

THE CHALLENGES OF TOMORROW

- IMPERATIVE NEED FOR ADDITIONAL BALANCING POWER

TRANSMISSION CAPACITY

FLEXIBLE GENERATION

STORAGE

FLEXIBLE DEMAND

EcoGRID: A REAL-TIME MARKET SOLUTION

- **EcoGRID OBJECTIVE:** TO USE FLEXIBLE DEMAND RESPONSE OF END-CUSTOMERS TO REDUCE THE IMPACT OF THE VARIABILITY AND UNCERTAINTY OF THE RENEWABLE PRODUCTION ON THE OPERATION OF THE POWER SYSTEM

EcoGrid: A REAL-TIME MARKET SOLUTION

OTHER SOLUTIONS

END-CUSTOMERS CAN PROVIDE
BALANCING POWER



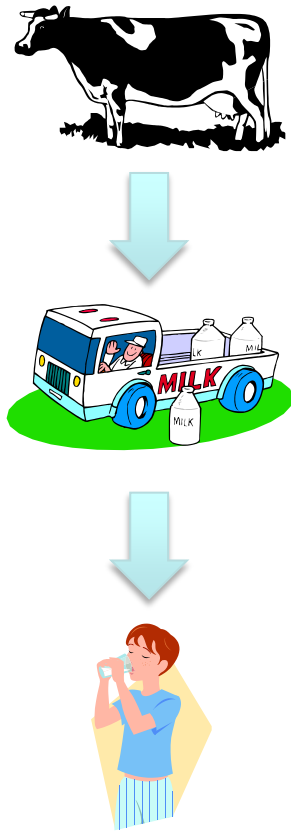
RETAILERS SELLS THE BALANCING
POWER OF THE CUSTOMERS TO TSO



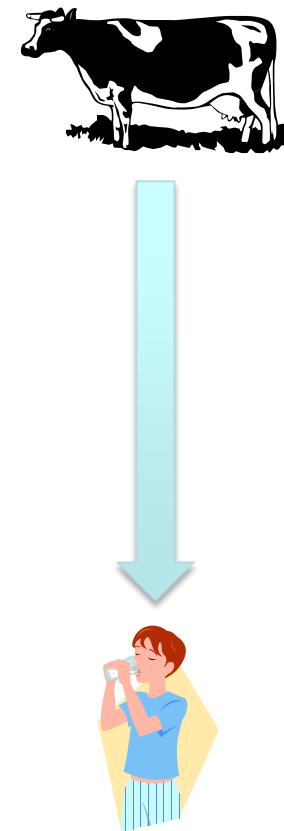
Tso BUYS BALANCING POWER TO
THE RETAILERS TO BALANCE WIND

EcoGrid: A REAL-TIME MARKET SOLUTION

OTHER SOLUTIONS



EcoGrid^{eu} SOLUTION www.eu-ecogrid.net



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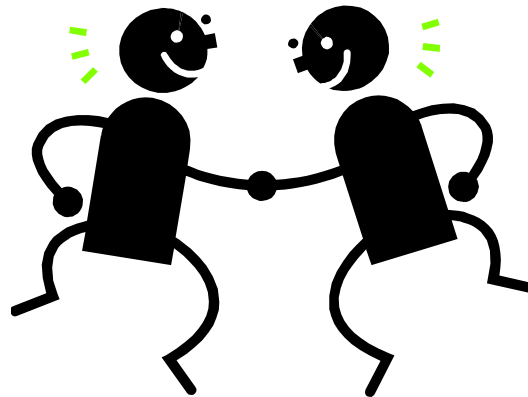


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THE CUSTOMERS TO BALANCE WIND

EcoGrid: A REAL-TIME MARKET SOLUTION

■ WHY?

