



SINTEF

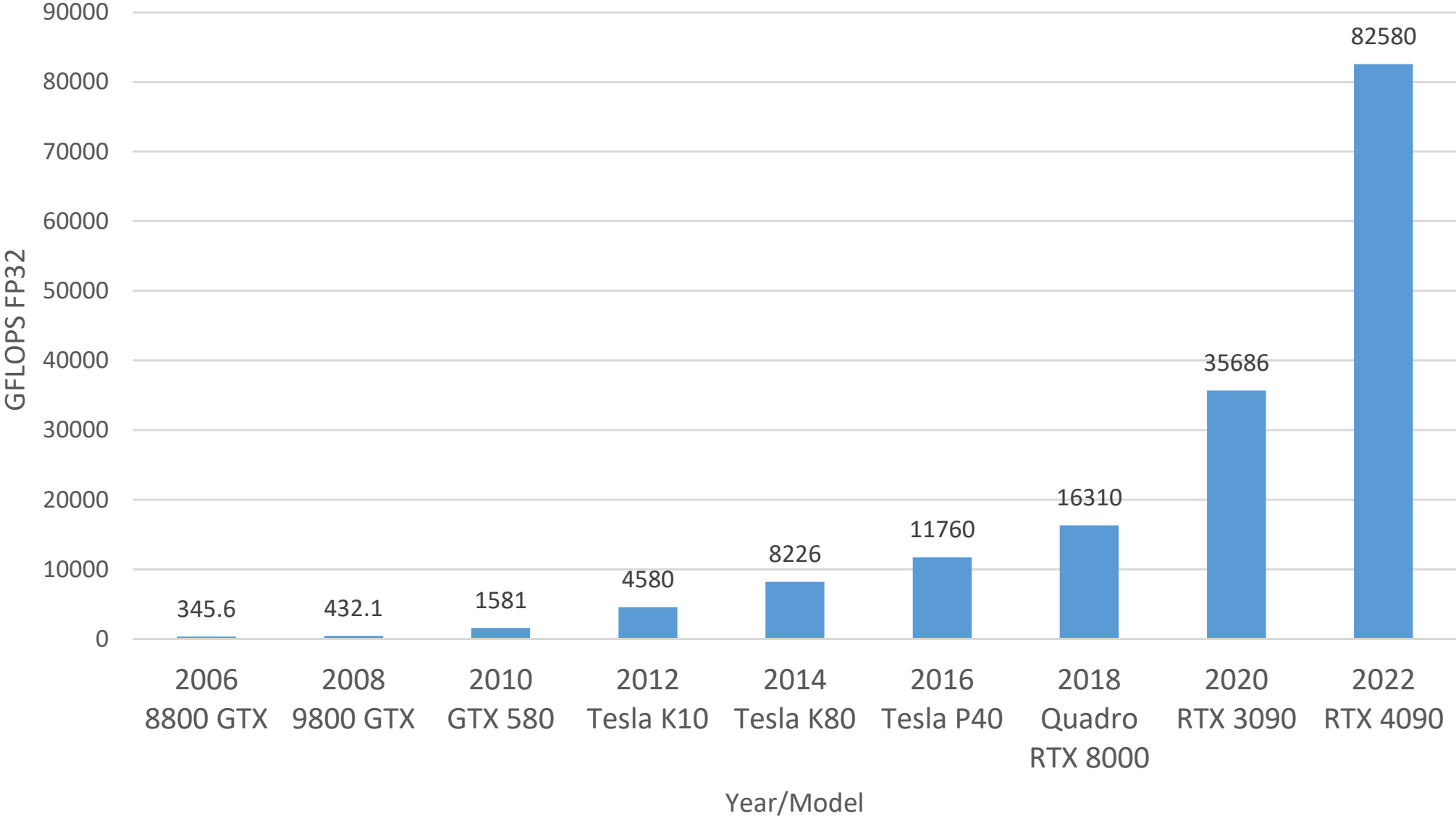


**GoHydro**

Hans Ivar Skjelbred, 28.11.2023  
SINTEF User Meeting, Trondheim

Technology for a better society

# GPU performance development

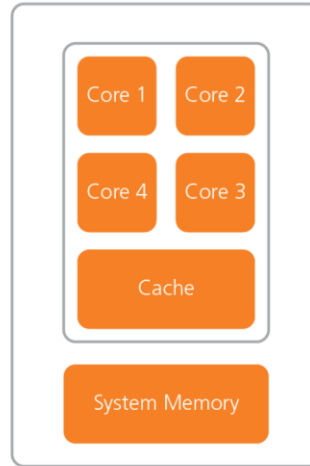




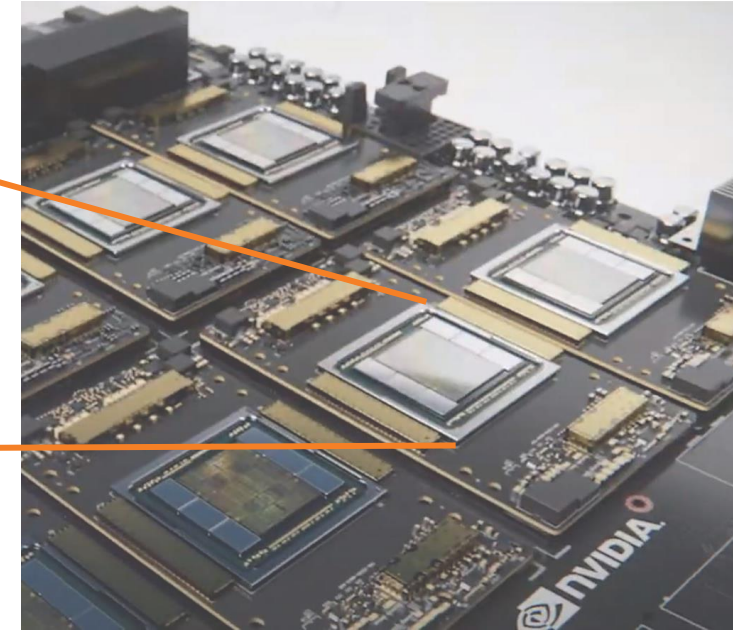
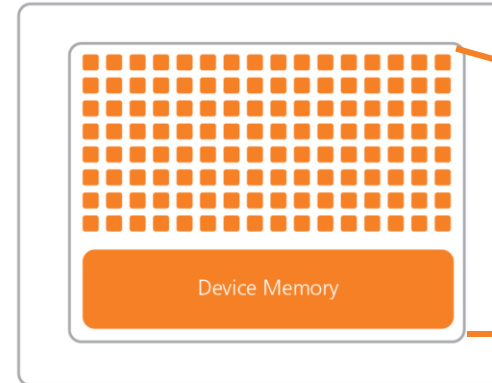
# GoHydro

