- Caring for the energy of tomorrow

Focus. Trust. Initiative.

Dantherm Power at HTAC, DOE

Dr. Per Balslev

February 17th 2011

Dantherm Power at HTAC

Outline

1. Dantherm Power A/S
2. Telecom back up power
3. Micro CHP
4. Wind and fuel cells
5. Cross Atlantic activities

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Dantherm Power A/S

January 2007 (Dantherm Air Handling A/S Spin off)	Dantherm Power Inc.
Location: Hobro, Denmark	Co-located at: Dantherm Air Handling Inc.
Employees: 43	Spartanburg, South Carolina
CEO: Per Albæk	Established Sept. 2008
Business focus: R&D, Engineering, Sales and Service	Sales and service
Manufacturing: Dantherm Air Handling A/S facility in DK	Offices: Toronto, Canada; New York, US

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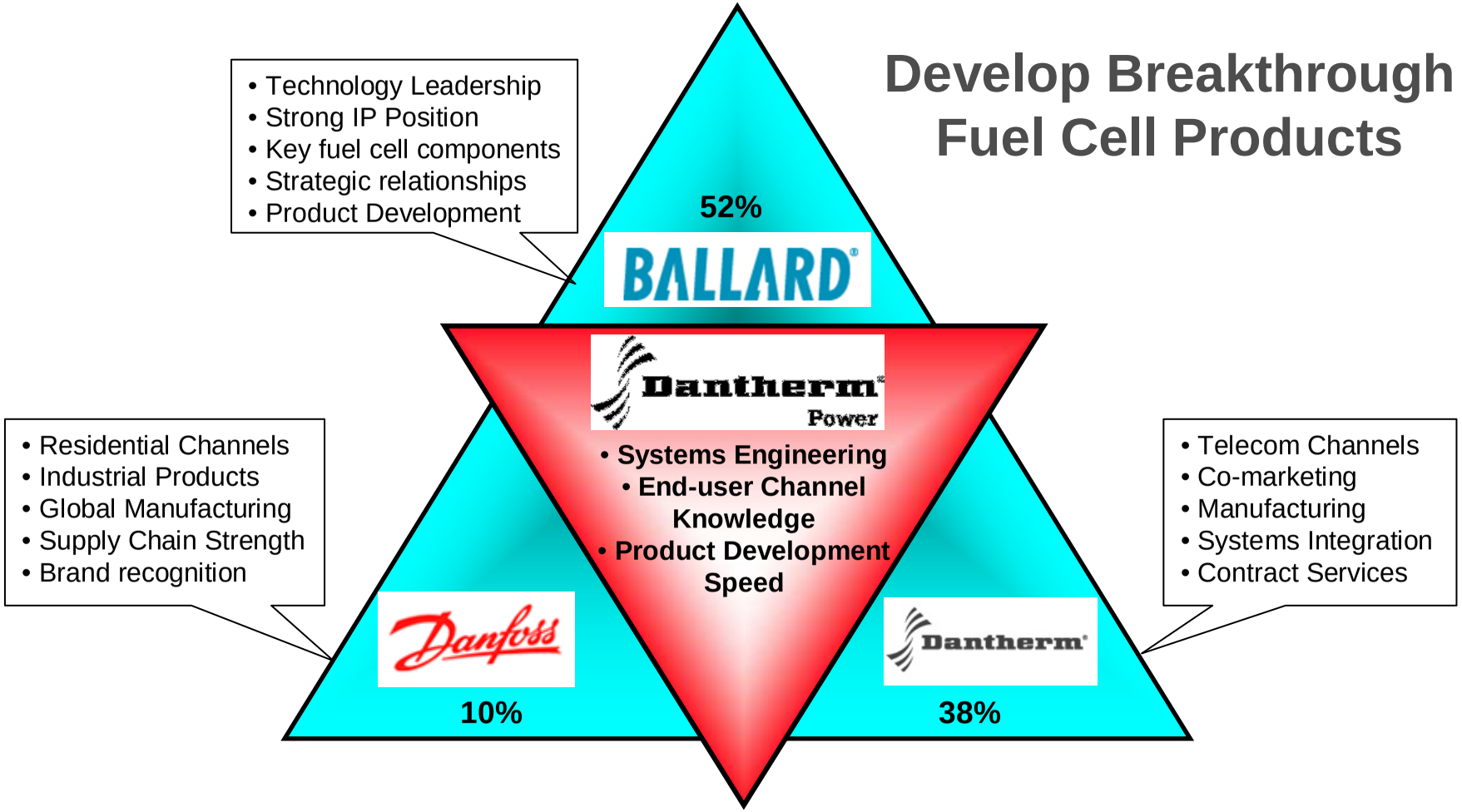
Dantherm Power at HTAC

Develop Breakthrough Fuel Cell Products



Small, focused company with partners bringing significant value

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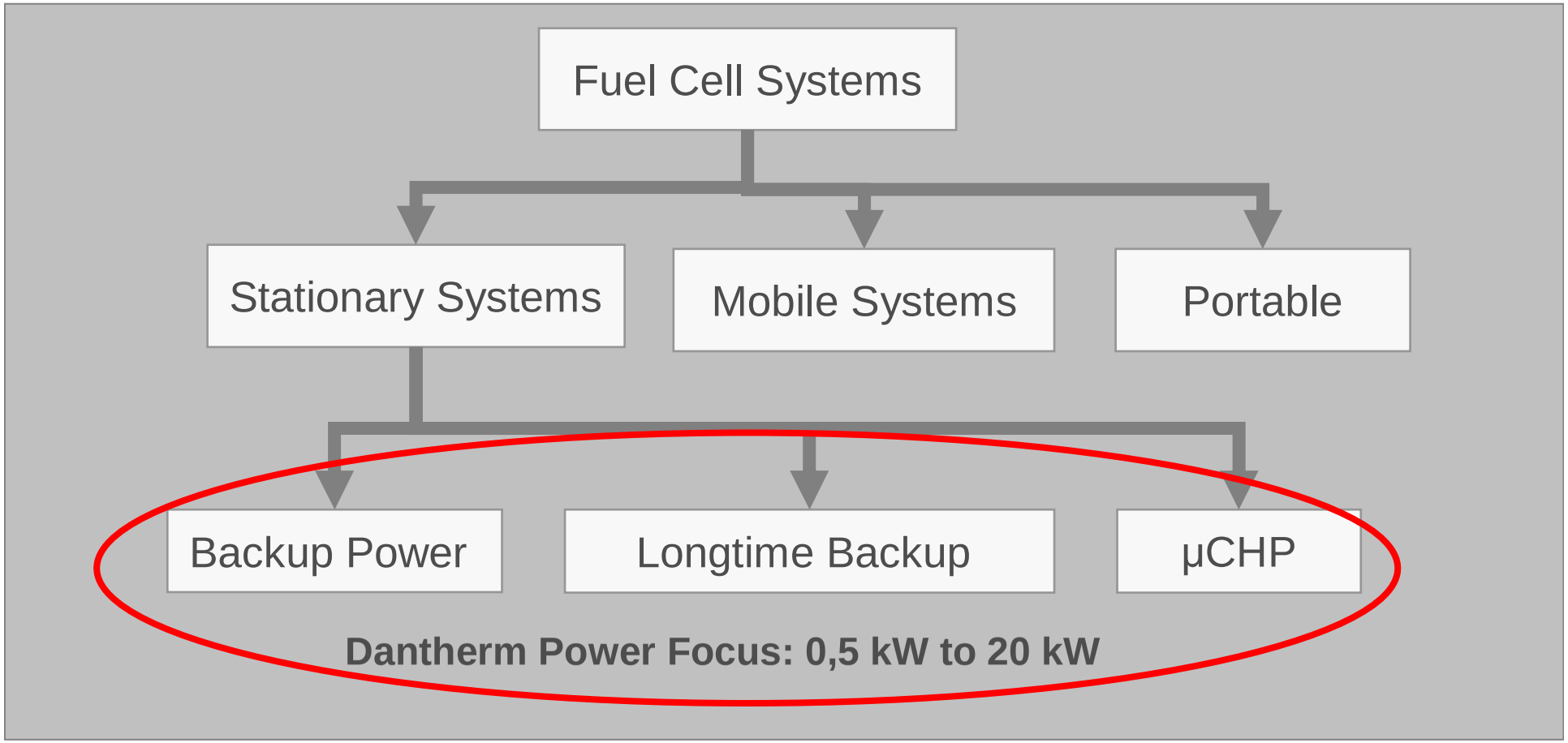
Dantherm Power at HTAC