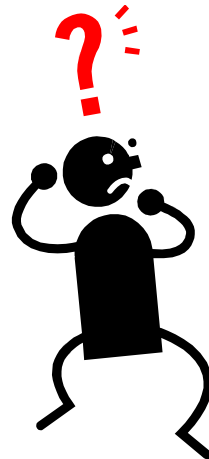
TO OFFER FLEXIBLE END-CUSTOMERS A TRANSPARENT
AND CLEAR PRODUCT TO TRADE THEIR FLEXIBILITY
WITH THE SYSTEM



EcoGrid: A REAL-TIME MARKET SOLUTION

■ CHALLENGE

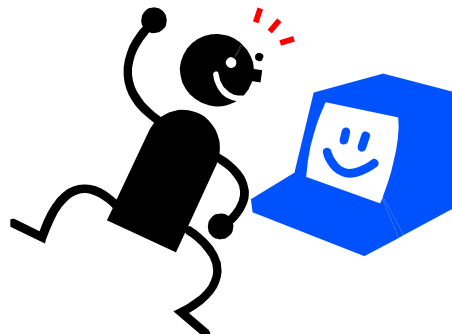
END-CUSTOMERS CANNOT SUBMIT BIDS TO BUY ELECTRICITY. IT IS DIFFICULT TO DETERMINE NUMERICALLY THE UTILITY FUNCTION OF A HOUSEHOLD.



EcoGrid: A REAL-TIME MARKET SOLUTION

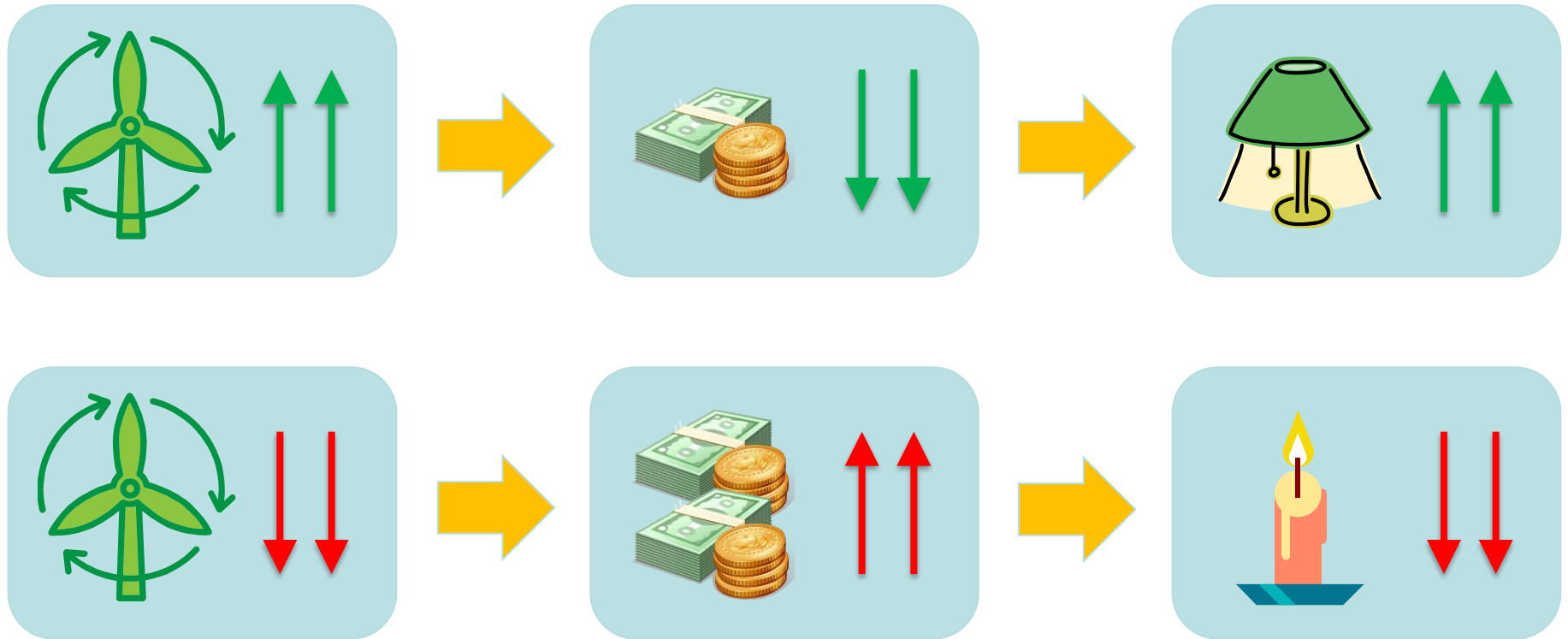
■ SOLUTION

END-CUSTOMERS WILL CONTINUOUSLY RECEIVE THE ELECTRICITY PRICE AT WHICH THEY WILL BE CHARGED BEFOREHAND.



