A model to optimise the organisation of grid operation

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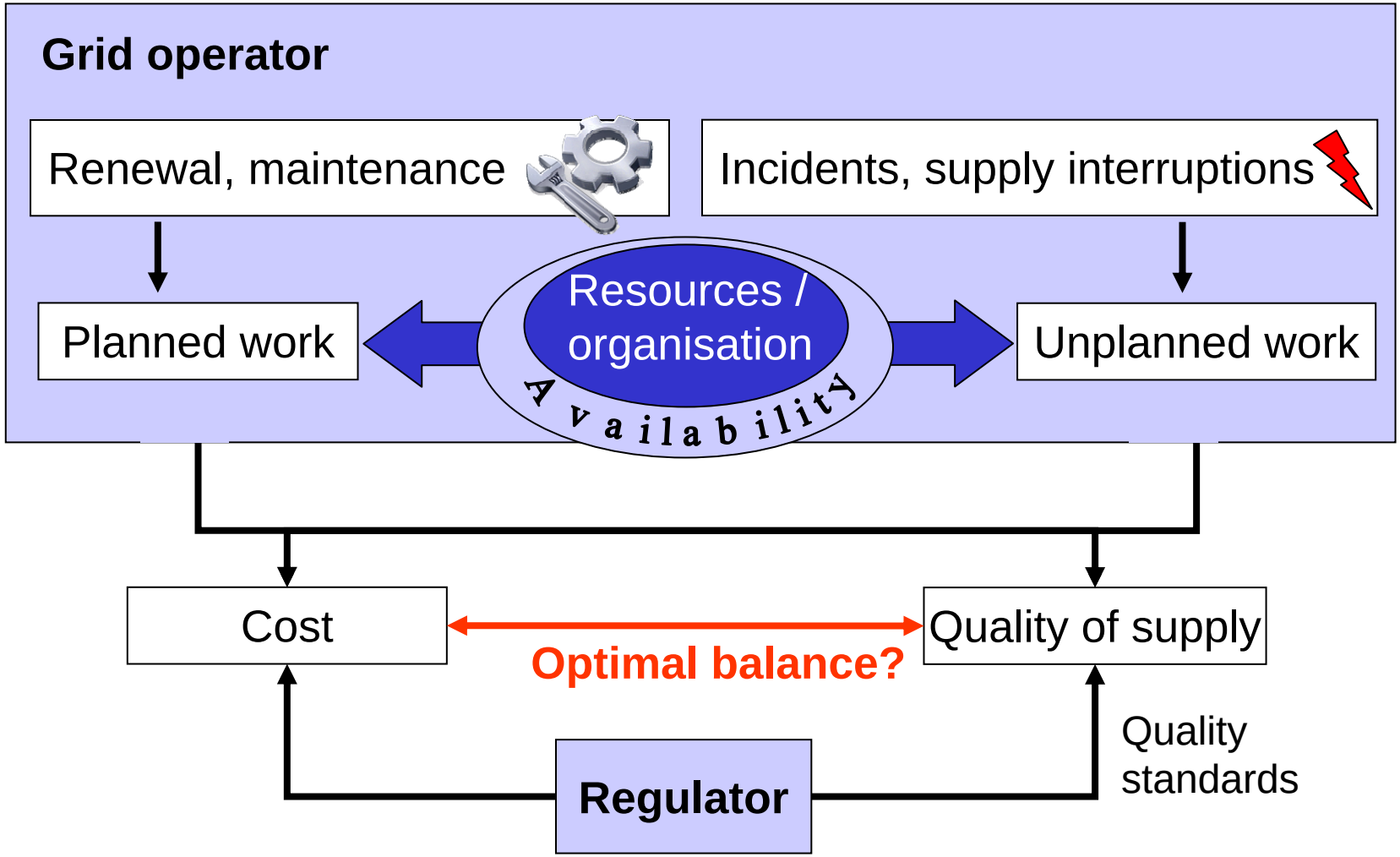
Outline

