Short-term scheduling models

New functionality and research projects

Hans Ivar Skjelbred
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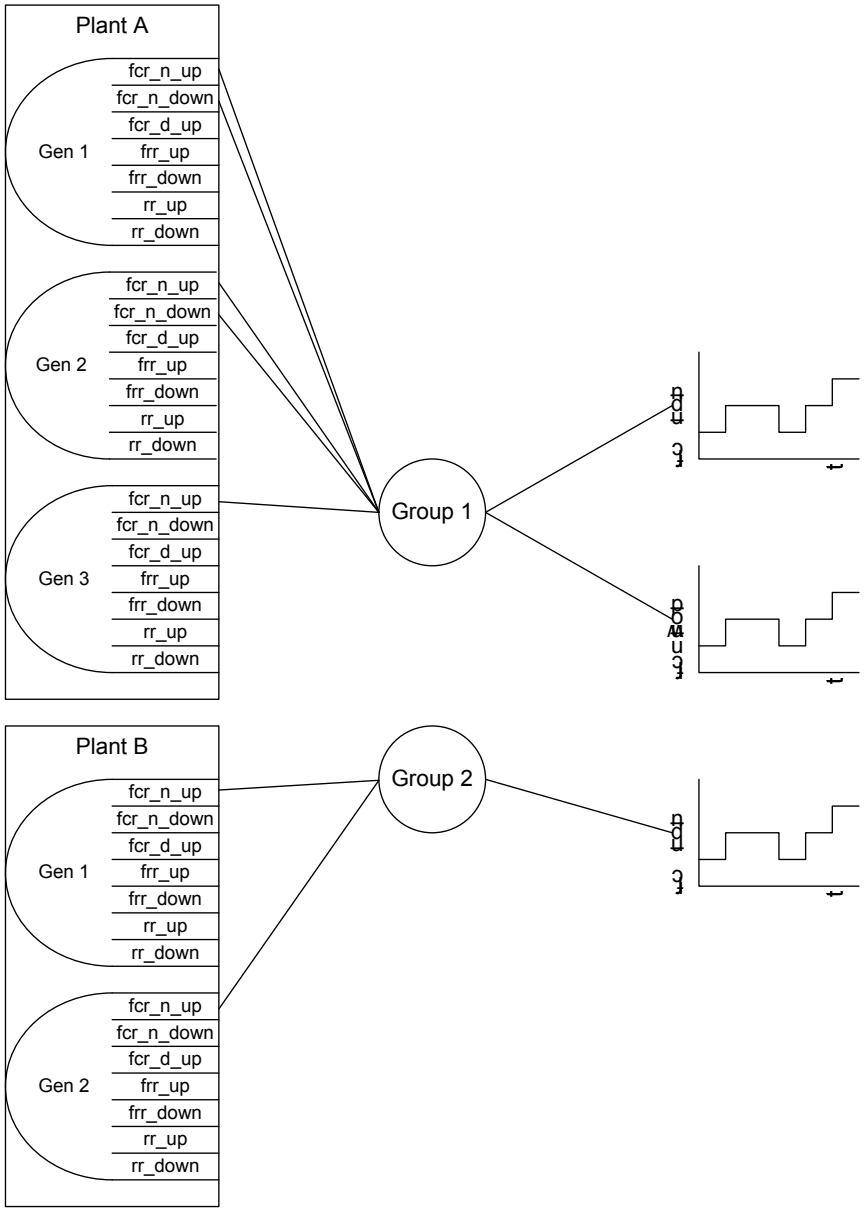
New functionality

- Stochastic short-term model SHARM (**separate presentations**)
- Simulation / API (**separate presentation**)
- Plant discharge cost curve
- Tailrace loss including bypass
- Intake loss including bypass
- Stop cost
- **Reserve groups**
- **Commit groups**
- **Alternative solvers / MIP tuning**
- **Mixing cuts and individual water values**
- **Pressure points**