EcoGrid: A REAL-TIME MARKET SOLUTION

■ SOLUTION



EcoGrid: A REAL-TIME MARKET SOLUTION

■ CHALLENGE

TSO HAS TO FORECAST THE RESPONSE OF END-CUSTOMERS TO PRICES TO MAINTAIN THE BALANCE IN THE SYSTEM. HOWEVER, THIS RESPONSE IS:

- TIME VARIANT
- UNCERTAIN
- DYNAMIC

EcoGrid: A REAL-TIME MARKET SOLUTION

■ SOLUTION

TO PUBLISH ONE PRICE EVERY 5 MINUTES IN ORDER TO TAKE CORRECTIVE ACTIONS WHEN THE FORECAST OF THE DEMAND RESPONSE IS NOT ACCURATE ENOUGH.

EcoGrid: A REAL-TIME MARKET SOLUTION

■ QUESTIONS

- HOW MUCH BALANCING POWER CAN WE OBTAIN FROM FLEXIBLE END-CUSTOMERS?
- CAN WE USE FLEXIBLE DEMAND OF END-CUSTOMERS TO REDUCE WIND POWER PRODUCTION FLUCTUATIONS?
- HOW MUCH DOES THE SYSTEM BENEFIT?
- HOW MUCH IS THE FLEXIBLE CUSTOMERS SAVING?

BORNHOLM: A UNIQUE DEMONSTRATION SITE

■ SOLUTION

DEMONSTRATION IN A REAL
SYSTEM WITH 50 % RES

HIGH VARIETY OF LOW
CARBON ENERGY
SOURCES

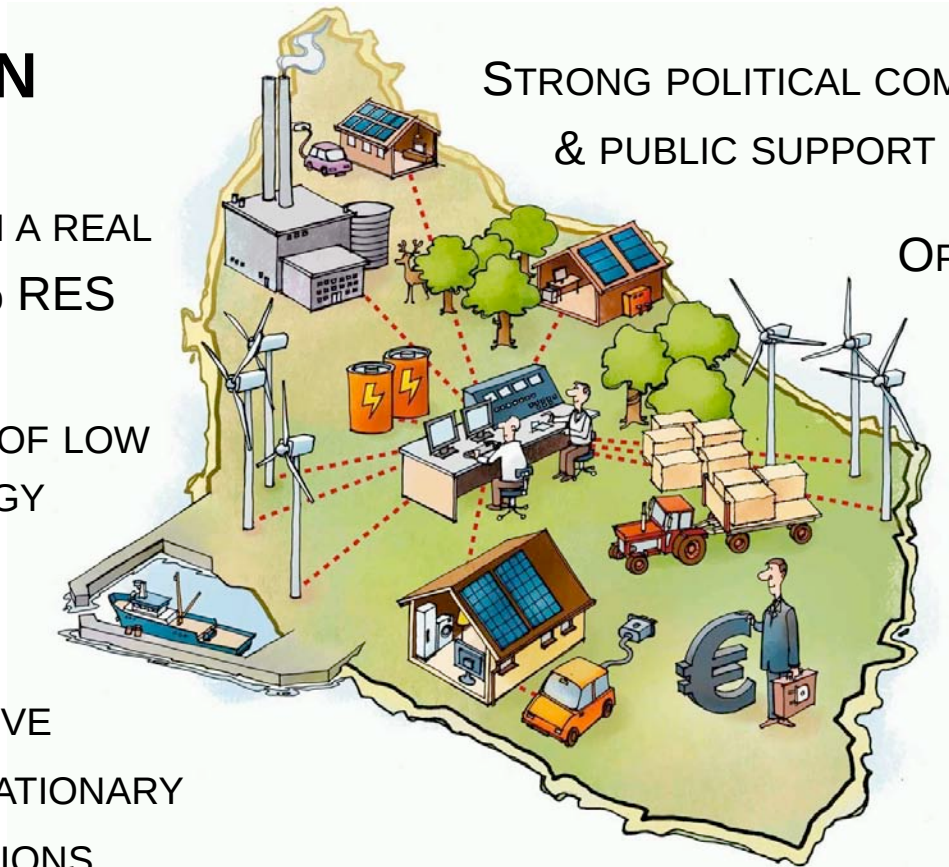
SEVERAL ACTIVE
DEMAND & STATIONARY
STORAGE OPTIONS