Dantherm Powers Markets for Fuel Cell System



Dantherm Power at HTAC

Status

- Commercial power backup system:
  - To date around 1 MW shipped in units primarily in 2 kW systems.
  - Fully commercial line production of fuel cell systems with our sister company, Dantherm Air Handling.
  - Largest commercial project to date is the Danish Emergency Network (Tetra) where 125 fuel cell systems are installed.
- Field test of mCHP systems:
  - Delivered 9 units. SOFC system running on natural gas. Next generation SOFC system under development, 2 units expected deployed March 2011.
  - 5 units HT-PEM systems installed. 11 units waiting for installation.
  - 3 LT-PEM on natural gas ready to be installed February 2011
- Power Plant
  - 100 kW power plant for grid balancing delivered to BC Hydro. After 4 months of successful testing at Powertech Labs the system in now being installed in Bella Coola - a small remote community north of Vancouver.

Line production of DIB 2000.

Power Backup Module DIB 2000.

100 kW testing at Powertech.

100 kW installation in Bella Coola.

SOFC mCHP system.

© Dantherm Power A/S

Production of backup power modules

- Serial production of the backup systems take place at Dantherm Air Handling in Skive
- Assembly line production with several stations ensures high quality and repeatability
- Full traceability on all major components within the unit
- All units are tested by use of PC-tester.
- All test records are stored at Dantherm Power linked to its serial number
- Packing takes place at the last station at the line

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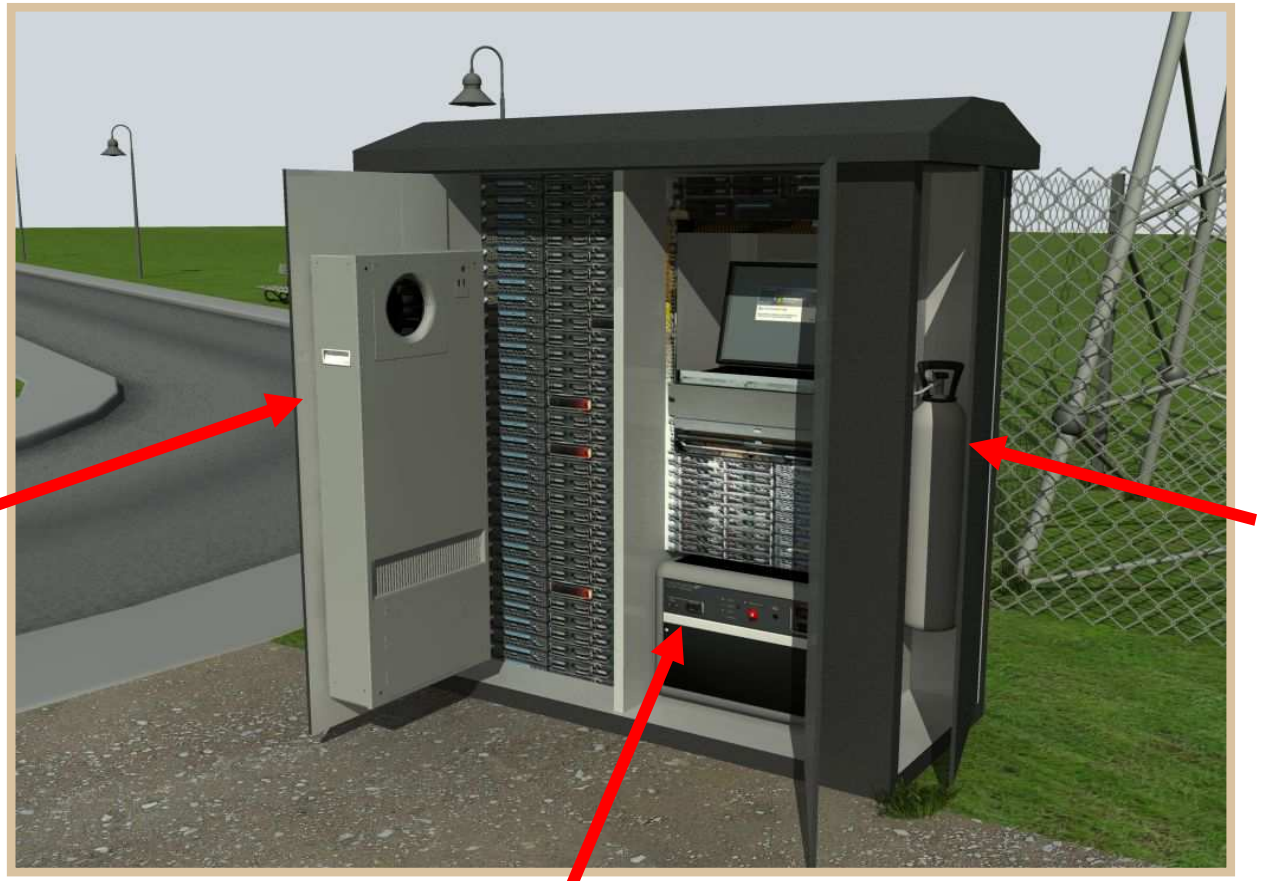
Dantherm Power at HTAC

The integrated solutions

Optional climate control solution for cabinets and shelters



- Hydrogen storage using compressed hydrogen in cylinders including hydrogen monitoring equipment
- Methanol tank with monitoring equipment in combination with a methanol reformer

Power Supply module with integrated UPS or power backup and reformer integrated when running on methanol