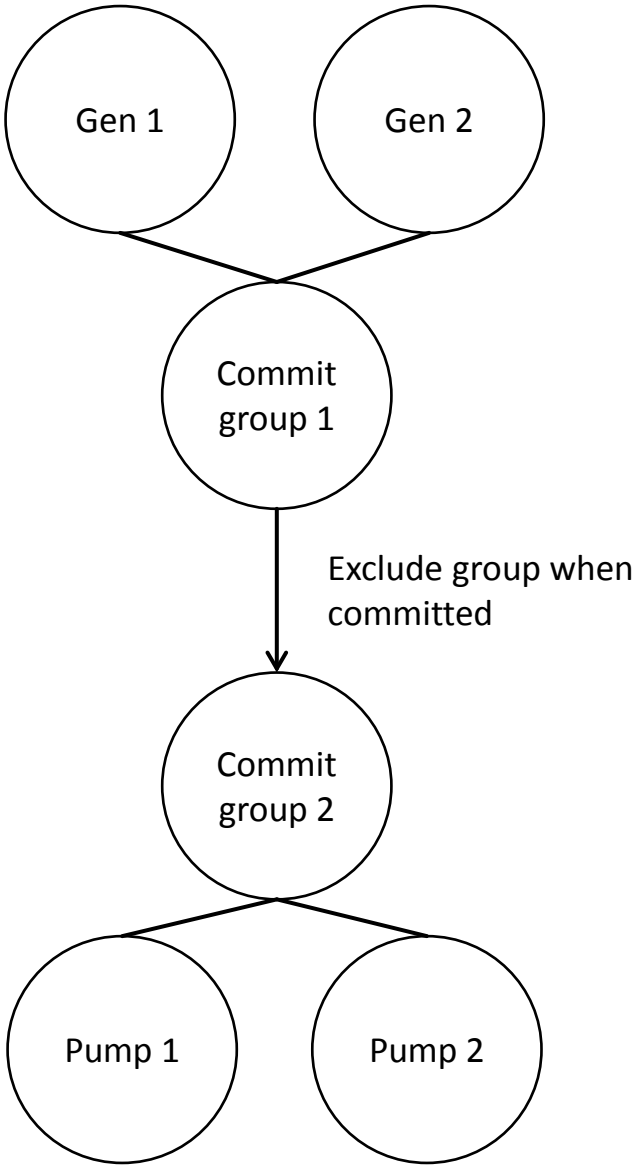
Reserve groups

- Distribute reserve requirements optimally on a group of generators
- Optimize droop on generator level
- Comply with several constraints
  - 2% available capacity
  - short-time min- and max-production limits
- Extra functionality
  - symmetry requirements
  - max / min plant restrictions
- New pump model allows pumps to contribute to reserve delivery

