

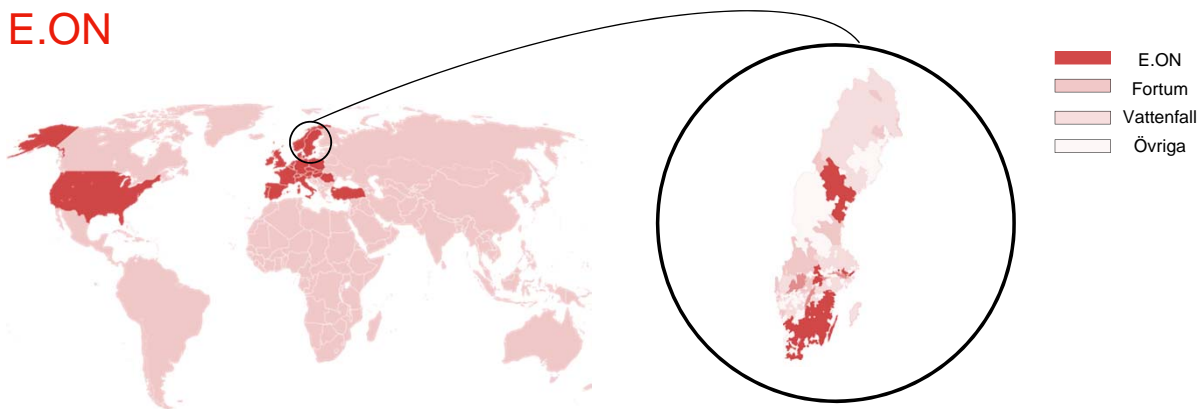
Demijan Panic
09.05.2018

DSO Microgrid in southern Sweden

Control, operation, management and power quality
within a zero-inertia microgrid

e-on

E.ON



■ E.ON
 ■ Fortum
 ■ Vattenfall
 ■ Övriga

Global

€ ~38,2 BEuro in revenues
 >22 M customers
 ~ 43.000 employees

E.ON Energidistribution

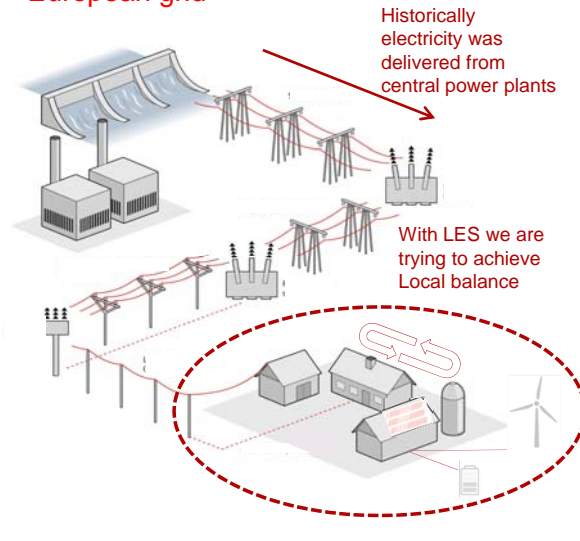
685 primary substations & 44.460 secondary substations
 ~ 8.656 km HV-grid & ~128.208 km MV-Grid
 ~ 1,2 BEuro in network investment

Background – changes to the grid structure in Europe/US

New challenges in the energy market

- ➔ **The Grid:**
In rural areas grids can be over-dimensioned and are expensive to re-invest in.
In other parts with lots of renewables or growing demand there can be bottlenecks to deliver enough power
- ➔ **Production:**
Renewables in general and small scale (PV) are growing and getting more competitive together with energy storage technologies
- ➔ **Customers:**
Customers demand green electricity and are also interested in becoming self-sufficient

European grid



EU's "Winter package"

In the Winter package it is stated that:

1. Member States shall ensure that local energy communities:
 - (a) are entitled to own, establish, or lease community networks and to autonomously manage them;
 where relevant, a local energy community may conclude an agreement with a distribution system operator to which their network is connected on the operation of the local energy community's network;

If this becomes reality, it would likely mean that Local Communities will be created to:

1. Maximize self consumption
2. Minimize the cost of energy

Project objectives

The objective of this LES Project is mainly:

- To build and demonstrate capability (technical and commercial)
- Understand the business of LES, cost drivers, barriers, possibilities etc.
- Develop business cases and business models as well as identifying potential customers



The vision is to develop new, demanded solutions on the energy market and bring E.ON closer to the customer

