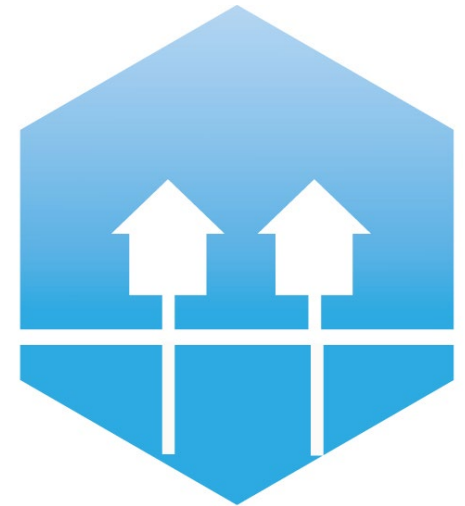
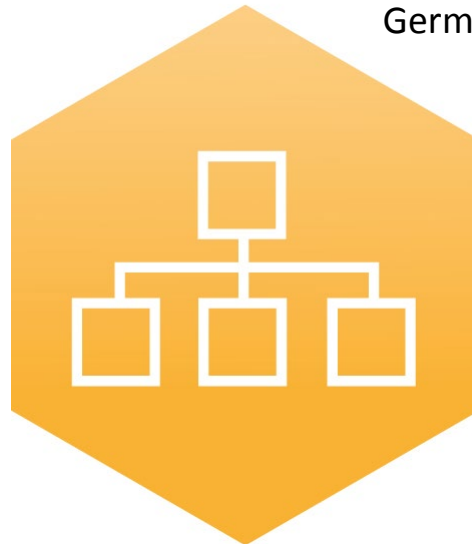


An Optimisation Model for Smart Distribution Network Planning

Julian Wruk
University of Wuppertal
Germany



AALBORG UNIVERSITY
DENMARK

4th International Conference on Smart Energy
Systems and 4th Generation District Heating 2018
#SES4DH2018

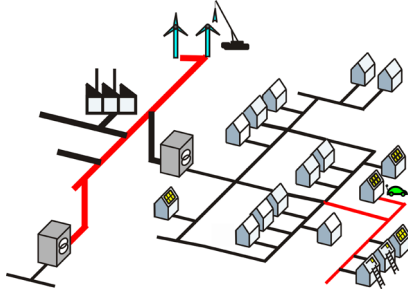
4DH

**4th Generation District Heating
Technologies and Systems**

Overview

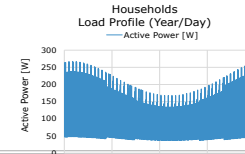
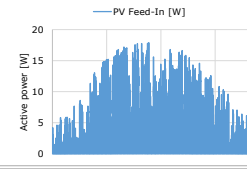
- Power distribution networks are not designed for upcoming challenges

➡ Increase of network congestions



Motivation

- Parameters
 - Generation and load scenarios
 - Set of technologies and solutions
 - Costs of solutions
- Variable
 - Network data (low voltage)



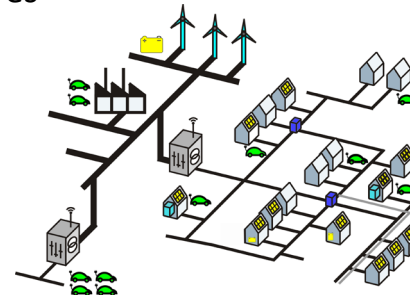
Inputs

- Automated and optimised network planning tool with conventional and innovative solutions
- Genetic algorithm (in Python) for solving the very complex optimisation problem
- Analyse many networks to derive guidelines on how to use innovative technologies



