Comparing and prioritizing between operational planning alternatives

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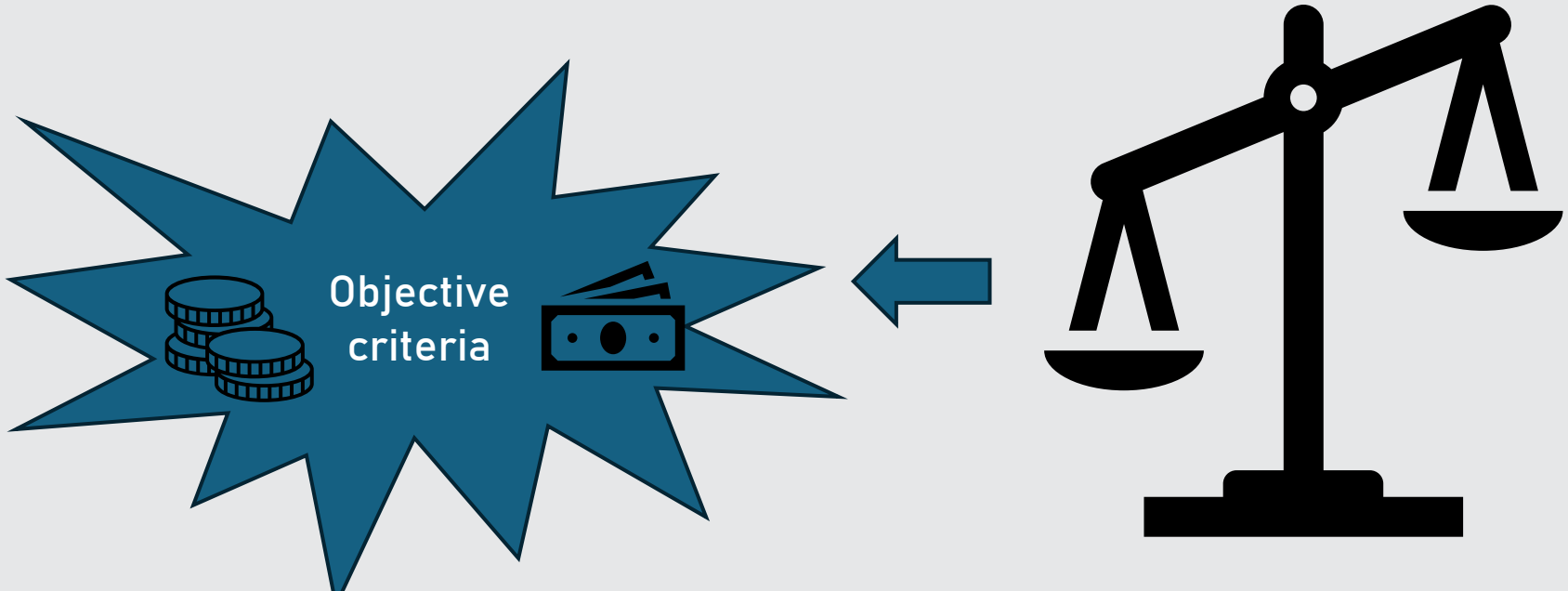
Motivation

Maximize grid capacity utilization → Active grid measures → How to coordinate/ prioritize? → Decision support system