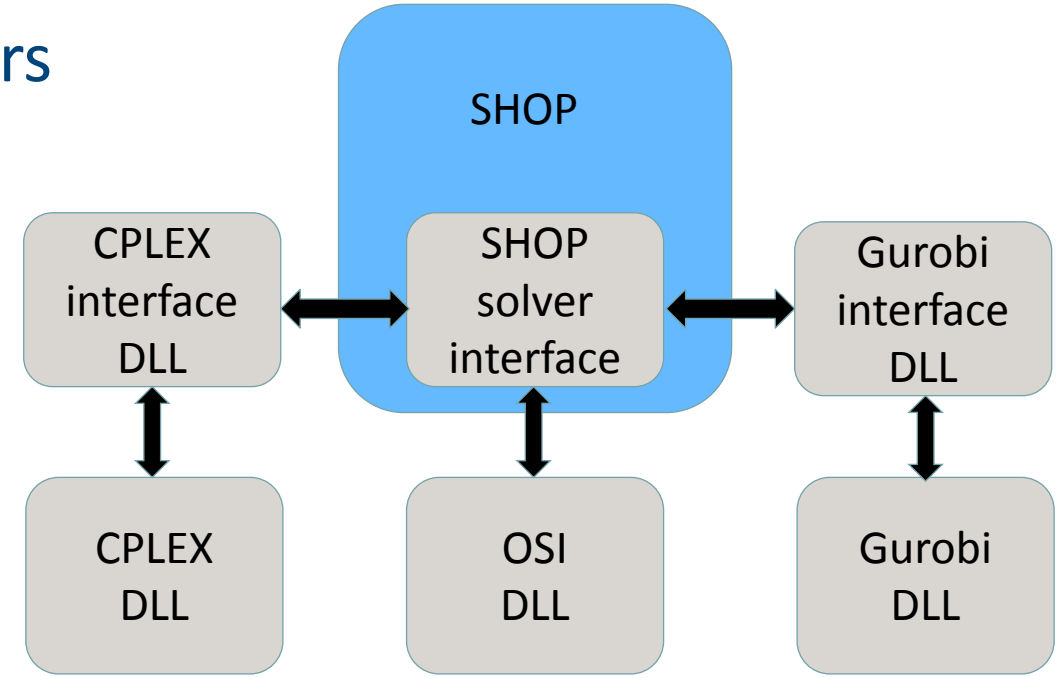


Commit groups

- Specify commitment rules between unit groups
- Examples
  - No generators can run if one or more pumps are running
  - Reversible turbines can not produce and pump at the same time
- Extensions
  - Two units can not start up at the same time
  - One generator has to run when a pump is starting