- >100 000 identical tasks that can be solved in parallel
- Efficient memory addressing

CPU (Multiple Cores)



GPU (Hundreds of Cores)



Parallelize the search for optimum

Maximize the parallelization of the optimization problem

Scalable algorithm for non-linear large-scale optimization problems



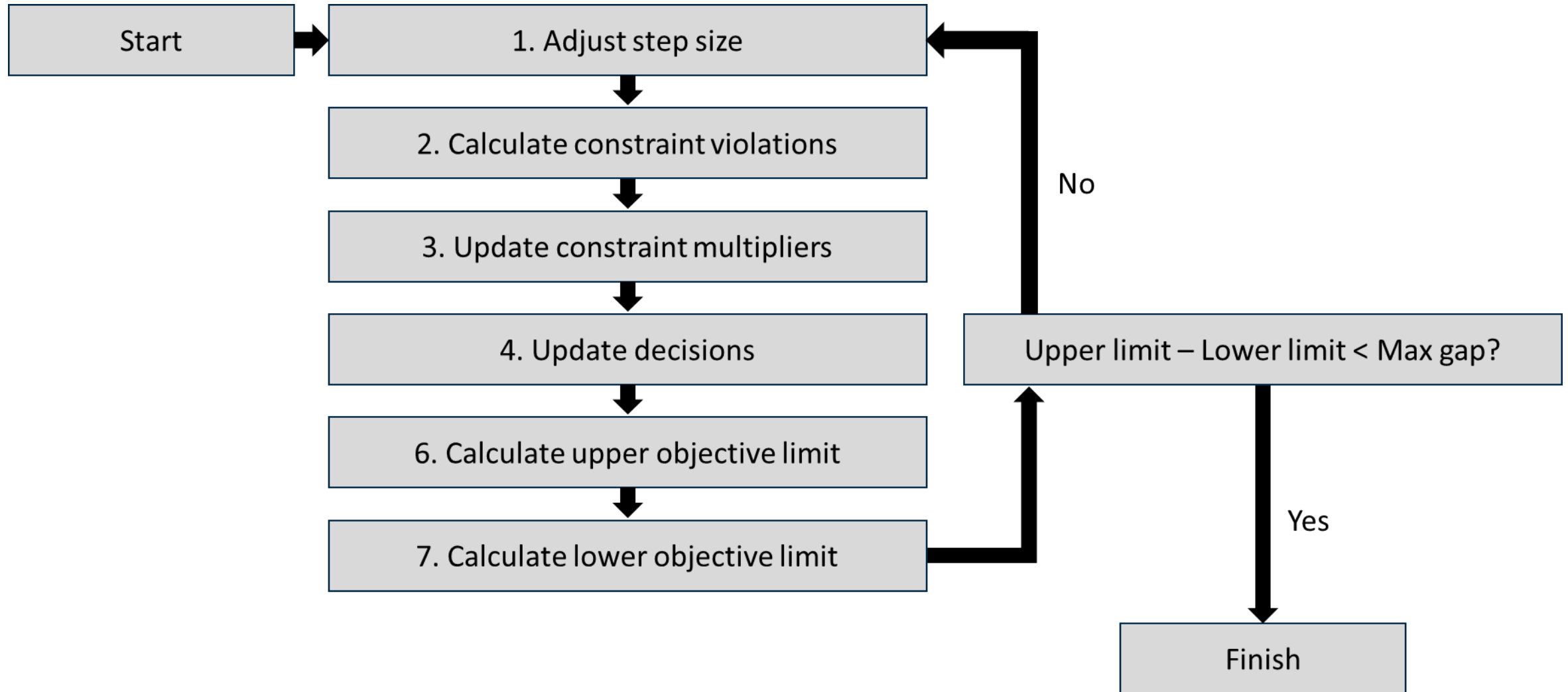
SINTEF

# GoHydro problem formulation

- Next volume = Previous volume + inflow + discharge in – discharge out
- Sum production + power flow in = demand + power flow out
  - => couples all nodes, all watercourses and all other production
  - => decompose by water value and energy price
- => All decisions can be made independently in parallel
- => Need to search for optimal multipliers for relaxed restrictions



