

# Energinet.dk Cell Controller Pilot Project

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Spirae, Inc.

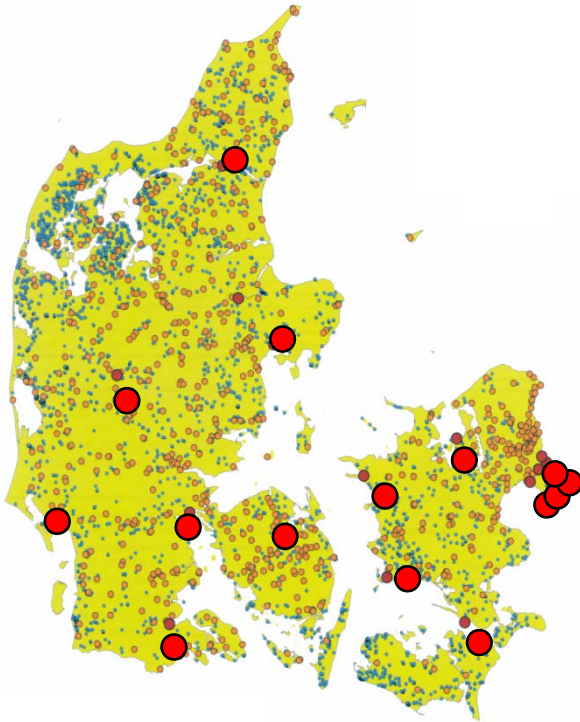
<b>Project Owner: Energinet.dk</b>	
Main Project Participants	
Syd Energi – Network Owner	Tjaeborg Industri, A/S
Spirae, Inc	Pon Power, A/S
Energynautics, GmbH	Siemens, A/S

EPRI Workshop on Active Distribution System Management  
3<sup>rd</sup> International Conference on Integration of RDER  
December 9, Nice, France

