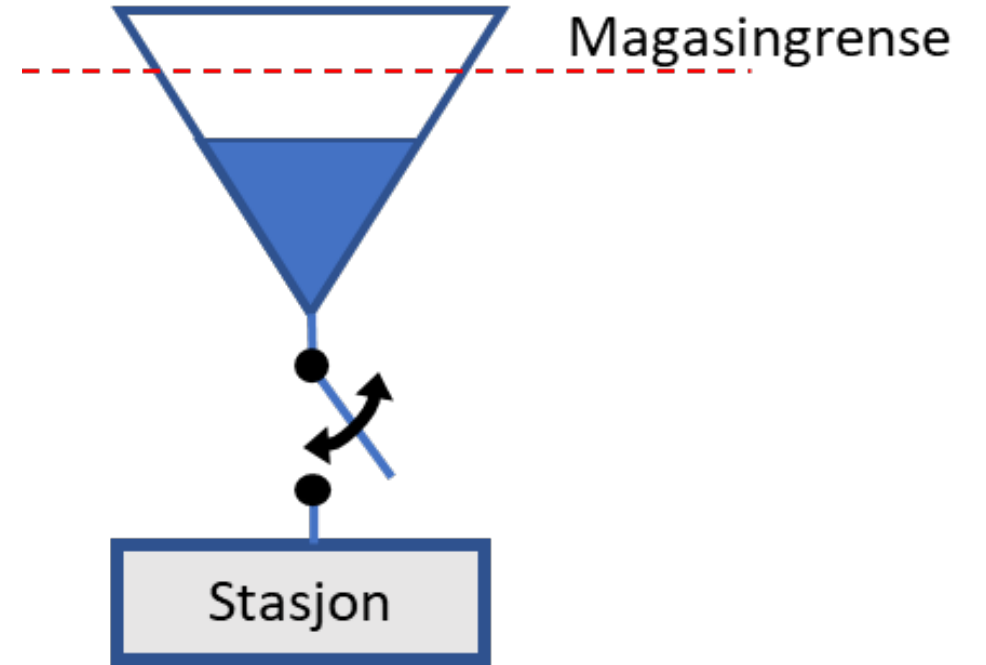
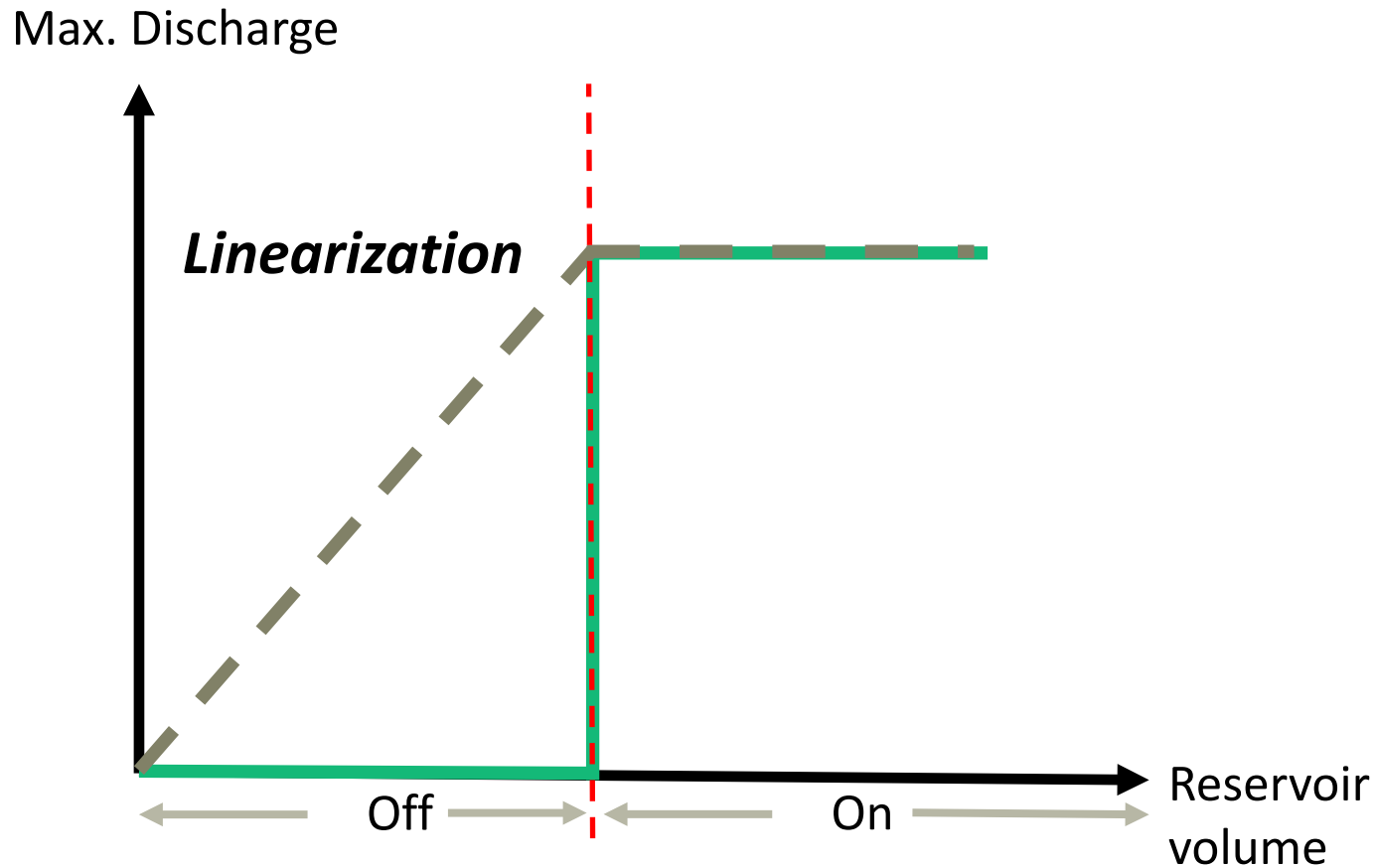
"Stop station" if reservoir is lower than a threshold

