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Battery Modelling

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Outline

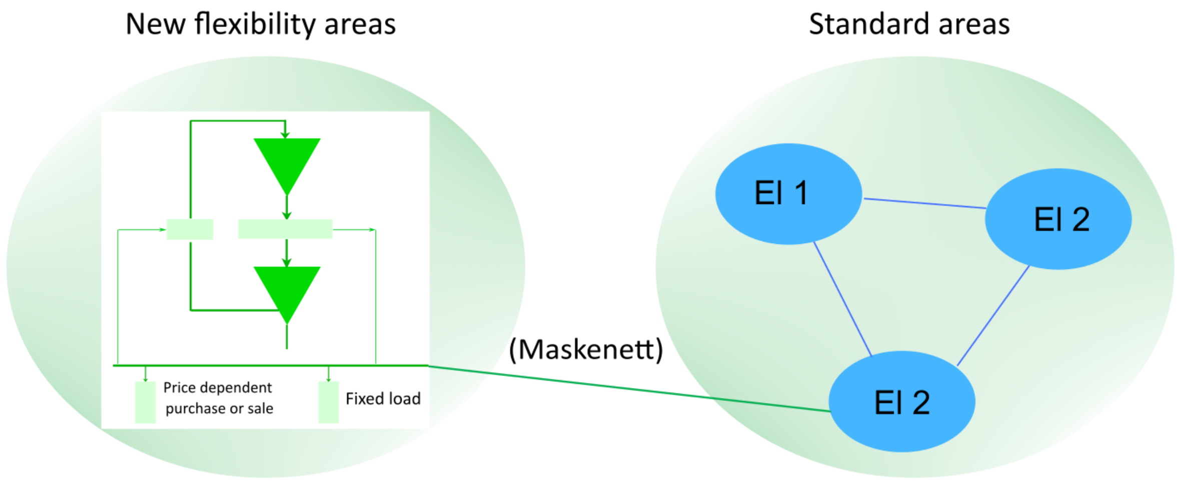
- Background and motivation
- Methodology – details of the EMPS implementation
- Usage
- Results
- Conclusion

Background

- Increasing demand for modelling short term storage
- Challenging in market models due to the combination of short and long time scales
- Implemented in EMPS
  - Market model which treats the hydro optimization through heuristics