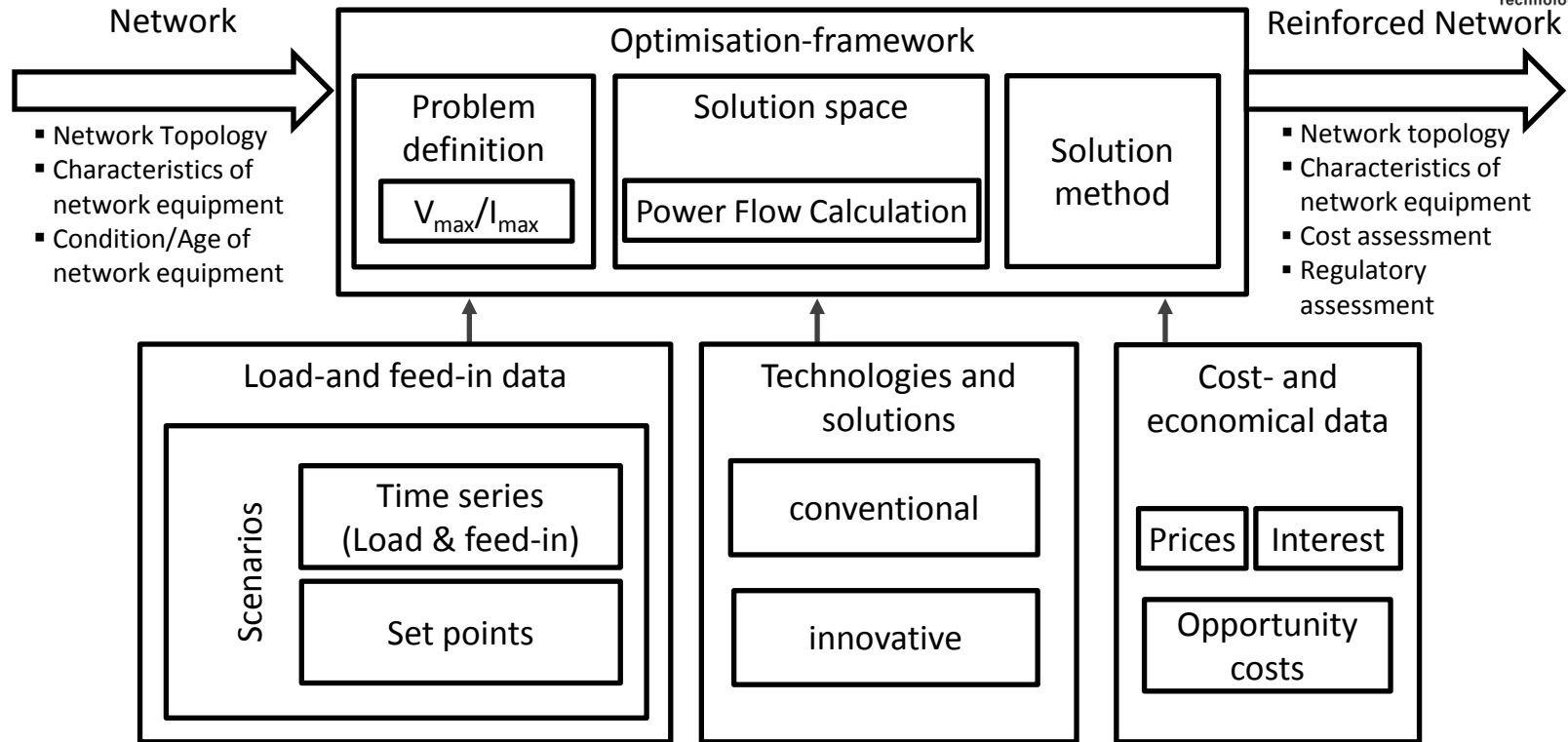
Approach

- New network structures and solutions considering innovative technologies and measures



Output

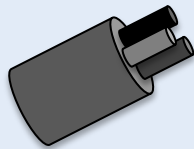
Main Concept of the Tool



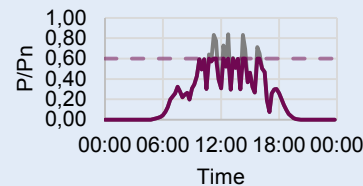
What is the most effective and efficient way to reinforce or redesign distribution networks under the assumption of forecasted generation and load scenarios?