02.05.2017 5

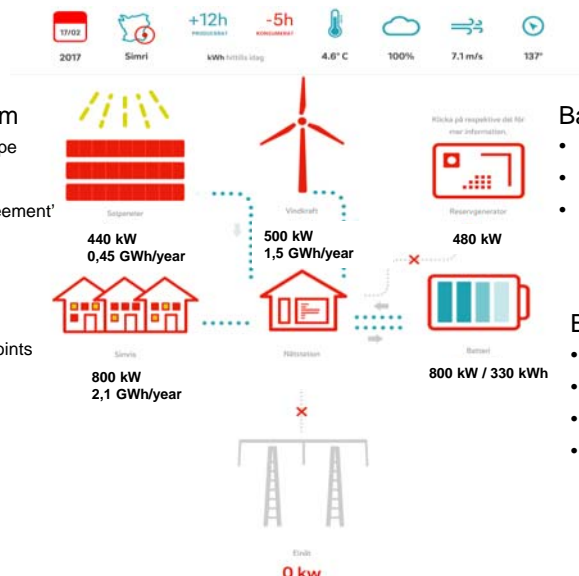
LES Simris can run on 100% renewable generation

WTG & Solar PV farm

- WTG is a full converter type
- Private owner
- EON has a 'Steering Agreement' with private owner

Customers

- Around 150 connection points
- Mostly residential
- Large portion of summer houses
- Can participate through a Demand Side Response program



Back-up generator

- Runs on Hydrated Vegetable Oil (HVO)
- External fuel tank of 4500 liters
- ~48 hours uninterrupted run-time at peak load without WTG & PV support

Battery system

- Samsung Li-Ion batteries
- Power Converters
- Transformer 0,4/10 kV
- Can maintain 50 Hz for ~30 min at peak charge/discharge

