



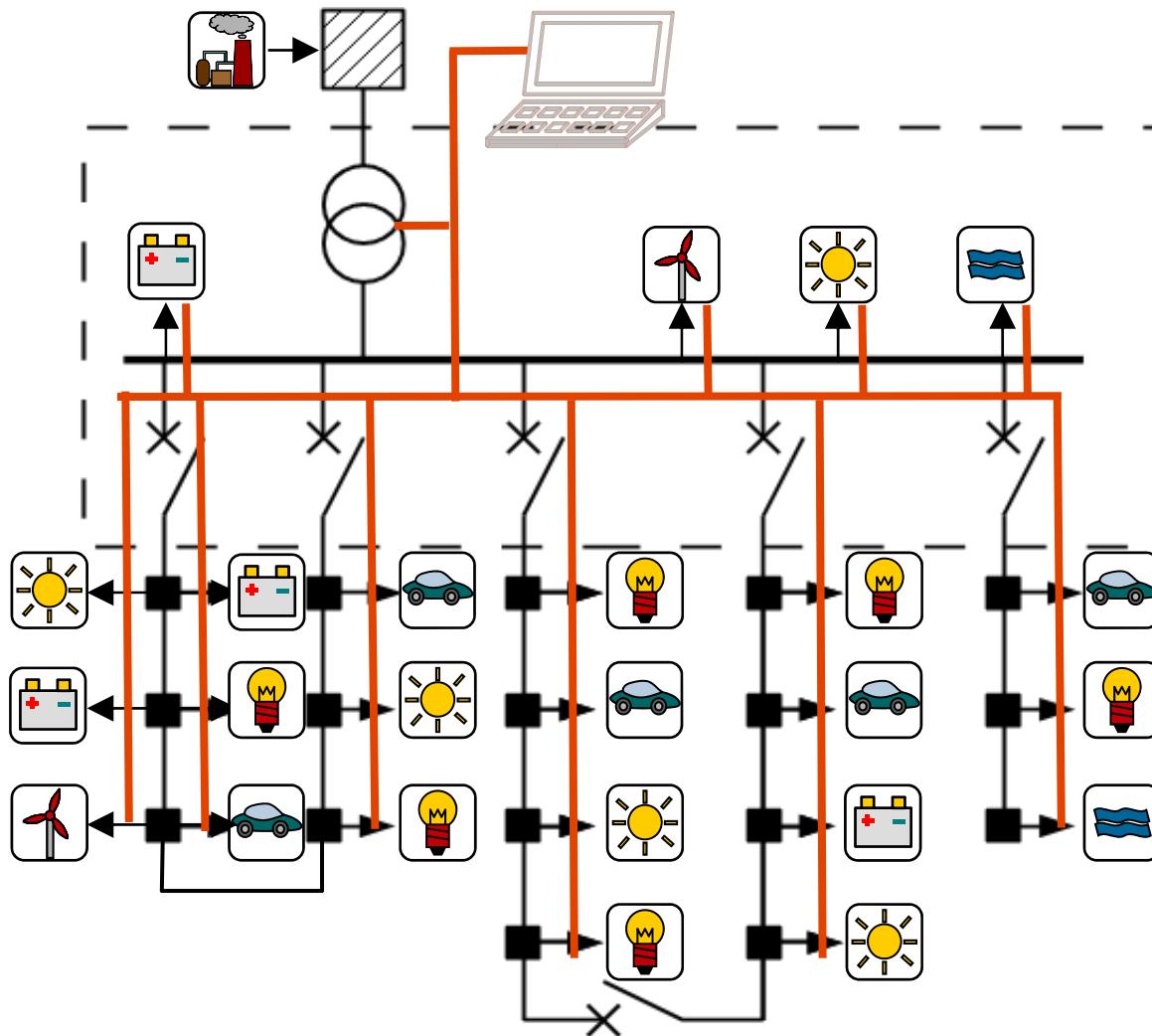
Decentralized measurements of the grid state

