MICROGRIDS – Novel Architectures for Future Power Systems, Paris, France, 29 January 2010

Field Tests on Actual Microgrids

Highlight results from the case of Bronsbergen, Zutphen, The Netherlands

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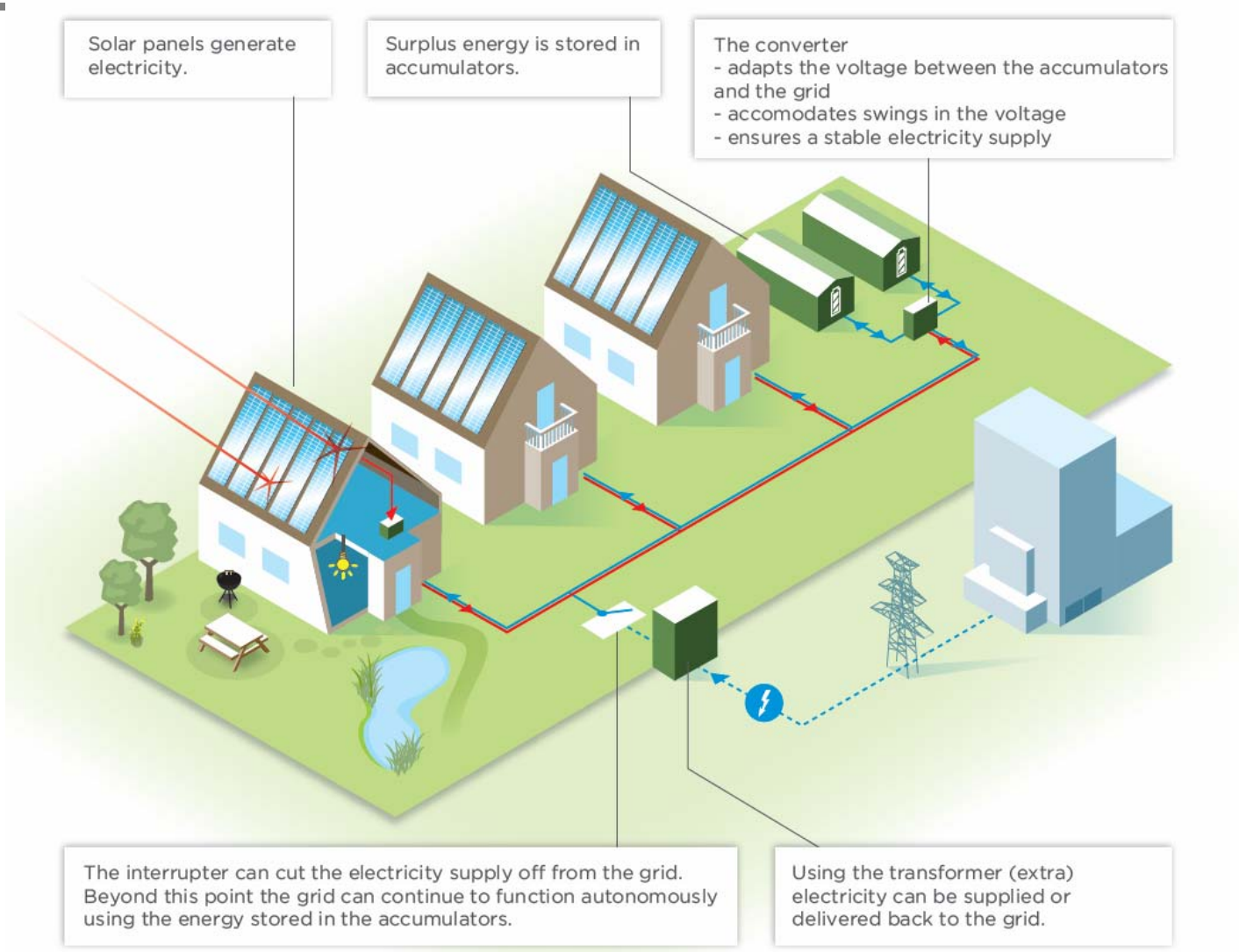
www.microgrids.eu