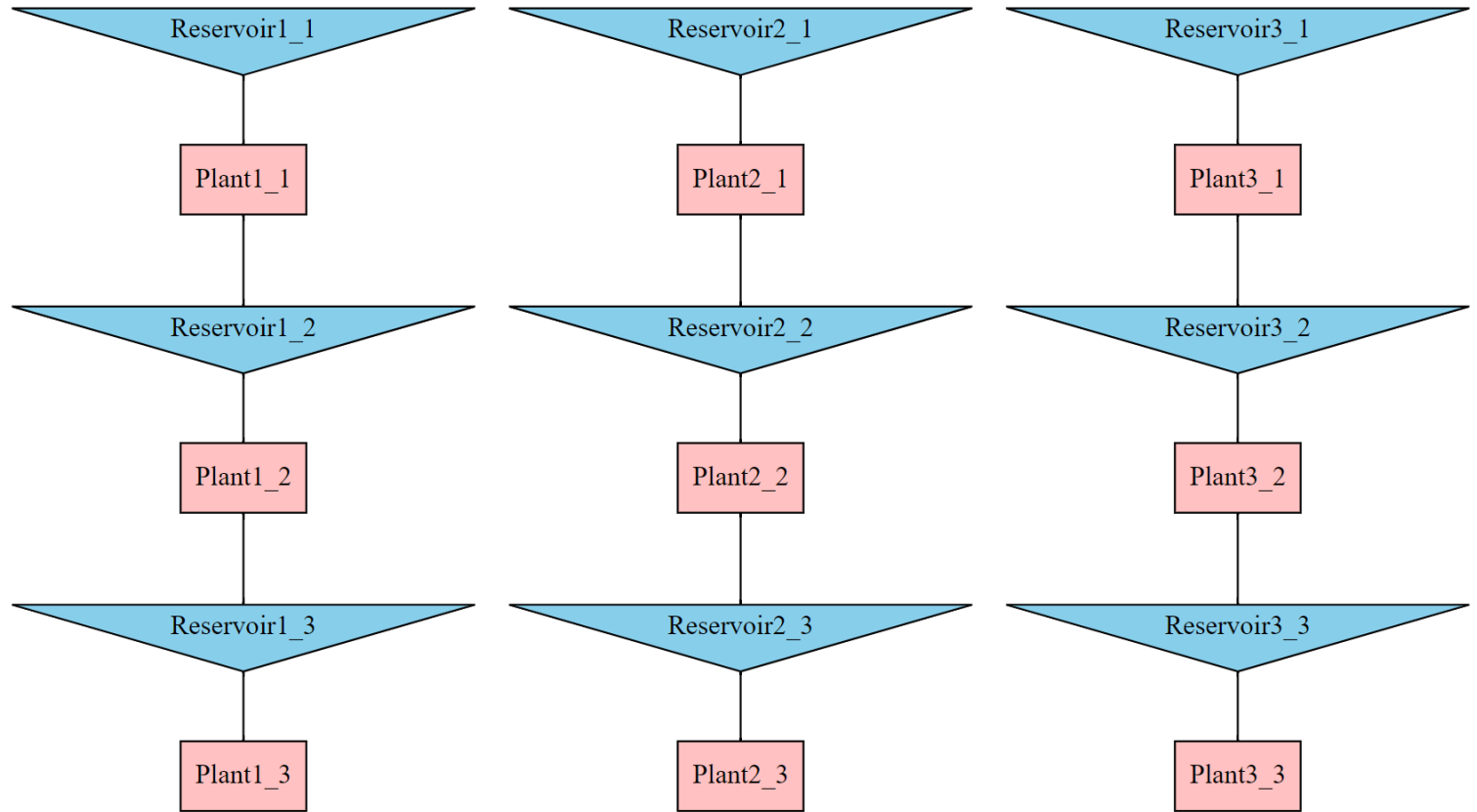
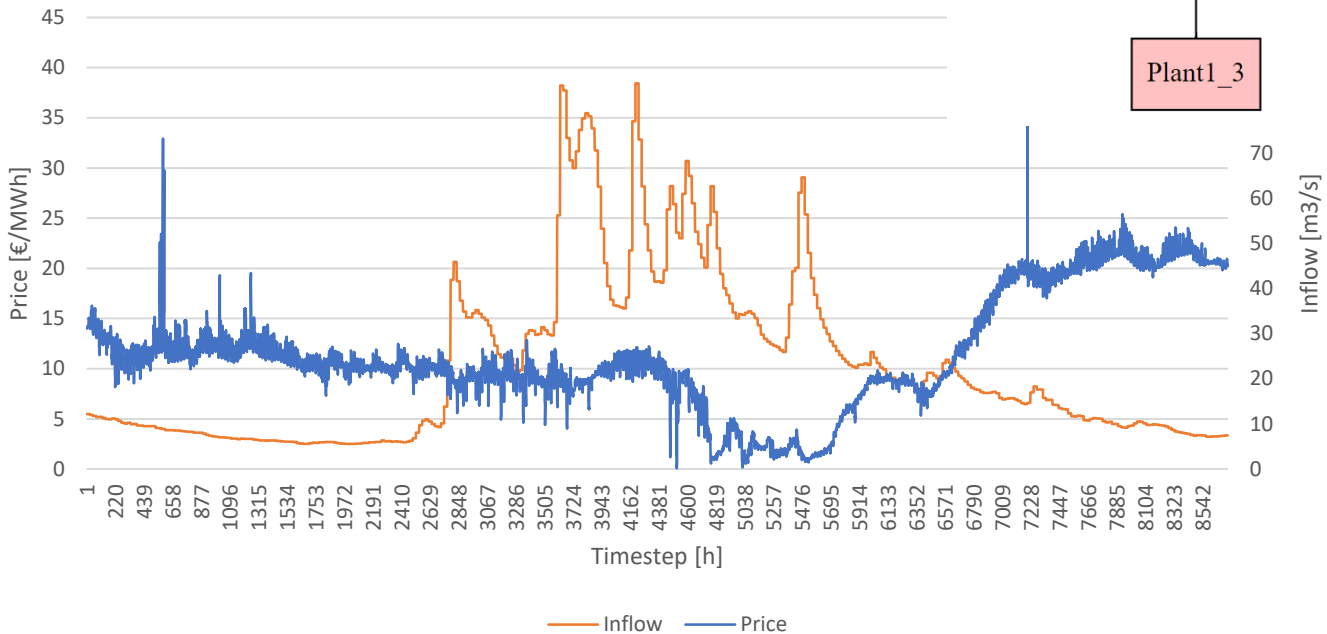
# GoHydro-algorithm





