THE DECISION PROCESS WHEN INVESTING OR REINVESTING IN A HYDROPOWER PLANT

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Motivation behind investments

Why invest in hydropower?
→ Clean, cheap (?) and flexible energy for the future!

The investment decision process
→ At the end it is all about profitability

“Rule No. 1: Never lose money. Rule No. 2: Never forget rule No.1” – Warren Buffett
Main challenges

- Hydropower plants are long-term investments (long lifetimes!)
- Understanding the needs and value potential in future energy systems
- Combining long-term valuation of water and detailed modelling of short-term variations
The importance of short-term variations

**Main drivers:** climate targets and rapidly falling technology costs

**Result:** Power systems with higher shares of unregulated generation
  - Higher variability
  - Higher uncertainty
  - Higher value of adjusting generation to short-term variations

*This will also unlock alternative (and new) flexibility sources that will reduce the variability*

**Implication:**
Detailed operational modelling necessary to evaluate long-term decisions?
Expected profitability

Costs

Income

Technological developments, changing markets, climate conditions

Uncertainties / Opportunities
Main focus has been

- Energy, power, system services (market design)
- Price predictions (fundamental modelling)
- Climatic corrections of inflow patterns (statistics)

Focus in the future

- Energy, partly power
- Price of energy, spot market
- Historical inflow series, varying standard for climatic correction

- Energy, power, system services, other services
- Spot, intraday, reserves, flexibility, frequency support, inertia
- Changing seasonal pattern/melting, intensity of precipitation

Income

Products

Prices

Available water

expected income (optimal operations)
Massive amount of assumptions

Cannot predict the future, only simulate "potential futures"
Why use models?

• To analyse the price impact of ongoing and expected developments we can use fundamental modelling of supply and demand.
• A tool for testing out assumptions and scenarios for the future.
• More detailed operational models can be used to optimise operations considering the constraints in the system
• A correct evaluation of the need for flexibility and the system's potential to provide flexibility
Assumptions on Inflow patterns, climatic trends

Fundamental modelling of demand and supply
- Stochastic
- Large scope
- Aggregated regions
- 3h time intervals

Analyses to evaluate future income: 2030, 2040, 2050

Development of the energy system
- Demand patterns, electrification?
- Generation capacity, shares of wind and solar power?
- Transmission grid?
- Fuel and CO2 prices?
- New flexibility, batteries, demand response?
Assumptions on Inflow patterns, climatic trends

Analyses to evaluate future income: 2030, 2040, 2050

Fundamental modelling of demand and supply

- Stochastic
- Large scope
- Aggregated regions
- 3h time intervals

Power prices

Reflect assumptions about the future system

Operational modelling against an input price series

- Stochastic/deterministic
- Individual hydropower courses
- Detailed modelling of plants
- 3h to minutes
Assumptions on Inflow patterns, climatic trends

Analyses to evaluate future income: 2030, 2040, 2050

Fundamental modelling of demand and supply

Operational modelling towards a price series

Investment scen. 1

Investment scen. 2

Scen. 1

Scen. 2

Scen. 3
The Simulator Concept

Premise is to analyse profitability in future systems:

1. Good long-term strategy
2. Detailed description of short-term operation (physical system)
3. Balance between long-term strategy and short-term operation
Conclusions

• Qualified assumptions are necessary → But are not predictions

• Modelling tools are useful → But never better than we make them

• Short-term variations increasingly important → But long-term assumptions also important

• Potential new products and markets → But best guess is to understand the needs

• There are also risks involved in not investing in new technology
Technology for a better society