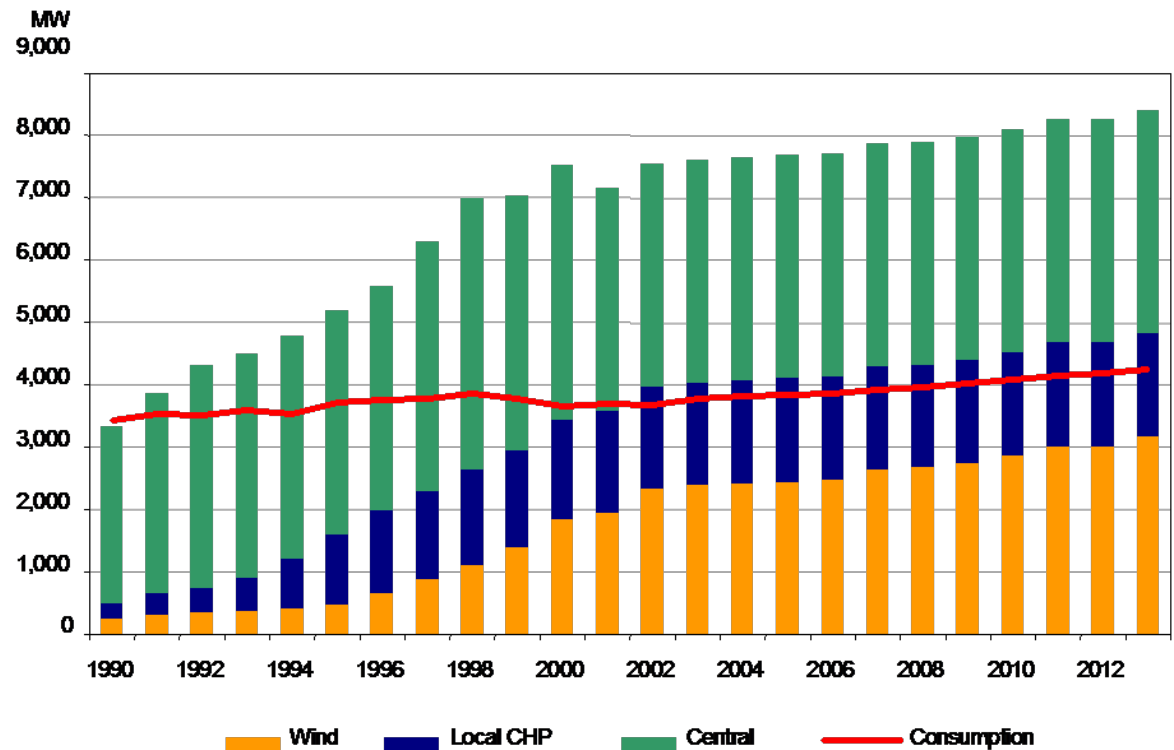
# Danish Power System



## Wind and DCHP Gen



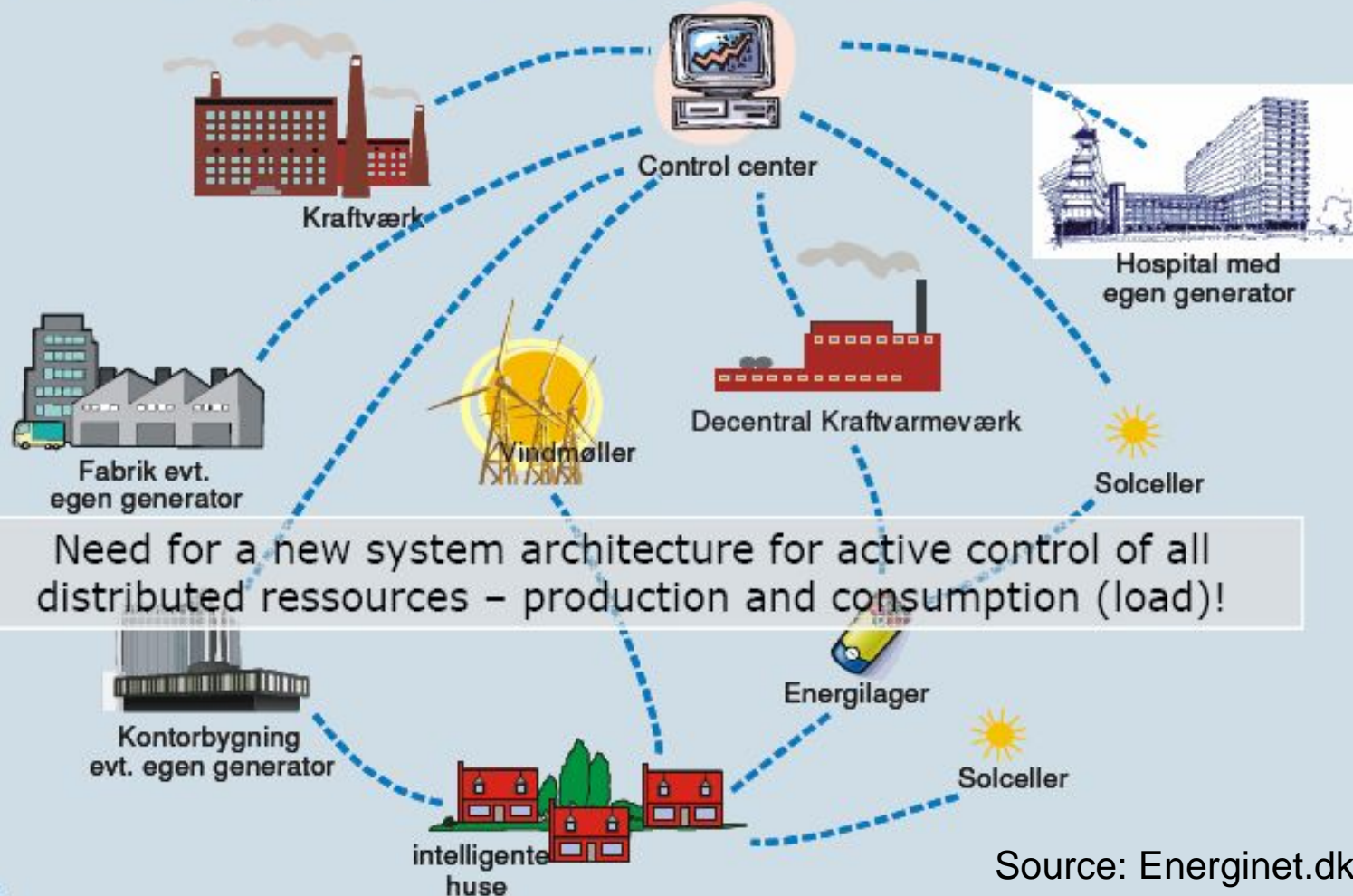
- Central power plant
- DCHP unit
- Wind turbine