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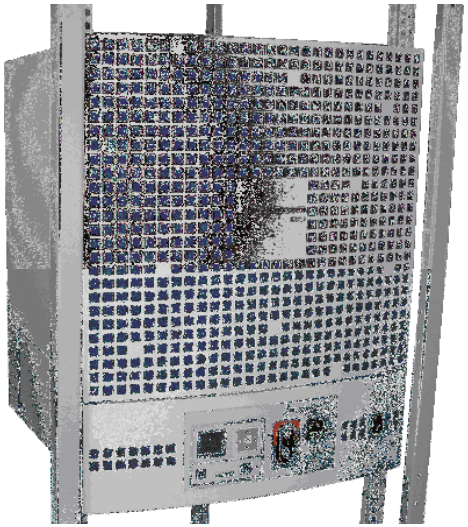
Dantherm Power at HTAC

Power Generator/Backup Solutions development since 2003

DBX2000: 1.7 kW backup power



DBX5000: 5 kW backup power

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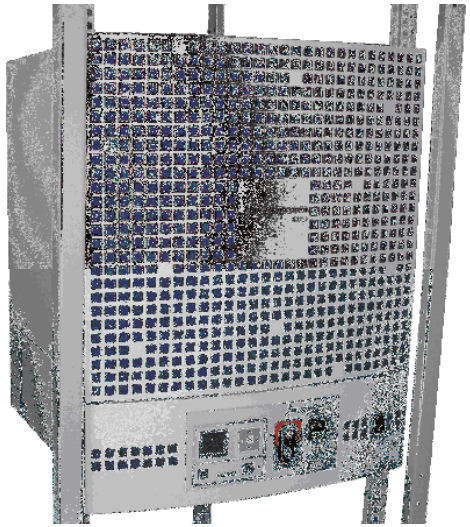
Dantherm Power at HTAC

Products available now

DBX2000			
Important Note	DBX requires fresh air supply and ducting of exhaust air to outside ambient. DBX can only work when equipped with Dantherm Power Valve Block and a fuel regulator supplied by or approved by Dantherm Power		
System capacity			
Power output	W_e	Continuous	1676
Voltage output	VDC	Fixed within	45 - 57
Voltage input	VAC	For Standby operation	90 – 264 / 50-60 Hz
Fuel			
Hydrogen purity (H_2)	%	Commercial grade 3.5	Min. 99,95
Inlet Pressure	Barg	Nominal to Valve Block	5
Consumption	Nm^3/kWh	Average at max. load	0,87
Physical			
Ambient Temperature	°C	Operational (optional)	-20 (-40) - +40 (+45)
Internal Temperature	°C	Operational	0 - +60
Storage Temperature	°C	Weather protected	-45 - +70
Unit dimensions	mm	H x W x D	355 x 446 x 628
Weight	kg	Each module	40

DBX5000			
Important Note	DBX requires fresh air supply and ducting of exhaust air to outside ambient. DBX can only work when equipped with Dantherm Power Valve Block and a fuel regulator supplied by or approved by Dantherm Power		
System capacity			
Power output	We	Continuous	5000
Voltage output	VDC	Fixed within	-47 to -57
Voltage input	VAC	For standby operation	90 – 264 / 50-60 Hz
Fuel			
Hydrogen purity (H_2)	%	Commercial grade 3.5	Min 99,95
Inlet Pressure	Barg	Nominal to Valve Block	5
Consumption	Nm3/kWh	Average at max. load	0,95
Physical			
Ambient Temperature	°C	Operational (optional)	-20 (-40) to +40 (-55)
Integration cabinet Temperature	°C	Operational	0 to +60
Storage Temperature	°C	Weather protected	-45 - +70
Cabinet dimensions	mm	H x W x D	611 x 500 (450) x 555
Weight	Kg	Stand alone module	75 Kg
Ingress Protection	IP-class	External to internal	55
Air flow	m3/h	Exhaust to outside	200-1600

DBX2000: 1.7 kW backup power



DBX5000: 5 kW backup power

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We take Fuel cell based systems from complexity to simplicity…

Quality and reliability

Compact solution

Short time to market

Plug & play deployment

Cooling & Power

Control and surveillance

Low Noise

Flexible design

Low TCO

Scalability

© Dantherm Power A/S

Emergency network - TETRA

- Tetra is used by firefighters, police, ambulances, defense,…. in a closed encrypted network.
- Tetra is a digital radio communication systen
  - substituting existing talkie talkie systems
- Tetra has many advantages:
  - enabling joint operations
  - enabling text messages
  - enabling central coordination

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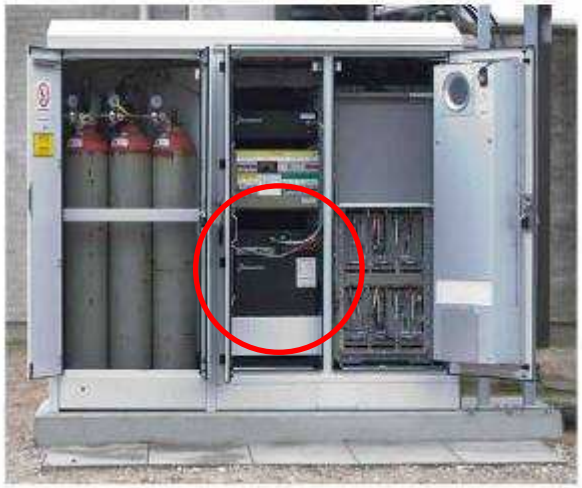
Dantherm Power Application

MOTOROLA

Dantherm Power

Motorola Delivers TETRA Solution with Innovative Fuel Cell Backup Power to Denmark's SINE Network

Robust, environmentally-friendly TETRA solution backed up by fuel cell technology



***GLOSTRUP, Denmark – 30 June, 2009 -** Motorola, Inc. (NYSE: MOT) today announced that a total of forty Motorola TETRA Base Stations with fuel cell back-up are now live across Denmark's SINE public safety network, with approximately 50 planned and commissioned for installation throughout the remainder of the year.

The environmentally friendly, fuel cell-based back-up solution, which was developed with Dantherm Power, was installed to provide mission-critical operations with continuous secure communication across the nationwide SINE network in Denmark. It is the first network of its kind in the world.