Network technologies

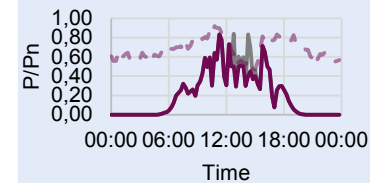
Conventional measures



Active Power Mgmt (static curtailment)



Active Power Mgmt (dynamic curtailment)



Voltage Regulated Distribution Transformer



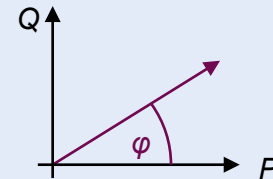
Fig: Siemens AG

Line Voltage Regulator

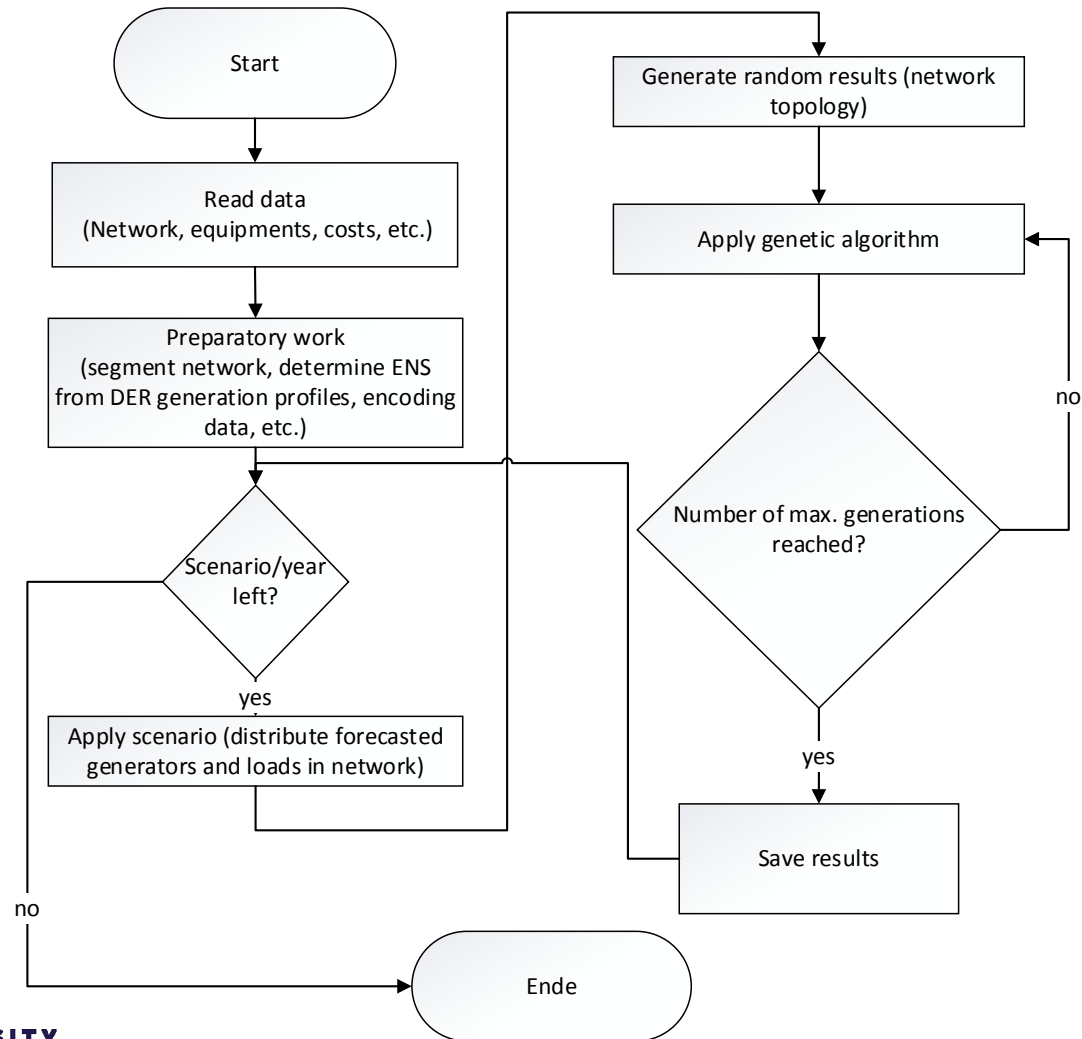