# Energinet.dk Vision

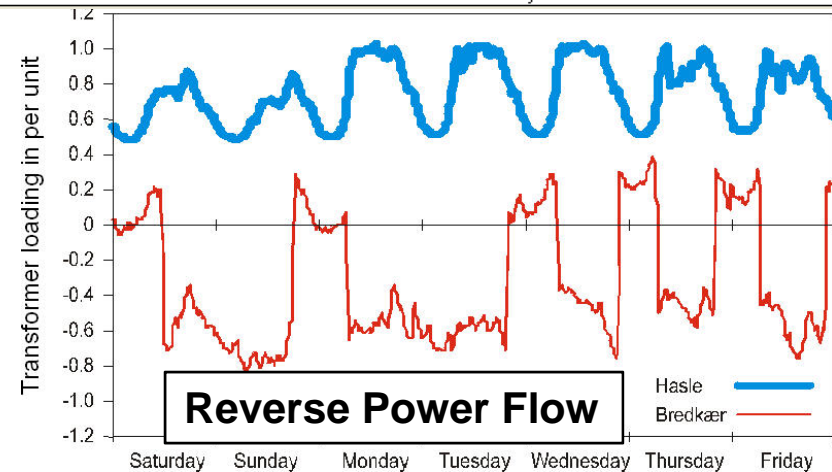
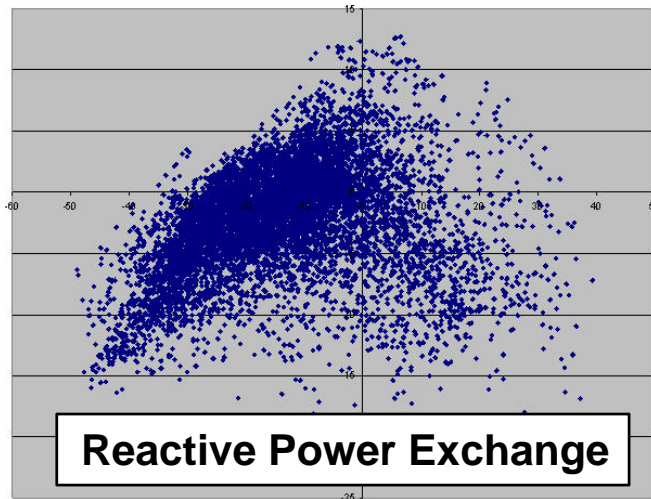
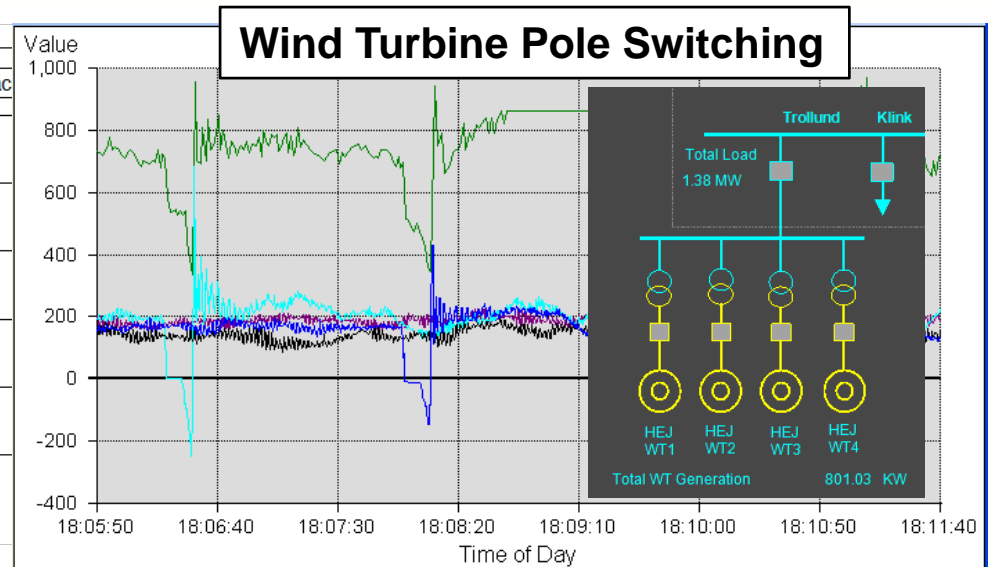
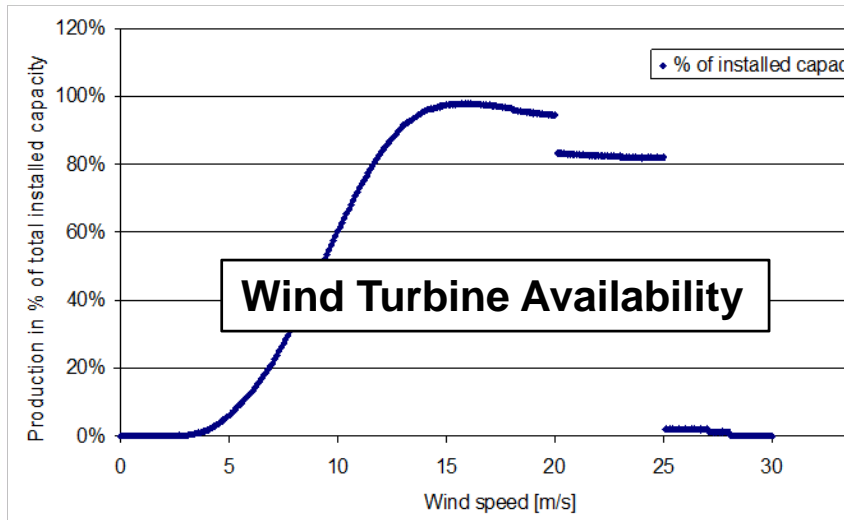


