



Islanding operation of a community power grid with renewable energy sources and a large battery

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How politicians think of renewables



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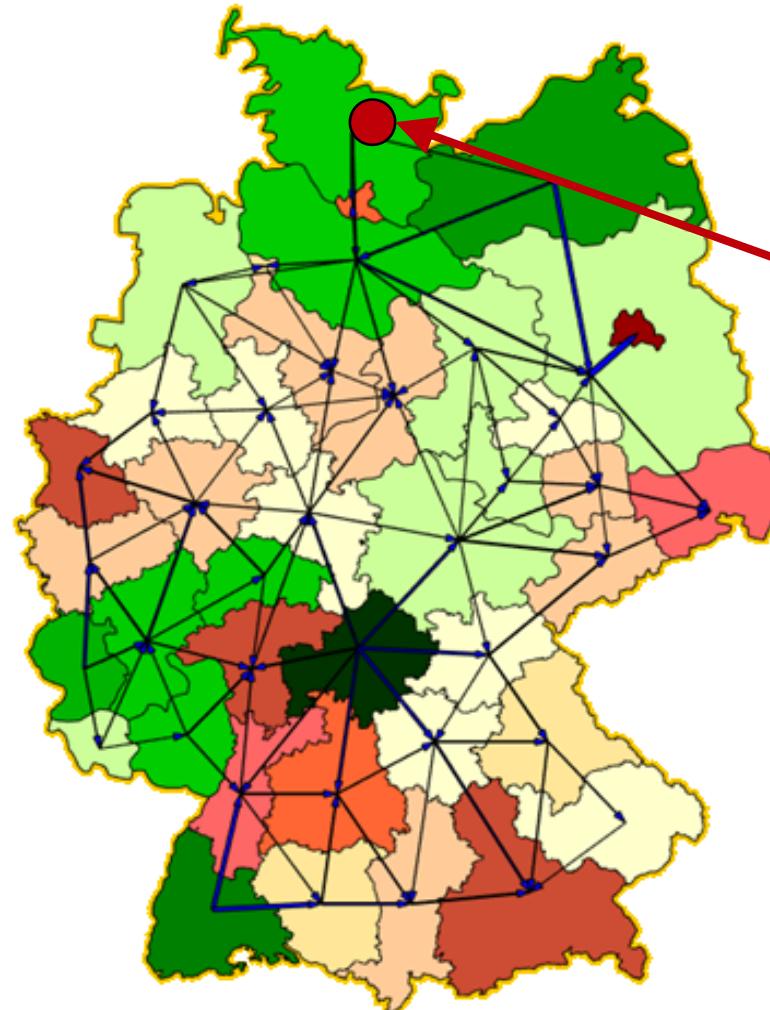
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Renewable energy is decentral

Cellular Power Grids are adapted



Demonstrator for
grid cell:



Battery Bordesholm

Partners



Bordesholm:

- 7500 Inhabitants
- Maximal electrical demand ca. 4 MW
- Installed photovoltaic power 1,4 MWpk
- Power biogas generator 2,4 MW
- Windenergie none

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Battery Bordesholm



- Up to 15 MWh / 12.5 MW
- 7 independent battery strings
- **Normal operation:**
Primary control market
- **In case of emergency:**
Battery supplies island power grid

Primary control operation



- Normal grid operation
- Stock exchange
- For financing
- Prequalified primary control power : 10 MW
- Since summer 2019

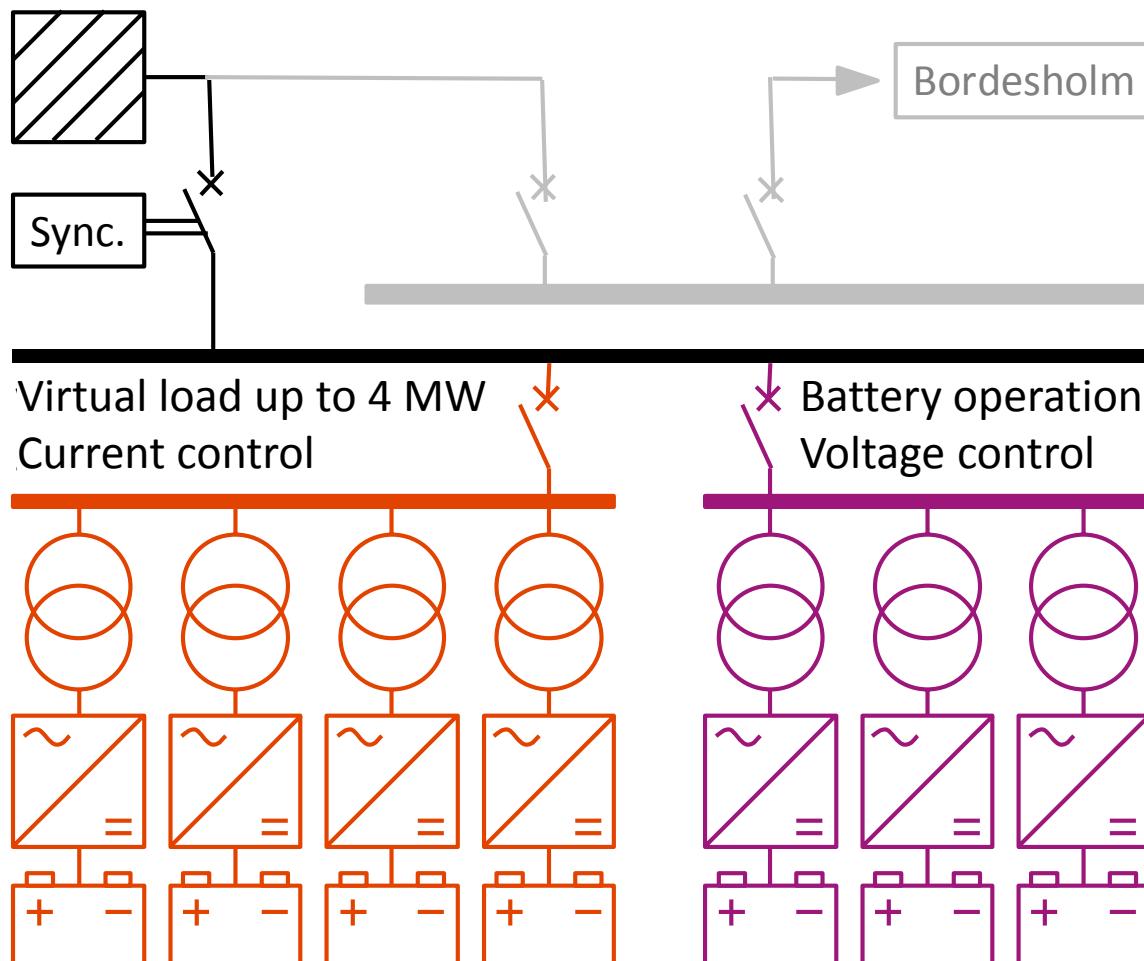
- Power converter operating in **current control mode**

