# From micro to Mega-GRID: Interactions of micro-grids in active distribution networks

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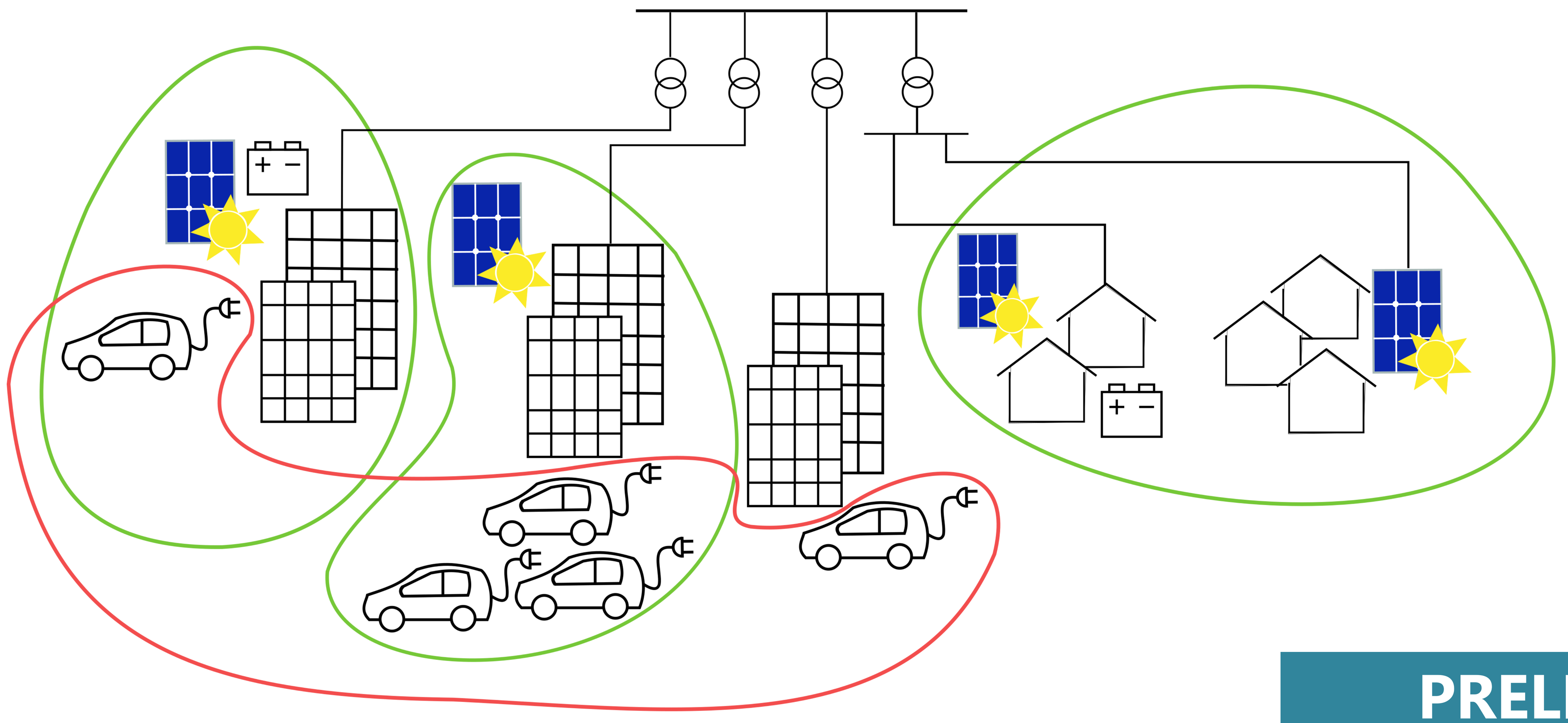
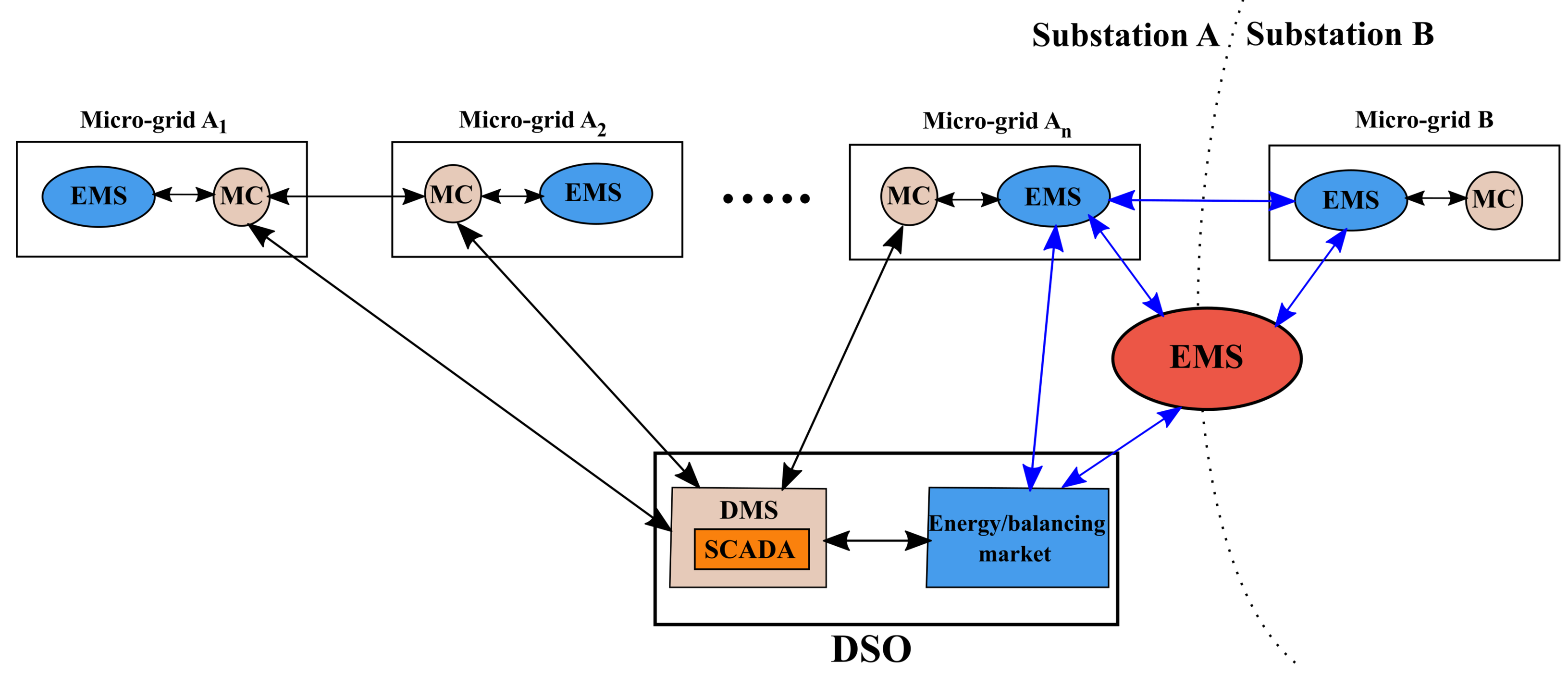
## PROJECT OBJECTIVES (Chalmers')