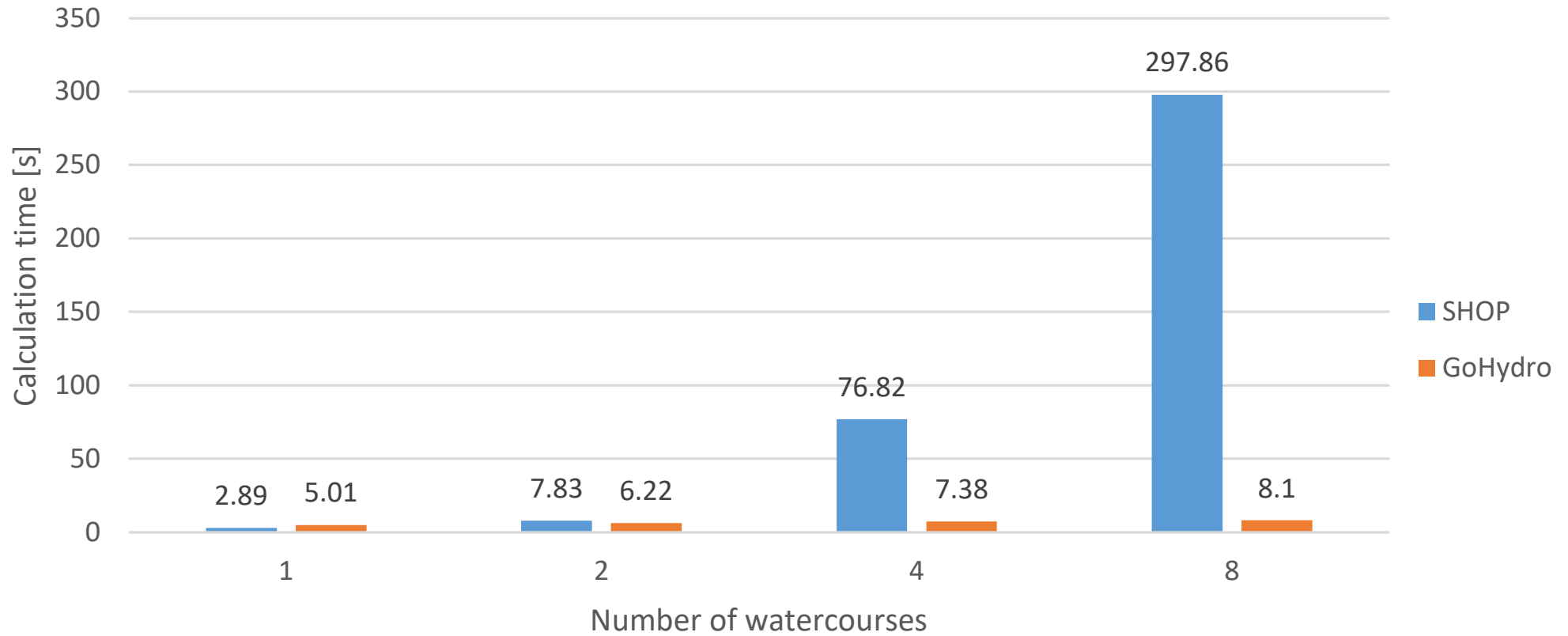
SINTEF

# First phase of GoHydro – proof of concept





# Scaling properties



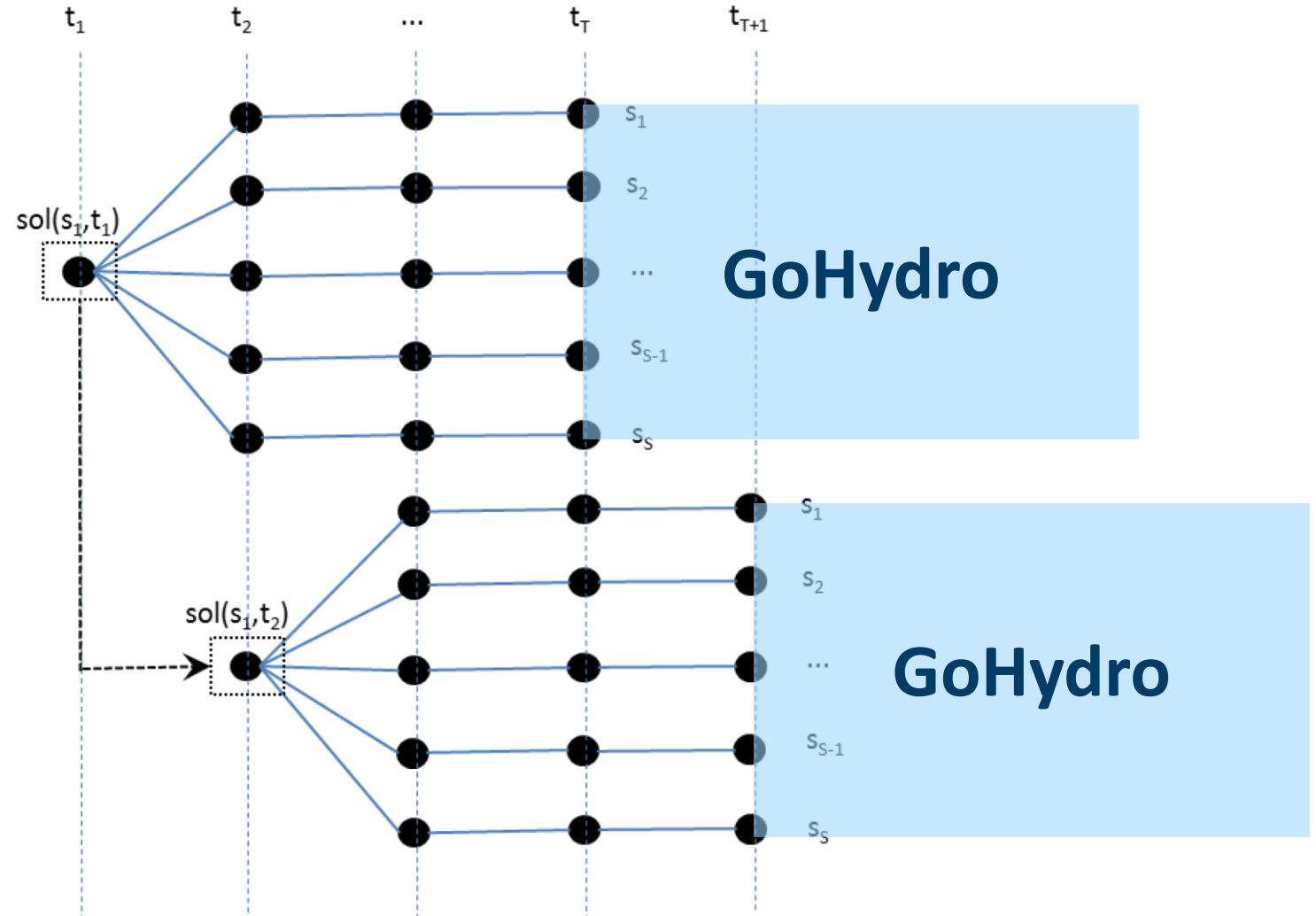
	SHOP		GoHydro				
Size	Time [s]	Objective	Time [s]	Upper bound	Lower bound	Absolute gap	Relative gap
1	2.89	24445209	5.01	24506526	24409086	97440	0.003992
2	7.83	49333248	6.22	49434980	49238424	196556	0.0039919
4	76.82	100389556	7.38	100608464	100210640	397824	0.0039699
8	297.86	207324174	8.1	207688976	207106144	582832	0.0028142



SINTEF

# Current phase of GoHydro – MVP for market modelling

- Use GoHydro to calculate water values systematically
- Test cuts generated from GoHydro as end value in other models
  - SHOP
  - ngLTM
- Deliver MVP for Market modelling