Islanding operation



- Battery as grid former, also for decentral generators
- Power converter operating in **voltage control mode**
- Voltage and frequency droop
- Synchronous coupling switch

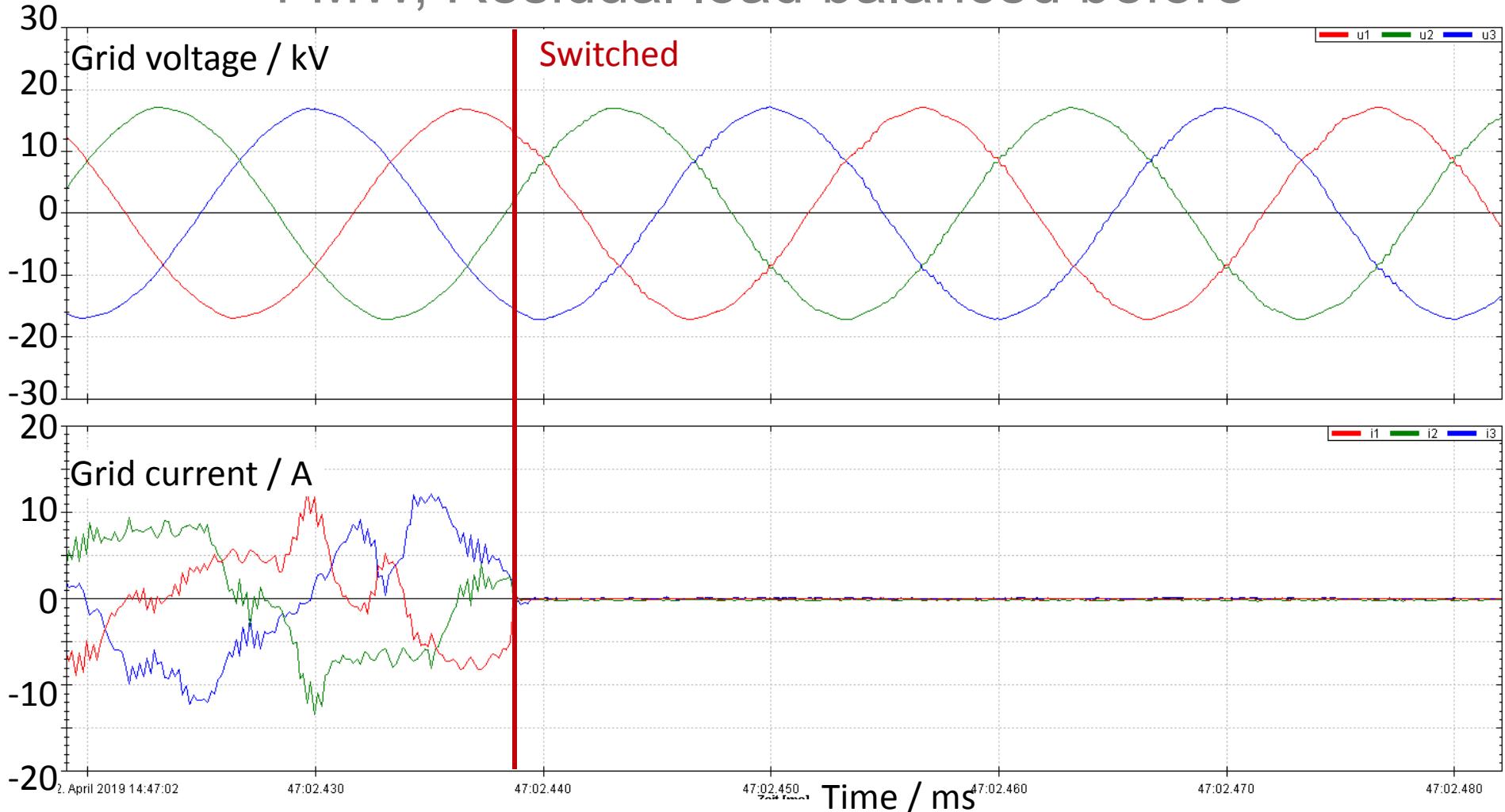
Preliminary experiment



- Battery divided into:
- Virtual load:
 - Up to 4 MW (comparable to Bordesholm)