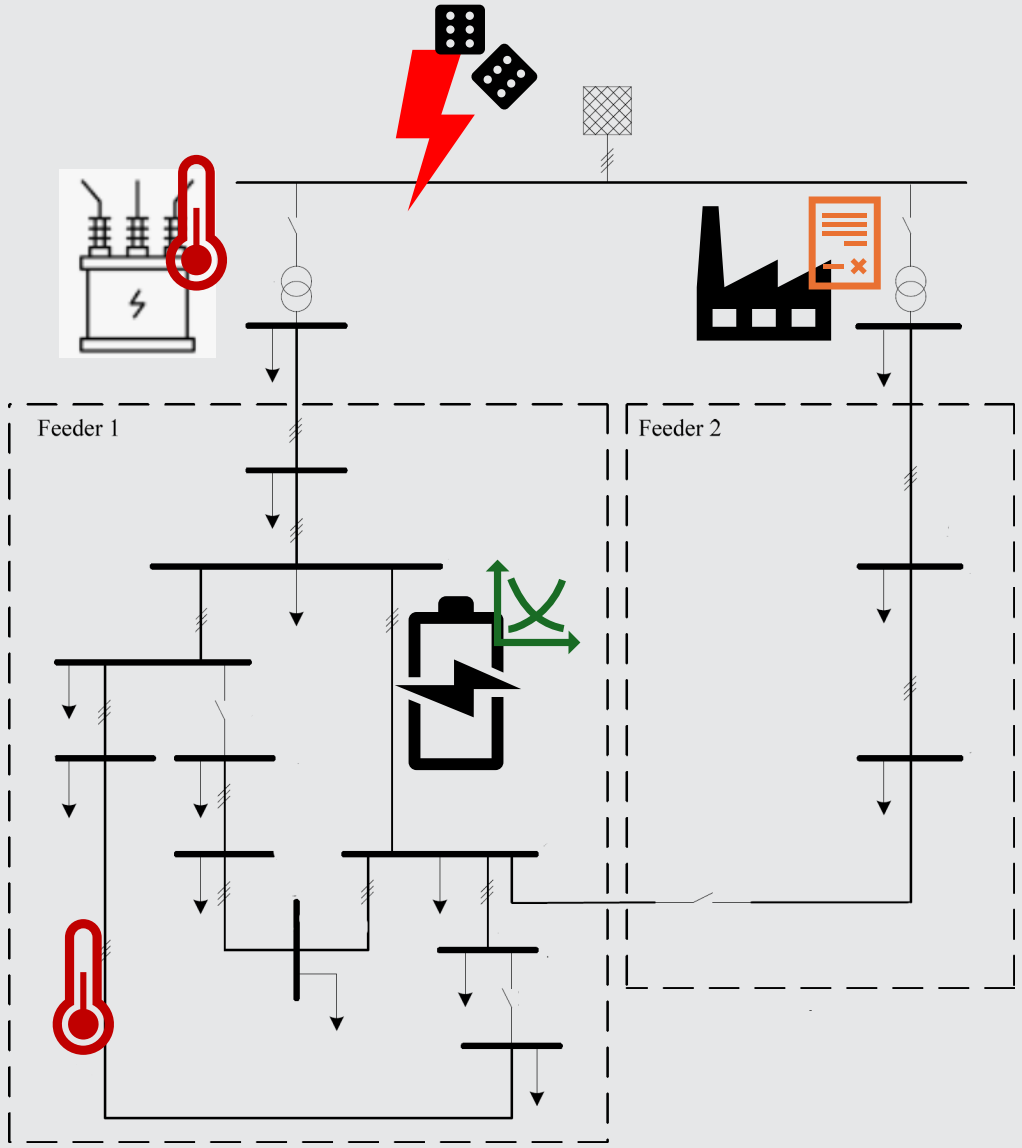
Possible objective evaluation criteria

- Risk-of-outage minimization
- Operational limit reserves maximization
- Expected system cost minimization