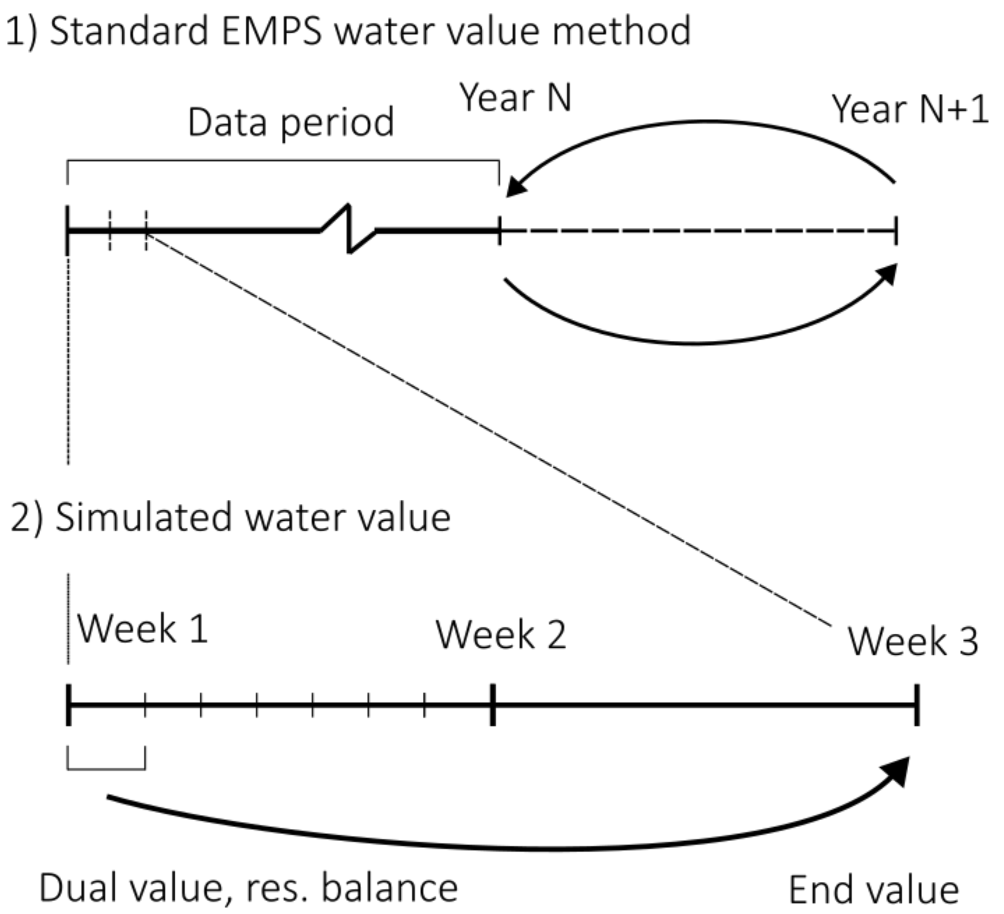
Methodology – Batteries in EMPS

- Model the battery as an aggregated hydro reservoir with a pump
- Reservoir balance constraints down to hourly time resolution
- Parameters of a battery
  - Charging/discharging effect
  - Charging cost
  - End values
  - Charging efficiency
- Loads and market steps



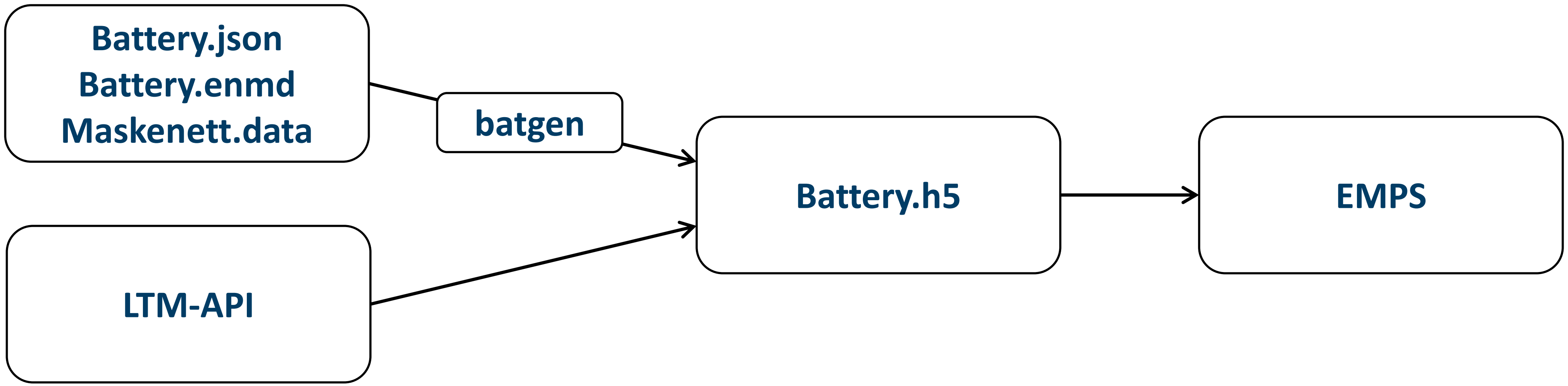
End valuation of energy

- Three options
  1) Standard EMPS water value calculation
  2) Previous week’s simulated water value
  3) Exogenous endvalue
- Time scale of charging/discharging must be considered