 - Current control
- Battery
 - Voltage control
 - Grid former
 - Up to max. 7,5 MW Available

Preliminär experiment: Open switch

4 MW, Residual load balanced before



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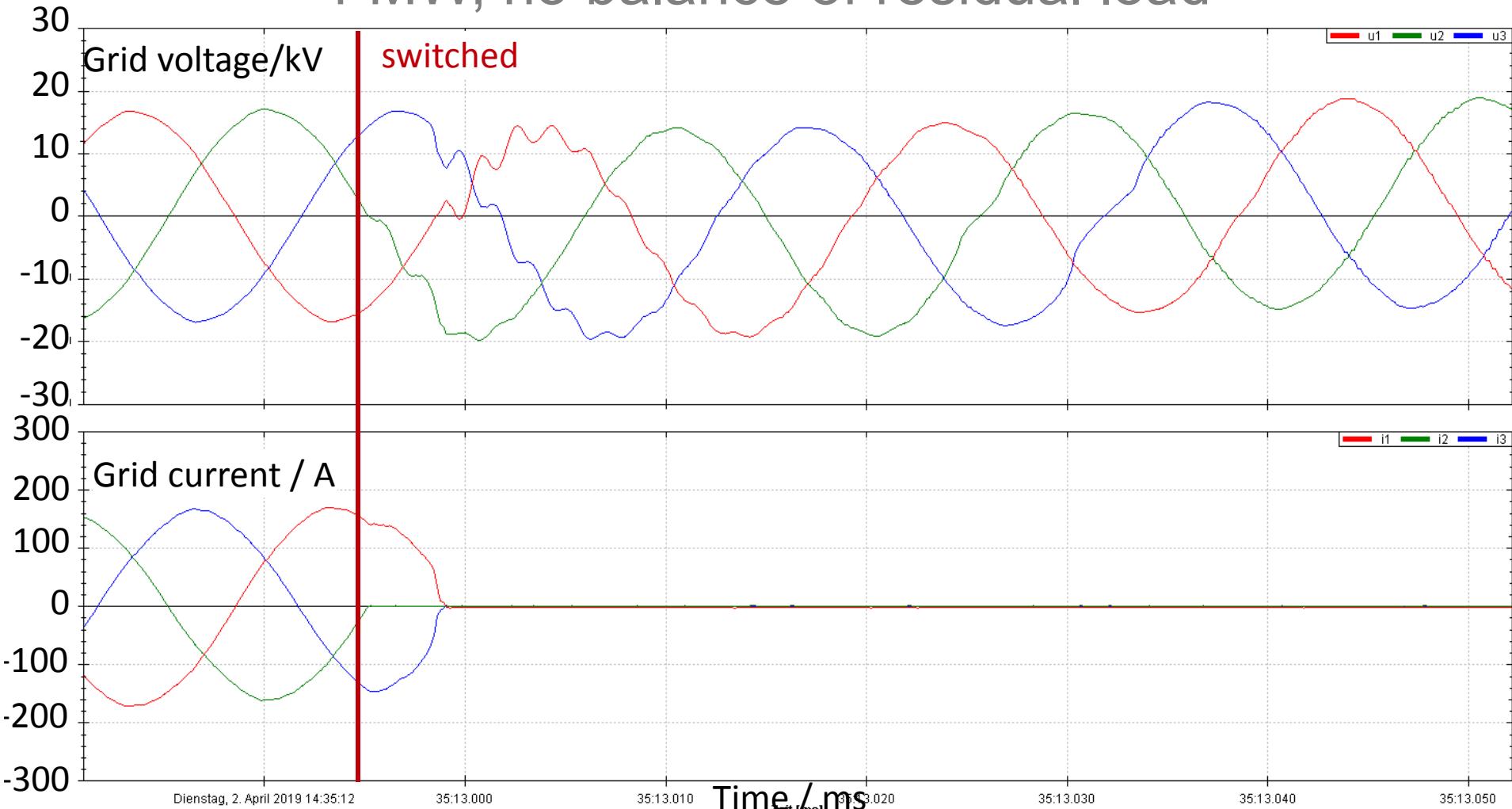


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Preliminär experiment: Open switch