12.10.2017 6

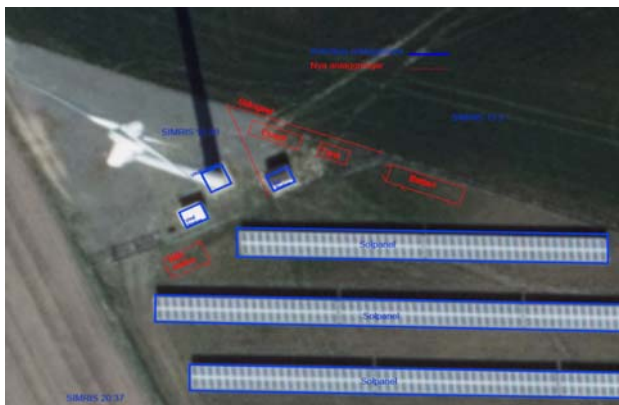
Simris – Simrishamn's Municipality



2017.12.05 7

LES Simris – Microgrid components

The microgrid was inaugurated in October 2017



Red = New

Blue = existing

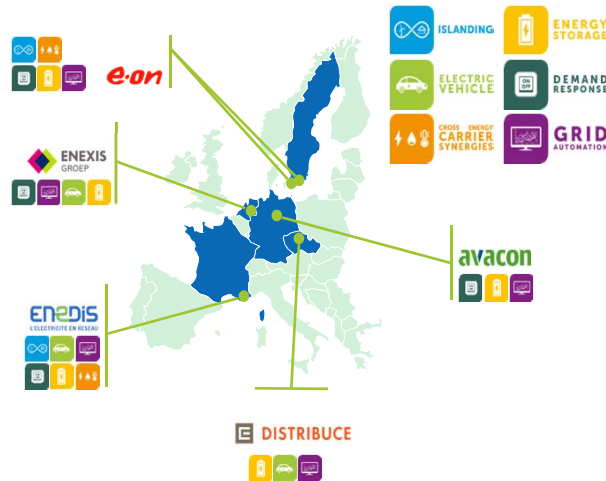


Battery system



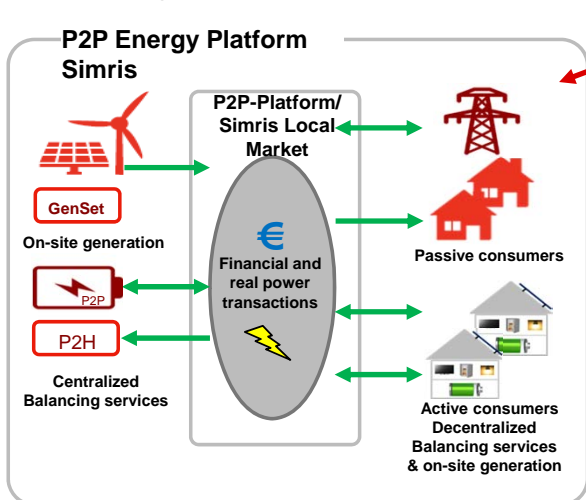
Back-up generator

Building technical capability through INTERFLEX: Demand side response programs



Unlocking customer flexibility– InterFlex use cases

LCE-02 Proposal for the Simris case addresses 3 main topics



LES Simris is a micro-grid project with the capability of going islanded and be powered by 100% of renewable sources. This innovation project will use its installed assets to enable the execution of the use cases named below.

Use Case 3 – Transforming passive consumers into active consumers

The focus here is to deploy centralized and decentralized balancing technologies e.g. P2H, P2P in the island and using this flexibility of the system and enable the creation of a local energy market.

Use Case 4 – Creating a Local Energy Market

Development of a Peer-to-peer market platform to facilitate increased consumer participation within the micro-grid by allowing real transactions to elicit an 'active' demand side response and thereby increasing grid-friendly consumption/production behavior.

Use Case 5 – Making LES a Smart LES

This use case focus on the development of smart algorithms that will target to improve the efficiency of the micro-grid as well as improve the operability and use of the inherent flexibility by the DSO.

02.05.2017 10

Technical solutions for DSR

Solutions for existing installations



Controls for water heater



Controls for heat pump

Solutions for newer installations



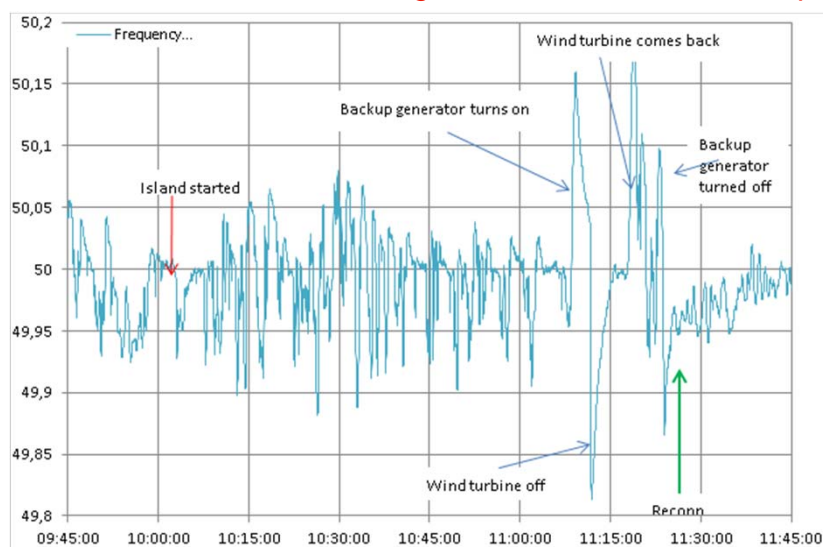
New controllable heat pump



Controllable
PV+Battery solution
2017.12.05

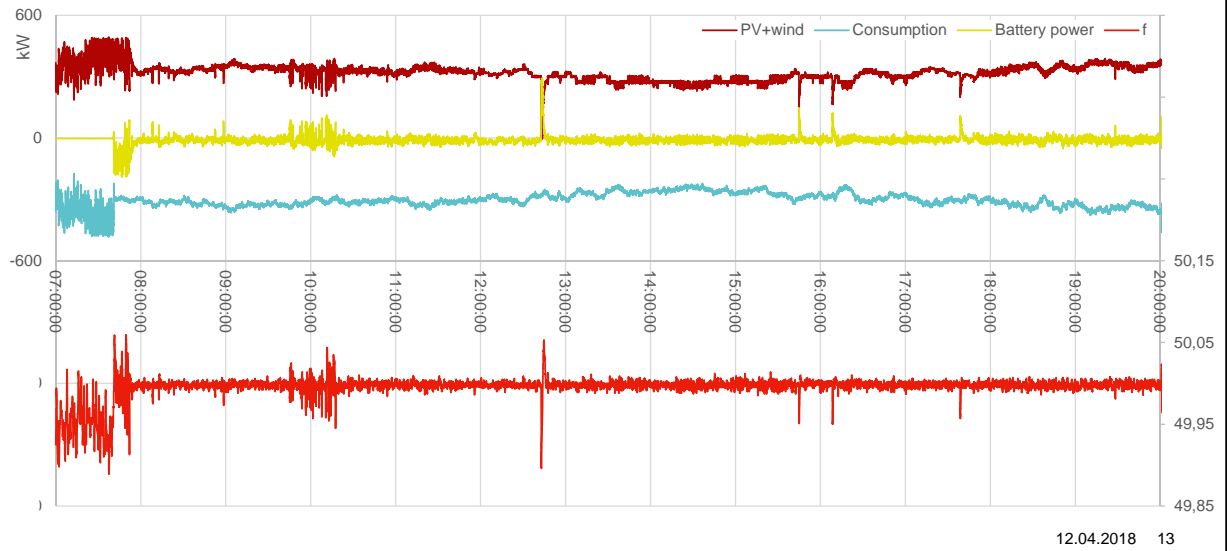
Frequency – Droop!