INTERCONNECTED WITH
THE NORDIC POWER MARKET

STRONG POLITICAL COMMITMENT
& PUBLIC SUPPORT

OPERATED BY THE LOCAL
MUNICIPAL OWNED
DSO, ØSTKRAFT

ELIGIBLE RD&D
INFRASTRUCTURE &
FULL SCALE TEST
LABORATORY



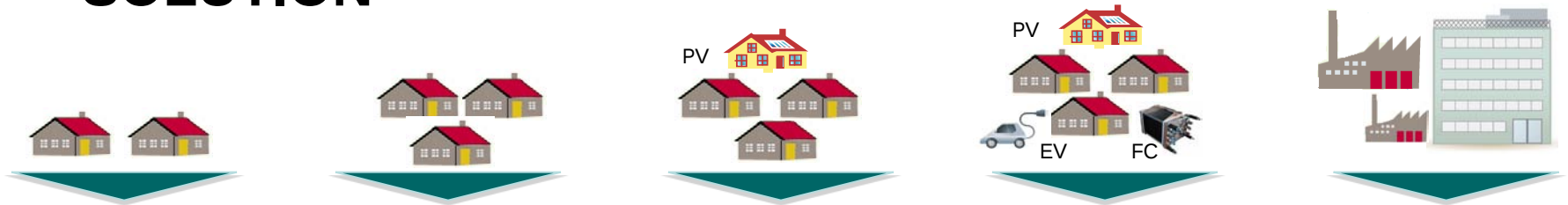
BORNHOLM: A UNIQUE DEMONSTRATION SITE

■ SOLUTION

Property	Value
Customers	
Number of customers	~28.000
Number of customers (> 100.000 kWh/year)	~300
Total energy consumed	268 GWh
Peak load	55 MW
Low-carbon energy resources	
Wind power plants	30 MW
CHP/biomass	16 MW
PV (roll-out under project)	2.0 MW
Biogas plant	2.0 MW
Electric vehicles (under roll-out)	
Grid	
60 kV grid	131 km
Number of 60/10 kV substations	16
10 kV grid	914 km
Number of 10/0.4 kV substations	1006
0.4 grid	1.887 km
Communication	
Fiber network between 60/10 kV substations	131 km
District heating	
Number of district heating systems	5
Total heat demand (in 2007)	560 GWh
Operation	
Normal operation mode	Interconnected Nordel
Island operation capability	Continuous