- To prepare a test site at Chalmers and propose functional requirements for micro-grid interoperability.
- To develop interfaces for micro-grid interoperability and integration of the micro-grid energy management system (EMS) to the distribution management system (DMS).





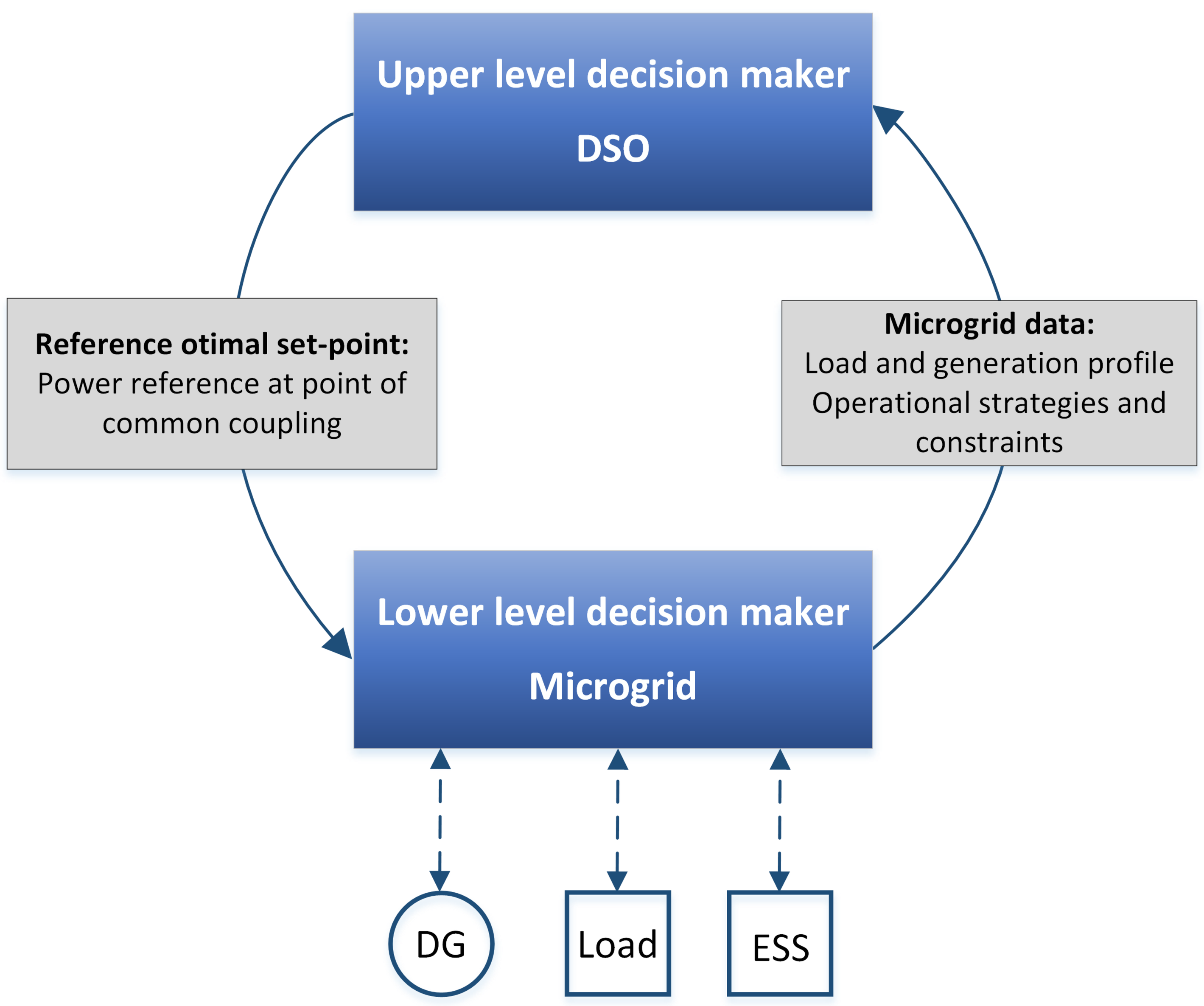

## MOTIVATION

**Grid-tied micro-grids:**

- Offer advanced controllability of the distribution network
- Can minimize uncertainties in energy scheduling
- Release network capacity and postpone grid investments
- Minimize energy cost
- Facilitate efficient resource sharing