Constraint period

- **Static**, e.g, week 20-35
- **Dynamic**, e.g,
 - End of "lavvansperioden"
 - Sum inflow higher than a threshold



Approach – SDDP/ProdRisk prototype

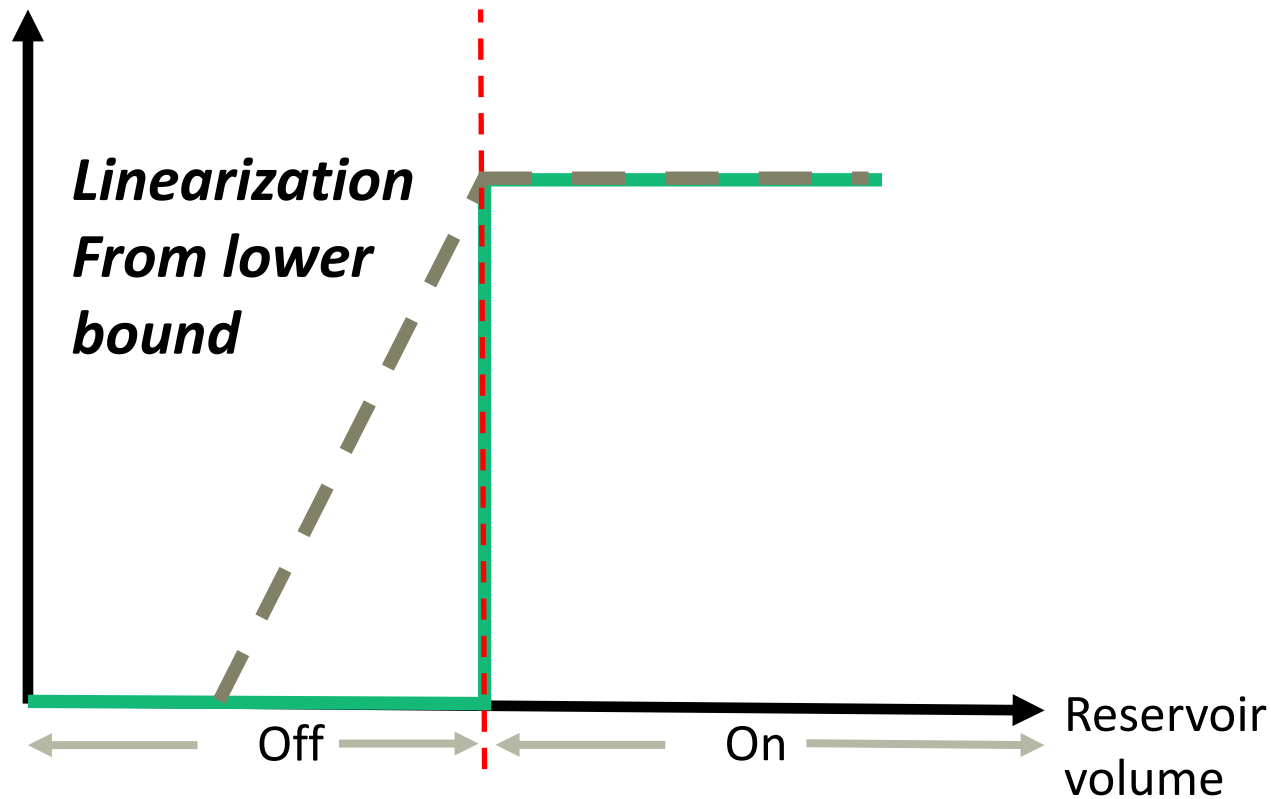




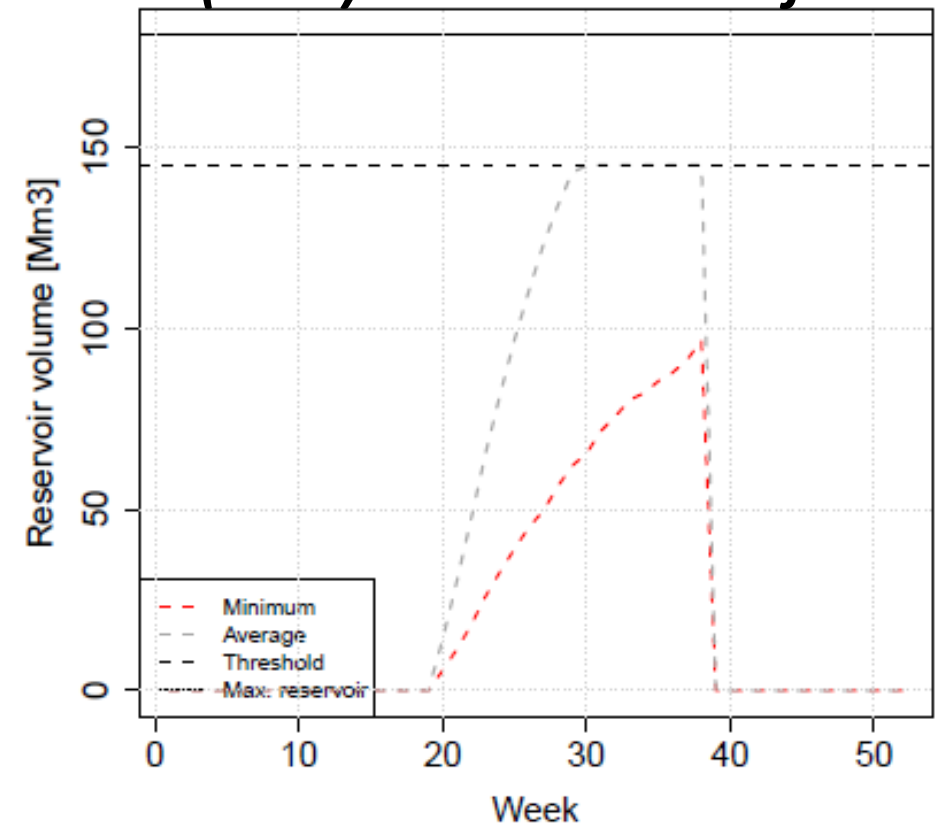
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Approach – SDDP/ProdRisk prototype