BORNHOLM: A UNIQUE DEMONSTRATION SITE

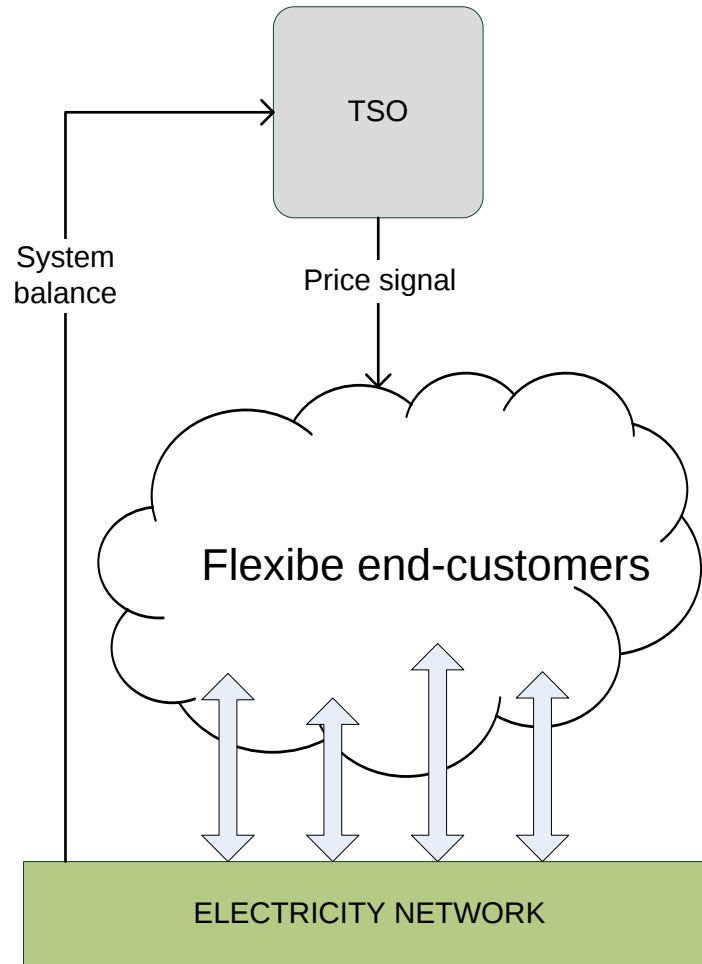
■ SOLUTION



Reference group	Manual houses	Automatic houses	Aggregator	Smart businesses
200 households	400-500 households	700 households	500 households	100 commercial/public customers
No access to specific information or smart equipment	Receiving market price information/prognosis	Installation of appliances responding to market price signals/prognosis (heat pumps or electric heating)	Installation of multiple connected appliances responsive to price signals	Smart meter and appliances
No response	Manual response to price changes	Automatic response	Direct control by aggregator	Automatic/manual response

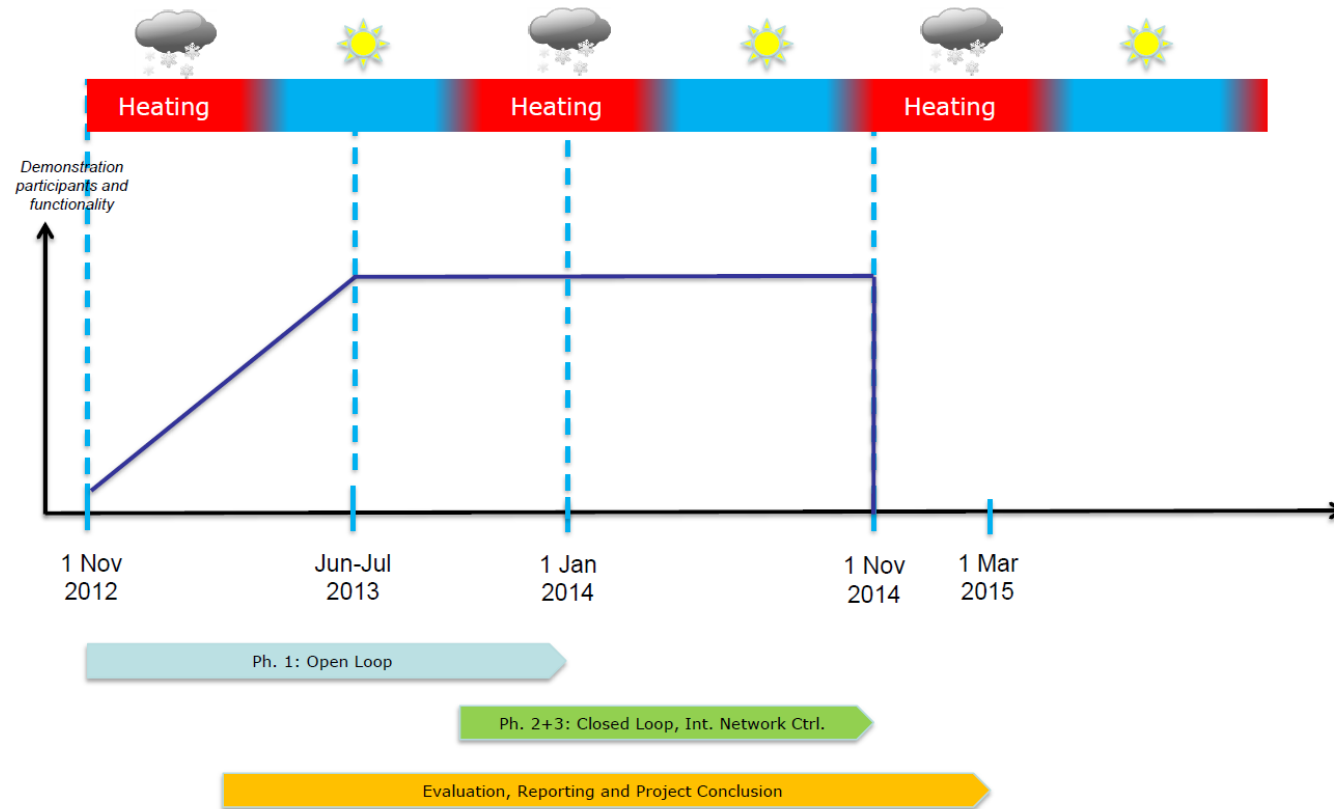
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■ SOLUTION