Microgrid “Bronsbergen”, the concept



Bronsbergen holiday resort

Holiday park, Zutphen, NL

108 cottages with PV roofs

Installed solar power 315 kWp

Peak load 150 kW

Research objectives

1. Maintaining islanded mode for 24 hours
2. Automatic isolation from and reconnection to MV network
3. Ensuring fault level to ride through MV fault and microgrid feeder faults
4. Reduced harmonic distortion, damping of resonances
5. Develop optimal energy management for service life optimization of battery system
6. Parallel operation of inverters
7. Black start demonstration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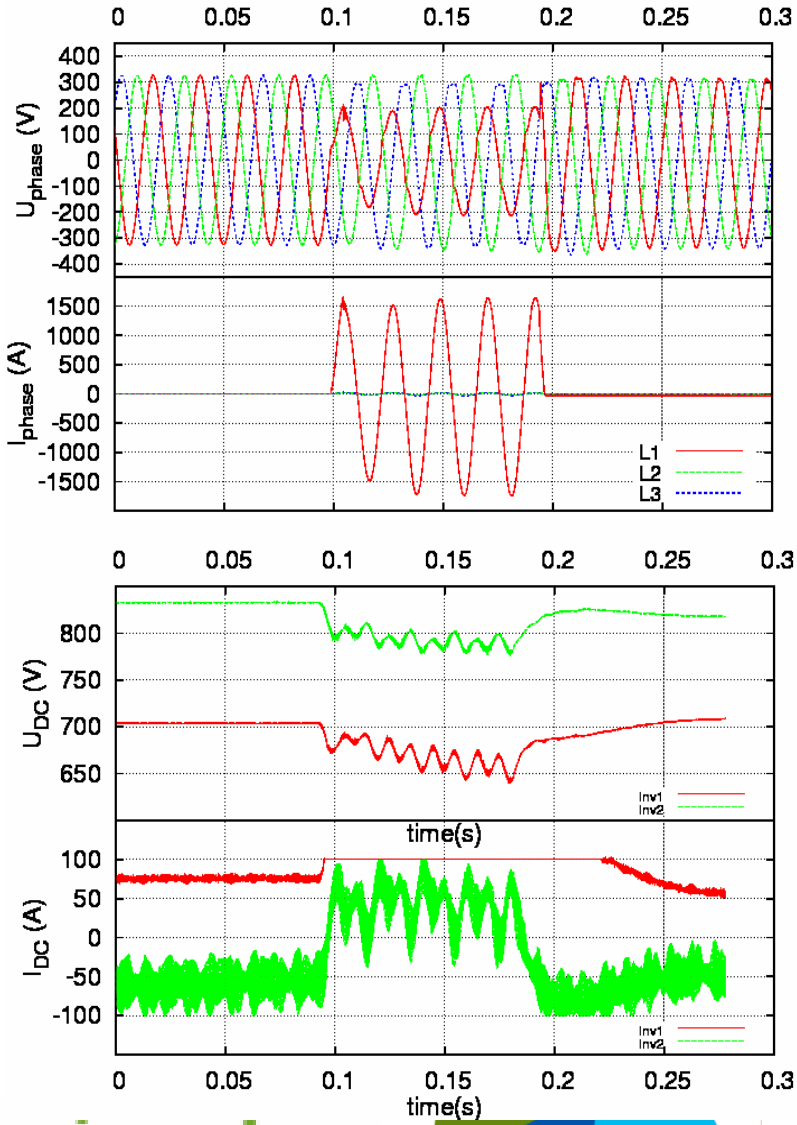
What about the test objectives ?