Expected system costs

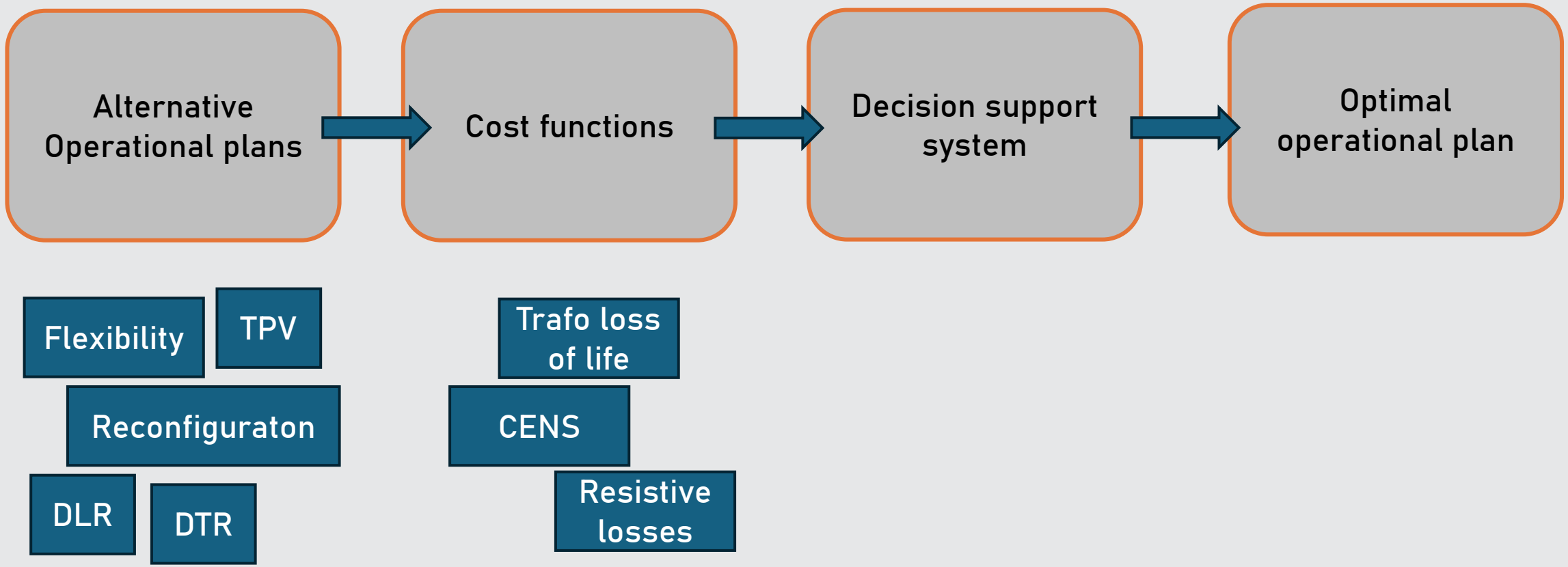
- Resistive losses
- Transformer loss-of-life
- Flexibility activation
- Conditional connection agreement
- Risk of outage/CENS

→Modular!



CENS – Cost of energy not supplied (=KILE)

Decision support



TPV – Conditional connection agreement (Tilknytting på vilkår)
DLR – Dynamic line rating
DTR – Dynamic transformer rating

Examples

Example cost function: Transformer loss-of-life

- Temperature dependent degradation of insulation
- Leads to reduced loss-of-life, Δt