Eberhard Waffenschmidt

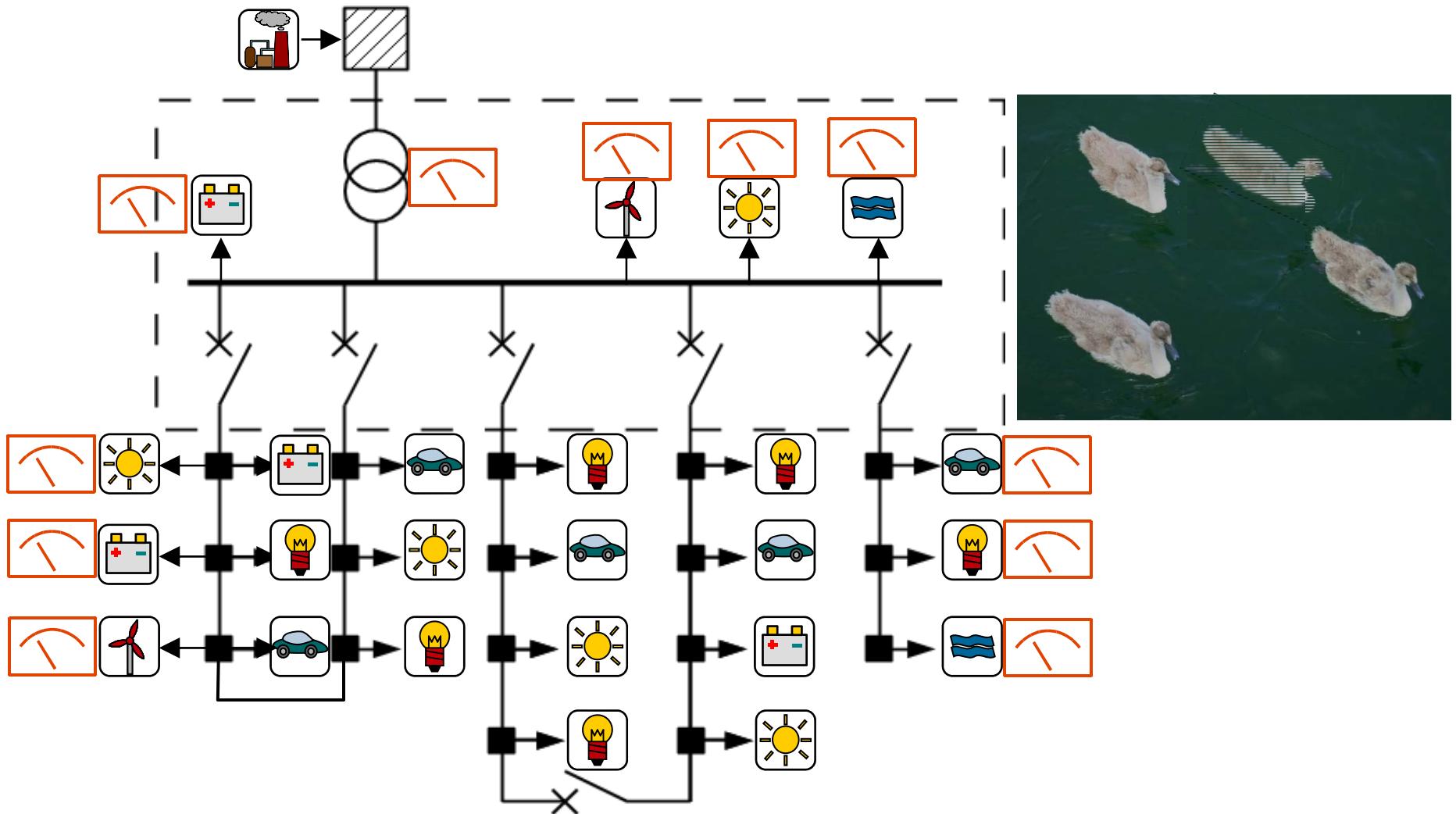
IESC 2018, Cologne, 17.-18. May 2018

Acknowledgements to: Leonard Schwochow, Sebastian Kersten, Kunal Saraf

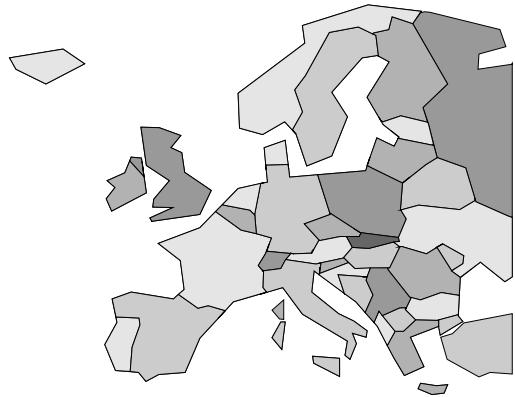
What people consider as Smart-Grid:



Swarm-Grid instead of Smart-Grid:



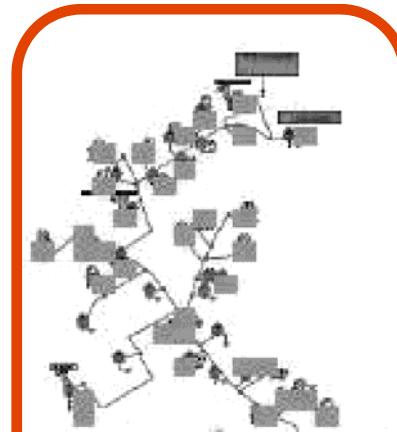
Measurement methods



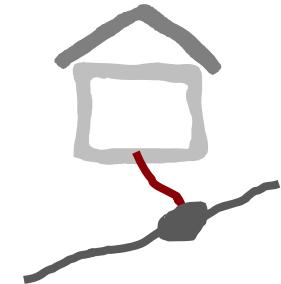
Complete Grid



Region



Surrounding



Connection point

Grid
Frequency



Phasor-
Measurements



Grid
Impedance



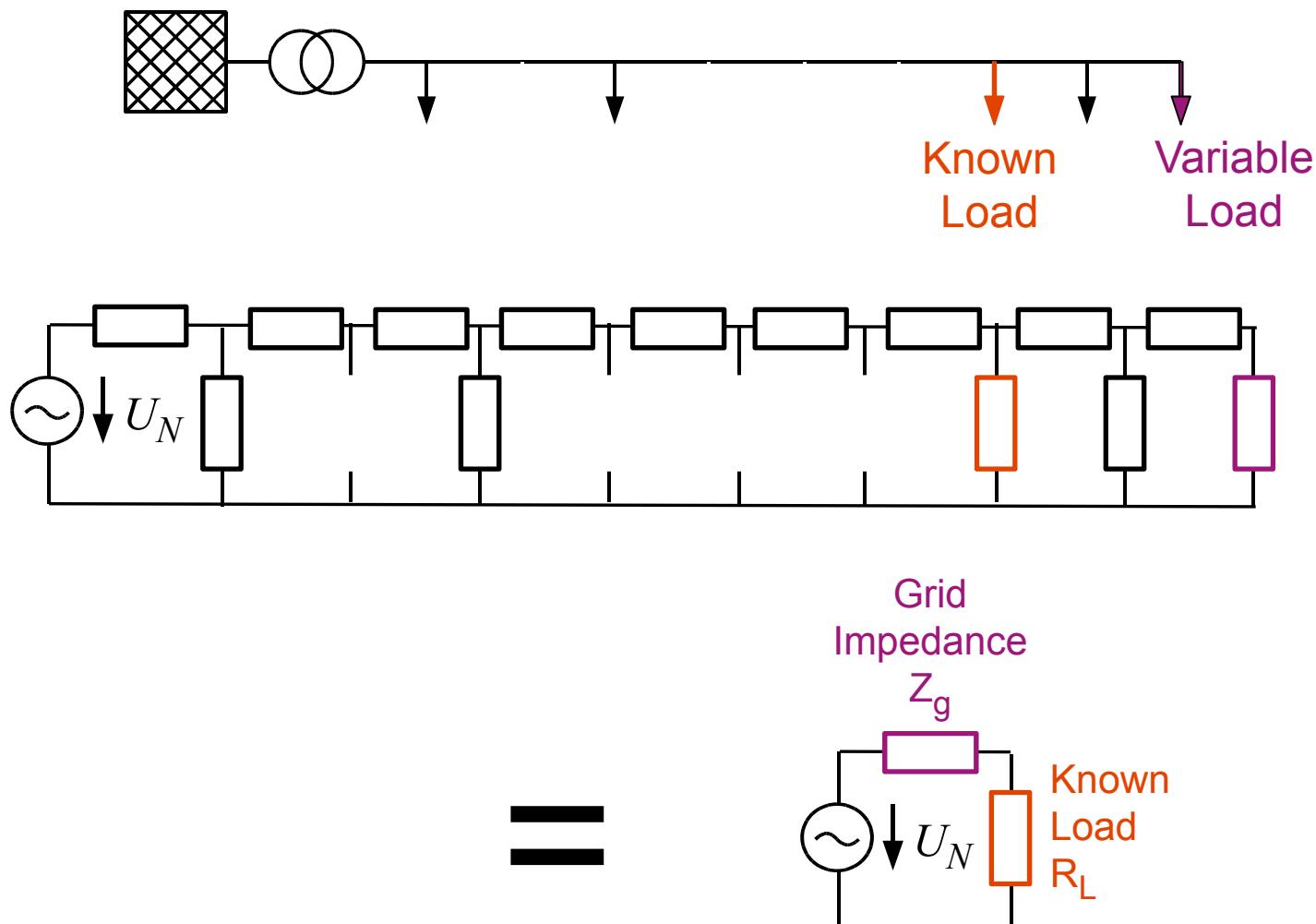
Voltage



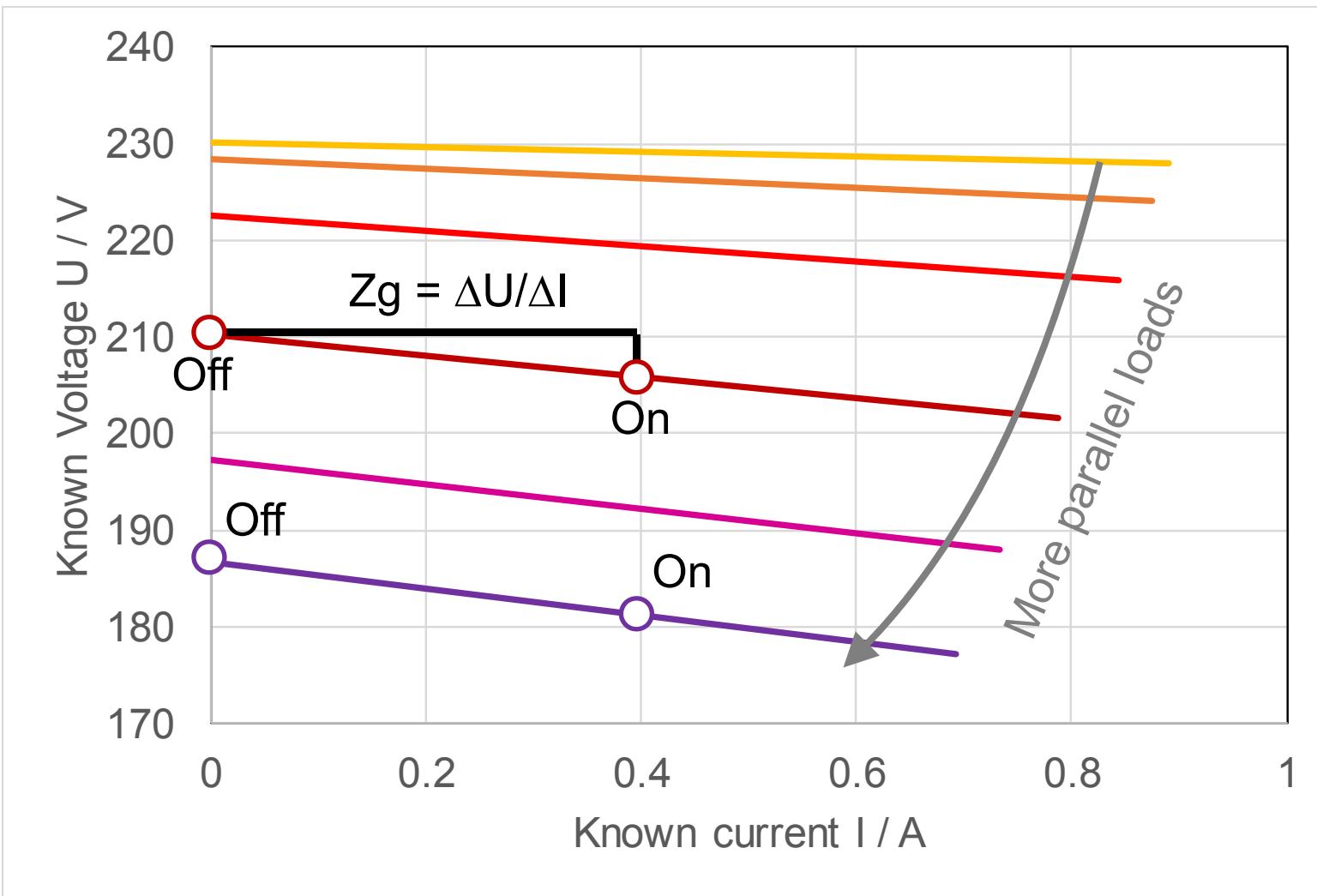