- Results from commissioning and the first ever island operation

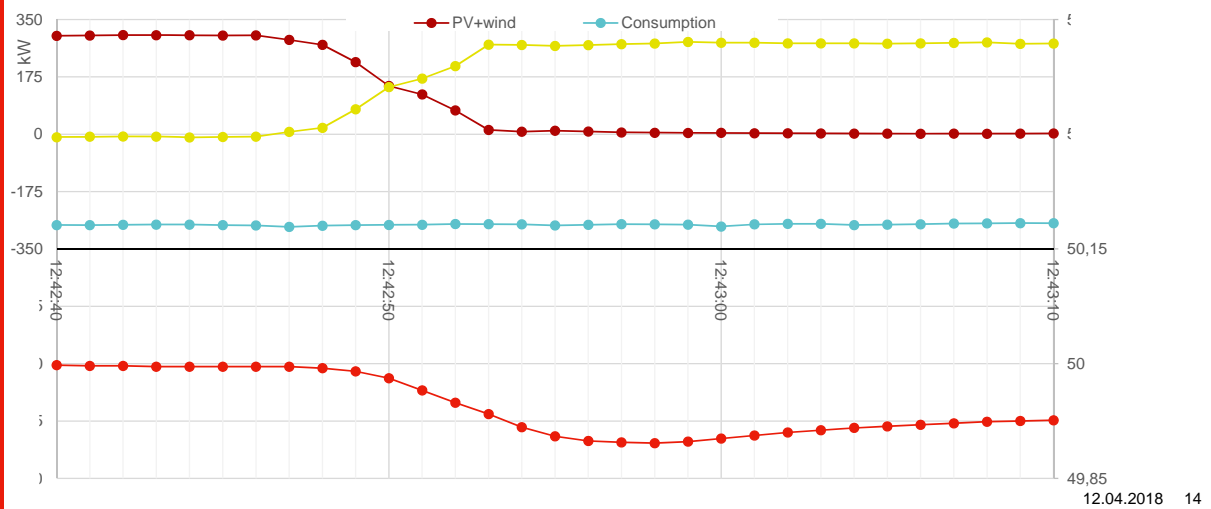


2017.12.05 12

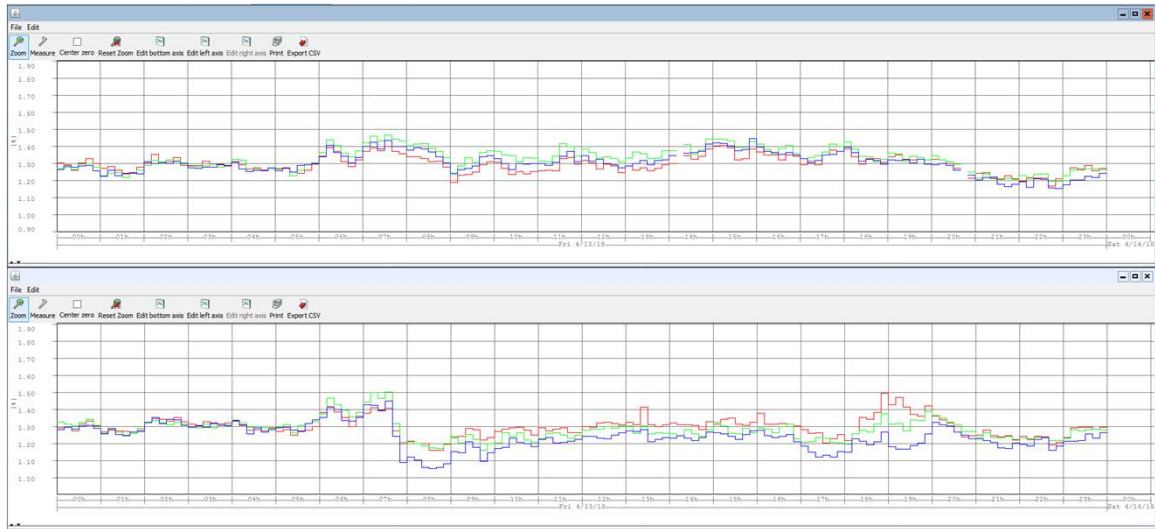
Results from off-grid operation 2018-04-10