"The use of our hydrogen fuel cell technology in mission-critical environments provides public safety networks across the country with uninterrupted network access." says Per Albæk, CEO for Dantherm Power. "Our partnership with Motorola is a world's first and we hope to continue developing innovative technology that helps professionals do their jobs more effectively."

www.dantherm-power.com

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Dantherm Power at HTAC

Fuel cell backup power in the DK SINE Network

Due to security reasons the specific locations are not correct in this map

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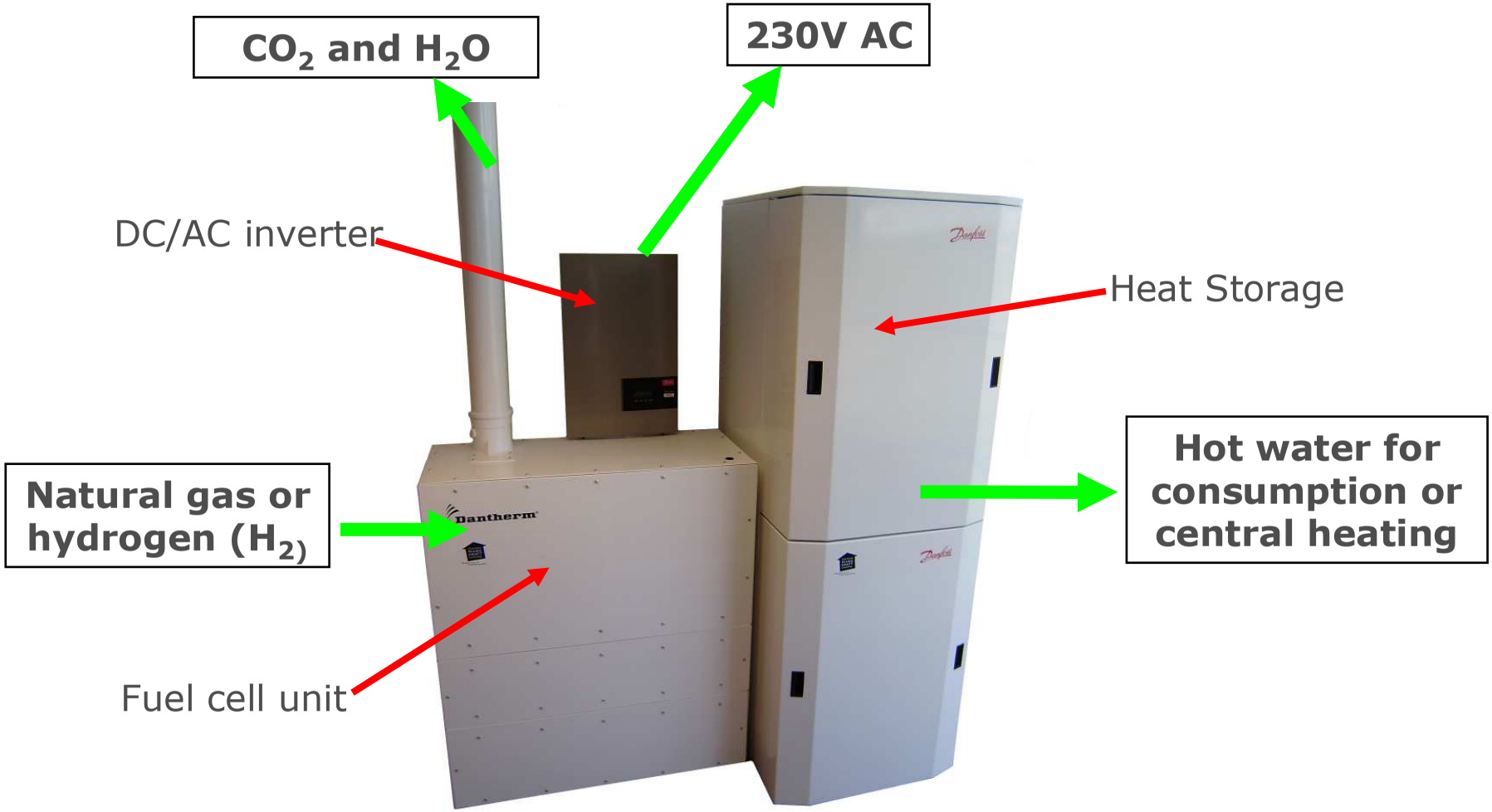
A Danish demonstrations project on fuel cell based micro CHP



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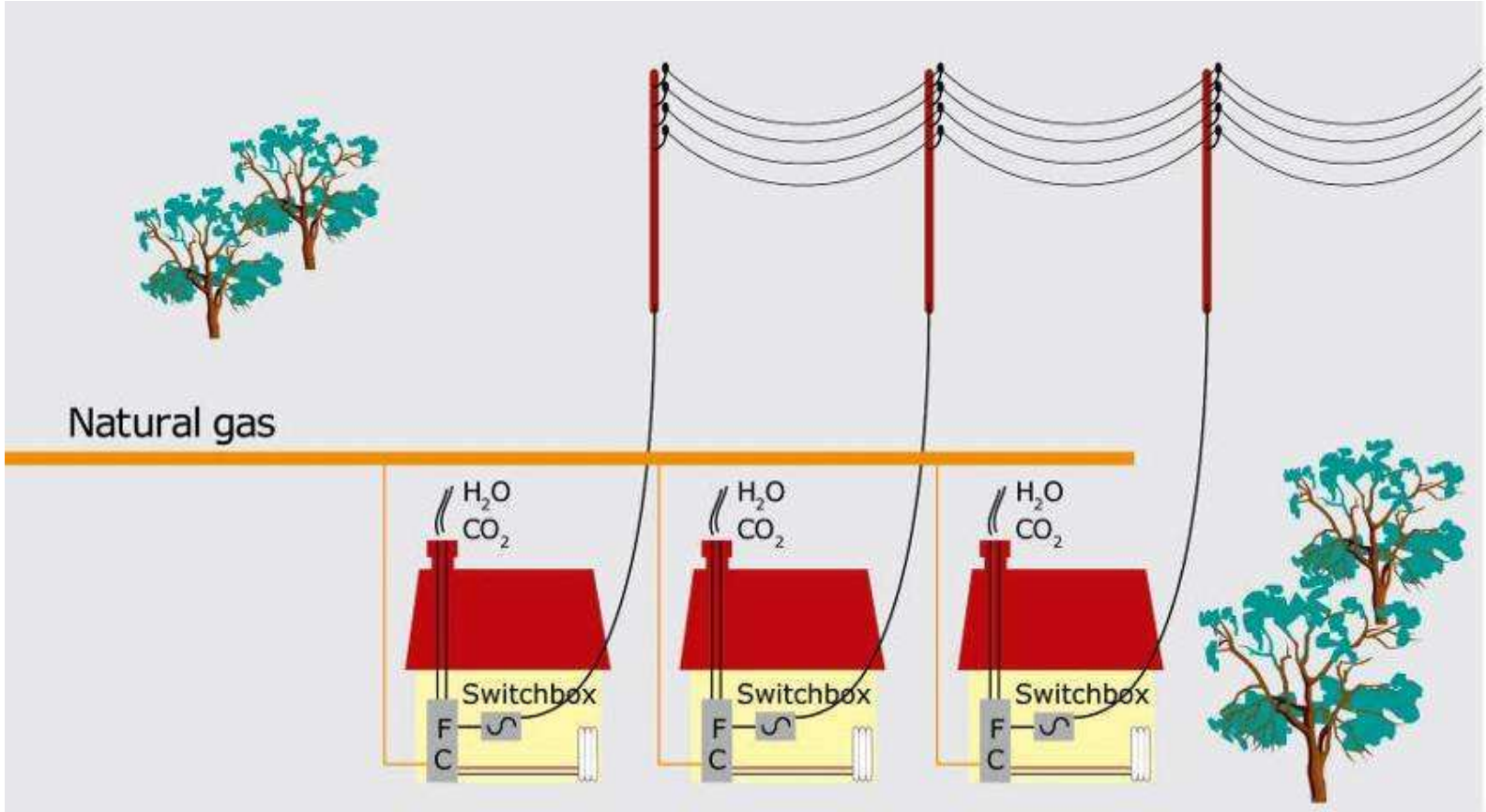
A Danish demonstrations project on fuel cell based micro CHP