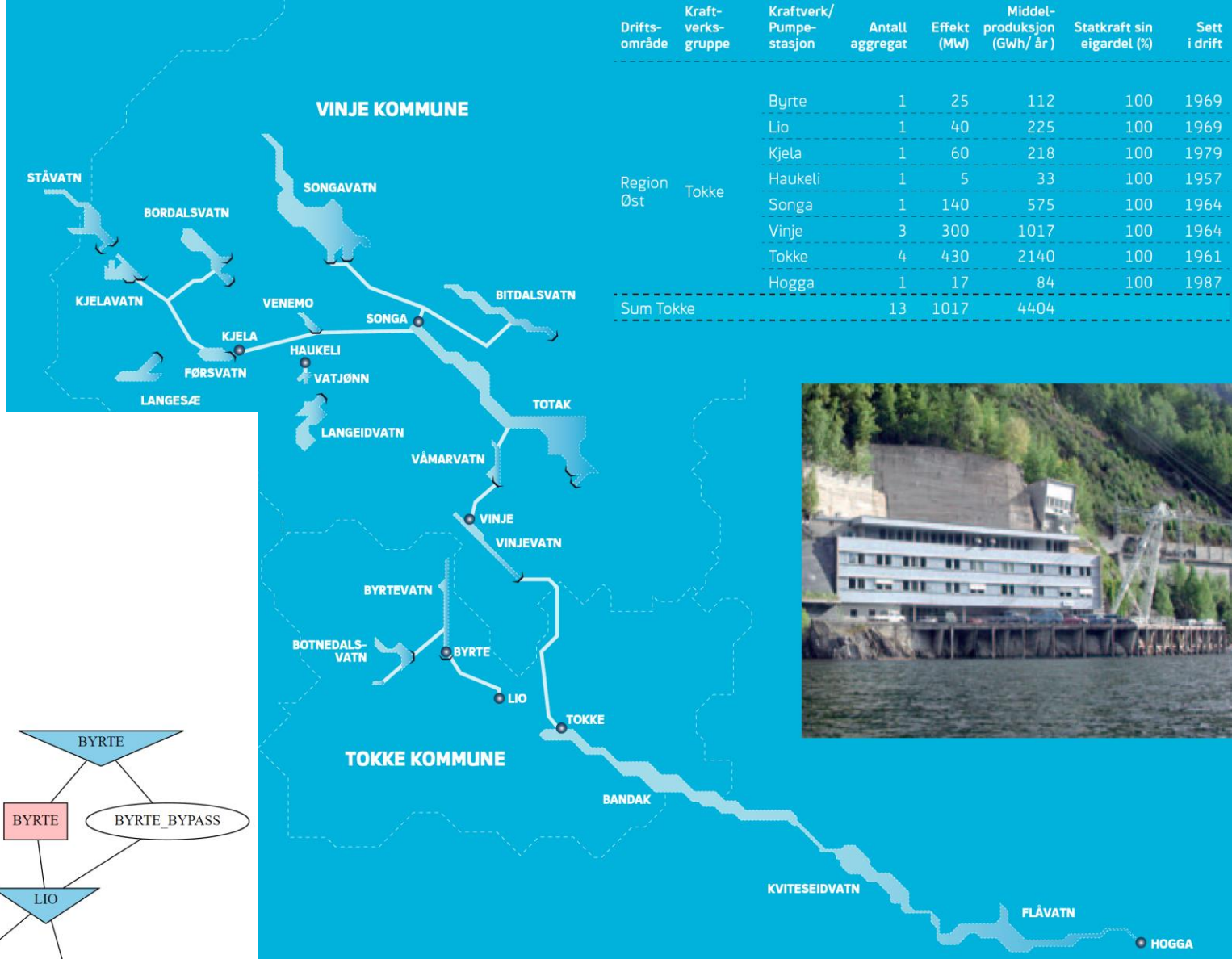
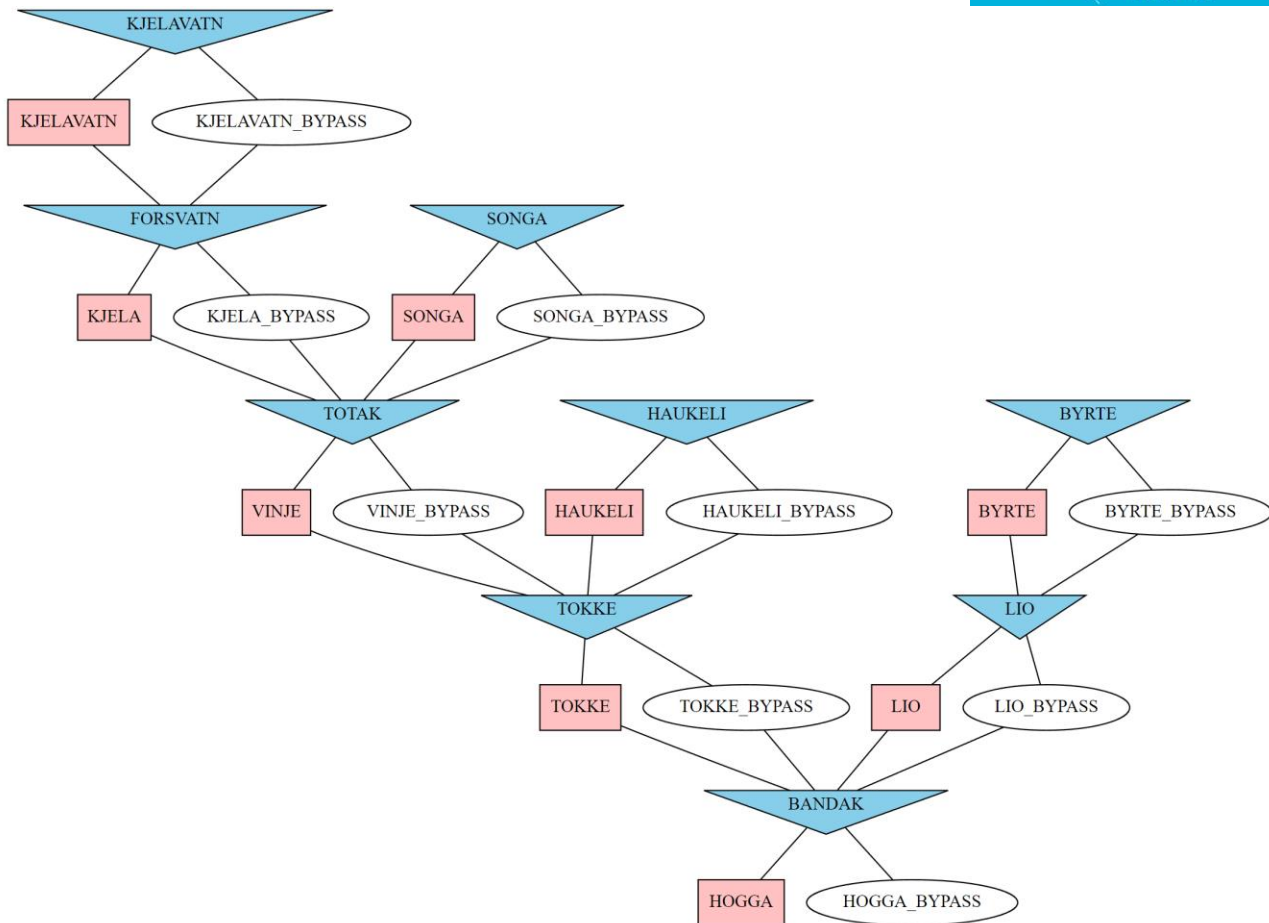