BESS response to load step



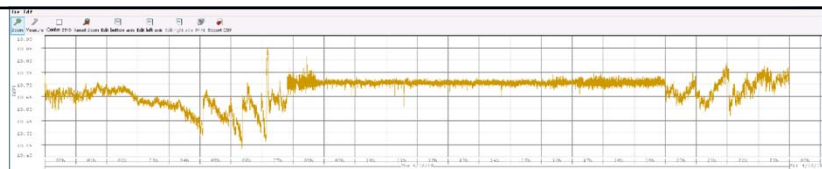
Total Harmonic Distorsion - THD



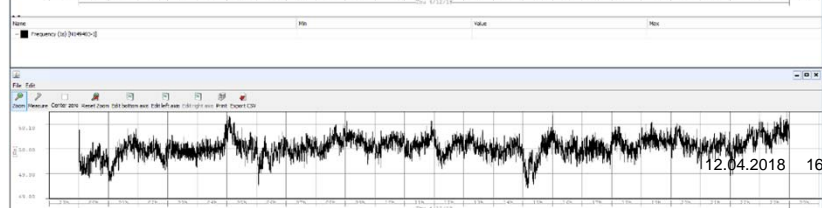
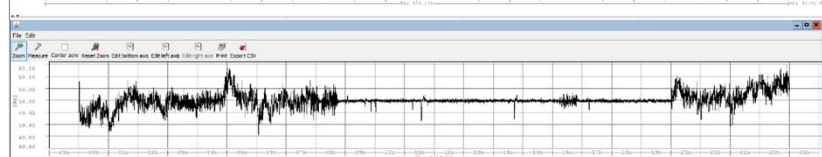
12.04.2018 15

Nordic System vs LES Simris

Voltage



Frequency



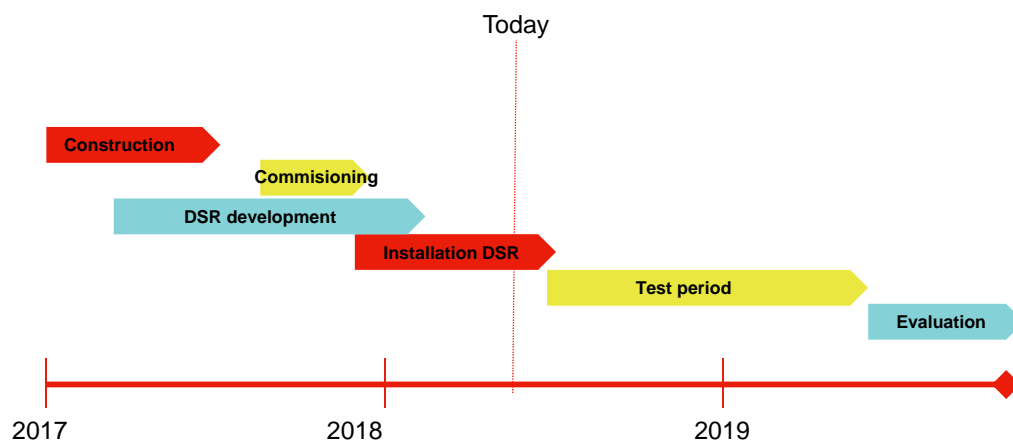
12.04.2018 16

Summary

- System has been running in Island-mode for approx. 100 hours
- Power quality well within limits (voltage, frequency, THD etc.)
- Security of supply maintained throughout transitions and island operation
- A Microgrid running only on Renewable Energy Resources is fully possible to implement
- A zero-inertia (no classical inertia) system is capable of handling big load steps
- Demand Side Response is being implemented

12.04.2018 17

Timeline





Thank you for your attention

If you want to follow the system live: les.eon.se
For more information, please visit www.eon.se/simris

e-on

Demijan.Panic@eon.se
Mike.Hirst@eon.com

20