Demonstration of Fuel cell micro CHP fueled by natural gas based on LT-PEM and SOFC



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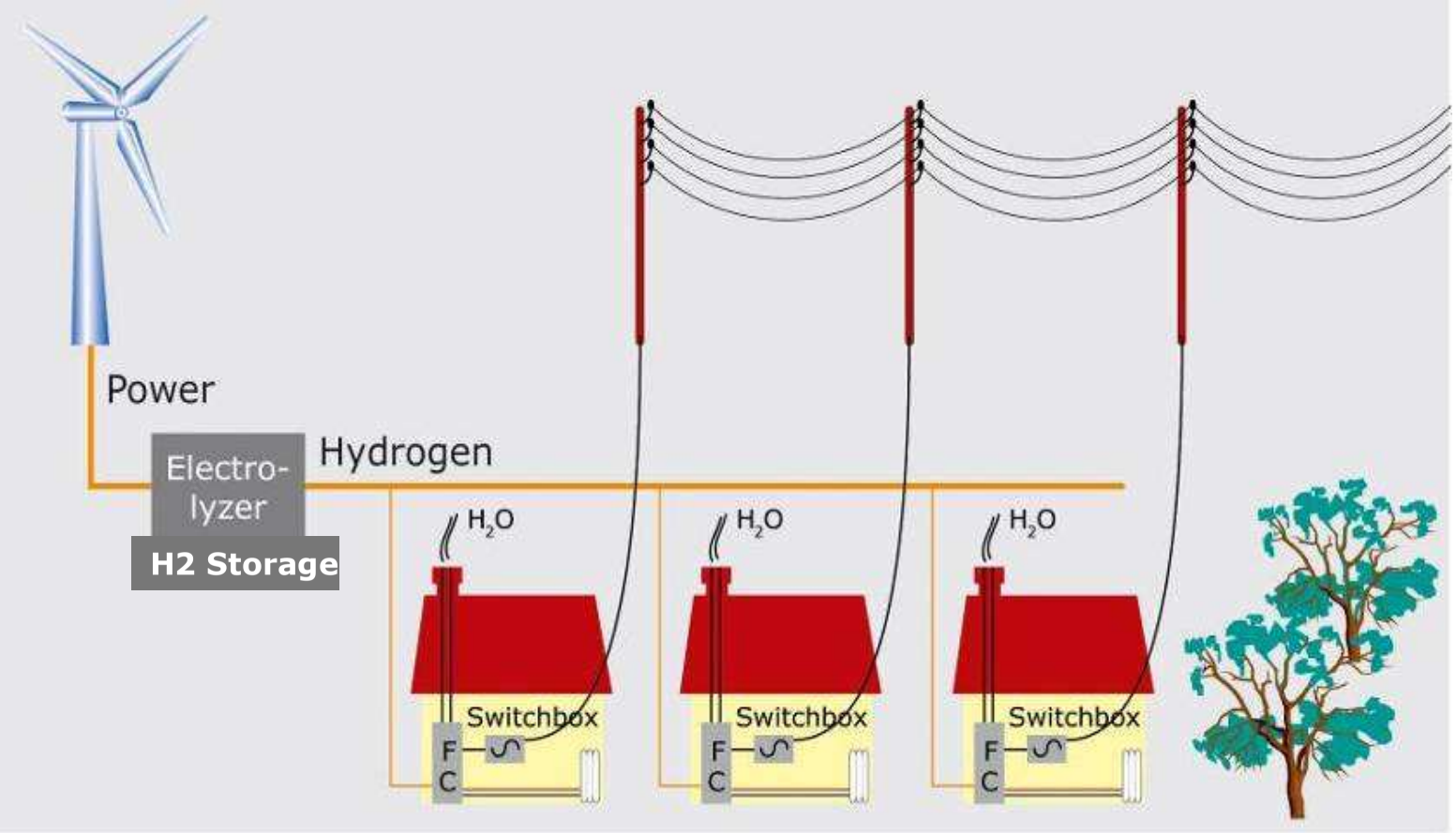
A Danish demonstrations project on fuel cell based micro CHP

Demonstration of Fuel cell micro CHP fueled by hydrogen based on LT-PEM



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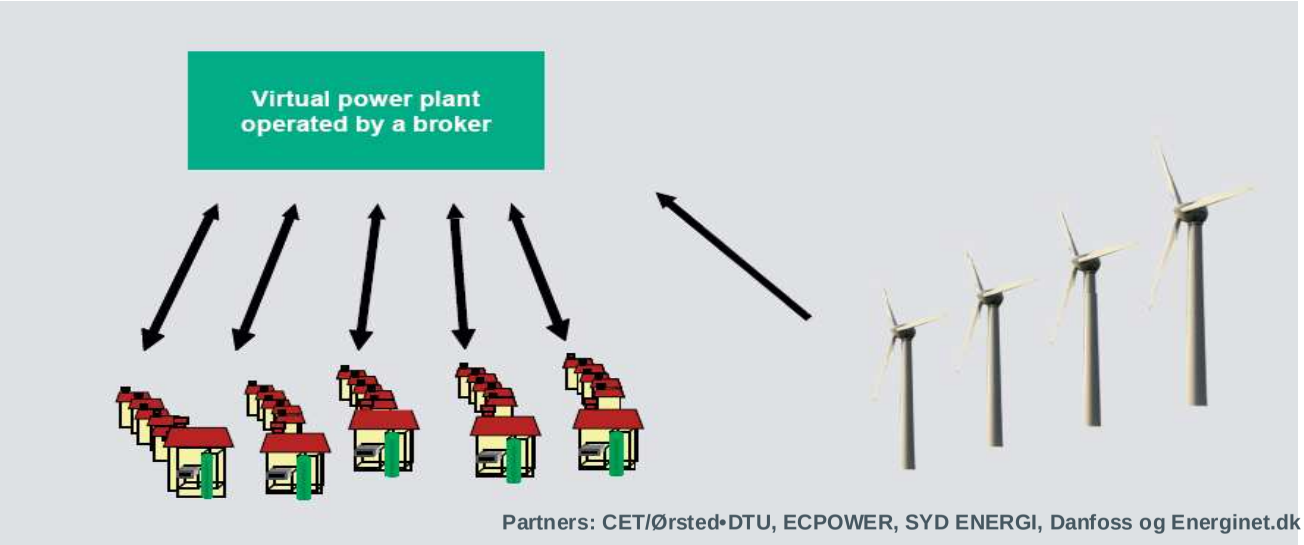
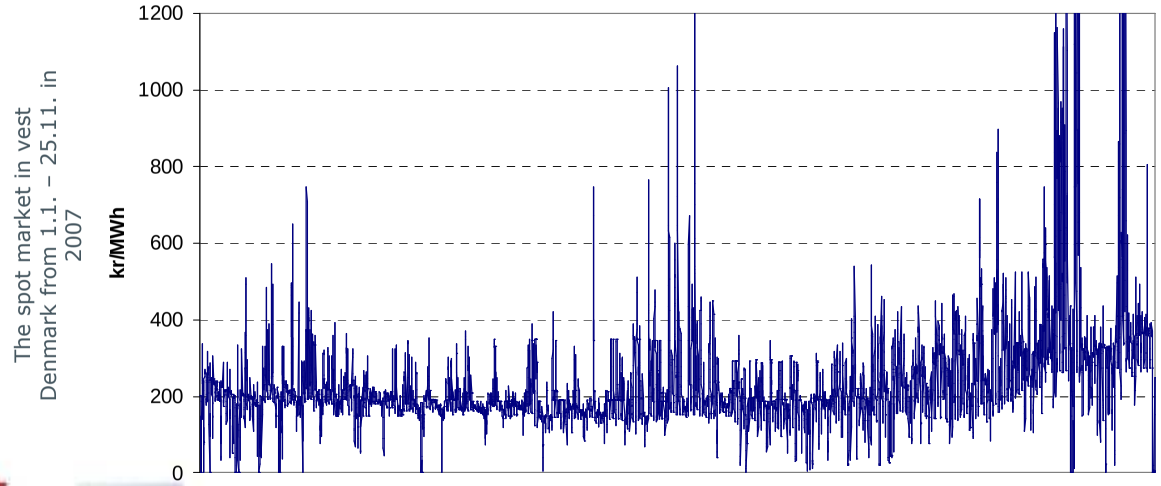
A Danish demonstrations project on fuel cell based micro CHP