$$\Delta t = A \cdot \exp\left(\frac{T_b}{T_R} - \frac{T_b}{T_{HS}}\right)$$

Model parameters

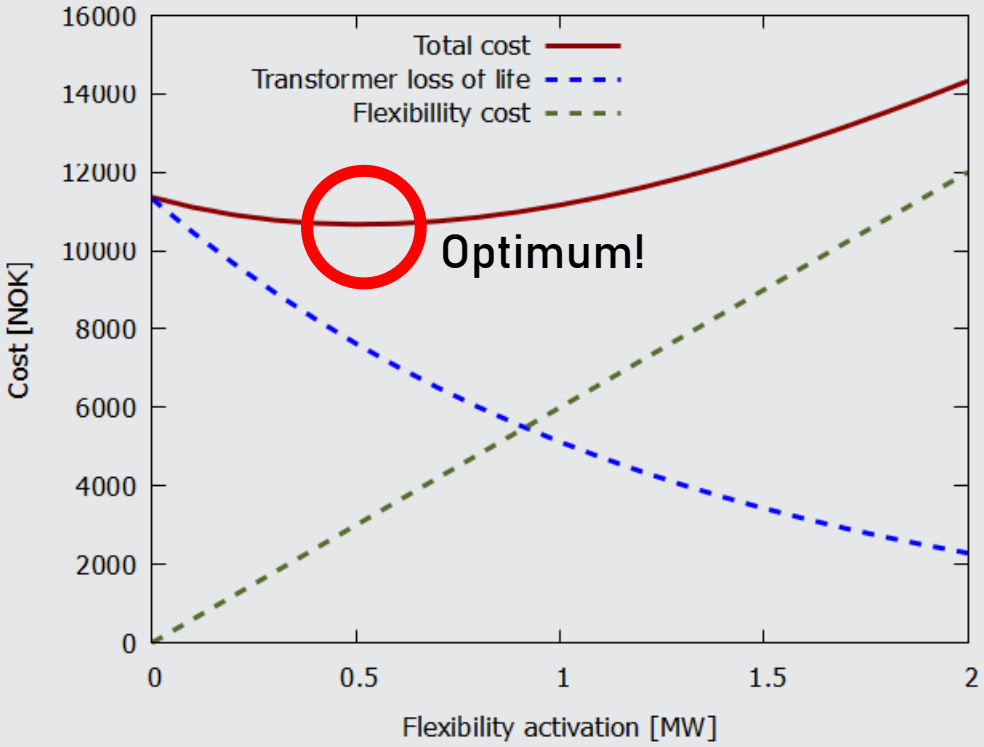
Hotspot temperature

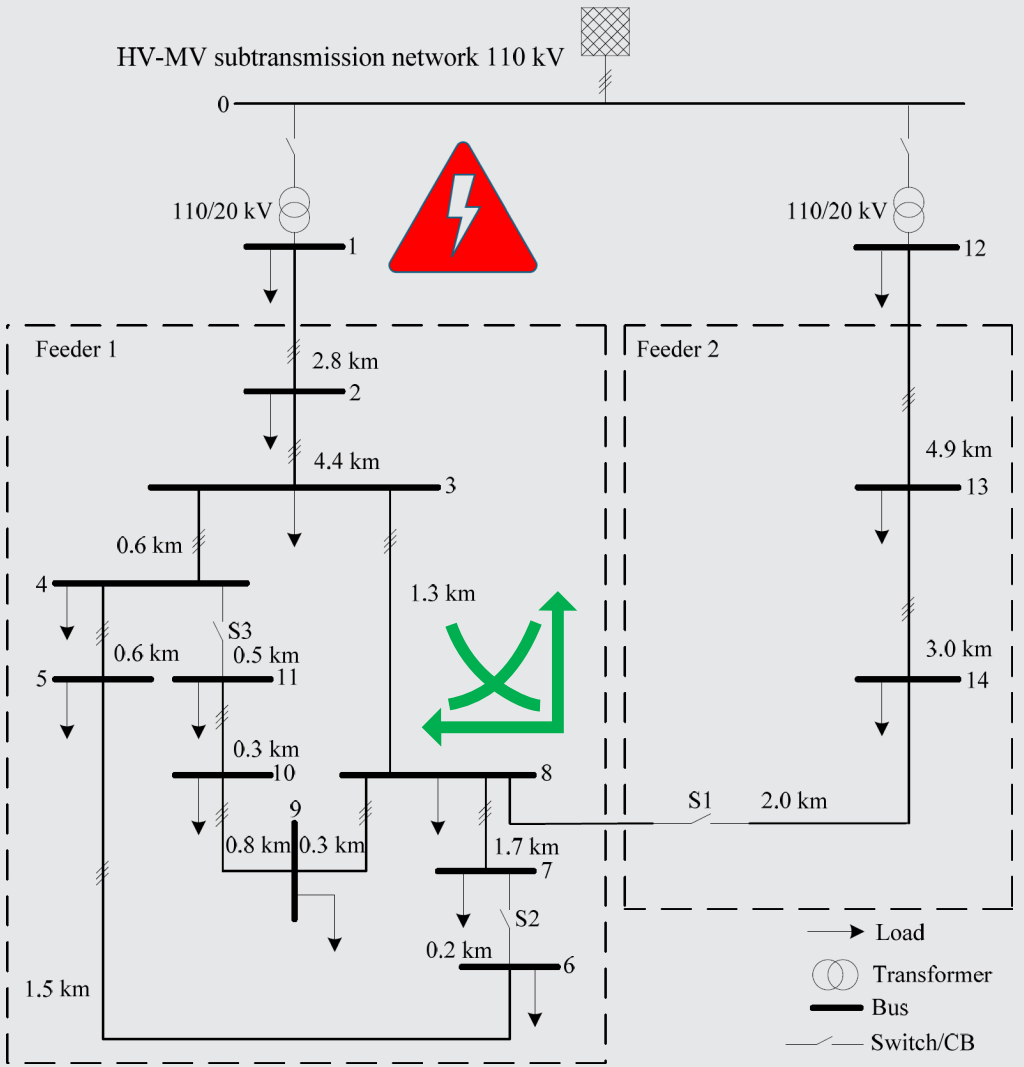
$$T_{HS} = f(T_A, P, \text{design} \ldots)$$