- Introduction: Quality of supply vs. cost
- Grid operation model
- Case study: existing MV/LV grid
- Conclusions

Background and aim

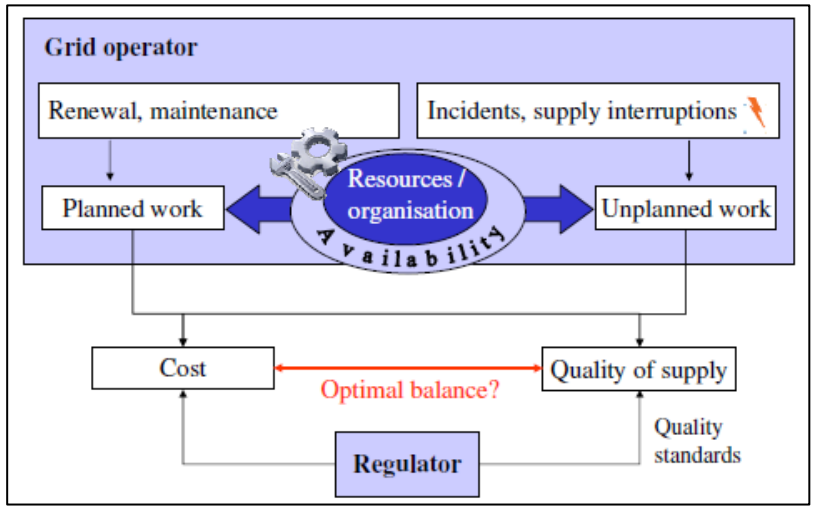


Grid operation model: 2 modules

Module 1

Organisation and optimisation of the unplanned work (quality aspects)

- stochastic
- time critical
- Dynamic simulation, Mixed Integer Linear Program (MILP)



Module 2

Organisation and optimisation of the planned work

- **deterministic**
- **not time critical**
- **MILP**

Power grid and geographical model

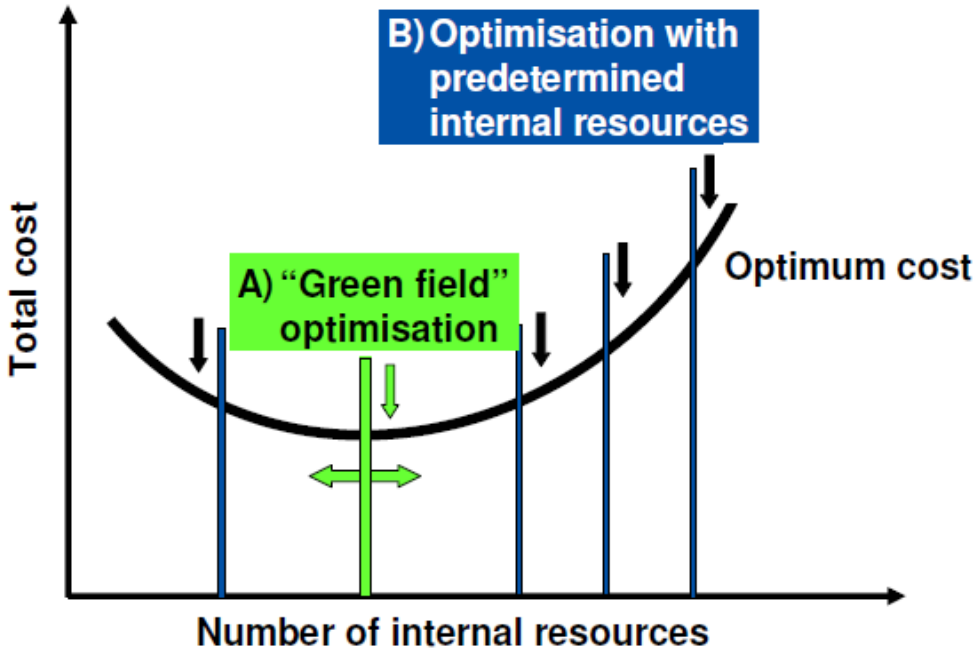
- **Power grid modelled by (sufficiently large) number of nodes.**
- **Node: aggregation of electrical equipment in corresponding geographical area.**
- **Amount of planned work in each node.**
- **Spatial structure of grid represented by edges between nodes.**
- **Estimated travel time for each edge.**