Virtual Power Plant: Power from µCHP can supplement wind turbines in periods with little wind.



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A Danish demonstrations project on fuel cell based micro CHP

Dantherm Power

Project sponsors:

ENERGINET/DK

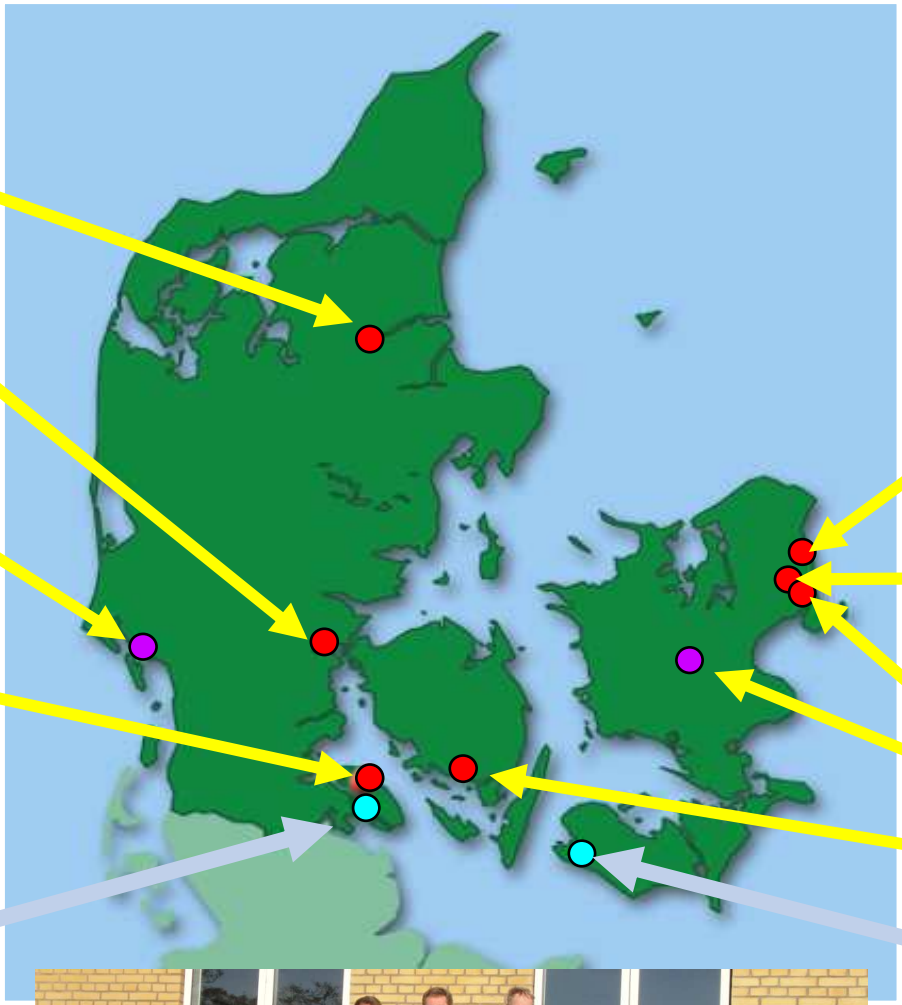
DANISH ENERGY AUTHORITY

Dantherm Power

DONG energy

SYD ENERGI

Dantherm Power



DGC

TOPSOE FUEL CELL

COWI

seas nve

IRD Fuel Cell Technology

Sønderborg

Lolland

DANISH MICRO COMBINED HEAT & POWER