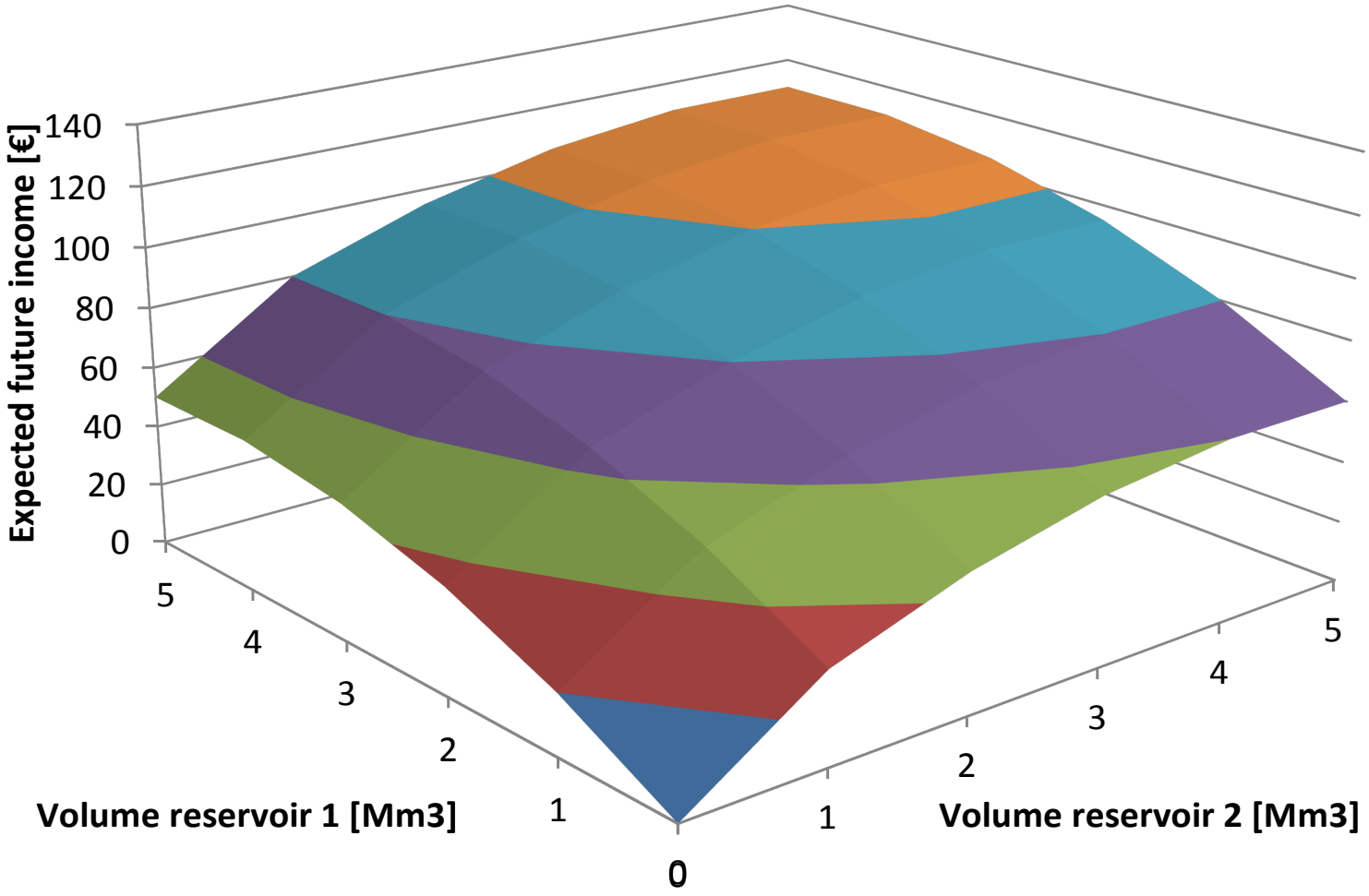
Alternative solvers



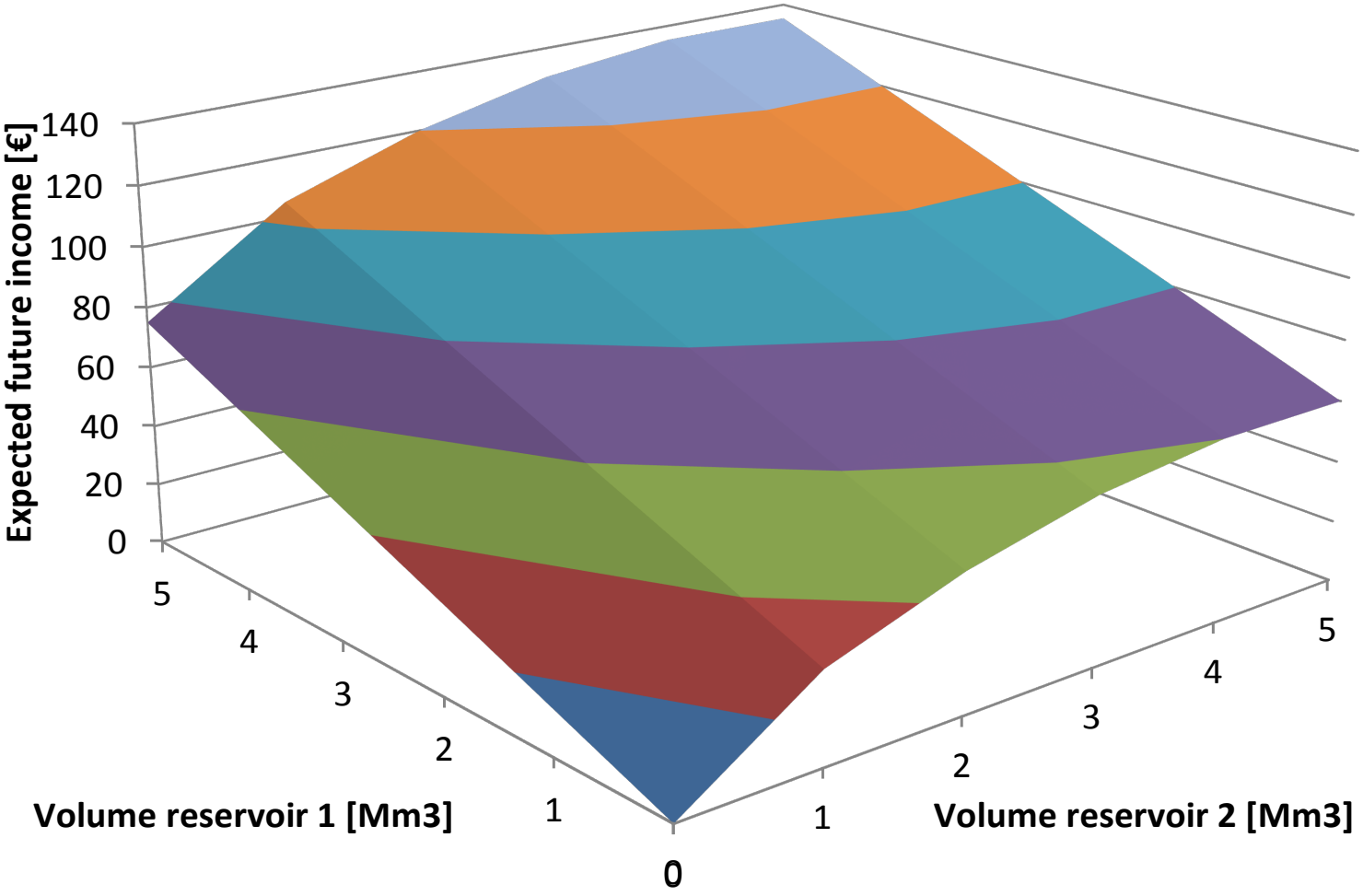
Solver	Relative LP time	Relative MIP time
CPLEX 12.2	1.0	1.0
Gurobi 5.6	0.3	3.0
OSI 2.8	5.6	9.0