Grid Impedance Measurements



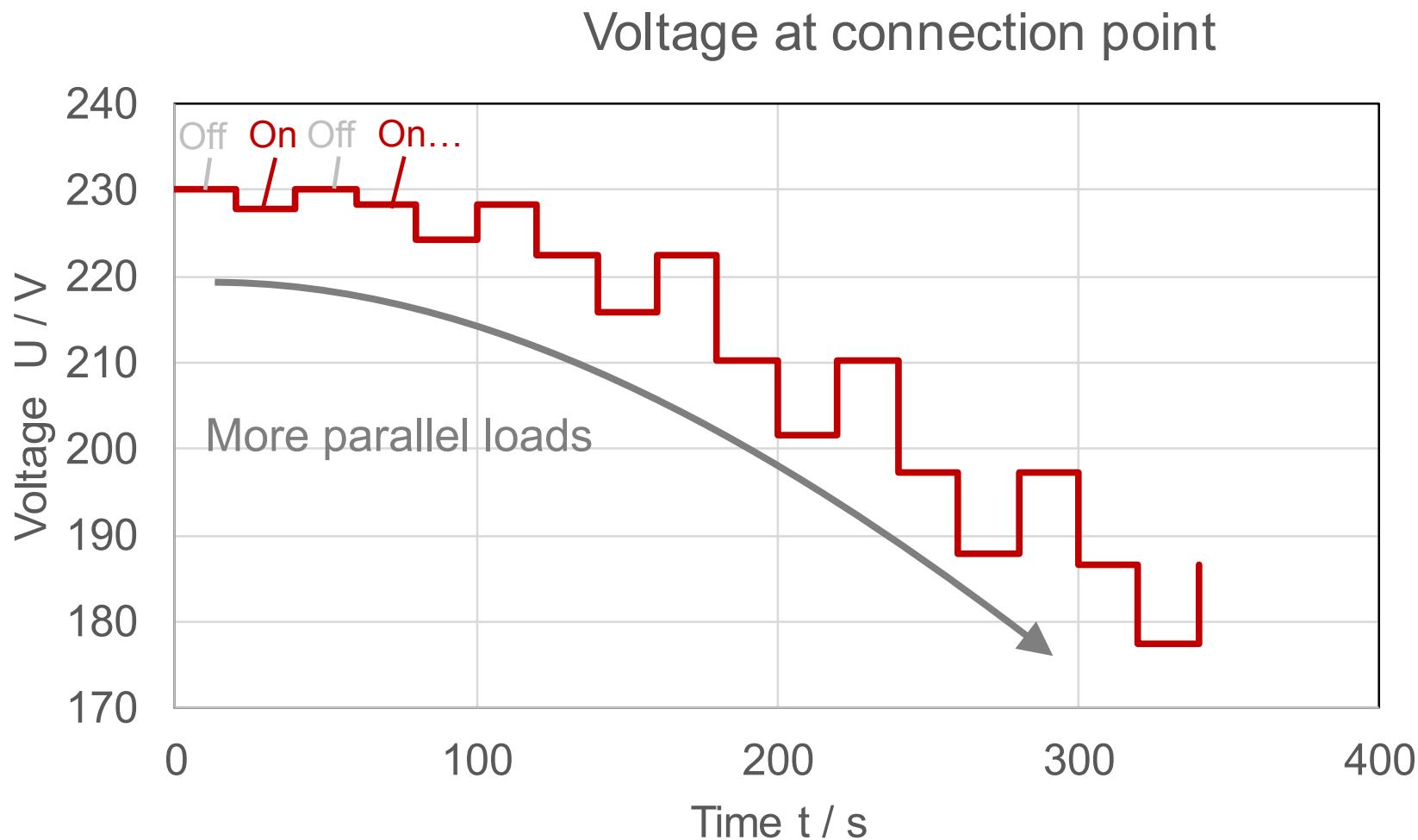
Grid Impedance and Admittance



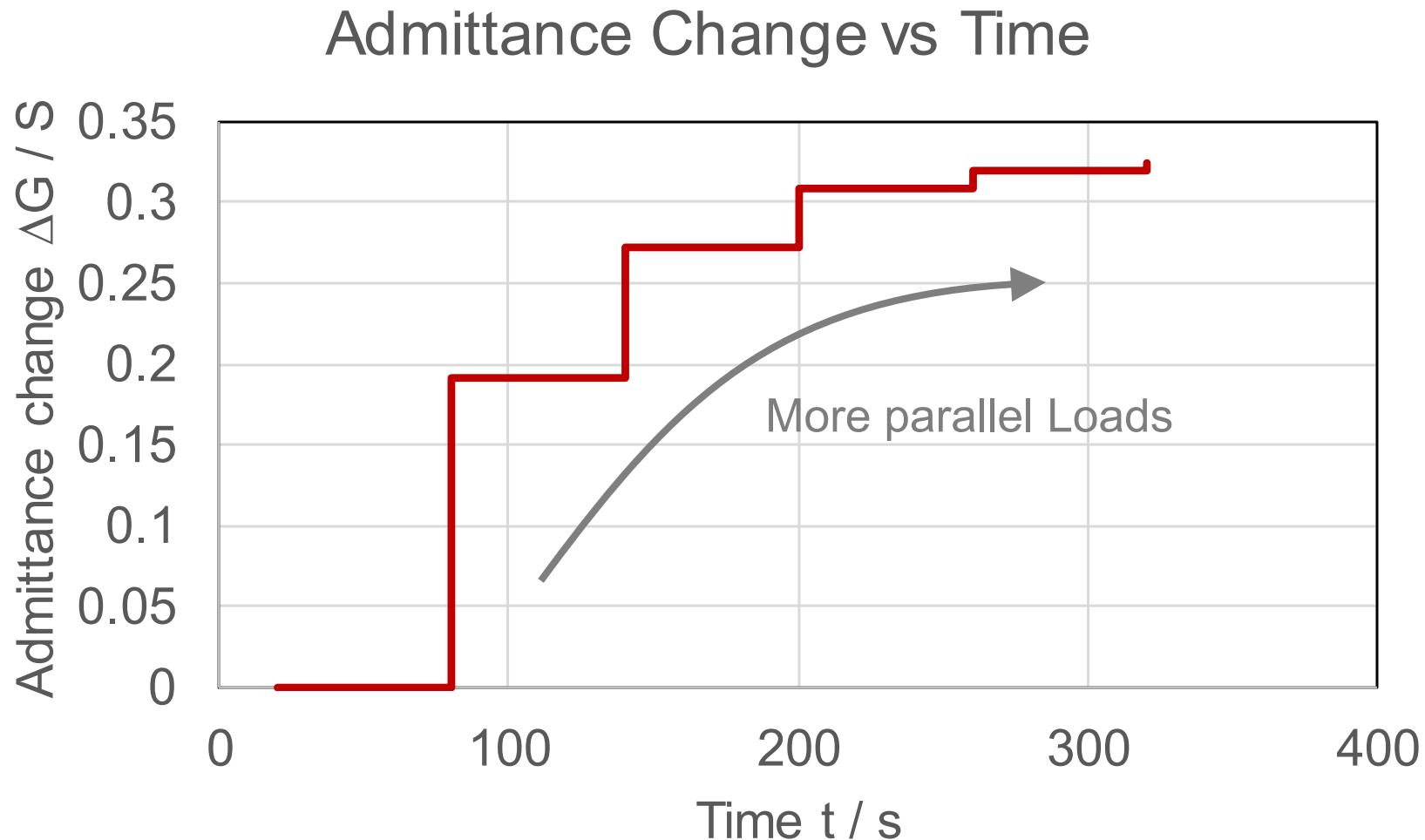
Current and Voltage at Connection Point



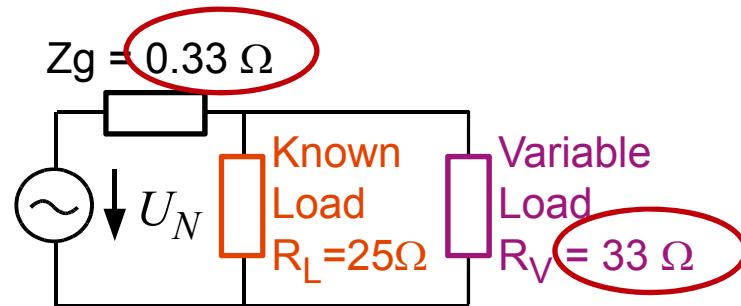
Switching and Measuring Principle



Change of the Grid Admittance