Optimisation possibilities

Find *minimum cost* by

A **"Green field" optimisation**

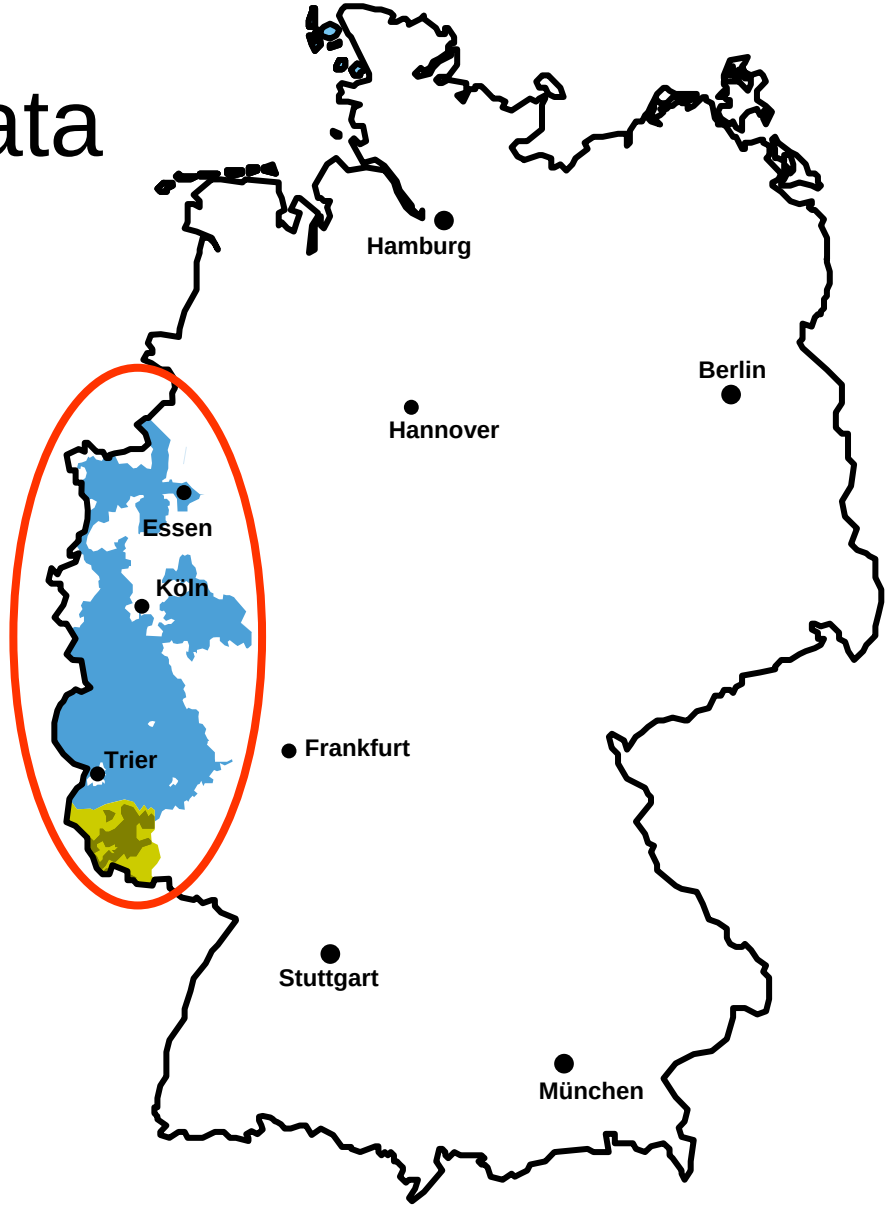
B **Optimisation for a predetermined number of own employees (internal resources)**