MIP-tuning achieves 30% reduction of calculation time without significant reduction in objective

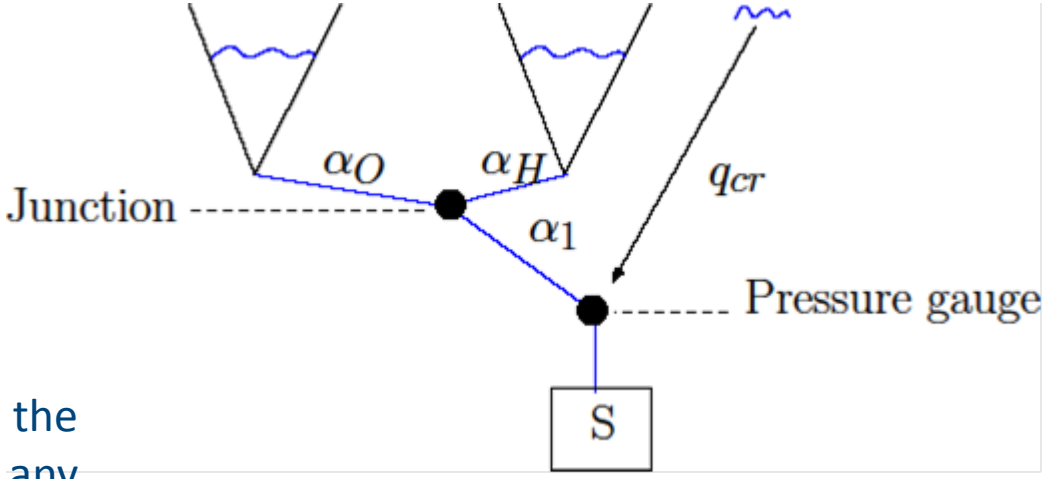
Mixing cuts and individual water values: pure cuts



Mixing cuts and individual water values: mixed



Pressure points



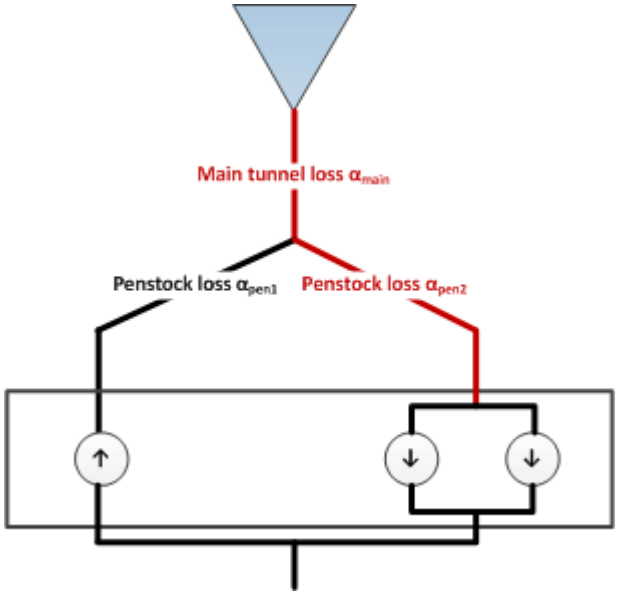
- New topology object:

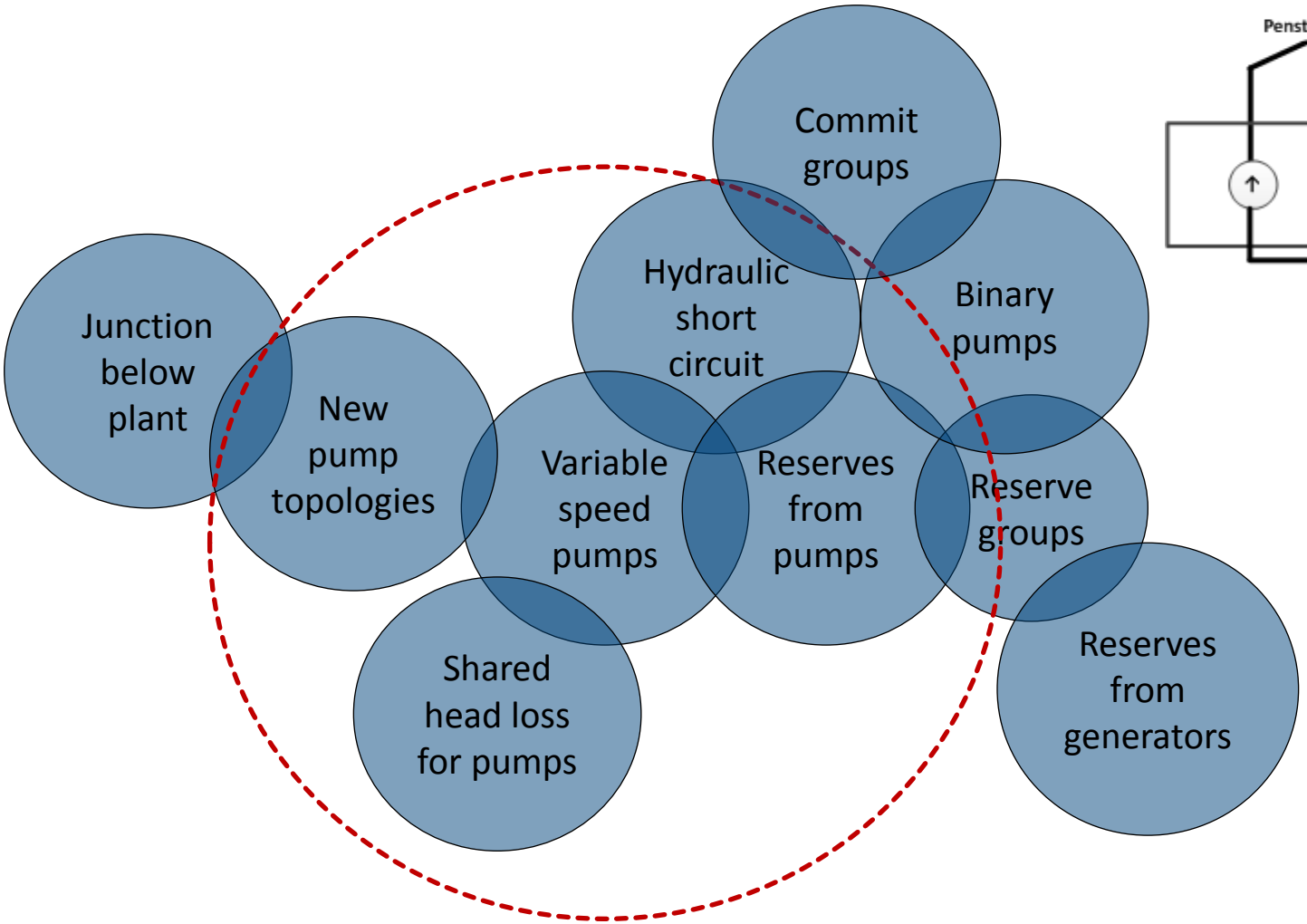
  "Pressure point"
- Minimum pressure restriction in the main tunnel must be met to run any generators in the plant
- Single reservoir or junction above pressure point
- Extra MIP-variables to account for direction of flow in junction tunnels
- Possible with pre-processed inflow directly into the pressure point

Current research and new projects

- Improved coupling between ProdRisk and SHOP (**separate presentation**)
- Marginal costs for new topologies
- I-SIP on improved modelling of non-linearities
- **Extended pump functionality**
- **MultiSharm**

Extended pump functionality





Stochastic multimarket development - MultiSharm

KPN (80% NFR financed)

2015 – 2018

Optimal bidding in day-ahead markets that are integrated in a sequence of balancing markets