Max. Discharge



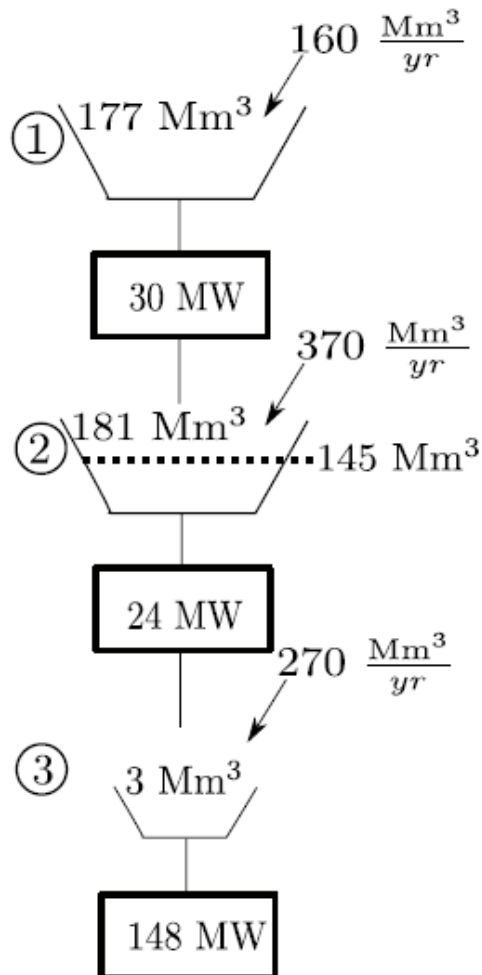
**Lower bound =
(Min.) Accumulated inflow**



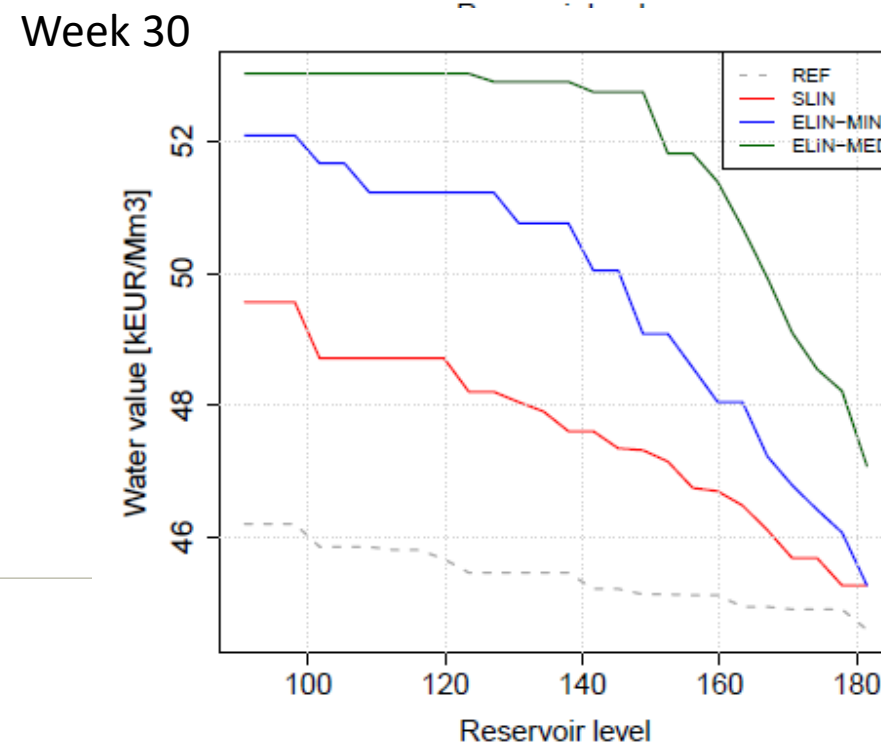
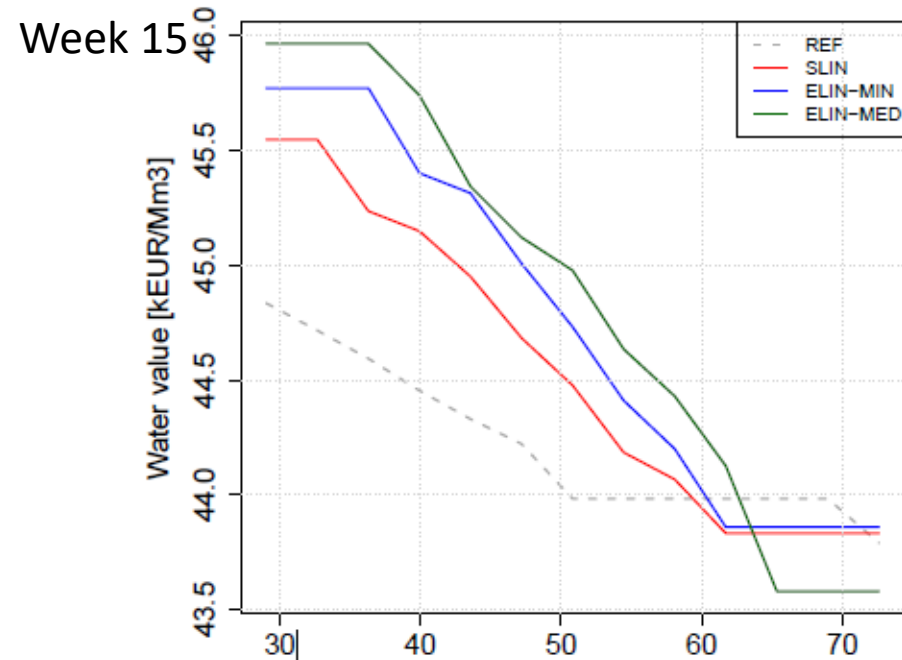
Case #1