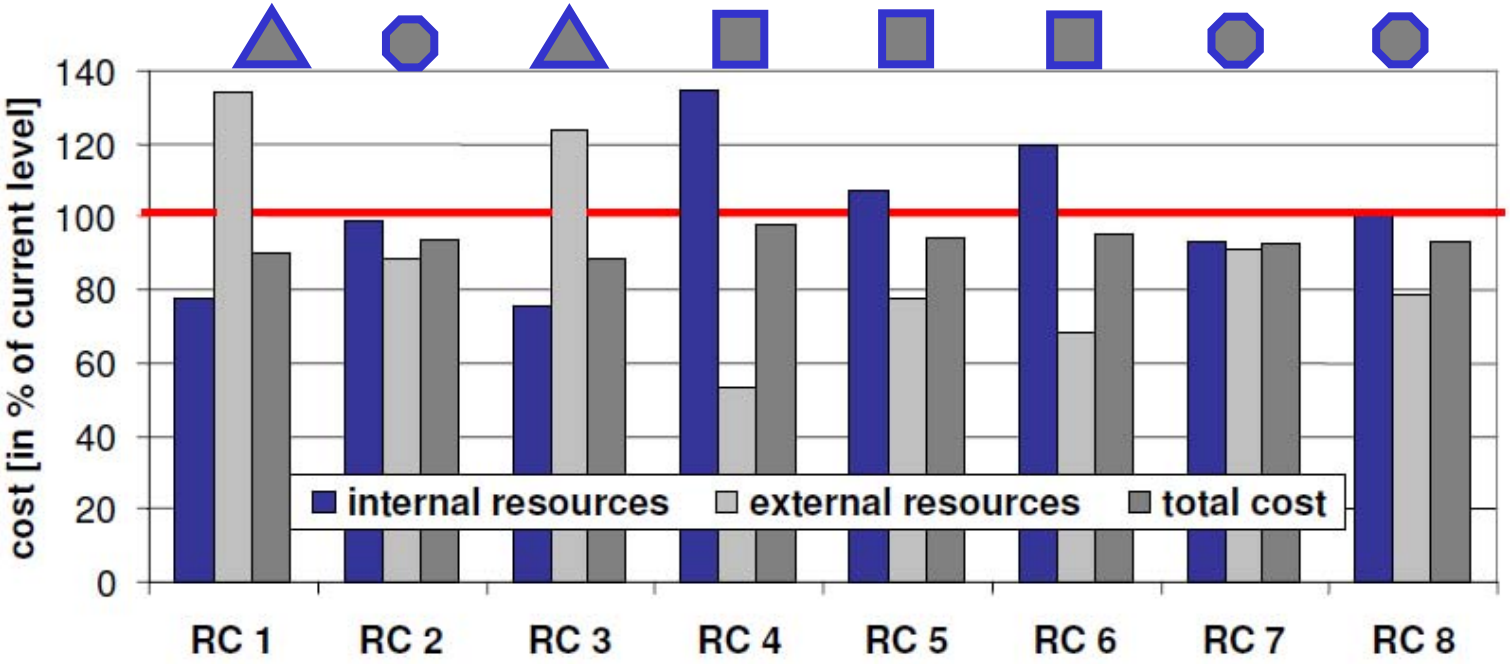
Minimiere $\sum_{i \in I} c_i x_i^l + \sum_{i \in I} \sum_{j \in J} \tilde{c}_{ij}^l y_{ij}^l$

Case study: Basic data

- **Area of 29000 km²**
- **55000 km cable lines (MV+LV)**
  25000 km overhead lines (MV+LV)
  30000 substations (MV/LV)
- **313 nodes, 937 edges**
- **8 regional centres (RC)**
- **96 types of jobs**