Measured quantities

Example : Transformer loss of life

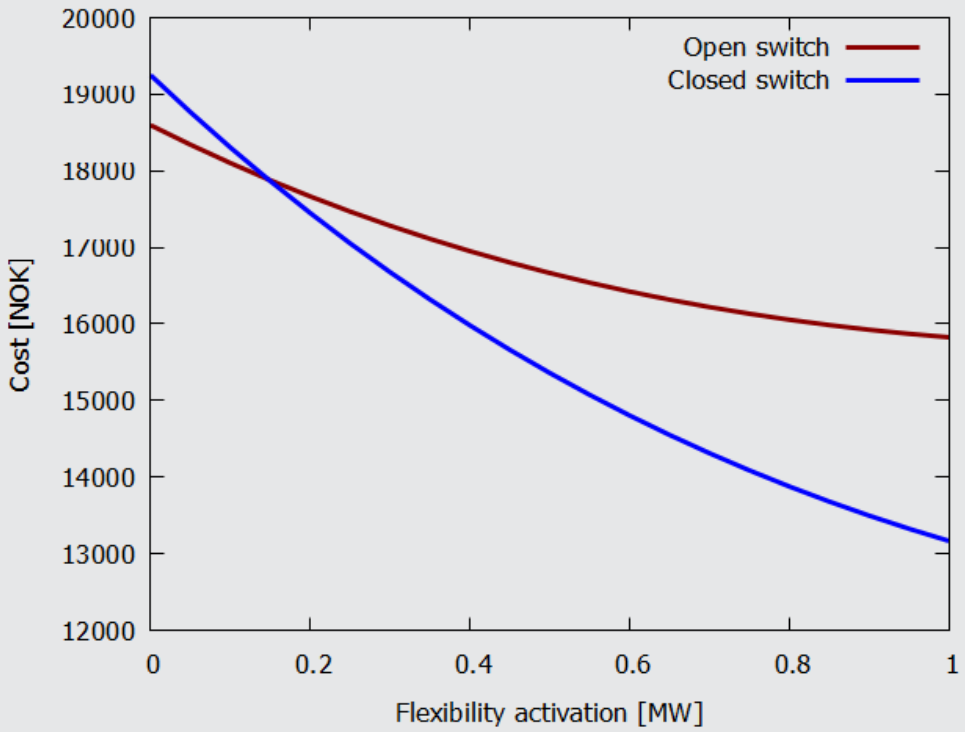
- Transformers at high load.
  - Accept transformer degradation?
  - Activate flexibility? How much?