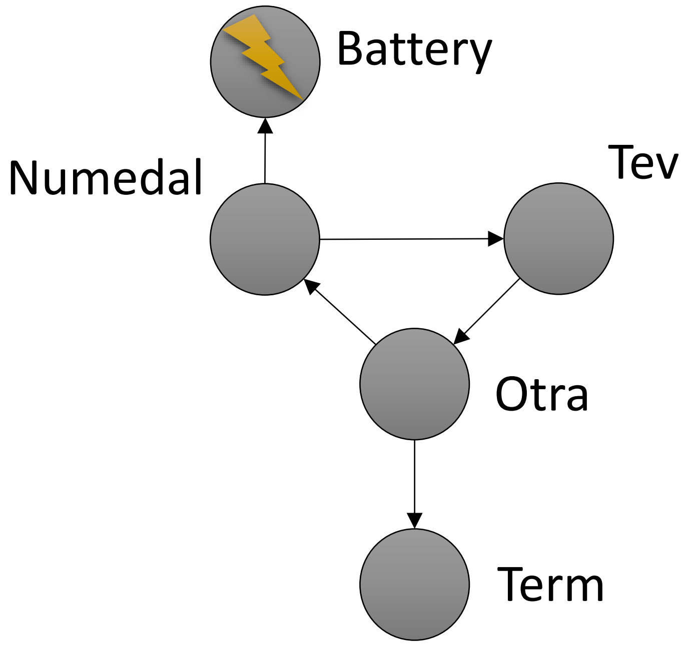
Usage - EMPS

- Introducing a new input file – 'battery.h5'
- 'batgen' -- easily create and edit 'battery.h5'
- LTM-API



Results

- EMPS 4 area dataset
- Battery capacity: 30 GWh
- Charge/discharge time: ~10 hours