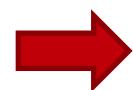


Real case: Household



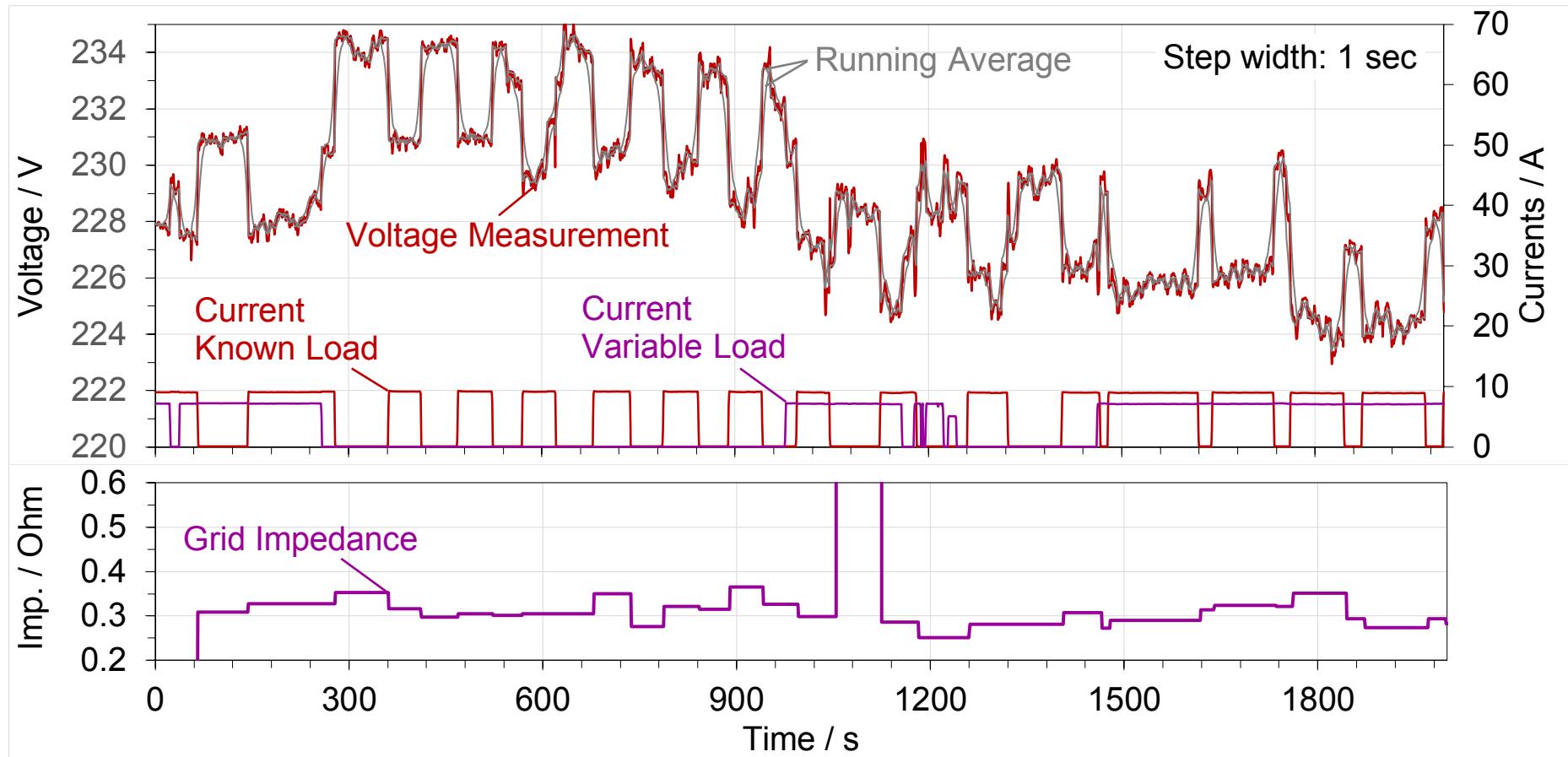
Assumptions

- 25m long, 1.5mm^2 Cross section
- Known Load: 2 kW
- Variable Load: 1.5 kW

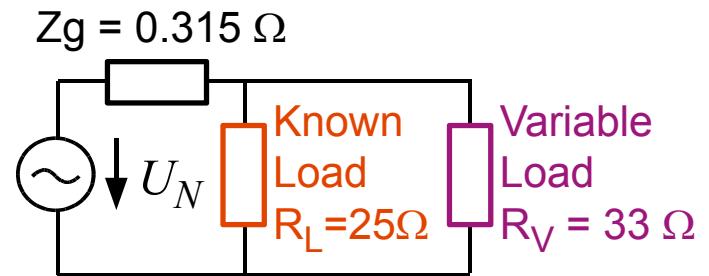
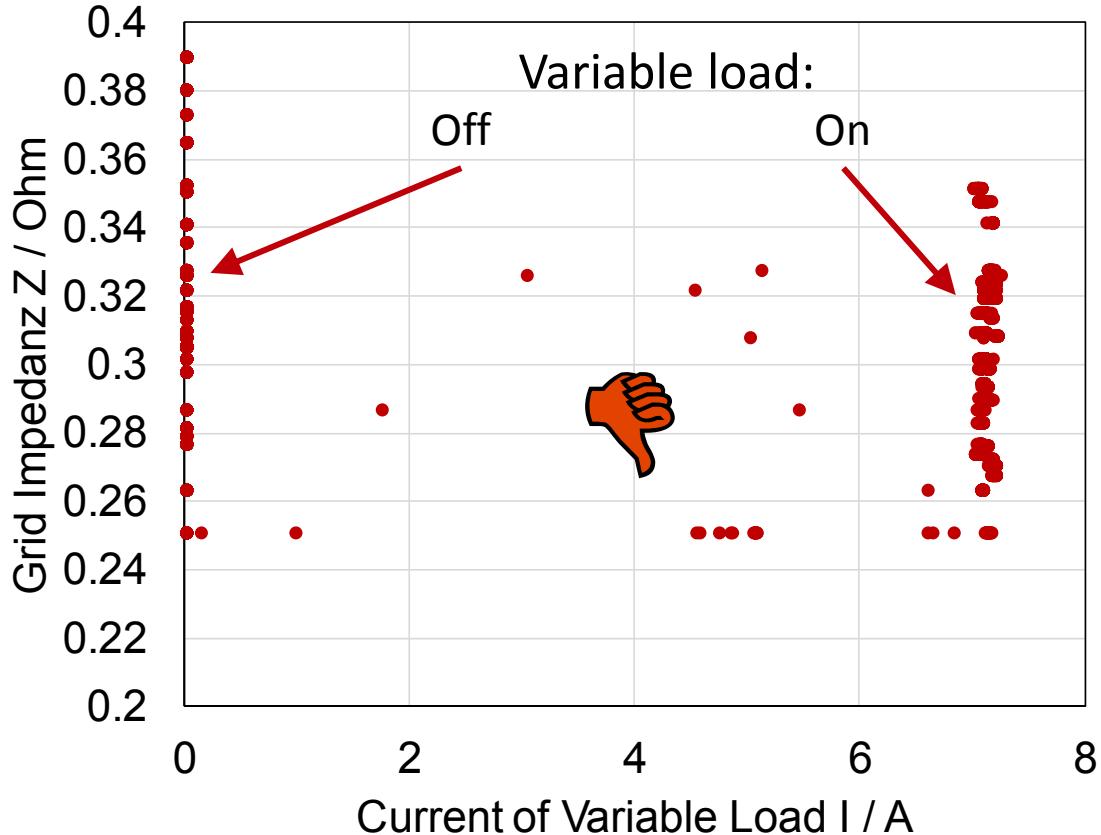


1% Preciseness required!