## Mobilizing all distributed resources

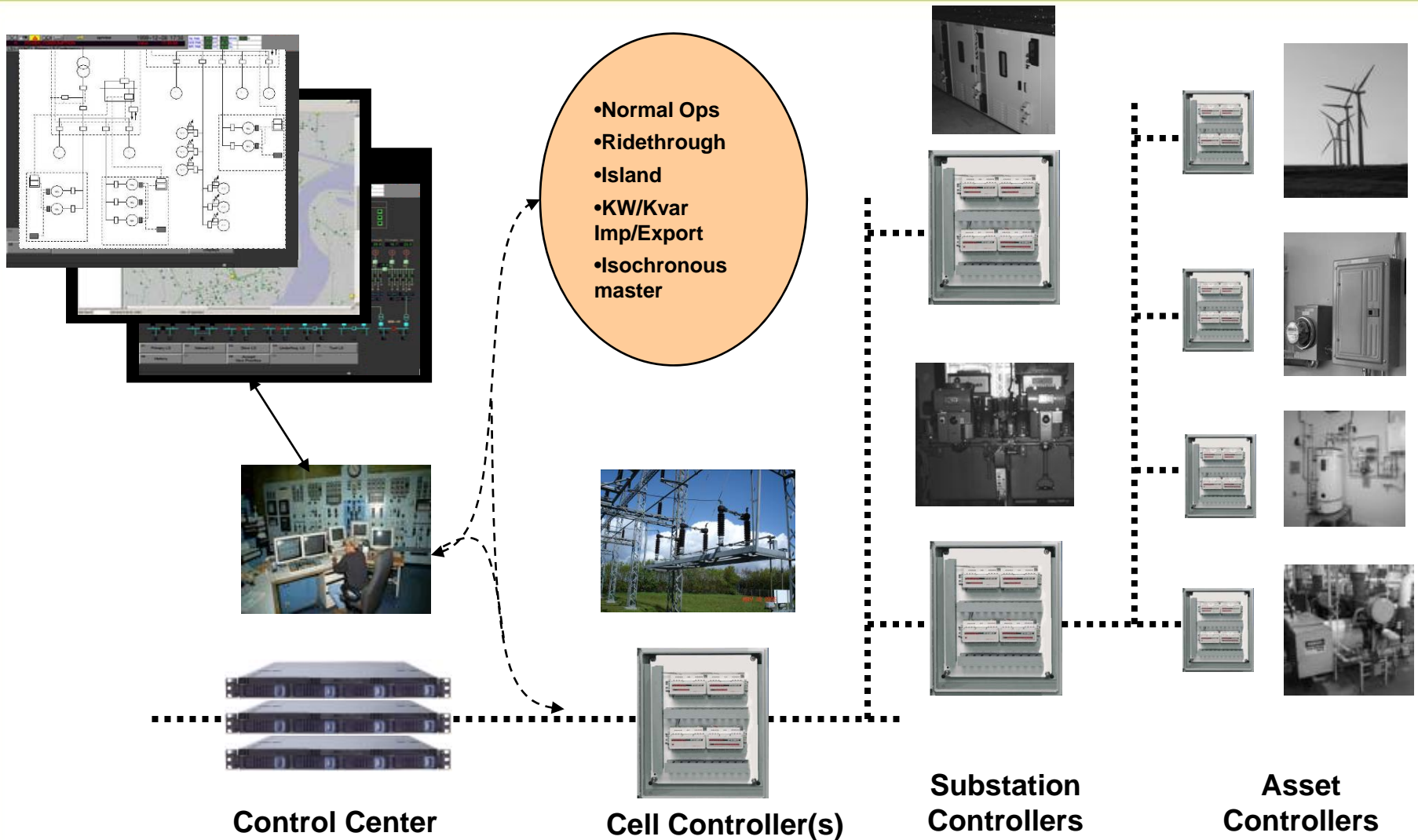


Source: Energinet.dk

# Transient Events



# Cell Controller Concept

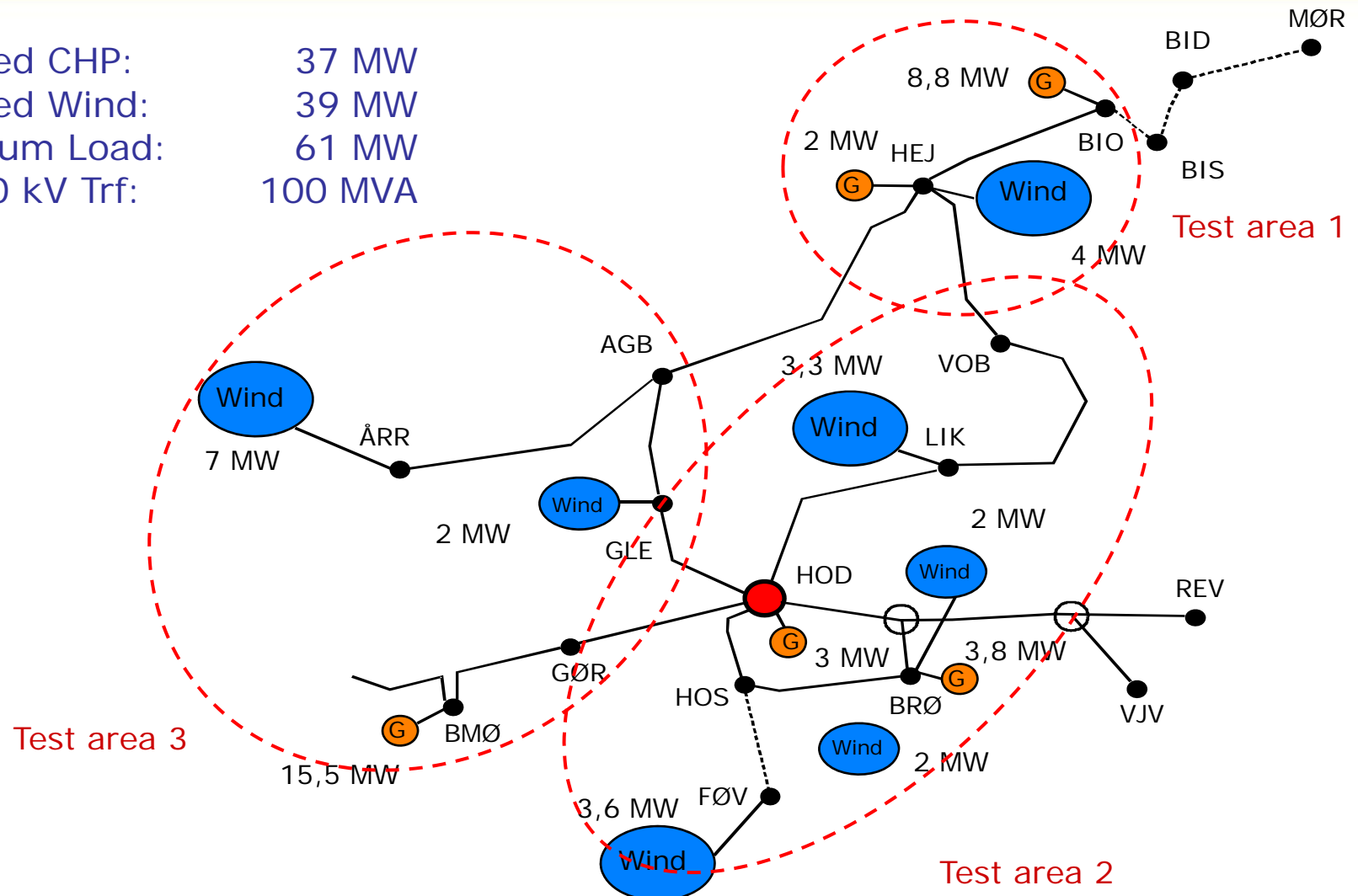