SINTEF

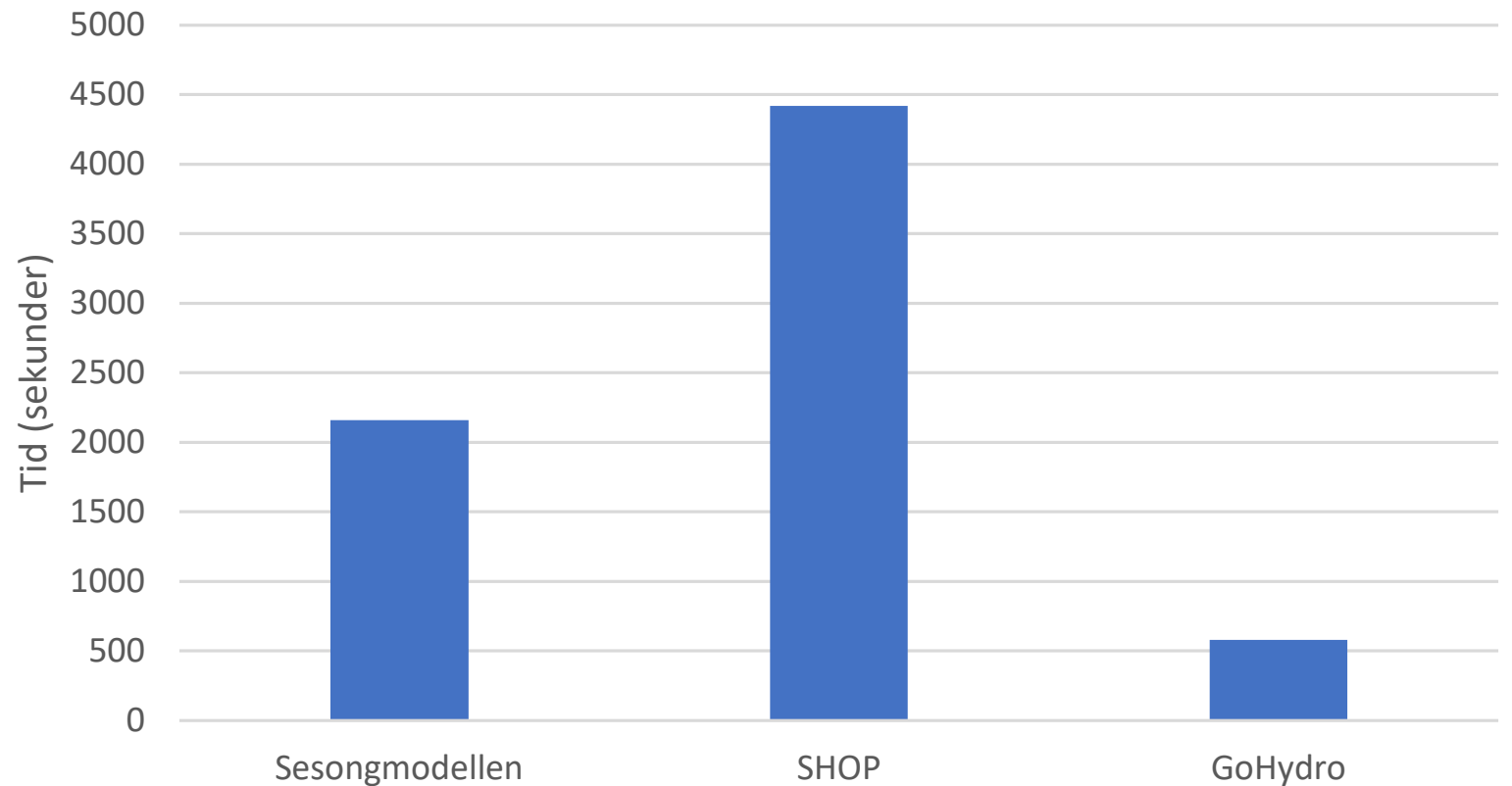
# Topology





# Case overview and calculation time

- Hentet fra mai 2022
- 88 scenario
- 56 prisavsnitt
- 242 uker
- 25% fylling i start
- 50% fylling i slutt