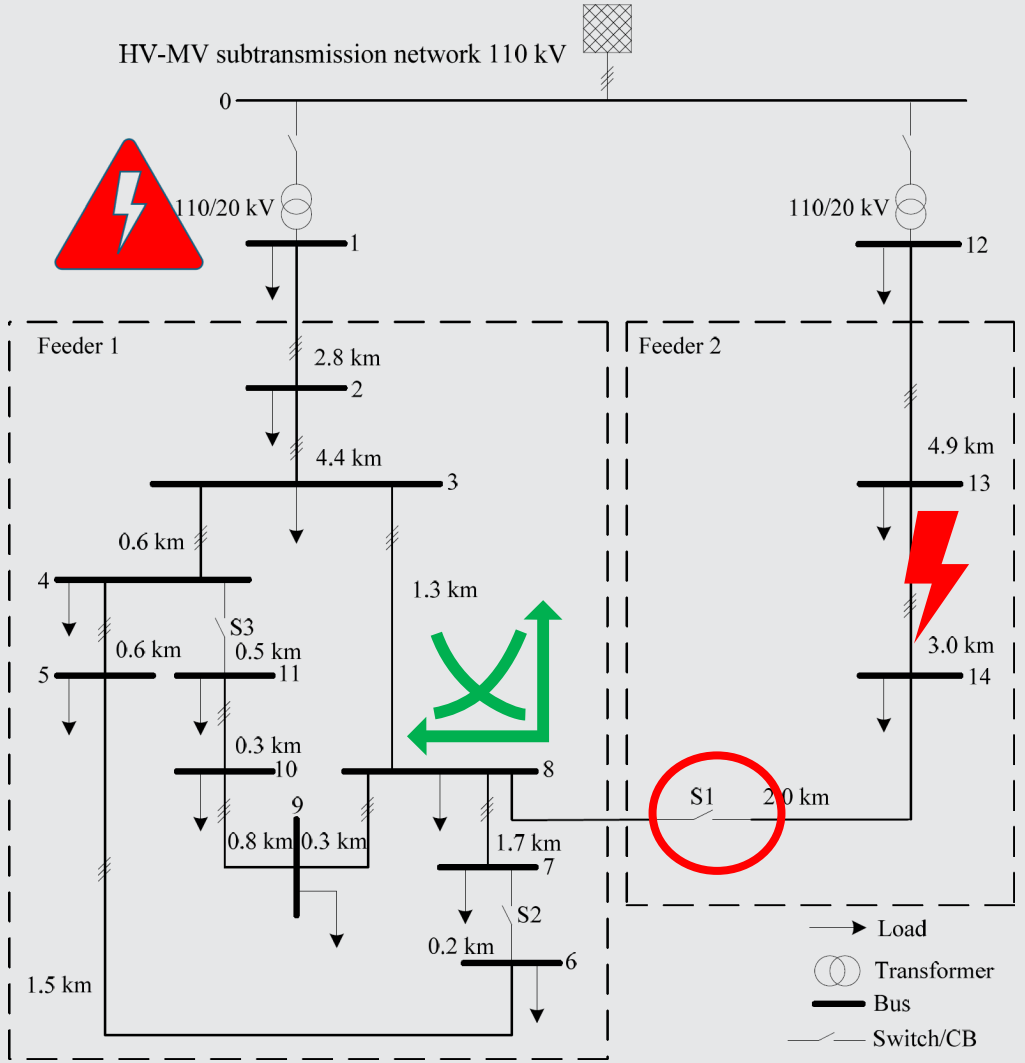




Example : Reconfiguration/CENS

- Customer disconnected.
  - Reconfigure and connect?
  - Accept CENS cost?





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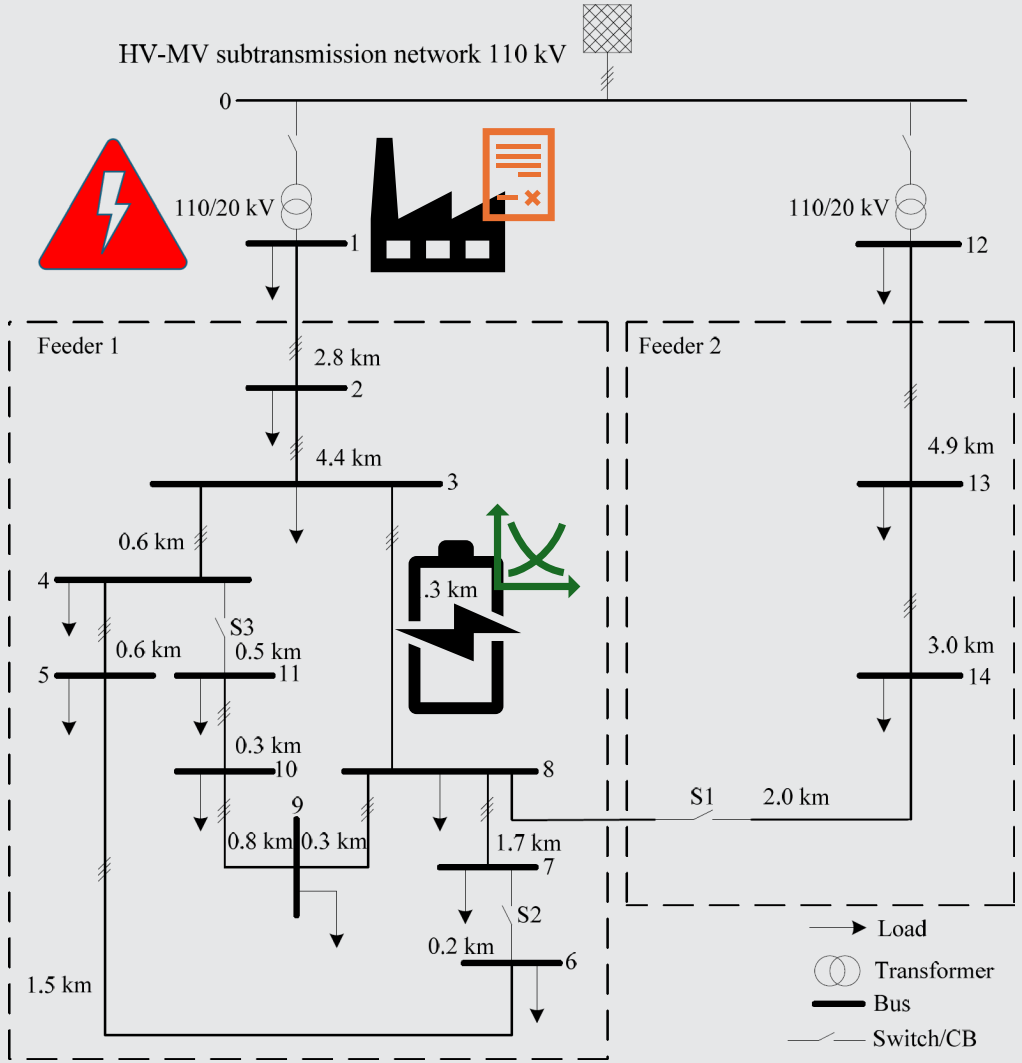
Example: TPV