Bergsdalen

Concession in brief:
Should meet threshold of 145 Mm³ in constraint period



- ✓ Water values for price scenario with high summer prices (exaggerated)
- ✓ Constraint treatment impacts water values





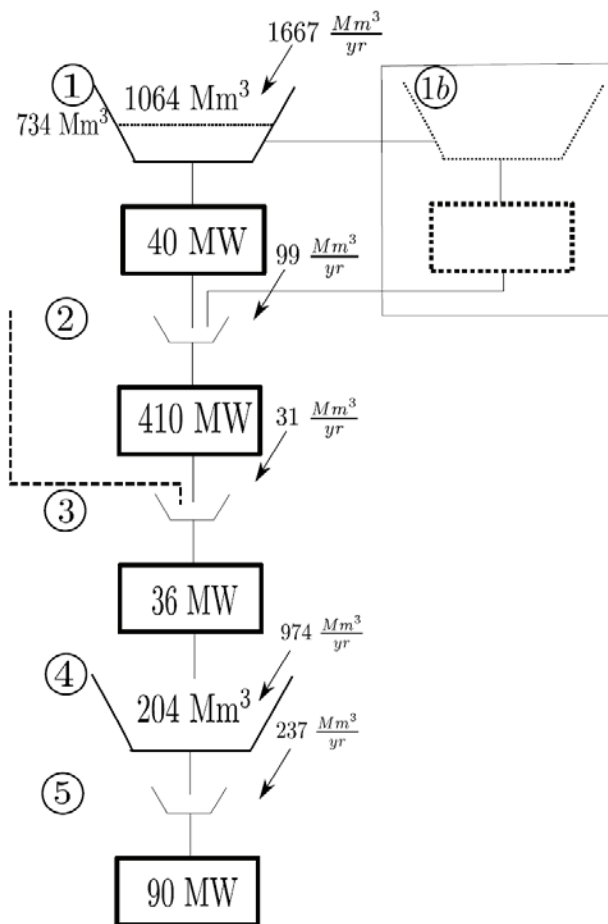
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Case #2