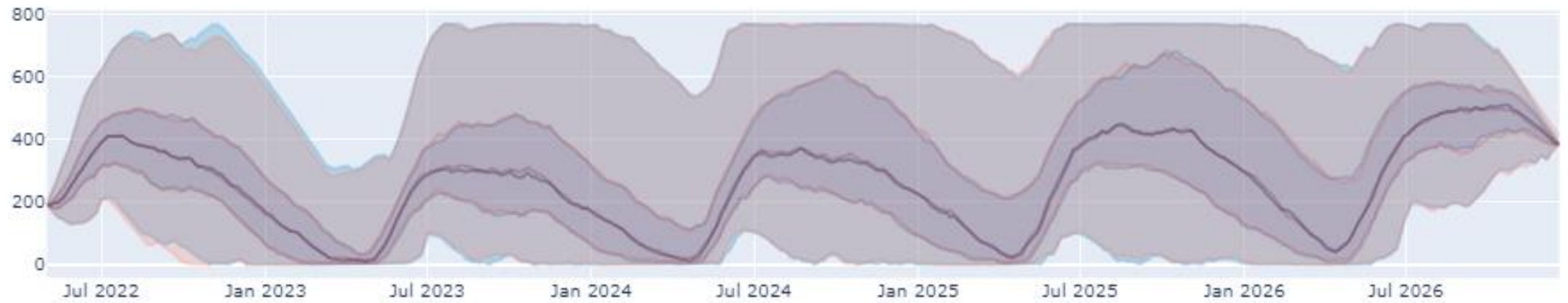




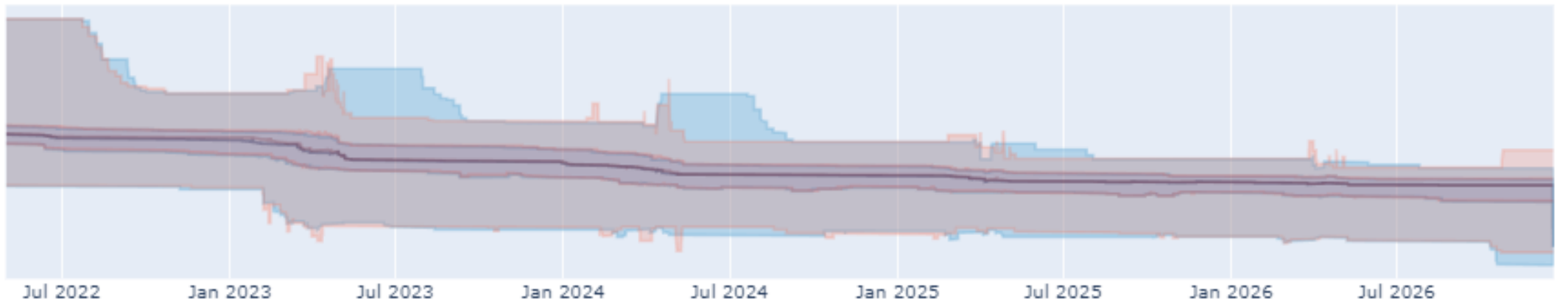
# Results – Songa

blue=sesmod/shop, red=gohydro

Storage



Water value





SINTEF

# Results – Haukeli

blue=sesmod/shop, red=gohydro

Storage



Water value



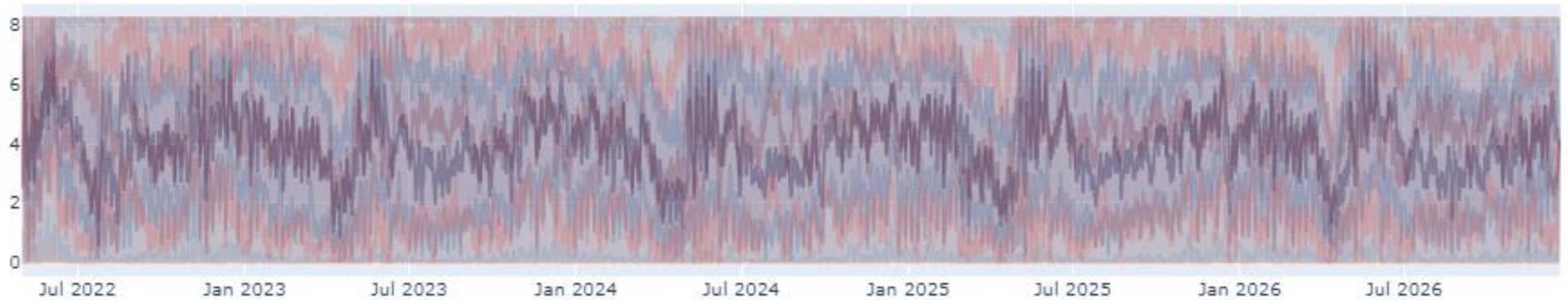




# Results – Tokke

blue=sesmod/shop, red=gohydro

Storage



Water value





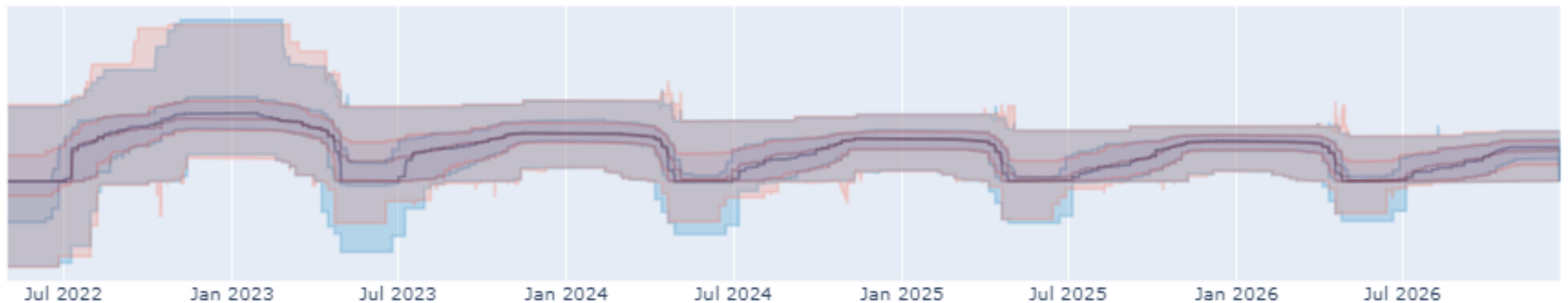
# Results – Byrte

blue=sesmod/shop, red=gohydro

Storage



Water value

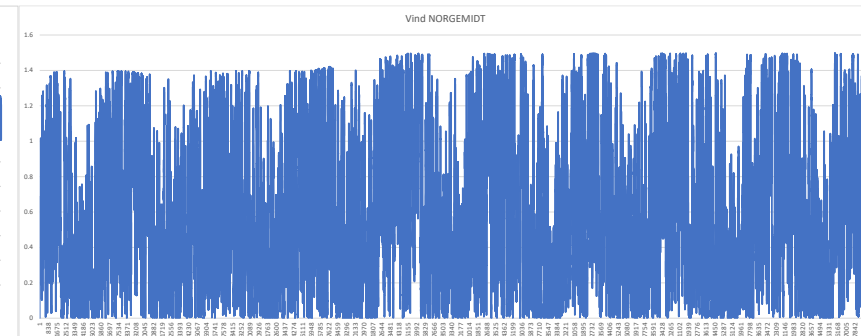
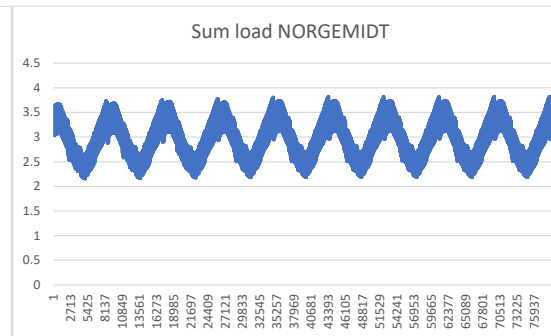
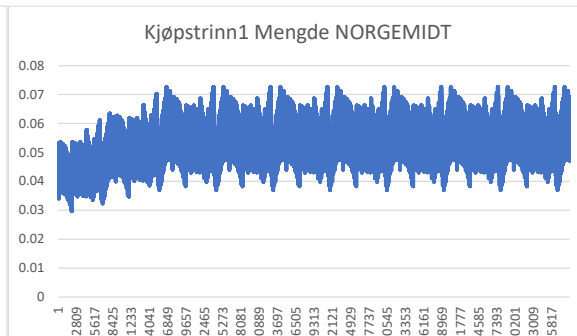
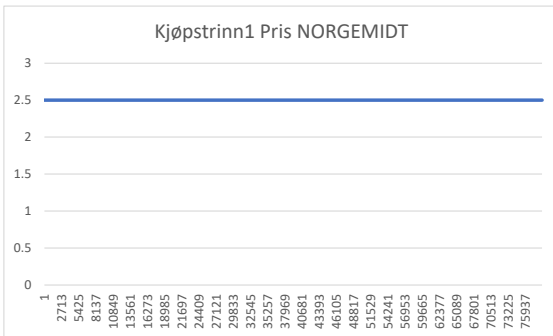
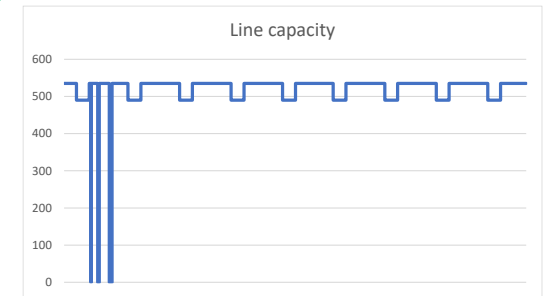
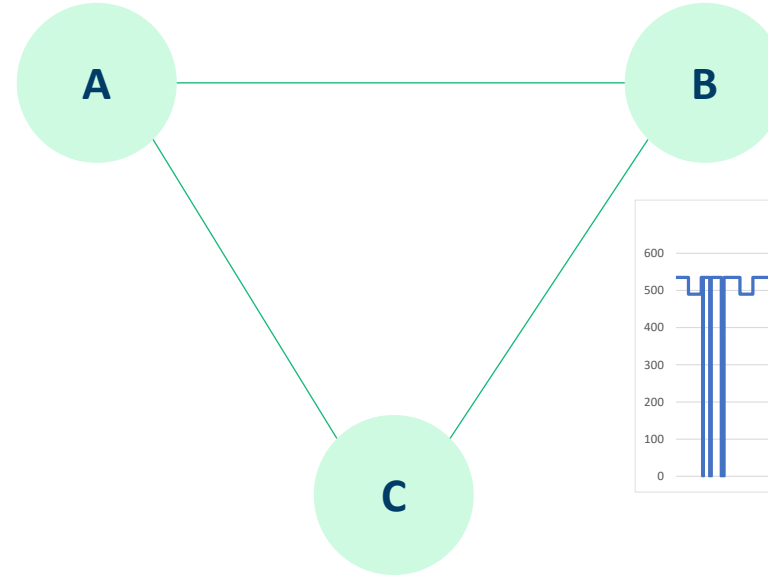
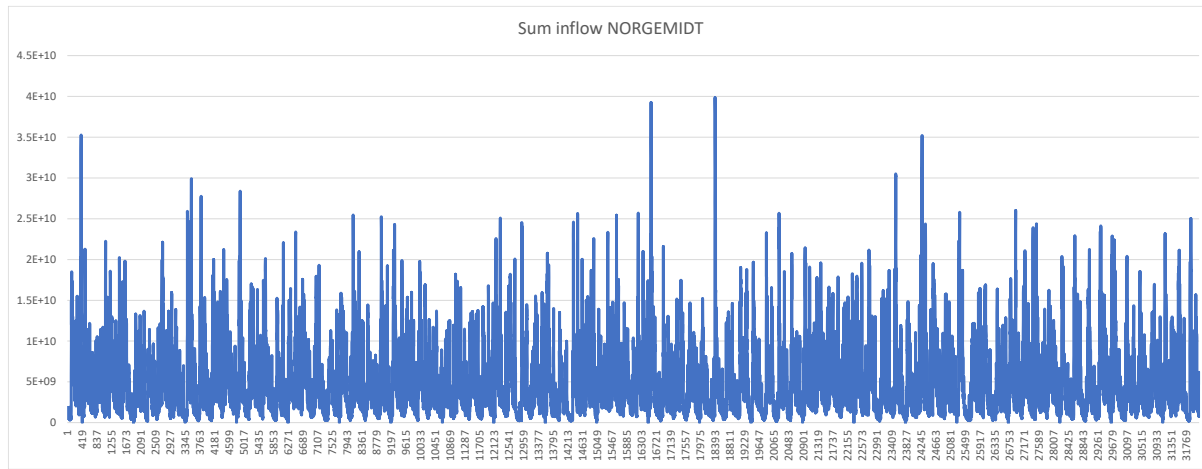