- Simulated water values for end valuation
- 50 scenarios, 3 years



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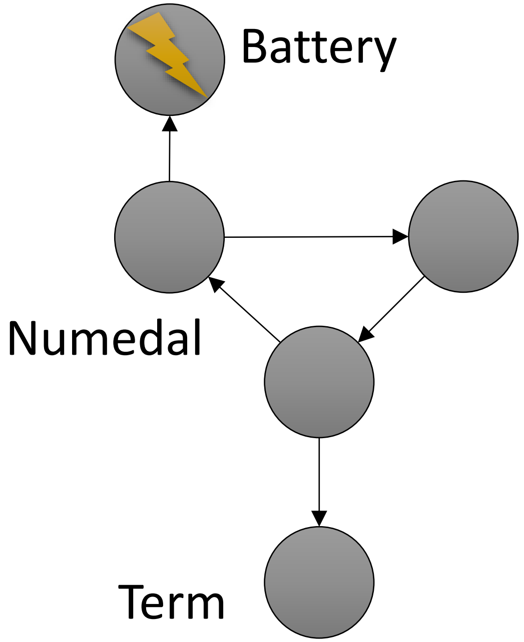
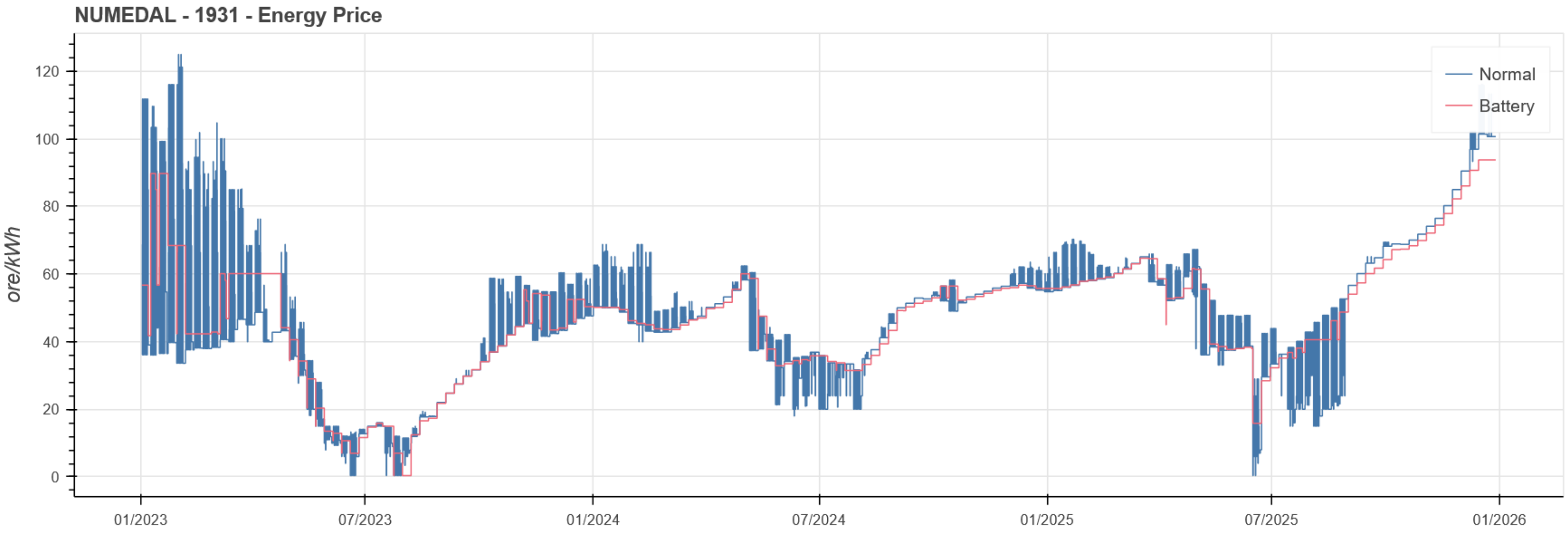
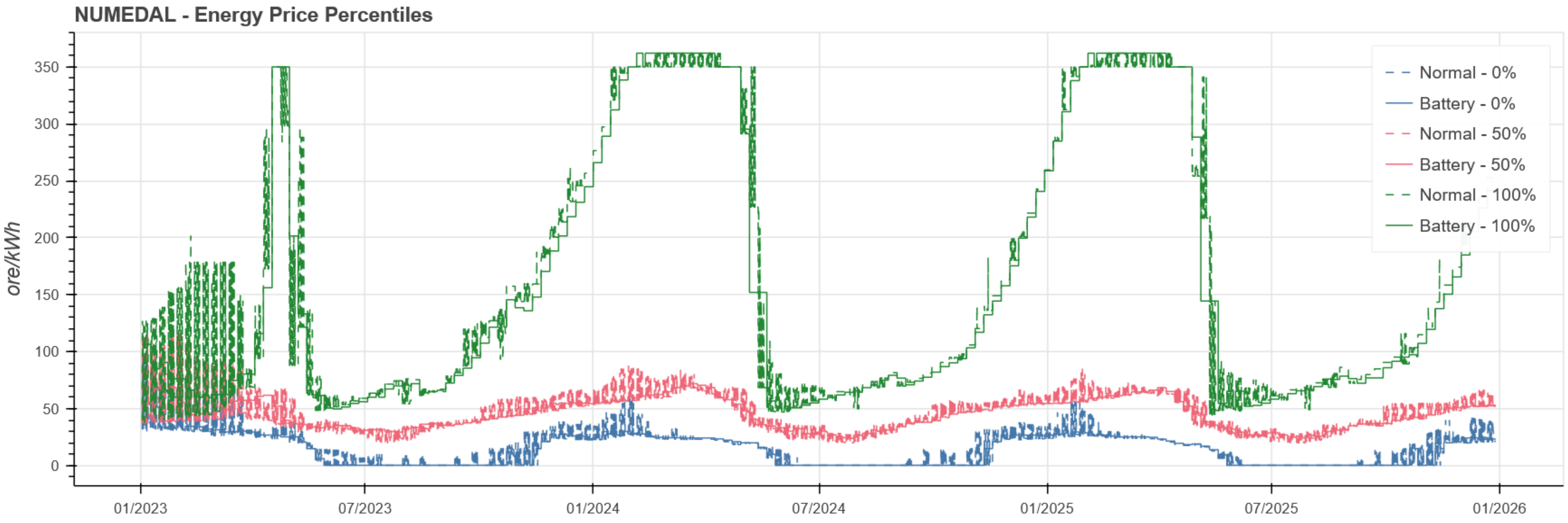