Measurement of Grid Impedance

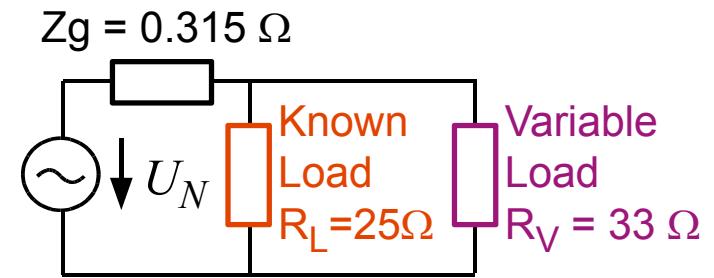
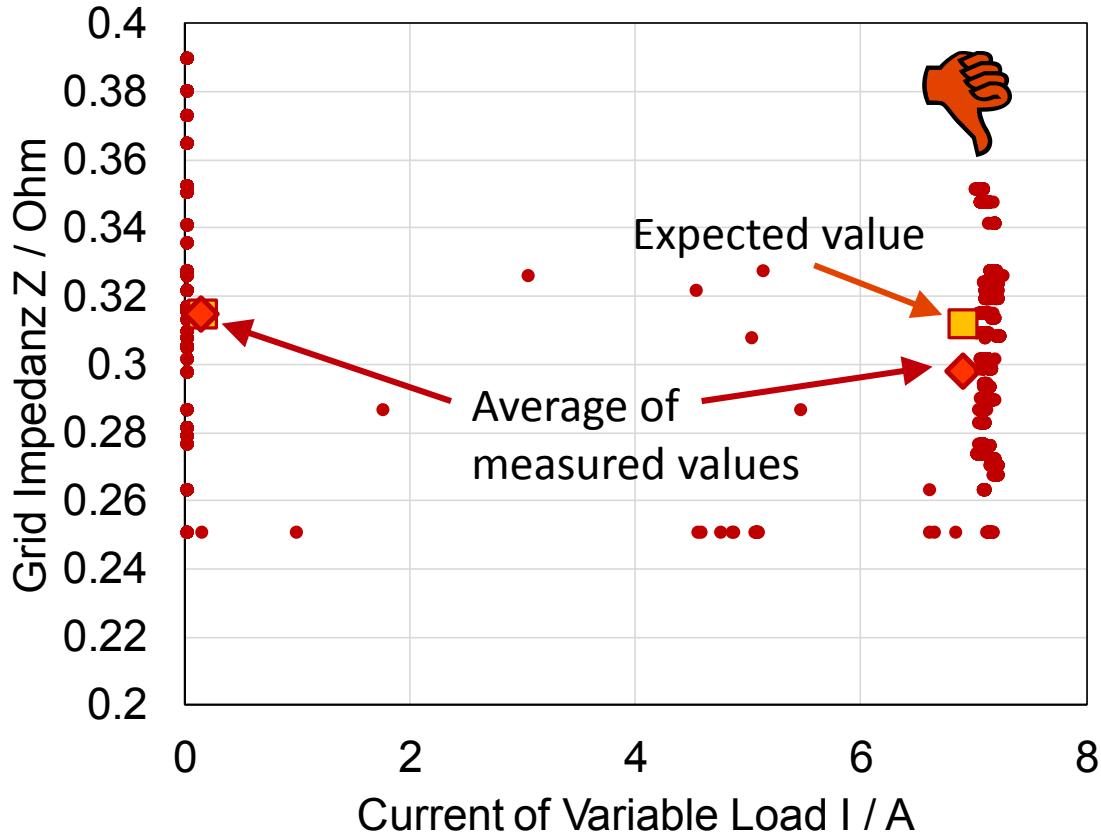


Measurement of Grid Impedance



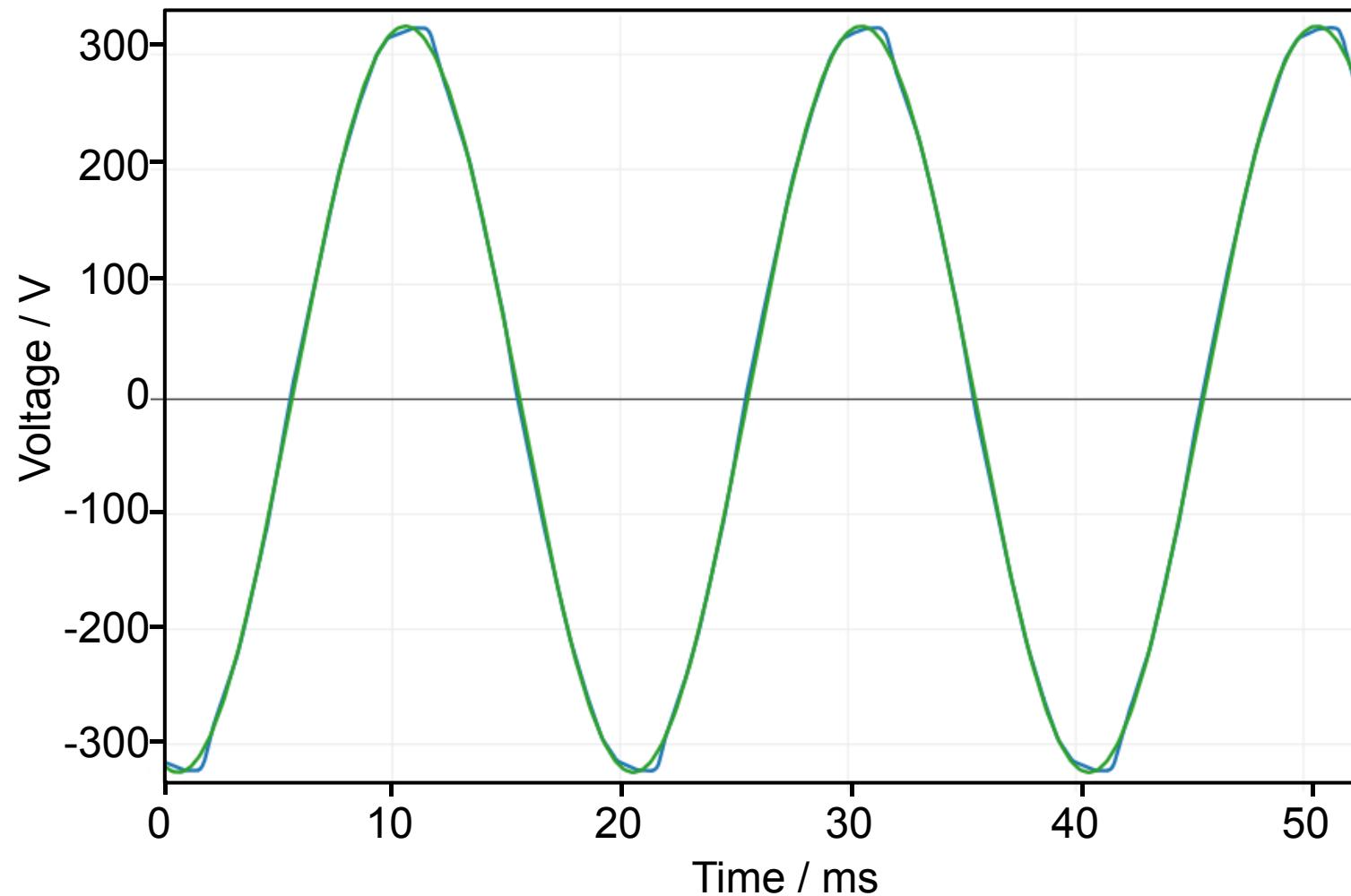
- Large scatter of Grid impedance measurement