4 MW, no balance of residual load

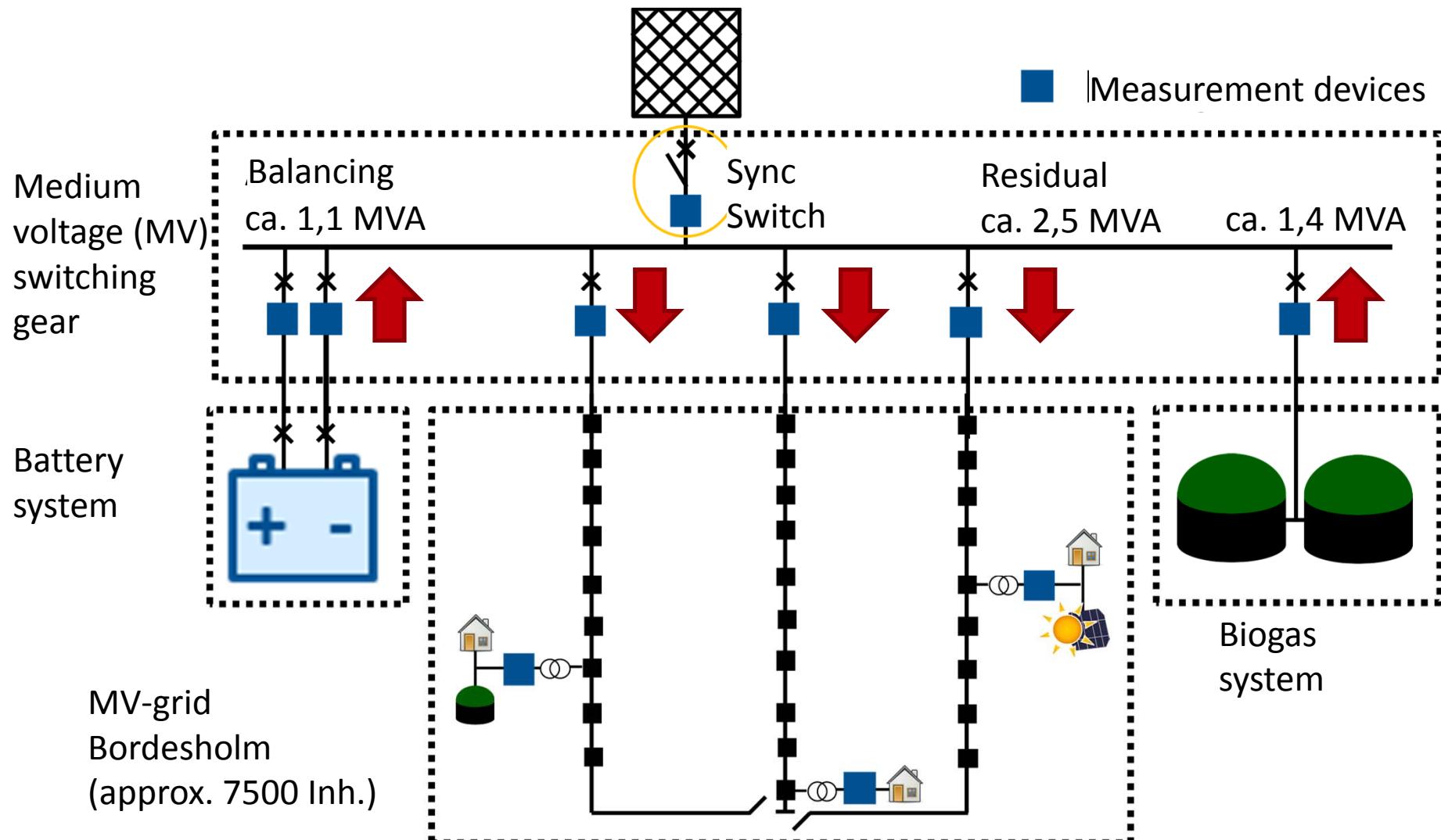


Preliminär experiment

Further measurements successful:

- Load step +1 MW
 - Load step -1 MW
 - Blackstart during islanding operation
 - Re-Synchronisation
- Real experiment with
community of Bordesholm planned!