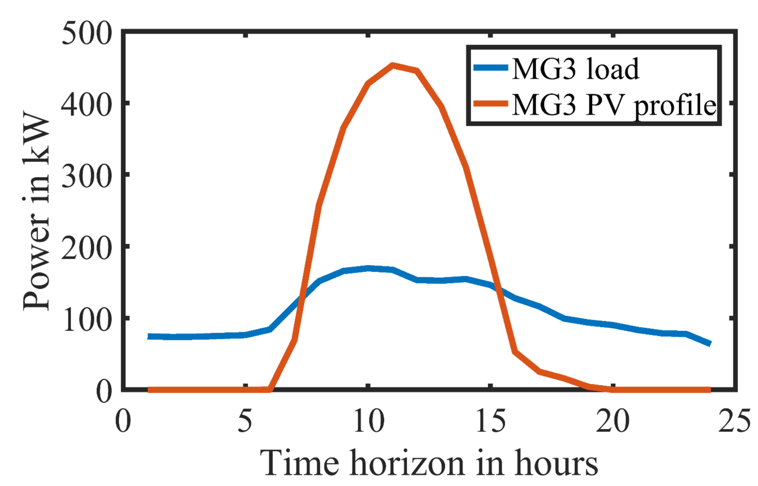
## METHODOLOGY

- Optimization methods (e.g., multi-objective, bi-level) for coordinated energy management.
- Validation through real site demonstrations in Sweden (Chalmers) and France.