Measurement of Grid Impedance

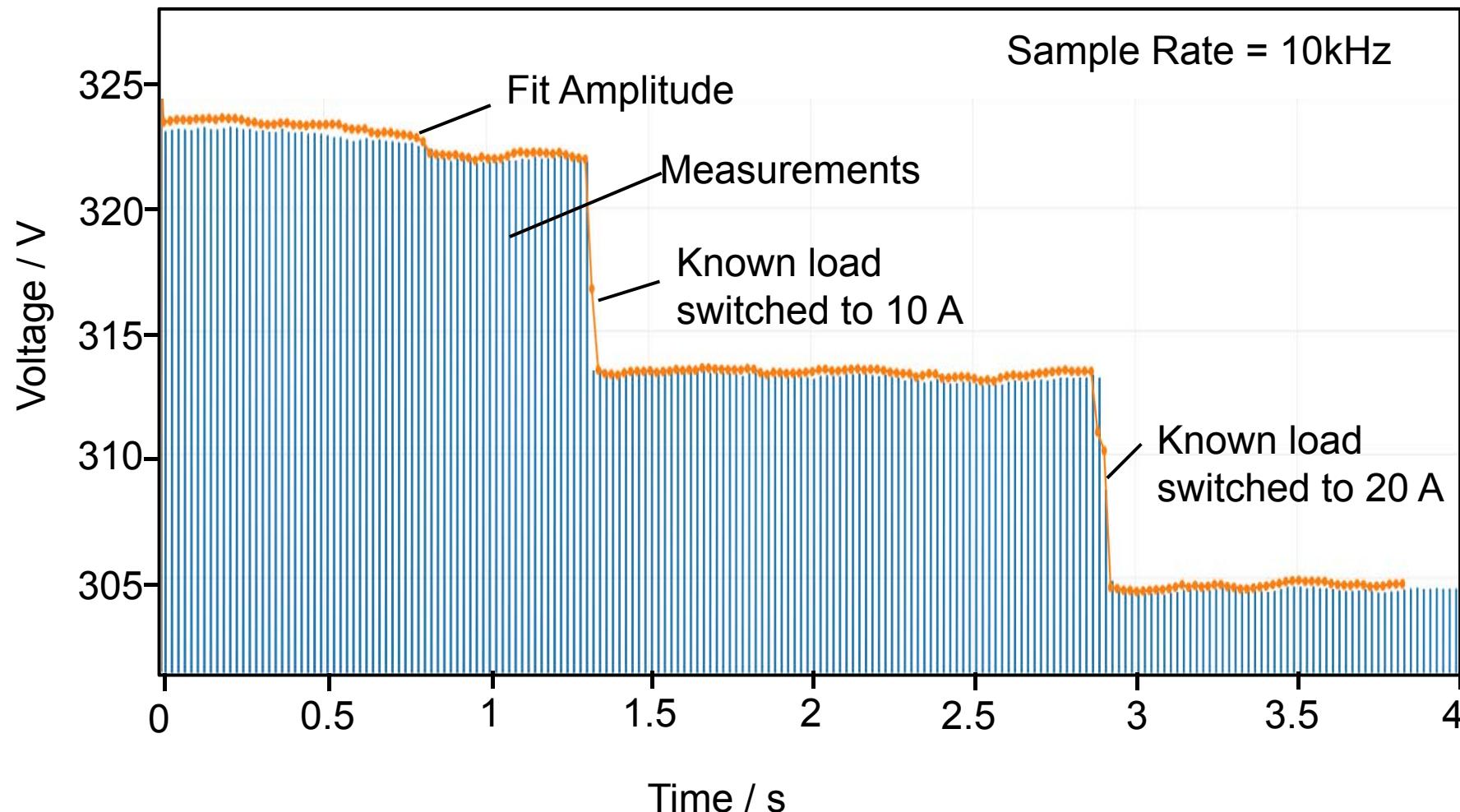


- Averaging:
- Confirms trend
 - Still much too large deviation from expected value

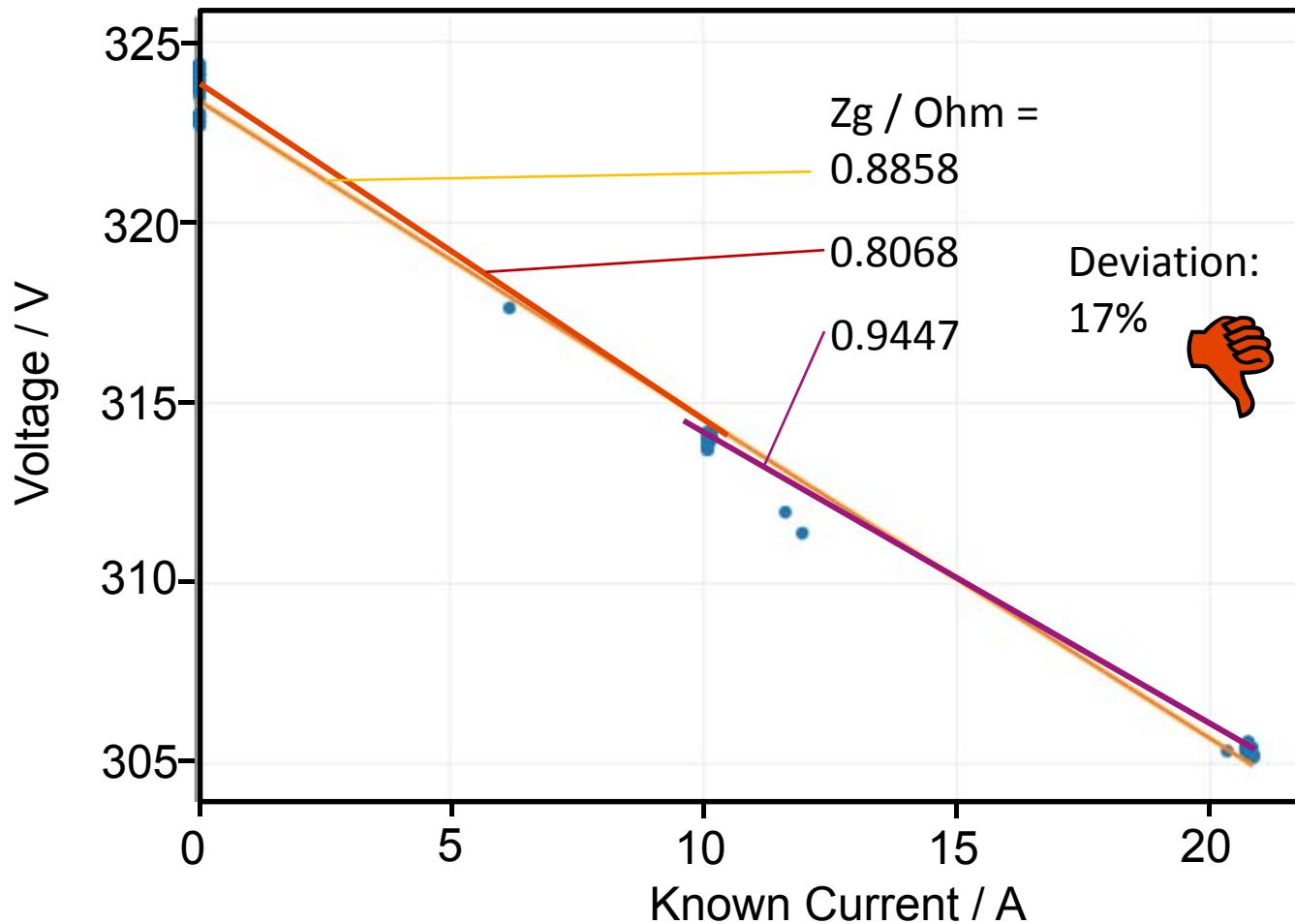
Higher Preciseness with Fit Algorithm?