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■ SOLUTION



DENMARK
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Østkraft
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Technology, DTU
Siemens DK
IBM DK
Landis+Gyr



BELGIUM
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EANDIS (+ORES)



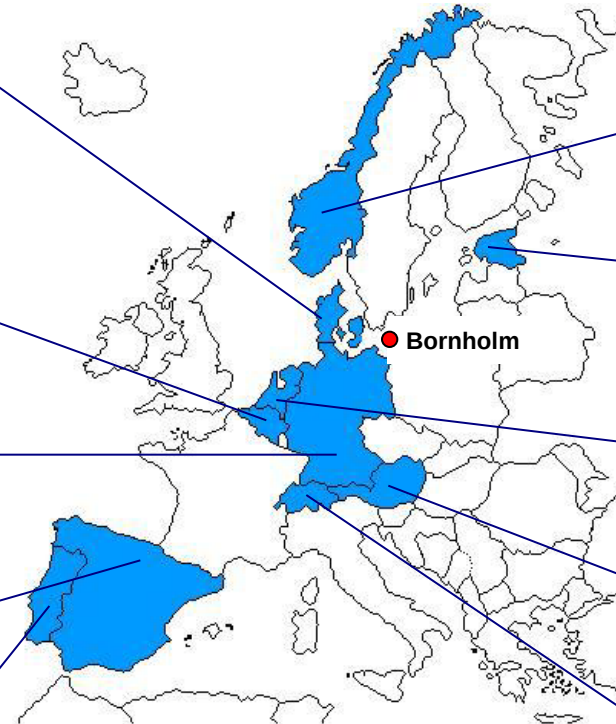
GERMANY
EnCT
Siemens AG*



SPAIN
Tecnalia



PORTUGAL
EDP



NORWAY
SINTEF ER
(Coordinator)



ESTONIA
Tallin University of
Technology (TUT)