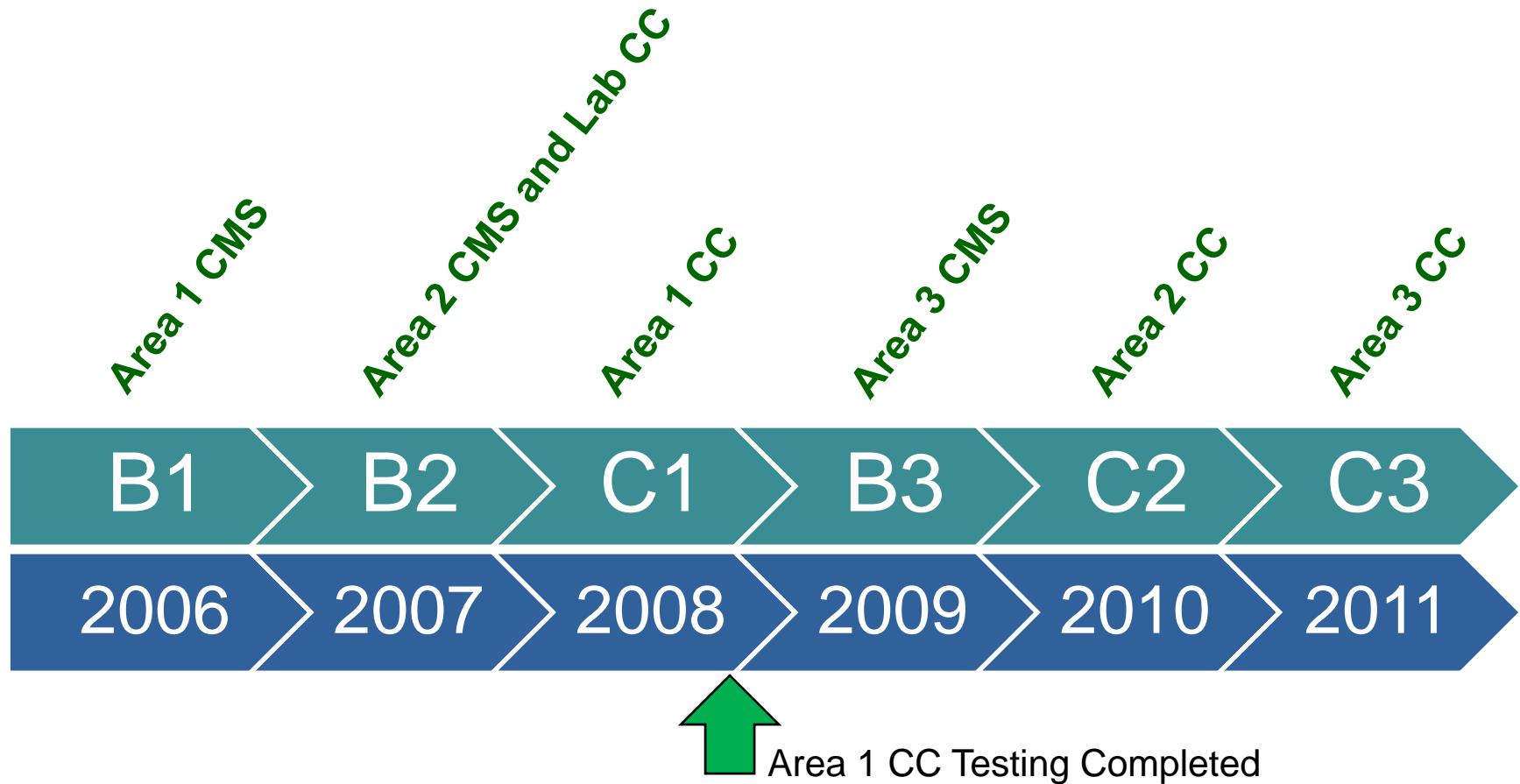


# Pilot Cell: Holsted 60 kV Grid

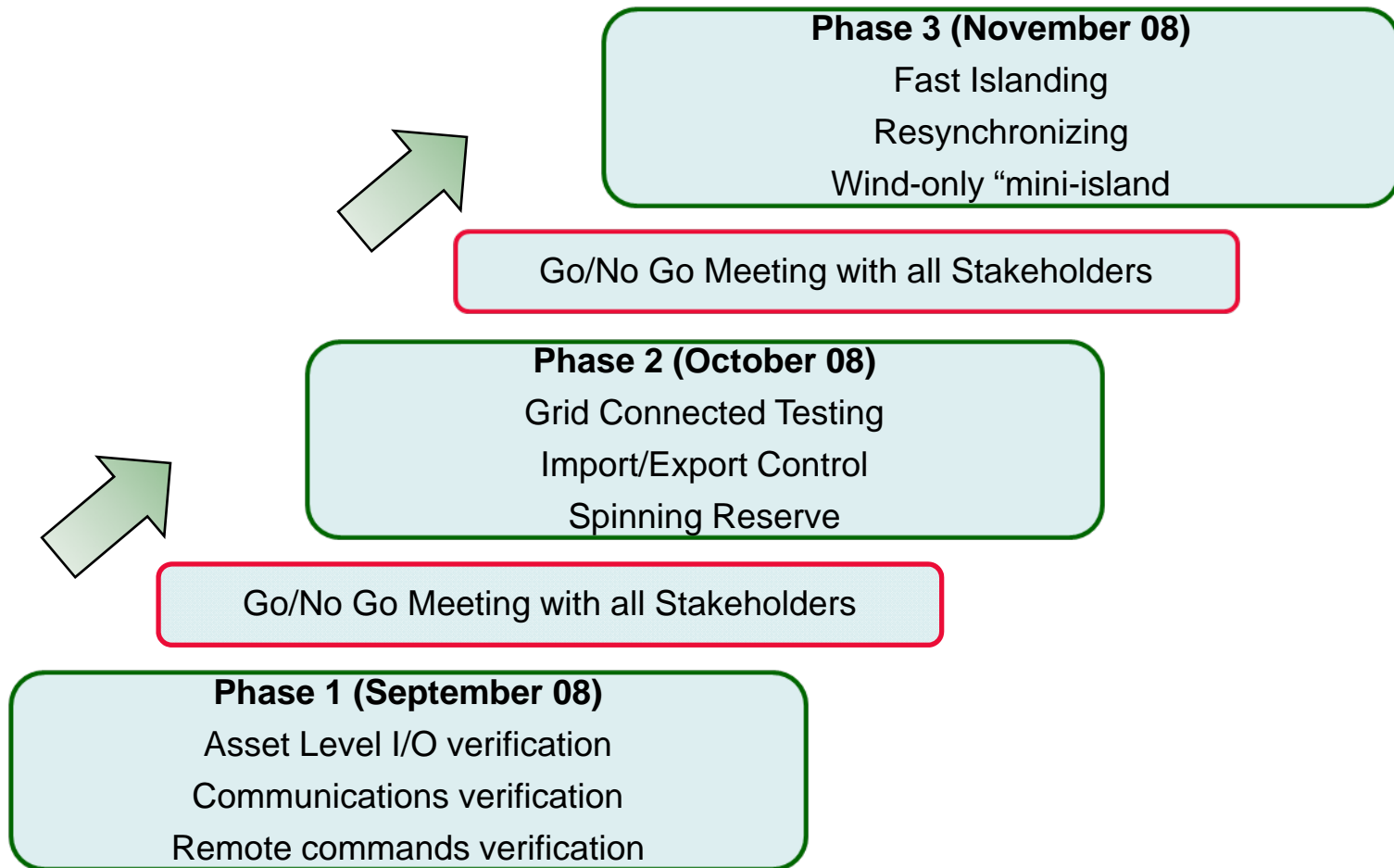
Installed CHP: 37 MW  
Installed Wind: 39 MW  
Maximum Load: 61 MW  
150/60 kV Trf: 100 MVA



# Project Timeline



# Area 1 Cell Controller Test Phases





# Wind Turbines and CHPs



# Synchronizer, Synch Condenser, and Secondary Load Controller





# Hejnsvig Substation: Cell Nerve Center



# Phase 2 Testing: Virtual Generator



On 14 November 2008, at 12:15,  
Virtual Generator (VGen) formed with:

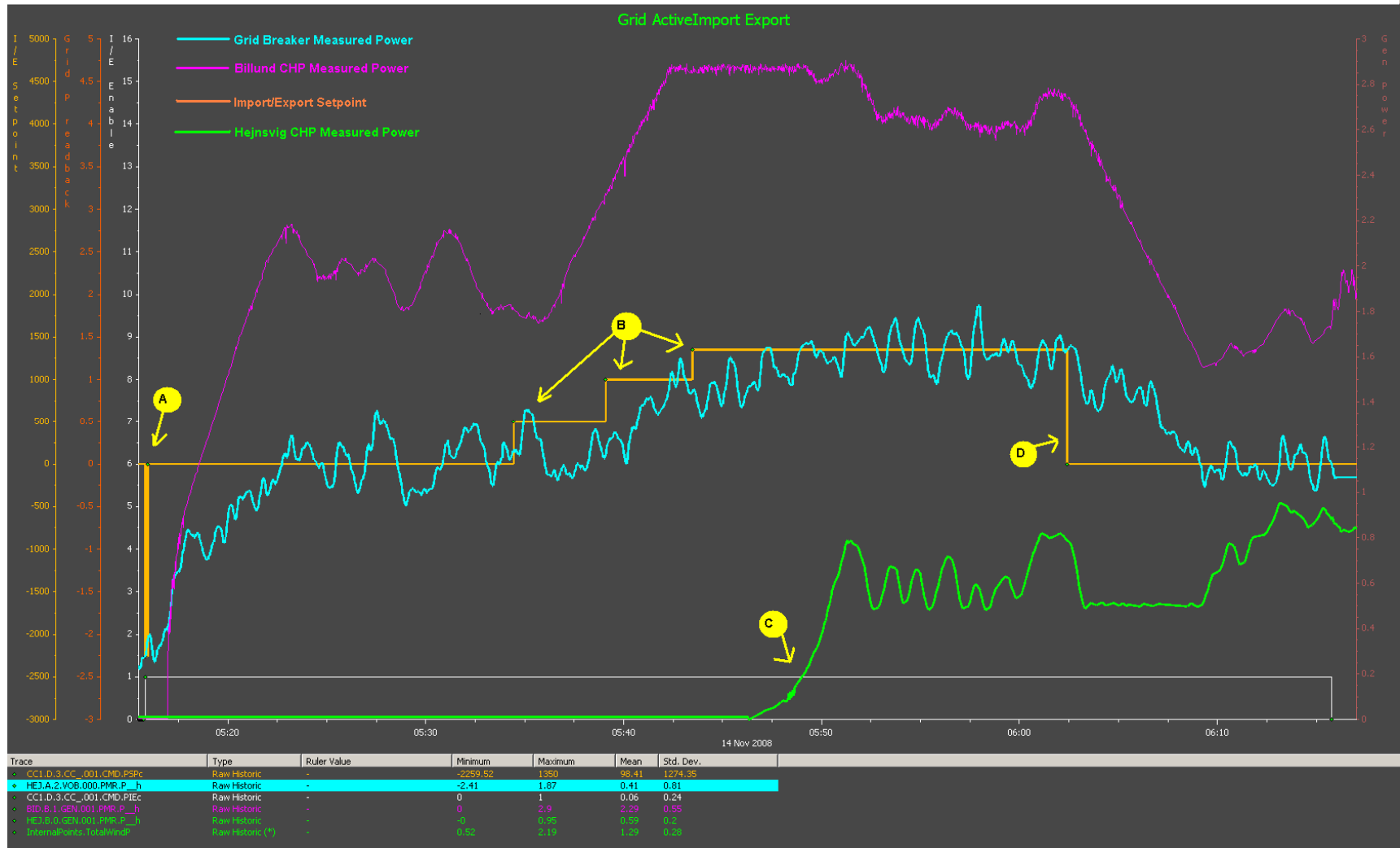
- Two CHPs (neither spinning): one at Billund CHP plant and one at Hejnsvig CHP plant.
- 3 wind turbines, generating at about 45% capacity.
- 7 online load-feeders.

The synchronous condensor (SC) and secondary load controller (SLC) are *not* available to the VGen.

Sequence of events:

- **A** (12:15): import/export control is enabled with a zero active/reactive set point for the VGen. In response to wind levels, Cell Controller starts only one CHP (Billund unit 1)
- **B** (12:35): operator increases import/export set point of the VGen is increased.
- **C** (12:45): the Cell controller brings a second generator (Hejnsvig CHP 1) online.
- 12:45 to 13:02: the VGen works to maintain the set point.
- **D** (13:02): a zero import/export active set point is requested and the VGen responds accordingly.

# VGen Performance: Overview





# Next Steps

- Complete C1 data analysis!
- Next phase will include Area 2
- Plan to demonstrate:
  - Dynamic Cell creation
  - Sub-cell formation and merging
  - Virtual Gens for market operations
  - Automatic topology management
  - Wind smoothing
- C2 Duration: 2009-2010



**Thank you for your attention!**

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