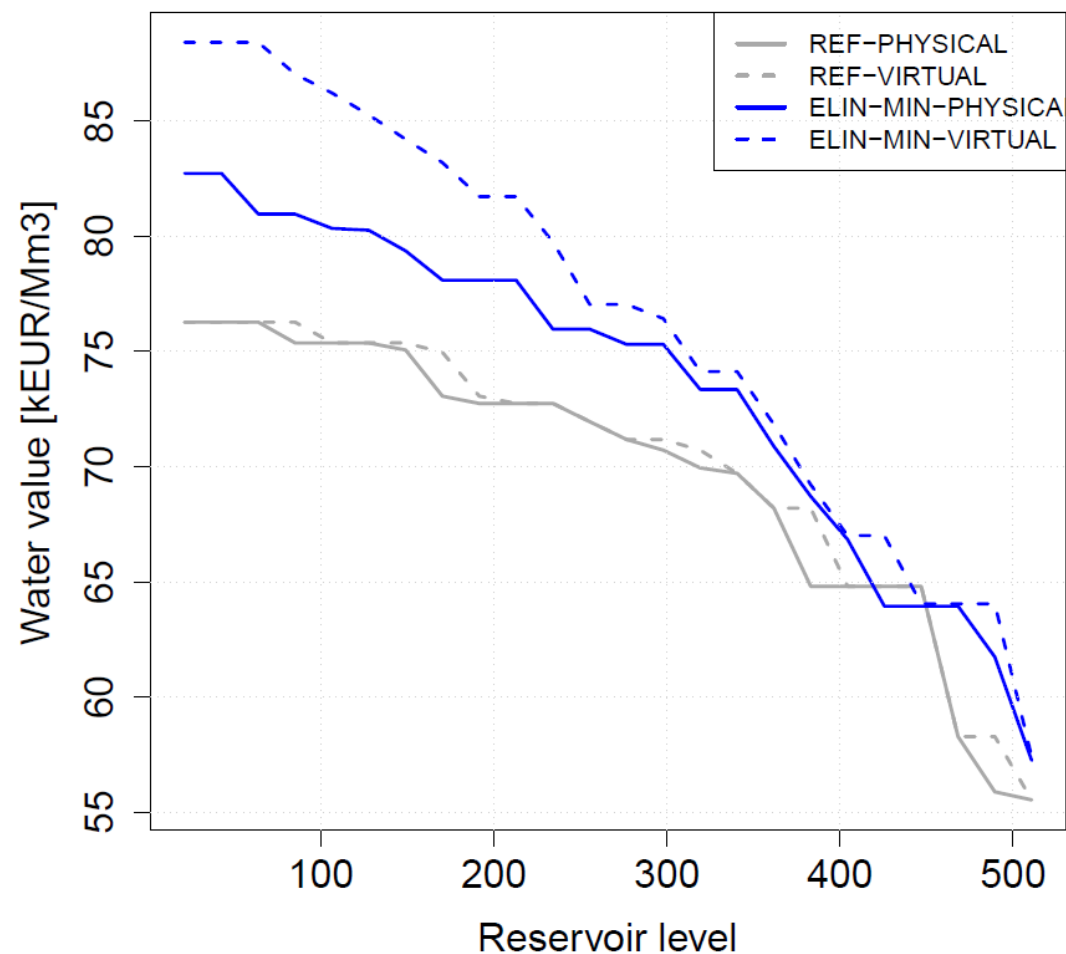
Møsvatn (part)

Concession in brief:

- Should meet threshold of 734 Mm³ in constraint period
- Water stored *before* constraint period can be used more freely



Water values in physical and virtual reservoir differ





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Comments

- Difficult to treat this type of constraint in SDDP/ProdRisk, easier in scenario-based models (Fansi, Sesongmodell, ..)
- Current treatment in ProdRisk often too strict
 - Soft lower reservoir volume bound converted to hard constraint based on mean accumulated inflow
 - Situations with constraint violation → High penalties → High water values
- A ProdRisk prototype based on the described methodology will be further tested
 - Includes sum reservoir constraint to deal with virtual reservoirs
- The project will mainly deal with ramping constraints in SDDP/ProdRisk next year