# Modelling EMPS-dataset, 29 areas, 5 years, 3-hour resolution, 88 years history

Aggregated hydro  
Wind and Load  
Price/Volume Purchase/Sale

Detailed hydro  
Wind and Load  
Price/Volume Purchase/Sale

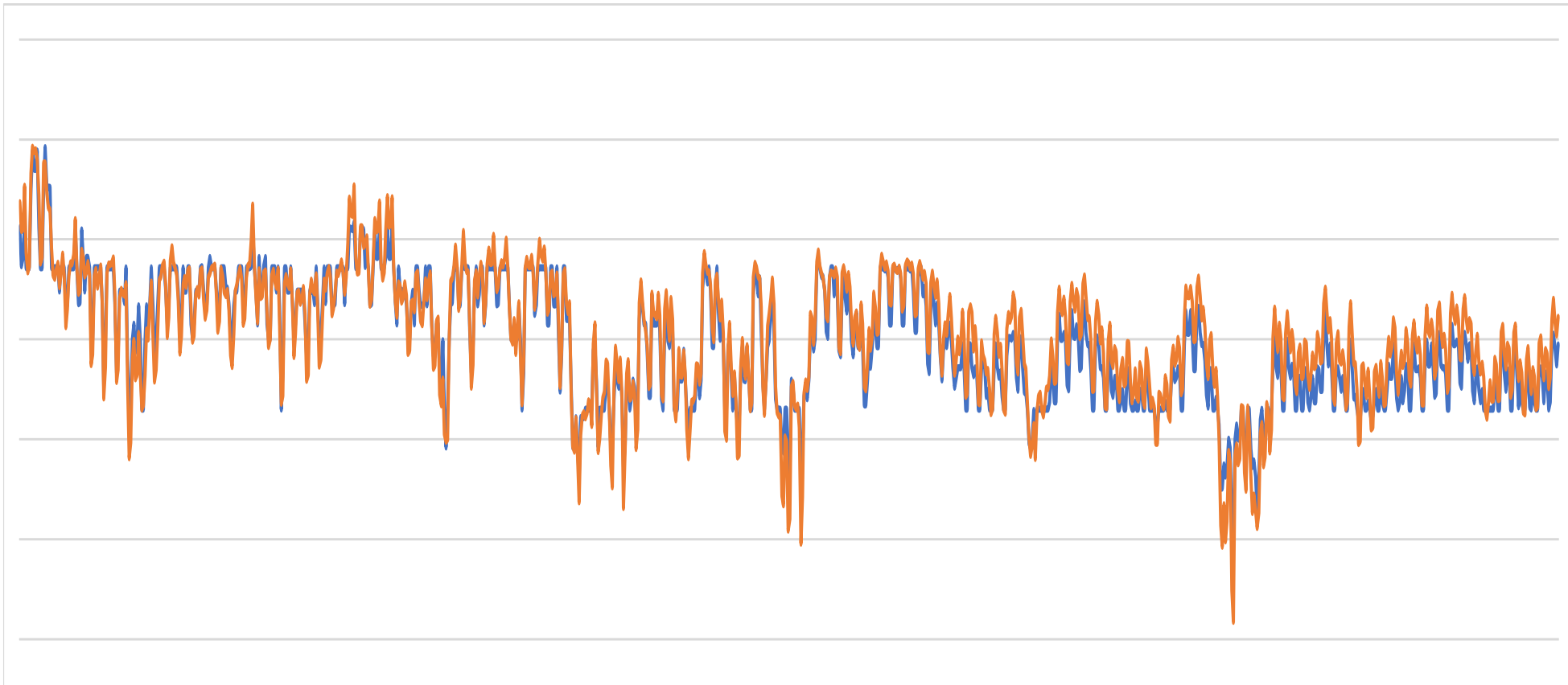




SINTEF

# Price calculation example (single scenario)

Blue = SHOP, Orange = GoHydro



- Calculation time SHOP 489 s
- Calculation time GoHydro 21 s





SINTEF

Teknologi for et  
bedre samfunn