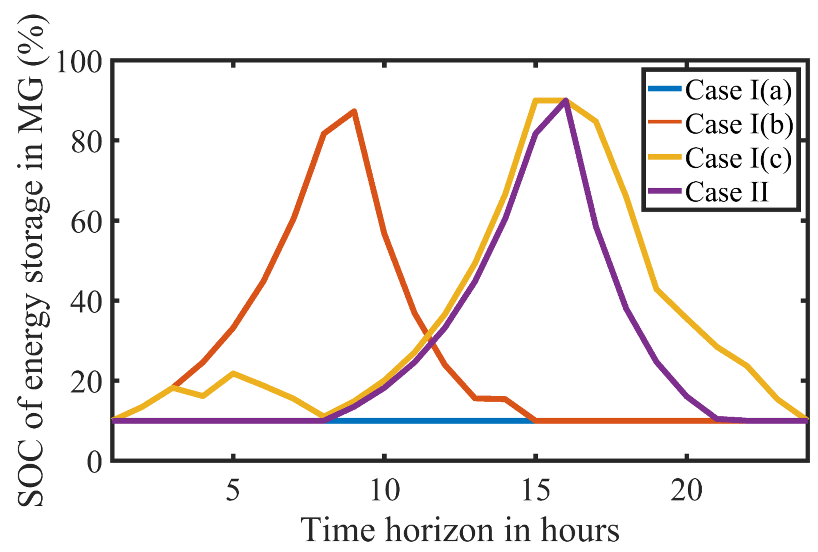



## PRELIMINARY SIMULATION RESULTS: DSO VS. MICRO-GRID OPERATION STRATEGIES

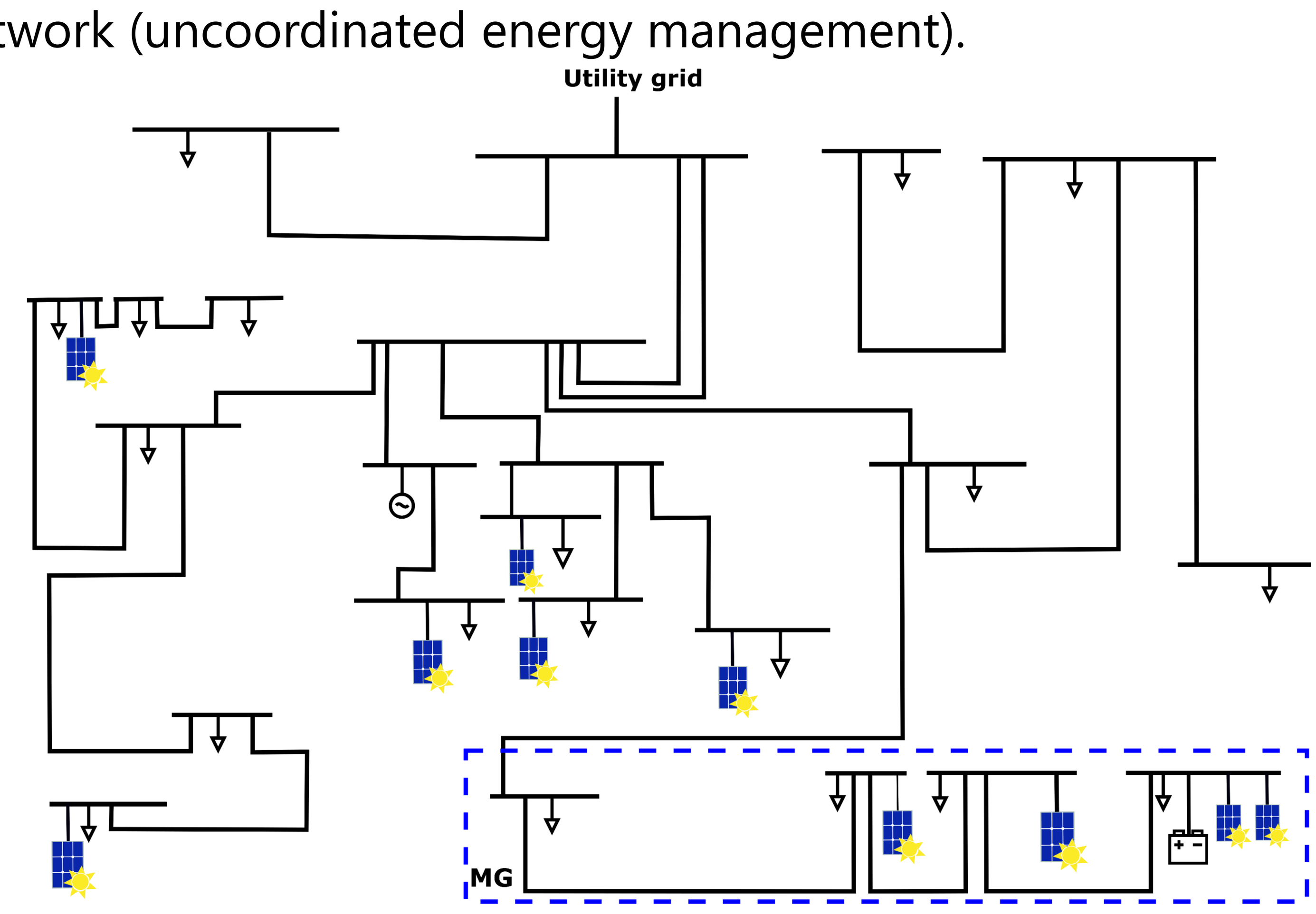
- Case I: The distribution system operator (DSO) owns the energy storage and seeks to:
  a) minimize the upstream daily energy import.
  b) minimize transformer losses (square of imported power).
  c) minimize the voltage deviation from the nominal voltage on all buses.
- Case II: The micro-grid (MG) operator owns the energy storage and minimizes daily energy exchange with the distribution network (uncoordinated energy management).