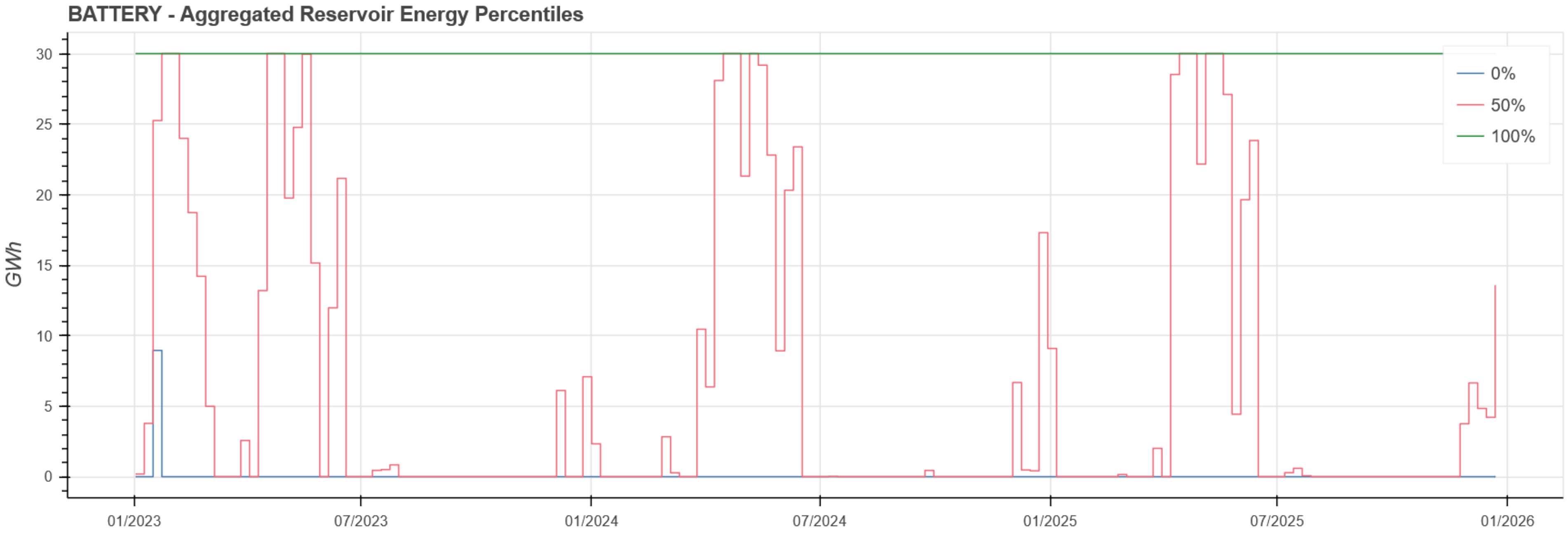
Battery
Numedal
Term

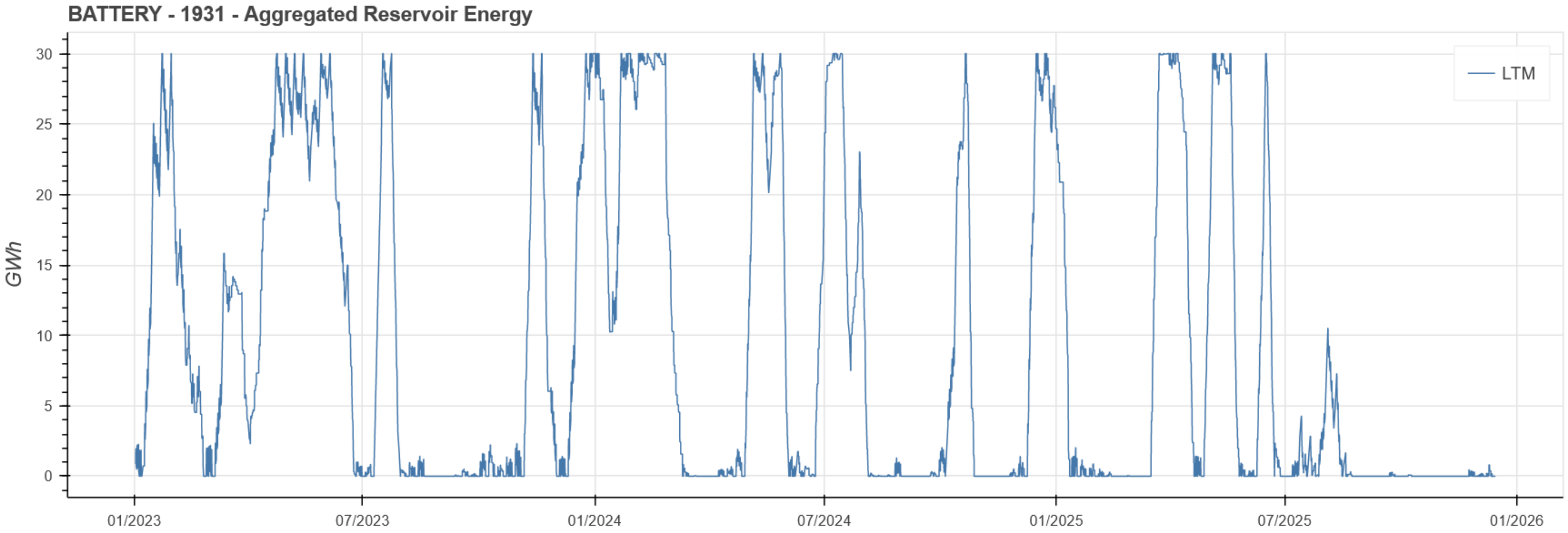


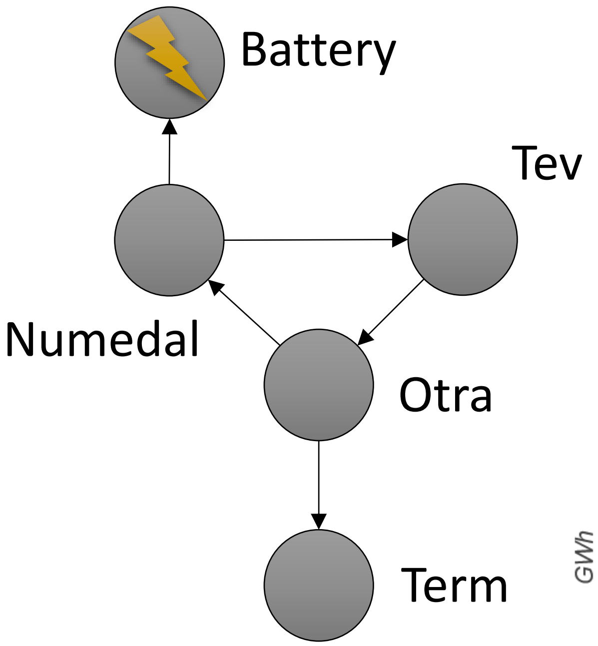
NUMEDAL - 1931 - Energy Price
ore/kWh
0
20
40
60
80
100
120
01/2023
07/2023
01/2024
07/2024
01/2025
07/2025
01/2026
Normal
Battery