Heat & Power from Fuel Cells

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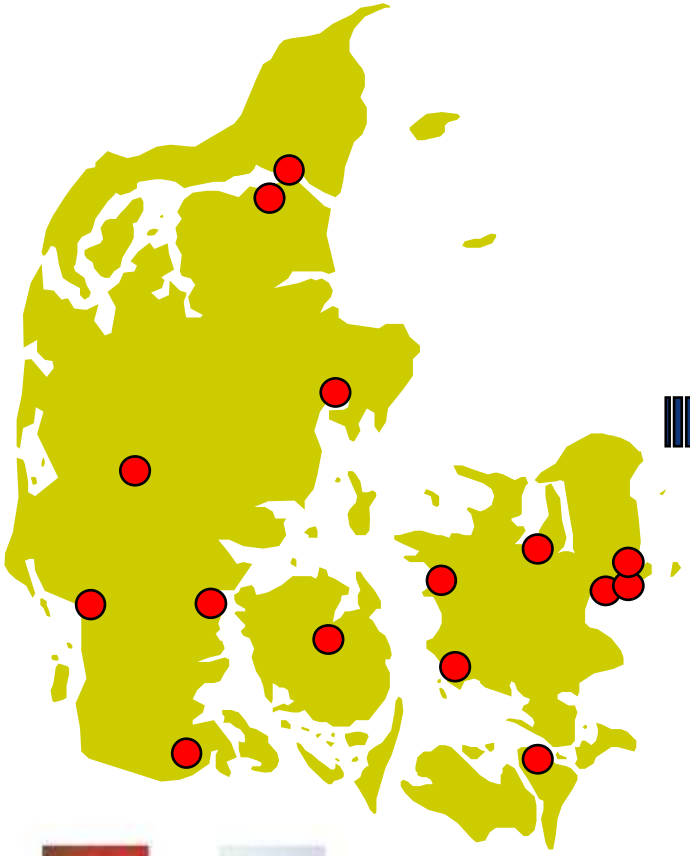
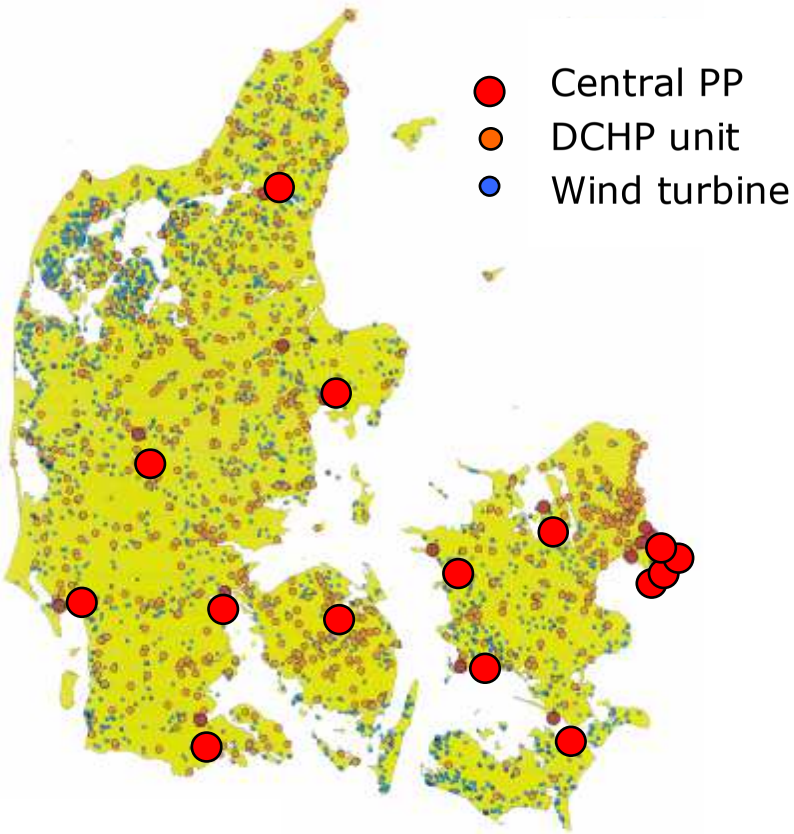
Distributed production of electricity in DK

Development since the 1980s

1980
Central Power Plants



2010
Locale Power Plants



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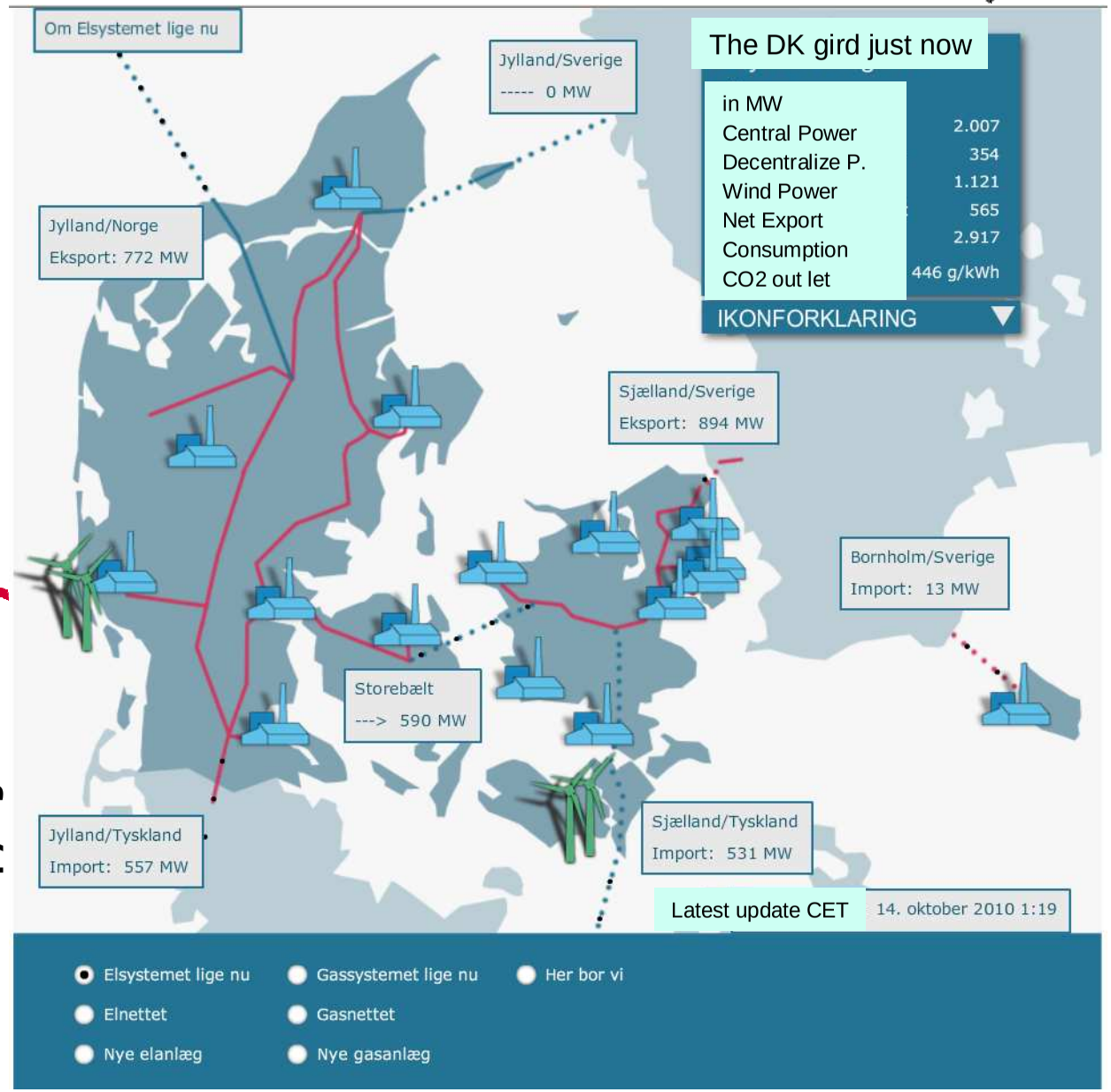
The electrical grid in Denmark



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http://energinet.dk/Flash/Forside/index.html