THE NETHERLANDS
ECN
IBM, NL*



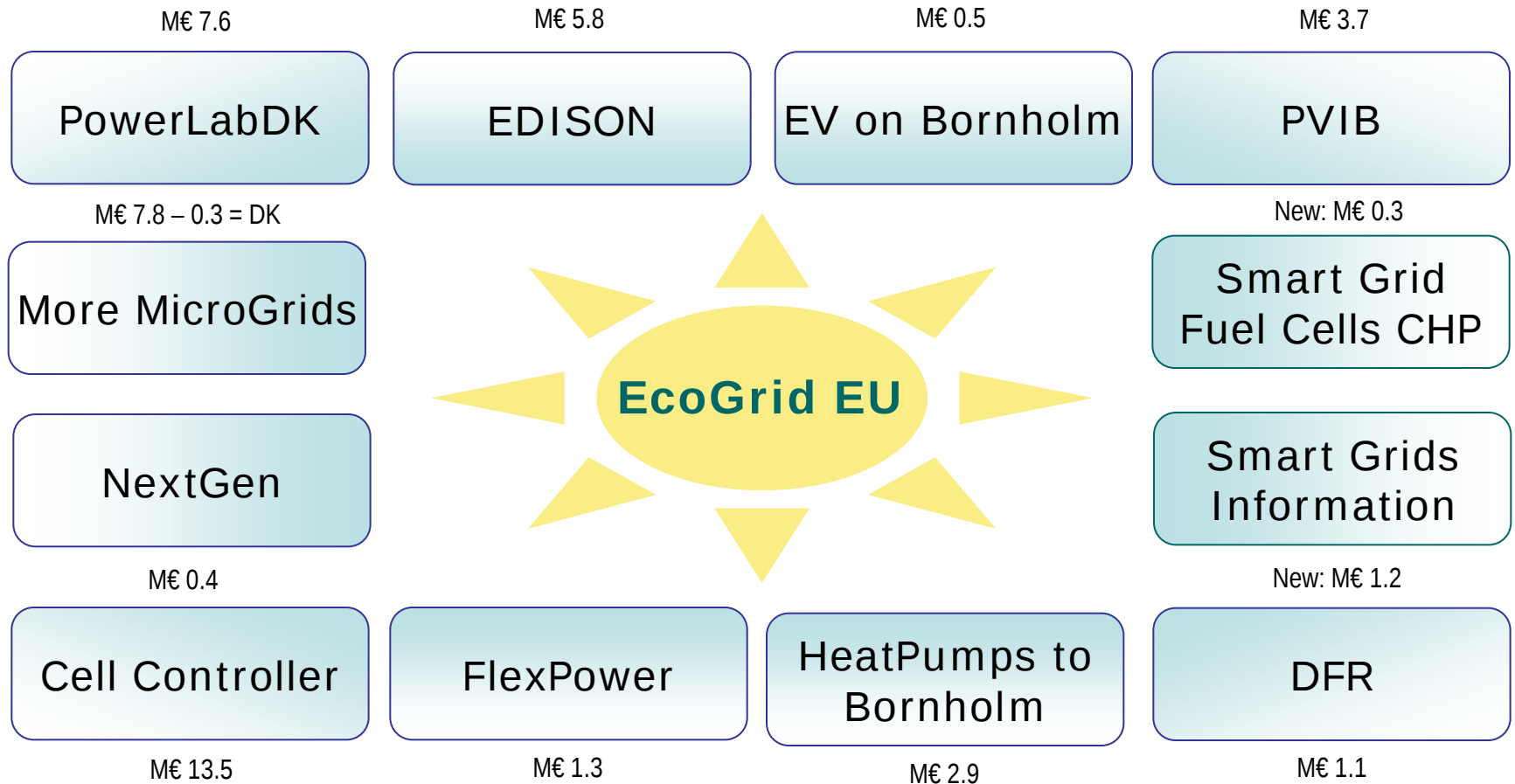
AUSTRIA
Austrian Institute of
Technology (AIT)



SWITZERLAND
IBM Zrl*
Siemens, CH*

* Third party

BORNHOLM: A UNIQUE DEMONSTRATION SITE



- Some M€ 40 National funding to related projects

BORNHOLM: A UNIQUE DEMONSTRATION SITE

Flexible multi-purpose laboratories

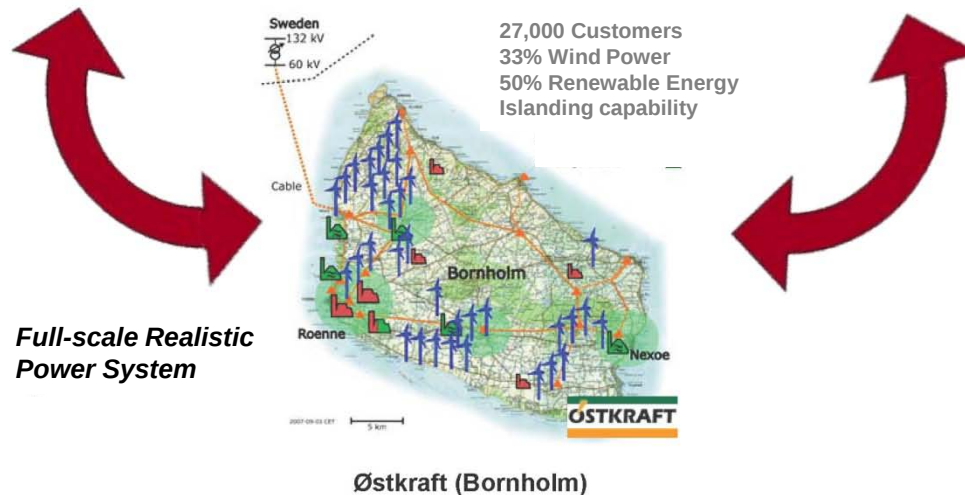


Lyngby &
Ballerup Campus

Large-scale power system (1:10)



Risø Campus



Full-scale Realistic Power System

THANKS FOR YOUR ATTENTION!

QUESTIONS?