Islanding experiment



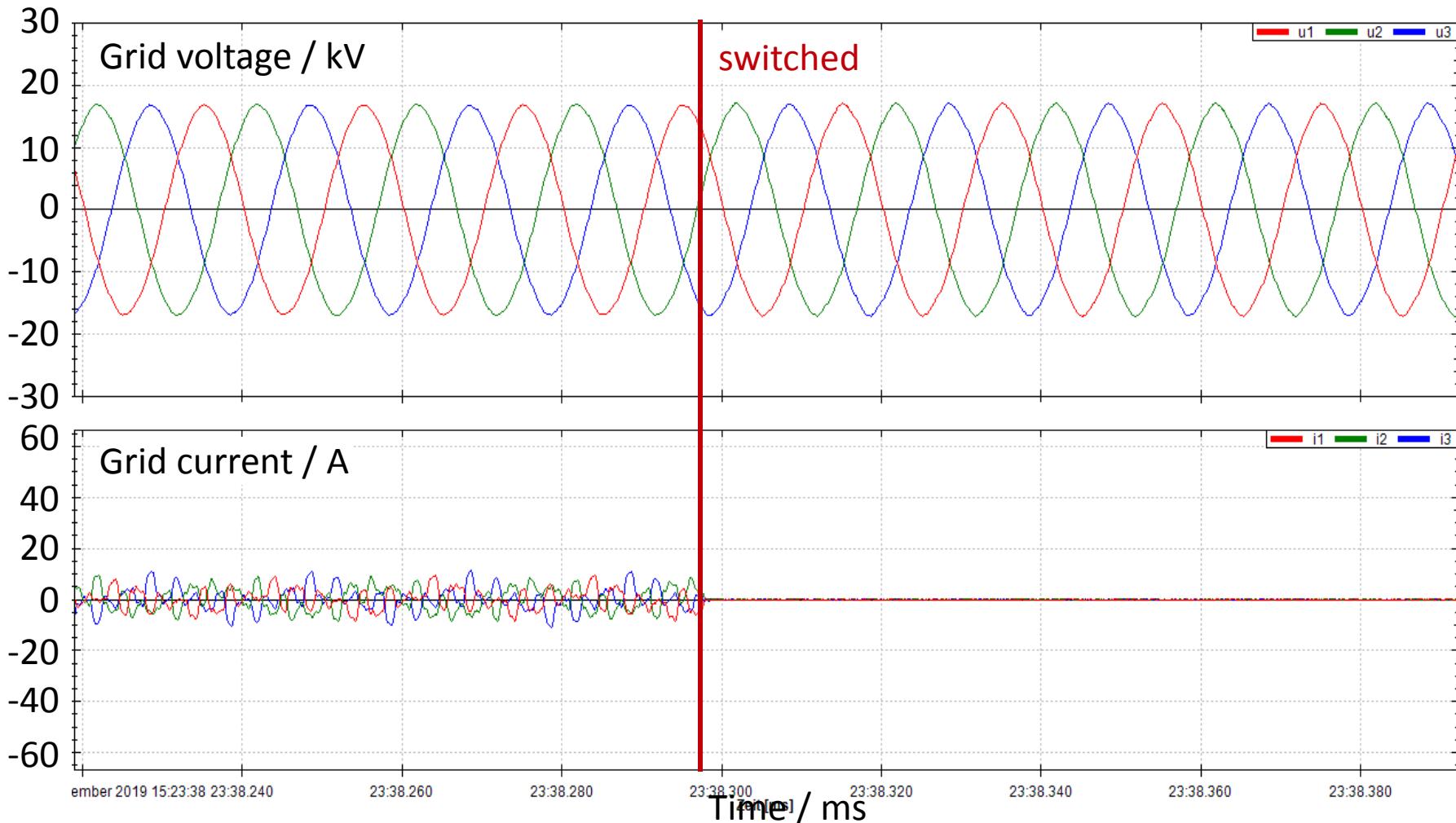
Islanding experiment



- With community of Bordesholm
- Approx. 1h island operation (with breaks)
- Supply with renewable energy (uncontrolled)
 - PV,
 - CHP
 - Biogas
- Battery for balancing

Islanding experiment

Transfer to island operation without residual load



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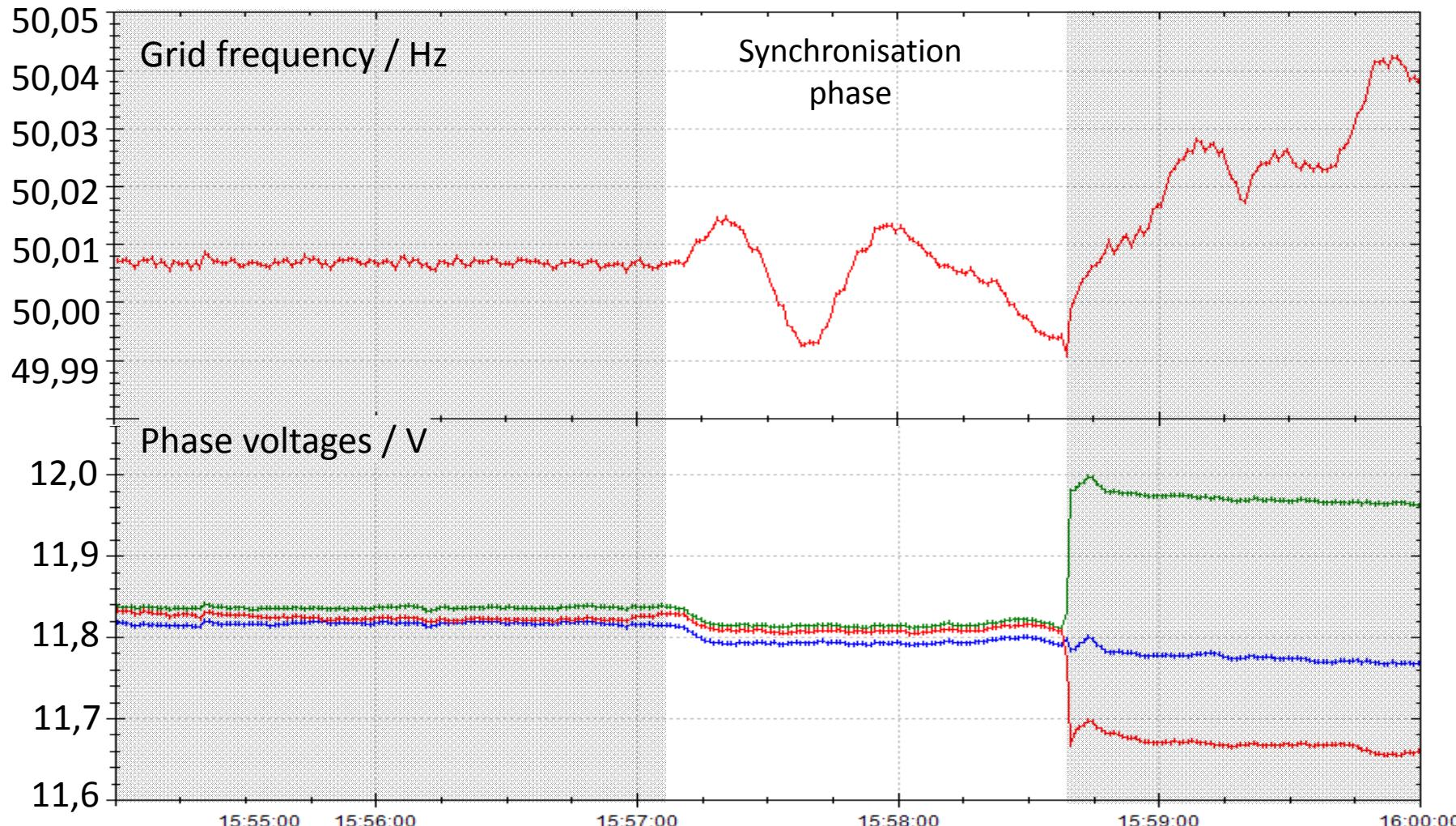