- Overloaded transformer
  - Activate TPV or buy flexibility?
  - TPV is “free”!
- Also include socio-economic cost
  - Attach CENS type cost to TPV

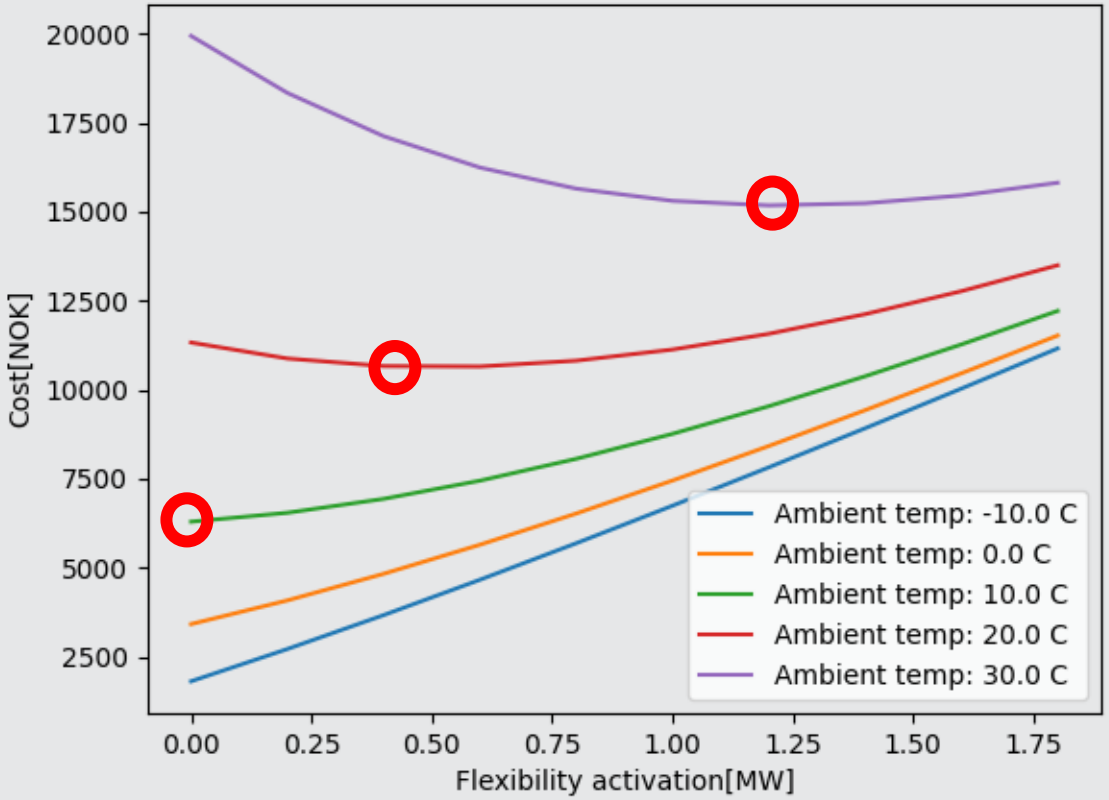


Parameter sensitivity

- Cost functions: Many parameters
- Changes in optimal operational plan
  - Quantitative: amount of flexibility
  - Qualitative: Don't activate!