“Green field” optimisation: Results

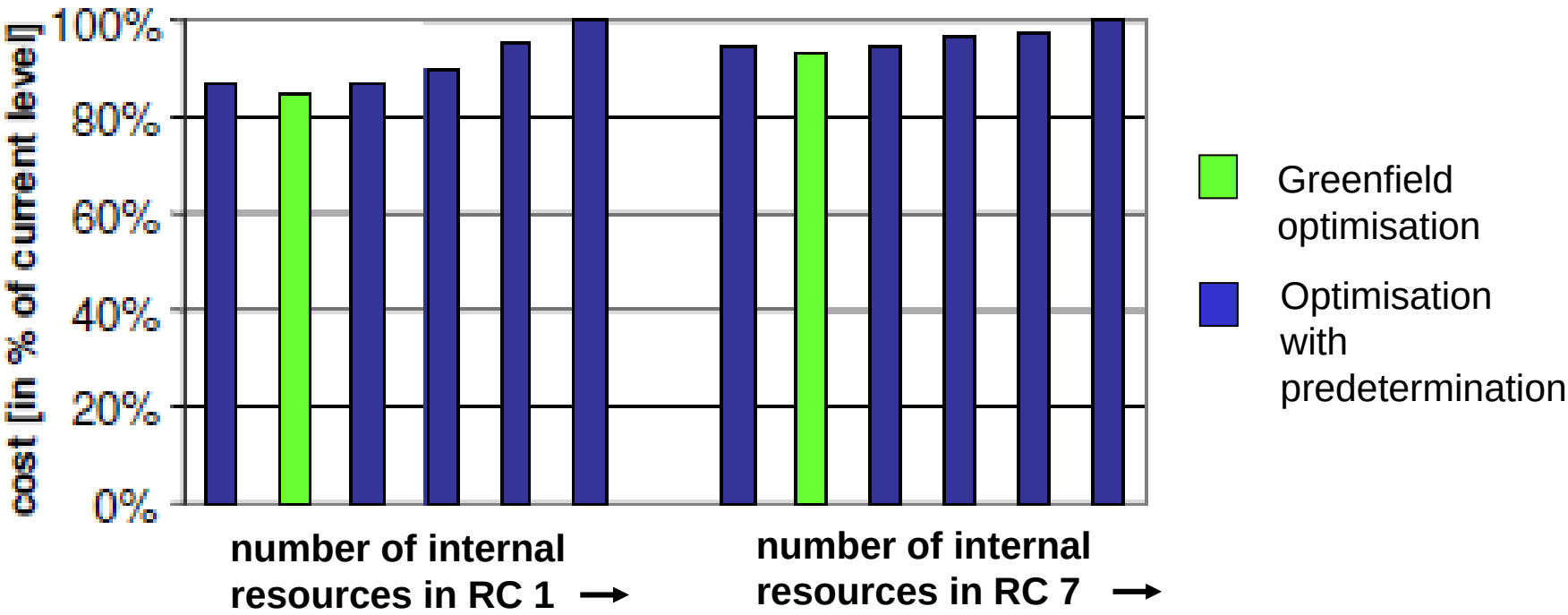


Increase outsourcing

Increase number of internal resources

Change outsourcing strategy (portfolio management)

Greenfield optimisation vs. predetermination



Results show the conceptual optimum curve

Results trace the way to minimum cost

Conclusions

- **A model to optimise the organisation of grid operation is developed**
- **Consisting of two modules**
  - **Module 1: Unplanned work**
  - **Module 2: Planned work**
- **Results for planned work show optimisation possibilities**
  - **long-term: “Green field” (global optimum for given work load)**
  - **short-term: “Predetermination” (local optimum for given work load and number of resources)**

Thank you for your attention!

Dipl.-Math. Catharina Friedrich
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