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Islanding experiment

Re-sync to main grid operation



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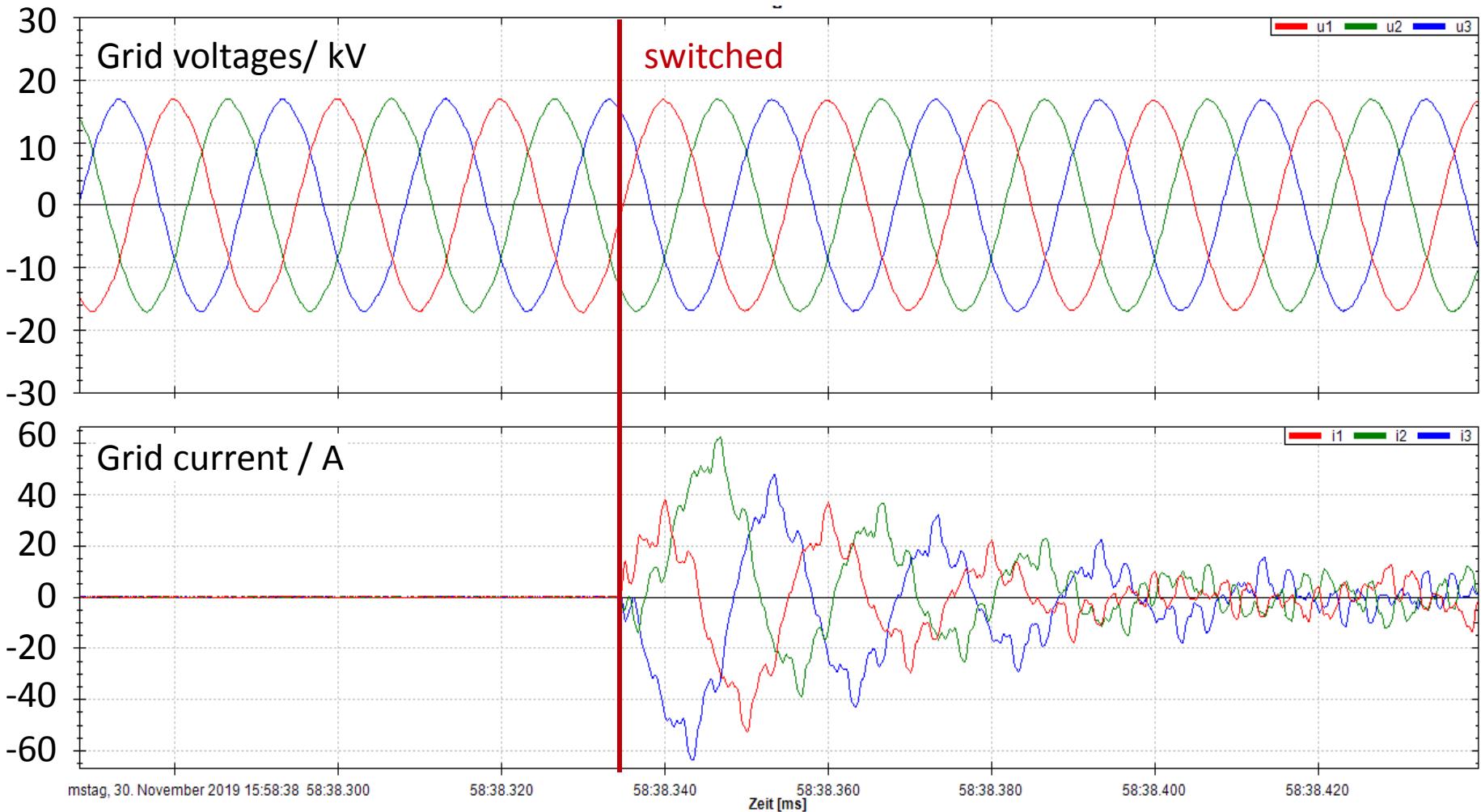