- Demonstrate stable parallel operation of inverters and load sharing in islanded mode √ done
- Demonstrate fault level in islanded mode √ done
- Demonstrate cap. to manage battery energy and lifetime √ done
- Demonstrate reduction of harmonics √ done, objective had to be expanded: successfully implemented after submission of report
- Demonstrate black start capability of microgrid √ done
- Demonstrate automatic isolation and reconnection √ done
- Demonstrate long-term islanded operation principle demonstrated, but 24h not permitted – load during the nights too high for batteries

short circuit tests - typical recording



1-phase to neutral fault

50 mΩ in each phase

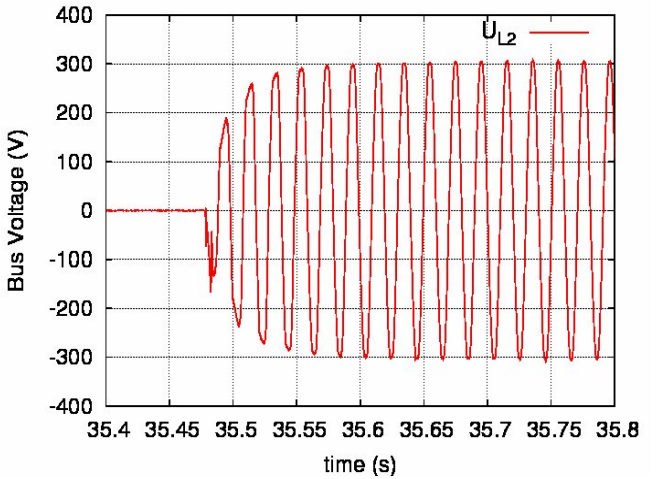
2 inverters parallel

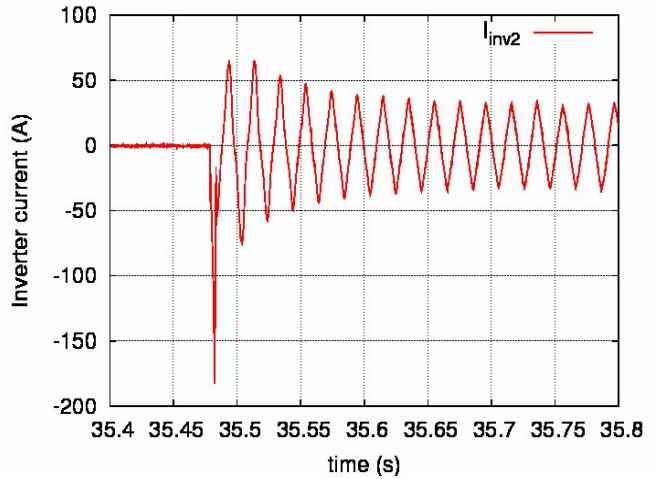
Initially one inverter absorbs 50 kW (green),
the other inverter supplies 50 kW (red)

Black start

Objective:
Show that a single inverter is capable to black-start a de-energised distribution network.

Methodology:
Run the microgrid in islanded operation, then switch both inverters off. Restart one inverter.





Important lessons learned

- Knowledge about the influence of dispersed generation in the low- voltage network
- Important knowledge about the ways to increase the maximum amount of DG in the low voltage grid without investments in the network itself.
- Advantages and disadvantages of storage in the low voltage network
- Costs involved in building microgrids (to make the cost-benifit analysis)

Important lessons learned

- Be aware that additional hard- and software gives a need for instruction and education of all who has to work with the equipment
- Additional safety-issues will rise as protection of equipment, (intended) islanding, protection against electric shock
- Cooperation with customers is required and information has to be given in an early stage

Lessons learned

- We started to make operational procedures for microgrids within a DNO framework - but more work needed, training of staff is a major issue
- Battery inverters with proposed control system , SC rating and black start capability very suitable for microgrids that must swap between grid-connected and islanded mode → being commercialized right now
- Very powerful capability to improve harmonic behaviour of the network → being commercialized right now
- Island detection on microgrid level remains an issue: Is possible but not as simple as for a single inverter. Standardization of concept would be helpful
- Batteries must be dimensioned generously to avoid operating too close to reliability limit; synchronization may fail if SOC close to 100%
- Adherence to grid codes by all components must be certified (our PV inverters failed to switch off when f>52 Hz)

Part of the Project team