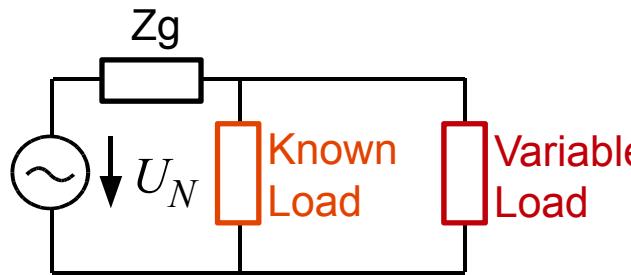
Voltage Measurement with Fit



Fit of Grid Impedance



Additional Problem:



Differential Resistance:

- Resistive \rightarrow Positive Value
- or
- Power Sink \rightarrow Negative Value

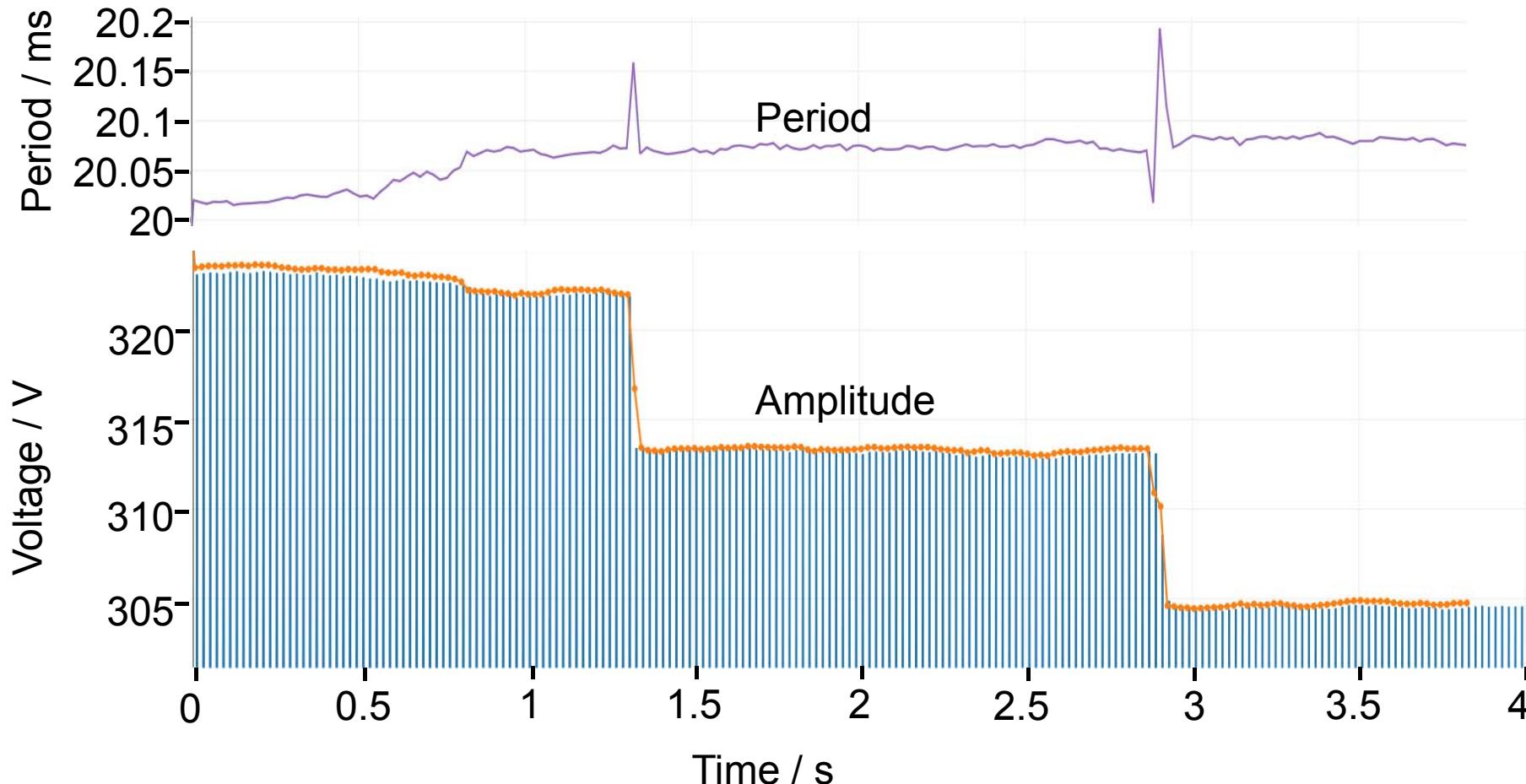


Never give up:

Phase or Period measurement
may help to distinguish voltage steps



Follow up
for details



Conclusion

Grid impedance measurement to determine loads in the grid

- Require too high preciseness
- Loads as power sinks lead to negative differential impedance

→ Not suitable 

- Combination with voltage phase change 

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