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Islanding experiment

Re-sync to main grid operation



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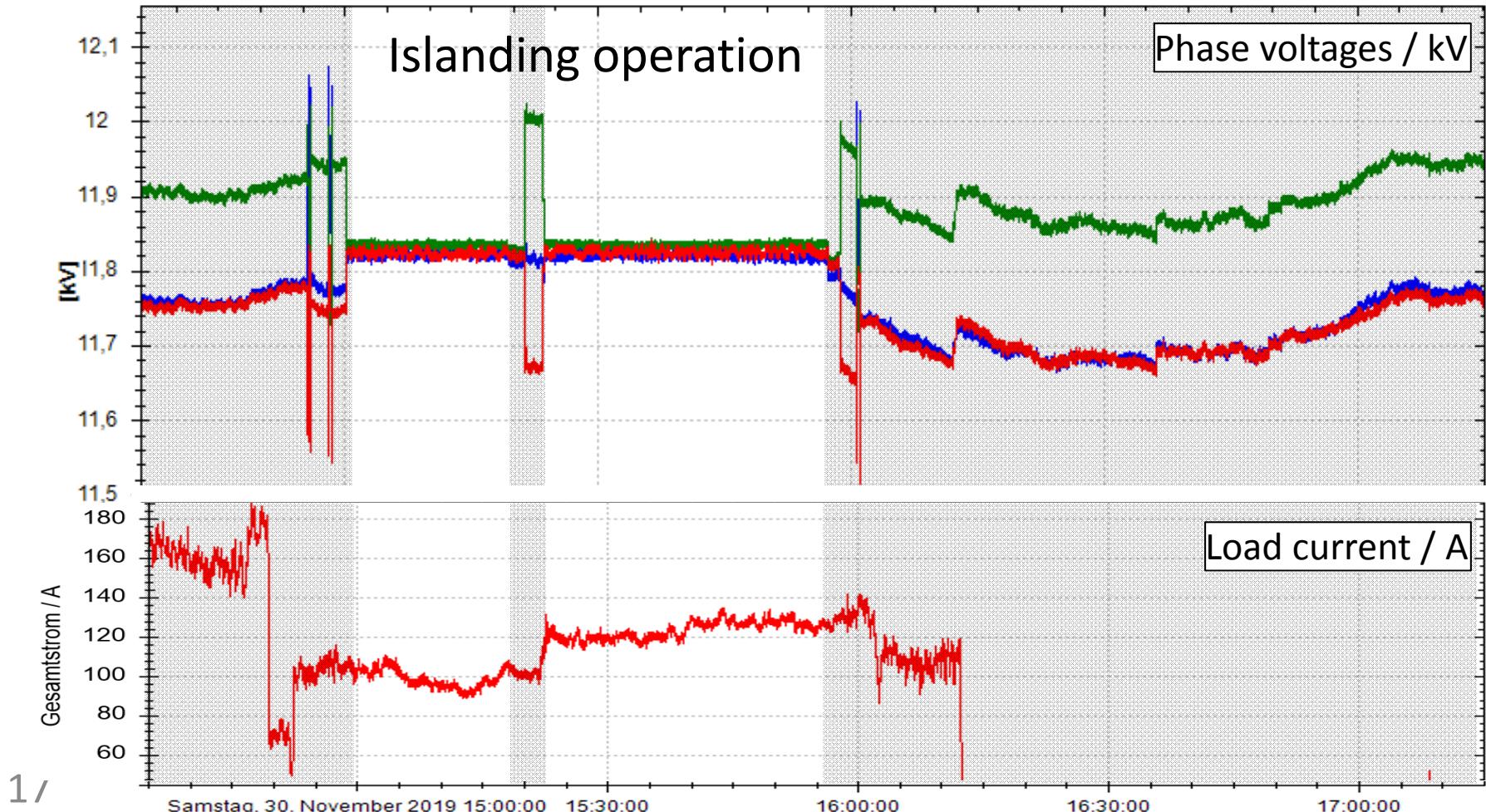
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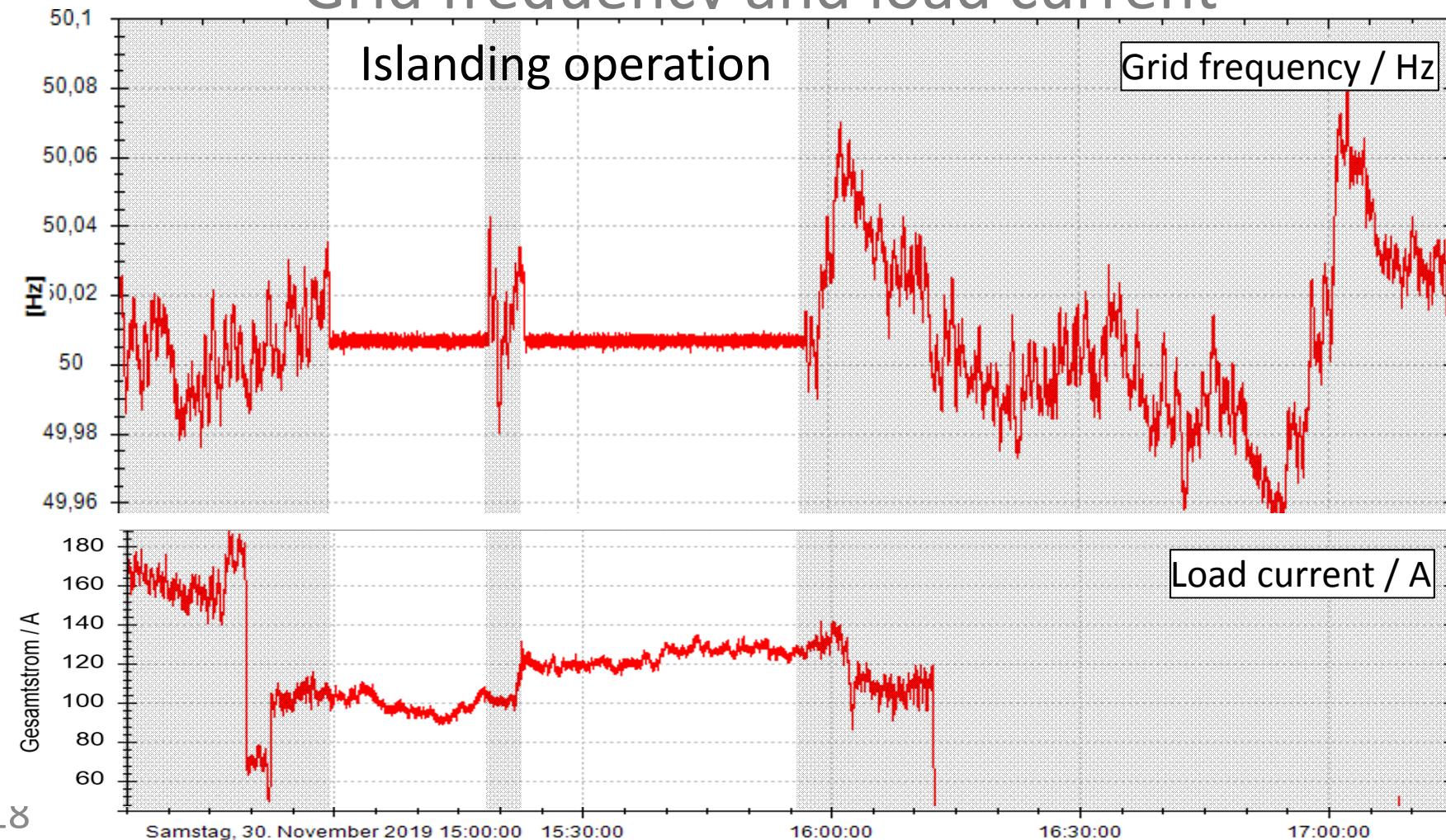
Islanding experiment