*Load and PV profile of micro-grid*



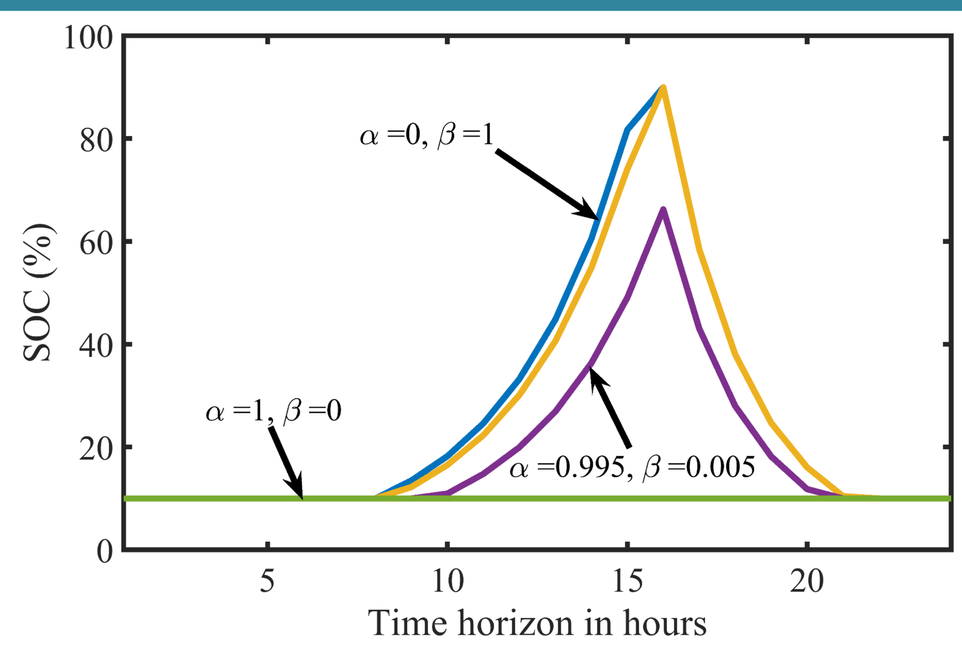

*SOC of energy storage in the micro-grid*



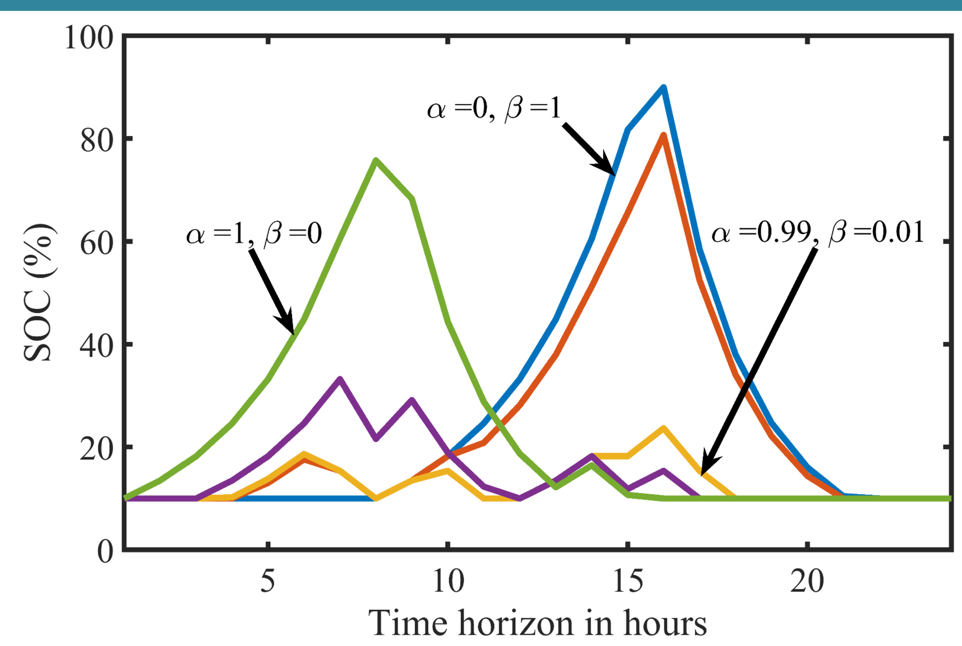

*Distribution network of Chalmers campus*

- SOC profile varies depending on operational strategies.
- Comparison of optimal micro-grid energy management (Case II) with DSO optimal operation (Case I (a)-(c)).
- Biggest differences found between Case I(a) and Case II.

## PRELIMINARY SIMULATION RESULTS: BI-OBJECTIVE OPTIMIZATION




*Optimization using the objectives of Cases I(a) and Case II*




*Optimization using the objectives of Cases I(b) and Case II*

- Bi-objective optimization using weighted sums method (α is the weight for the DSO and β the weight for the micro-grid).
- A compromised objective of the DSO and the micro-grid operator may lead to less utilization of the energy storage during the day (see right figure for α = 0.99).

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M2M-GRID

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Smart Grids Plus ERA-Net