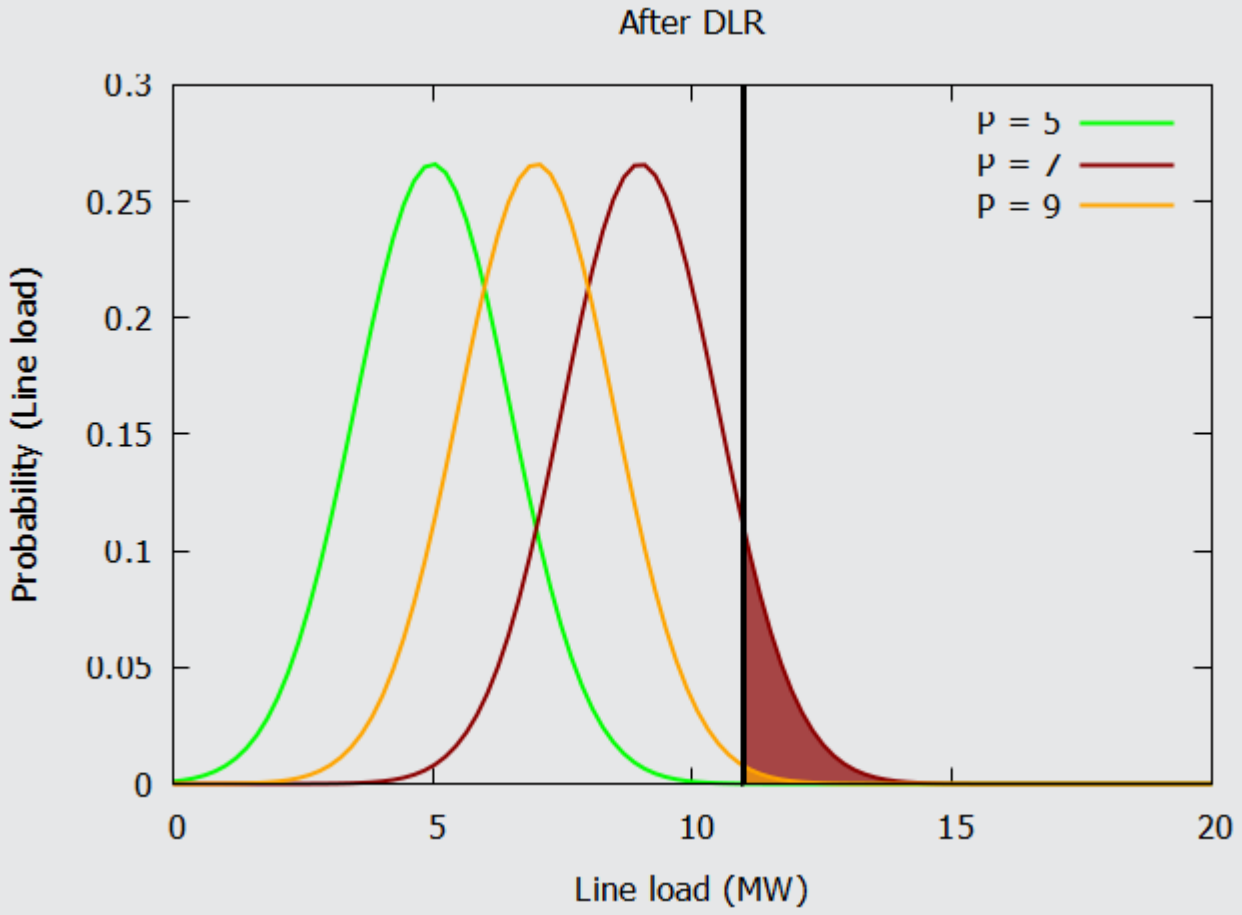
→Present uncertainty to decision maker

→ Accurate parameters/ measurements



Cost of operational margins

- Probabalistic prognosis (proactive)
- Cost?
  - Probability of incurring CENS
  - $C = P(P_L > P_{\max}) \cdot \mathrm{CENS}$
- Similar for DTR, Line voltage



Summary and further work

- Expected cost functions: promising candidate as basis for decision support systems
  - Encodes many operational goals
  - Objective
  - Modular