Fig: ABB Ltd

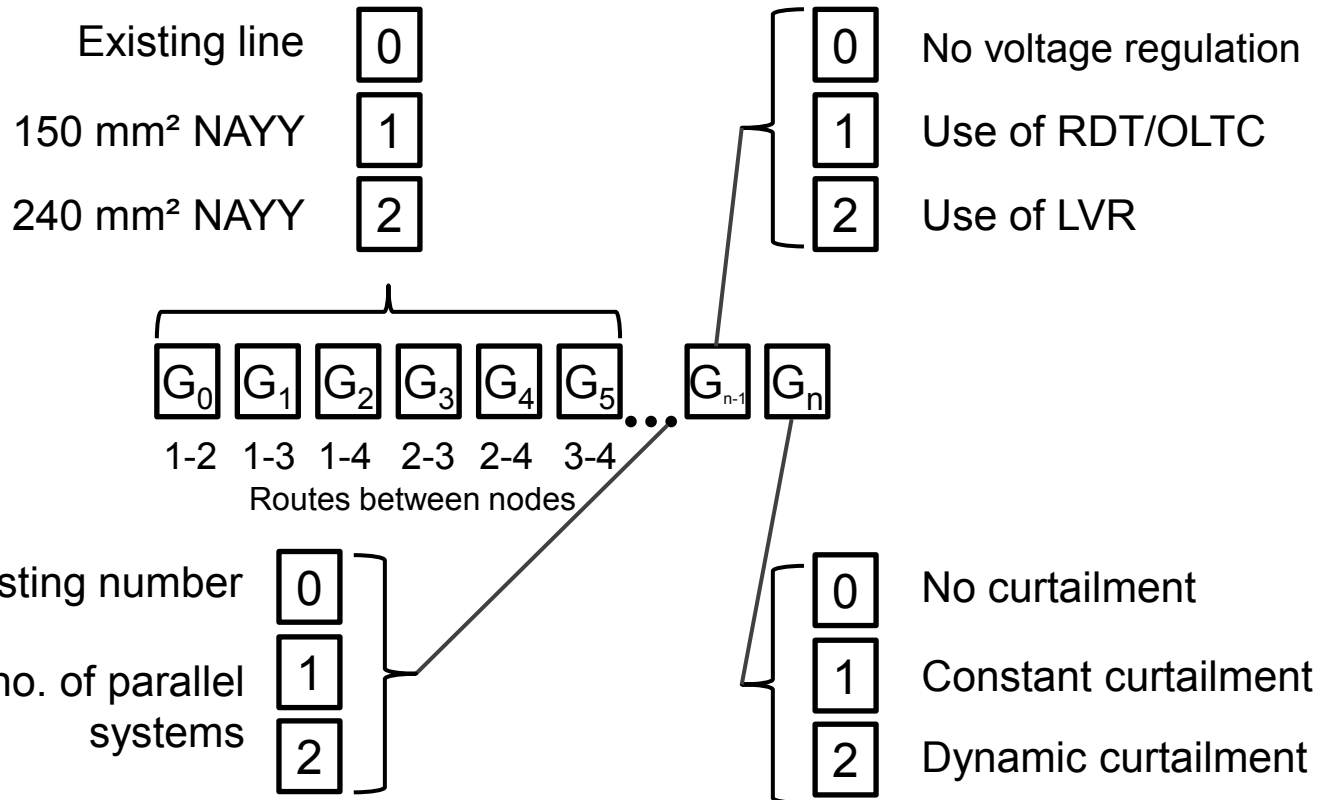
Reactive Power Mgmt



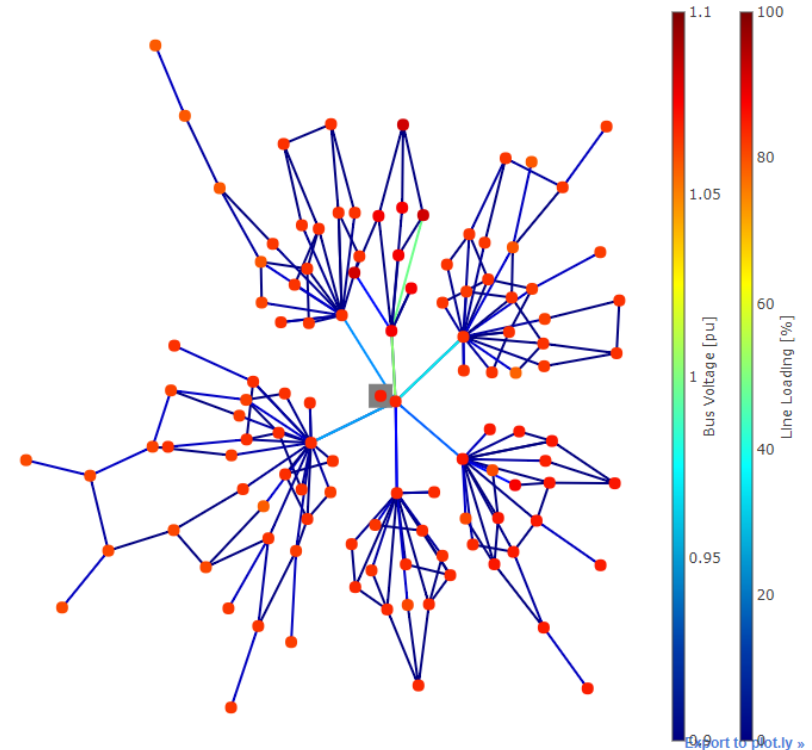
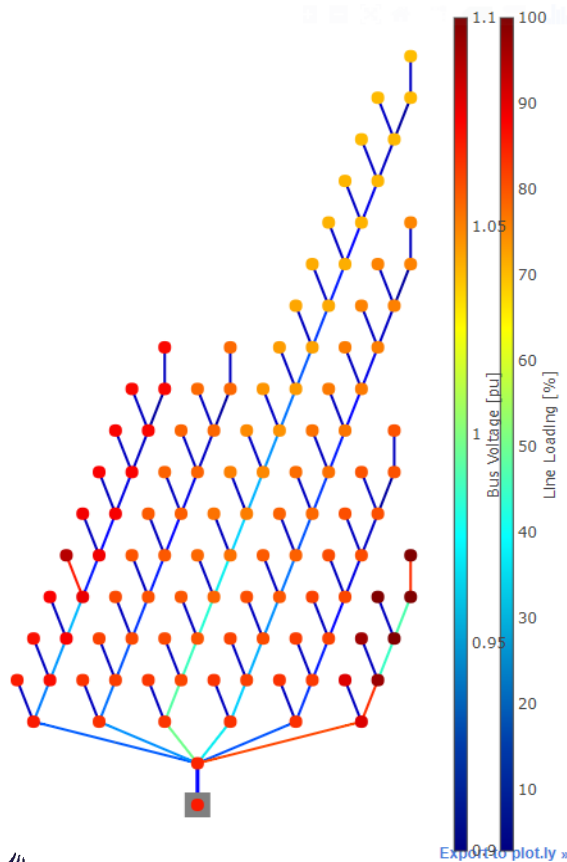
Flow of the tool



