

# 1 Smart Community Bornholm

Test and demonstration in full-scale renewable energy laboratory



Test and demonstration of Smart Grid and other technologies under realistic and stressed conditions, corresponding to future renewable-based energy systems.

Fluctuating power test scenarios:

- ▶ Energy system with 28,000 customers (55 MW peak) and 4 district heating systems
- ▶ 100% renewable based electricity and heating
- ▶ Equivalent to 1% of Denmark with regard to area, population, and energy consumption
- ▶ Distributed energy resources: wind power, solar PV, combined heat and power, electric vehicles, biogas, district heating etc.
- ▶ Islanding operation capability
- ▶ Integration with Intelligent Control Center Lab at DTU



## Applications

Full scale analysis, test and demonstration of:

- ▶ Distribution grid automation
- ▶ Customer behavior
- ▶ Electricity markets
- ▶ Wind turbine control
- ▶ Frequency control
- ▶ Wind power and PV integration
- ▶ Electric vehicle integration
- ▶ Islanding operation, loss of mains
- ▶ Energy forecasting systems

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## 2 Smart Community Bornholm

### Supervision and measurement systems

#### CONTROL ROOMS WITH SCADA SYSTEMS

Operational ABB NM SCADA at Bornholms Energi & Forsyning  
Experimental ABB NM SCADA at DTU  
Measurements collected with 1 s time resolution  
1,300 analogue signals 2,200 digital signals

#### ELSPEC G4430 BLACKBOX POWER QUALITY RECORDERS

All network parameters with up to 1,024/cycle resolution  
10 units in the grid + 7 units in the power plant

#### PHASOR MEASUREMENT UNITS (PMU'S)

Voltage and current RMS + phase with 20 ms time resolution  
Extremely accurate time stamping

#### INTERVAL METERS AT CUSTOMERS

Advanced 5 min interval meters

#### FORECASTING SYSTEMS

Wind power generation, PV generation, electricity and heat demand

## Technical Data of the Bornholm Power System:

Property	Value	Property	Value
<b>Customers</b>		<b>Grid</b>	
Number of customers	~28.000	60 kV grid	131 km
Number of customers (> 100.000 kWh/year)	~300	Number of 60/10 kV substations	16
Total energy consumed	250 GWh	10 kV grid	927 km
Peak load	55 MW	Number of 10/0.4 kV substations	1039
<b>Generators</b>		0.4 kV grid	1913 km
1 CHP steam turbine (wood/coal/oil chips)	37 MW	<b>Communication</b>	
35 wind turbines	30 MW	Fiber network between 60/10 kV substations	131 km
SOLAR PV (2012)	5 MW	<b>District heating</b>	
2 gas engines (biogas)	2 MW	Number of district heating systems	5
14 backup diesel generators (oil)	34 MW	Total heat demand (in 2007)	560 GWh
1 backup steam turbine (oil)	25 MW	Normal operation mode	Interconnected Nordel
Electric vehicles (under roll-out)			