Phase voltages and load currents



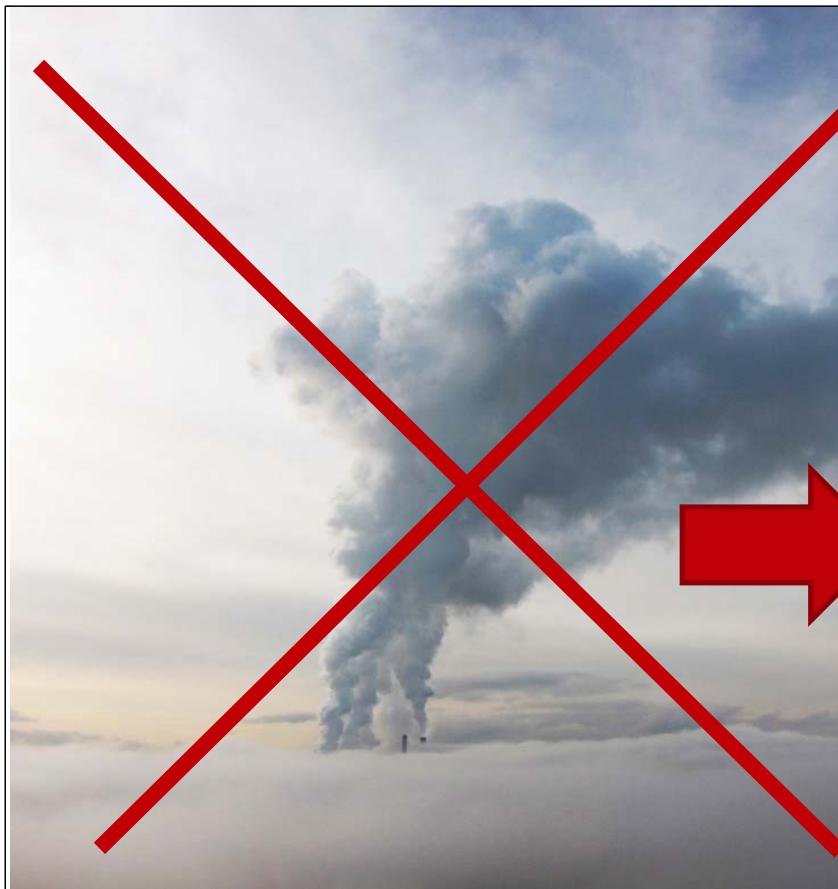
Islanding experiment

Grid frequency and load current



Conclusion

Grid control without large power plants is manageable



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