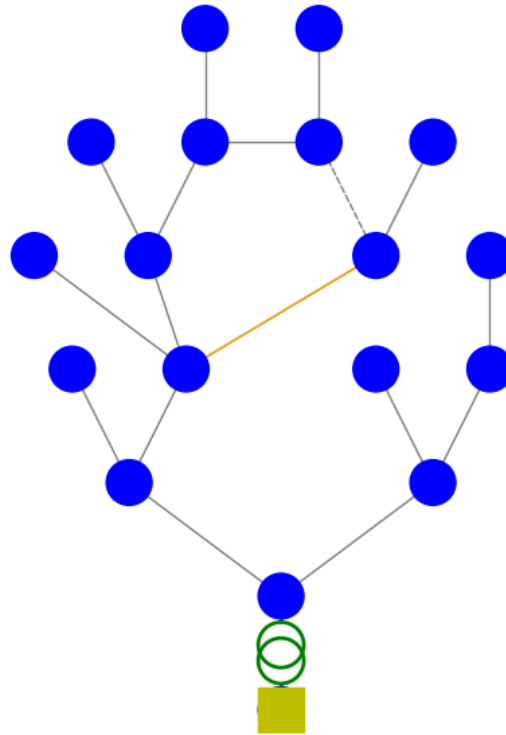
Automated Network Planning as a Genetic Algorithm



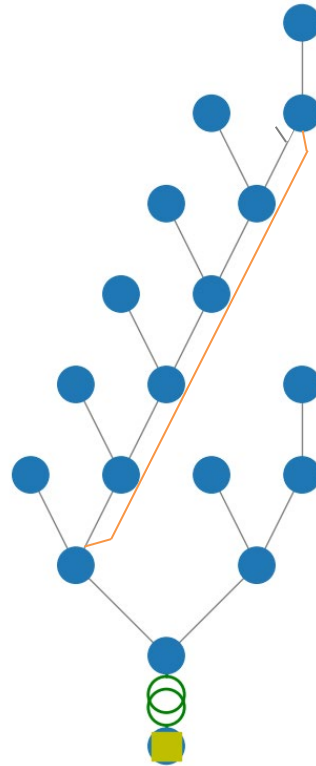
Comparison: Original Network vs First Solution



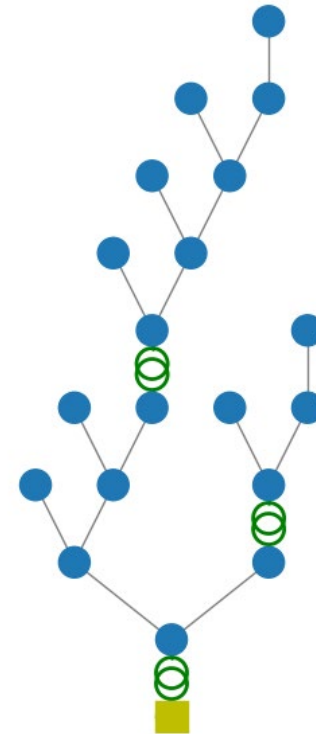
Comparison: Conventional Planning vs. LVR



 principle



actual routing



Outlook



- **Validate the tool's output (against manual planning and small networks)**
- **Network planning for > 100 low voltage networks in order to ...**
- **Derive guidelines about how to use smart network technologies**
- **Add other energy carriers (heating, gas)**





SmartGuide



<https://www.smartguide.uni-wuppertal.de/en/>

Julian Wruk, M.Sc.
Network structures and planning

Supported by:



on the basis of a decision
by the German Bundestag



"This project has received funding in the framework of the joint programming initiative ERA-Net Smart Energy Systems' focus initiative Smart Grids Plus, with support from the European Union's Horizon 2020 research and innovation programme under grant agreement No 646039."



AALBORG UNIVERSITY
DENMARK

University of Wuppertal
Institute of Power System
Engineering
Rainer-Gruenter-Str. 21
42119 Wuppertal
Germany

T +49 202 439 1926
F +49 202 439 1977
julian.wruk@uni-wuppertal.de
<http://www.evt.uni-wuppertal.de>