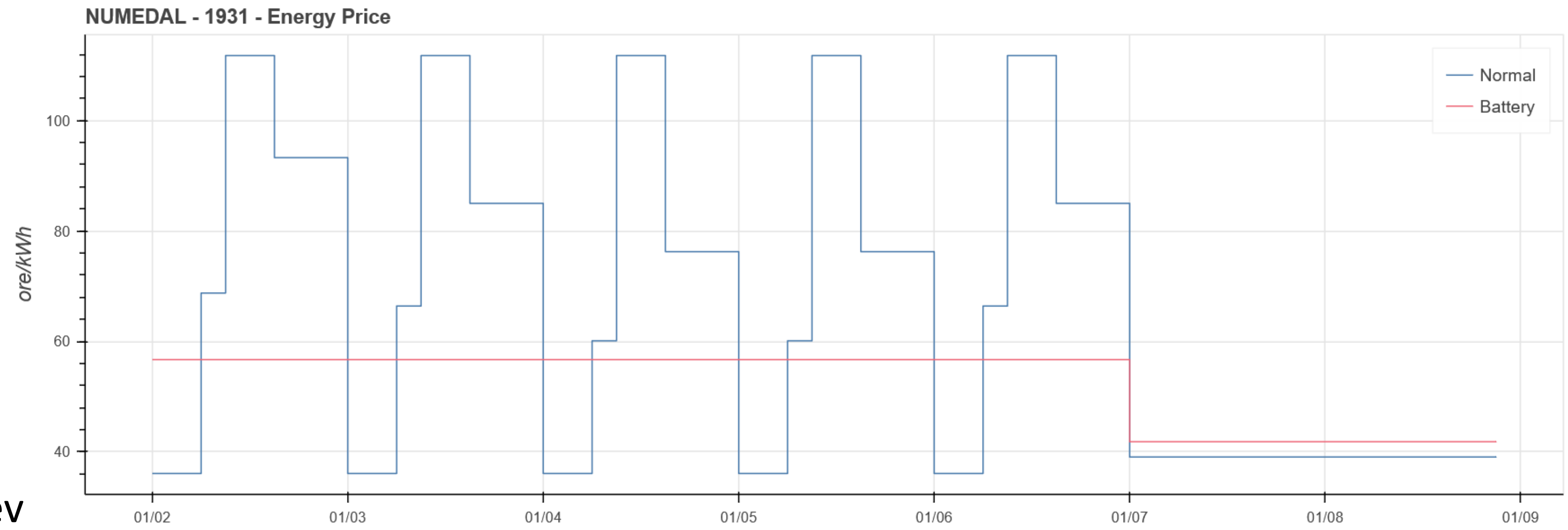


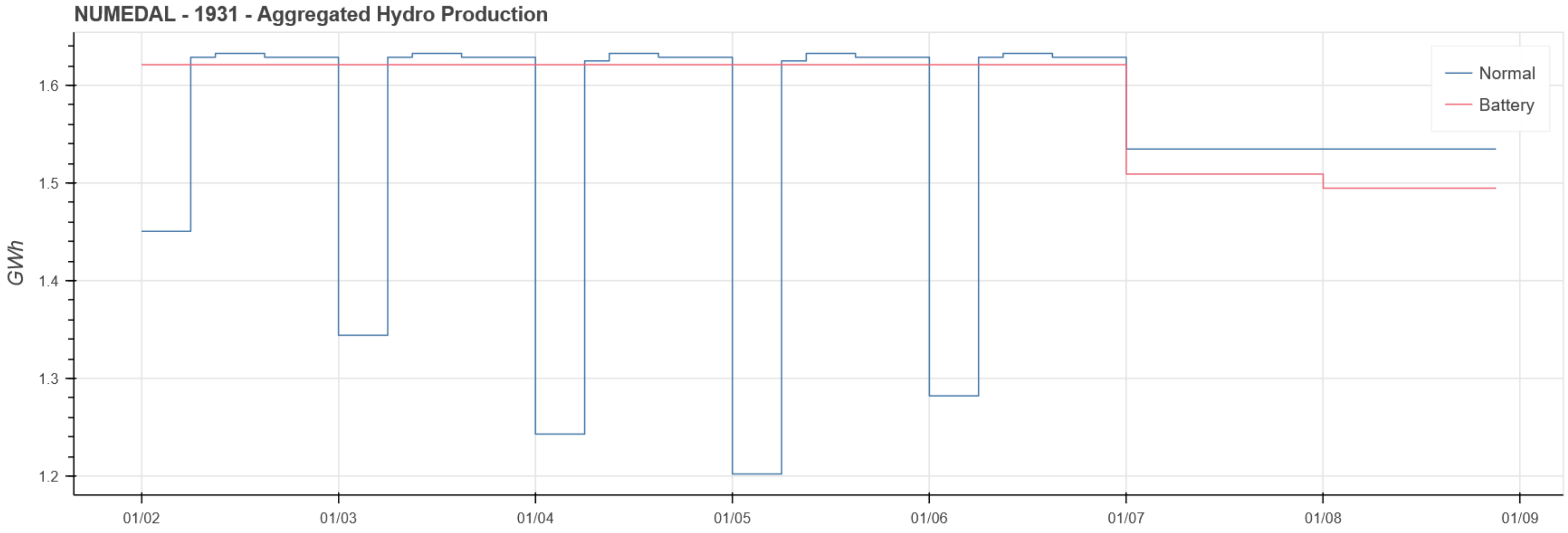
NUMEDAL - Energy Price Percentiles
ore/kWh
0
50
100
150
200
250
300
350
01/2023
07/2023
01/2024
07/2024
01/2025
07/2025
01/2026
Normal - 0%
Battery - 0%
Normal - 50%
Battery - 50%
Normal - 100%
Battery - 100%


BATTERY - Aggregated Reservoir Energy Percentiles
GWh
0%
50%
100%
01/2023
07/2023
01/2024
07/2024
01/2025
07/2025
01/2026


BATTERY - 1931 - Aggregated Reservoir Energy
GWh
LTM
01/2023
07/2023
01/2024
07/2024
01/2025
07/2025
01/2026


Battery
Tev
Numedal
Otra
Term


NUMEDAL - 1931 - Energy Price
ore/kWh
100
80
60
40
01/02
01/03
01/04
01/05
01/06
01/07
01/08
01/09
Normal
Battery


NUMEDAL - 1931 - Aggregated Hydro Production
GWh
1.6
1.5
1.4
1.3
1.2
01/02
01/03
01/04
01/05
01/06
01/07
01/08
01/09
Normal
Battery

Socioeconomic surplus

- Increase in socioeconomic surplus in our datasets
- May decrease if the capacity on the connection to the battery is too low

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Conclusion

- New functionality for modelling short term storage
- Presented two user interfaces
- Desired effect of reduced price volatility
- Increased socioeconomic surplus

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