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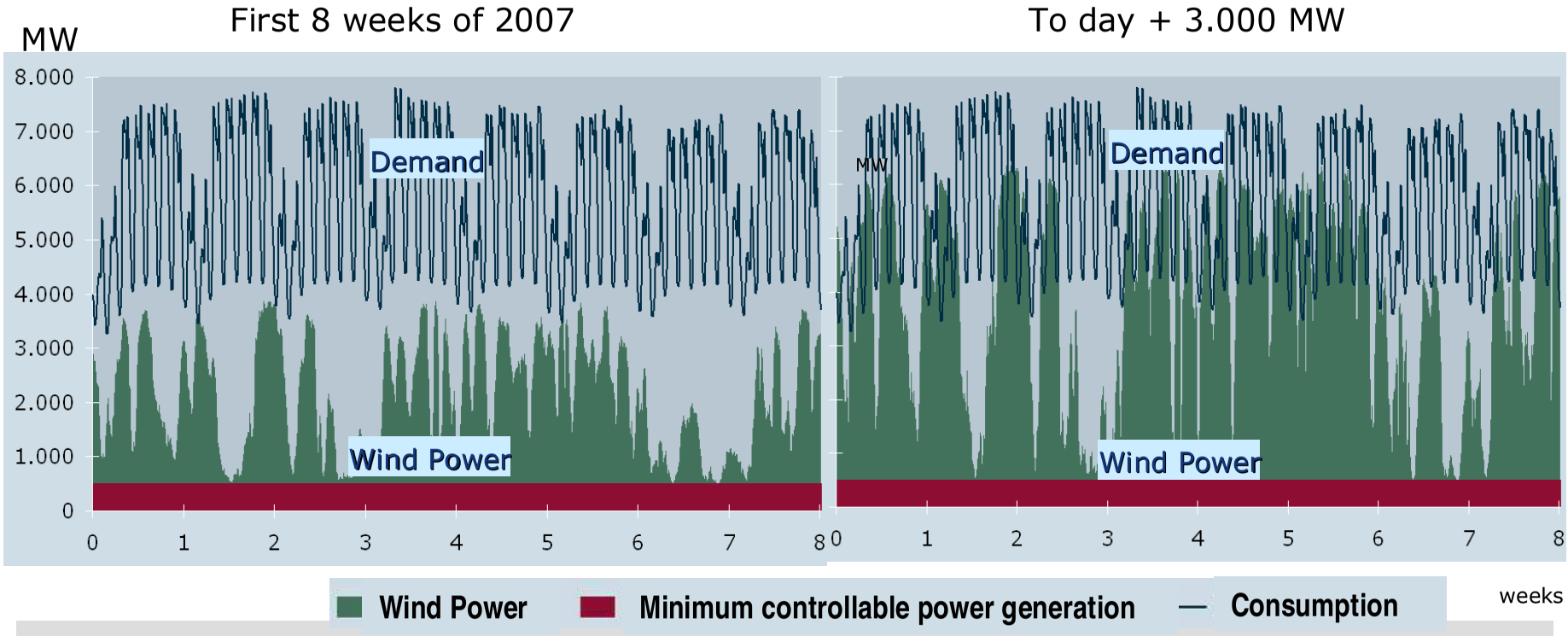
Wind Power in Denmark

Integration of extra 3,000 MW wind power?



Denmark must utilize **domestic resources** and **trade with neighbors.**

Security of supply must bee maintained and the value of wind power should be maximized ecological and economical

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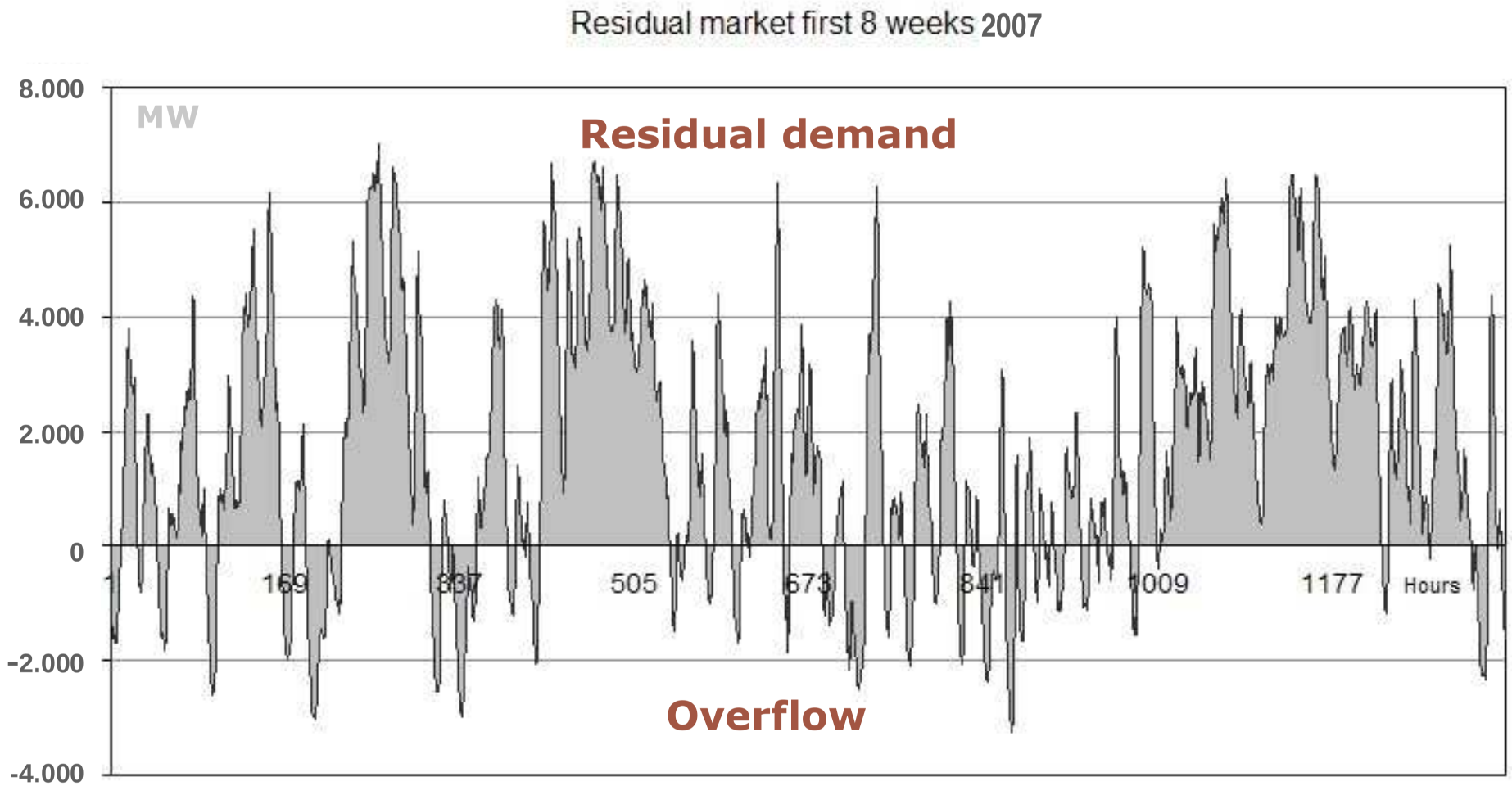
Wind Power in Denmark



This profile needs a lot of expensive regulating power

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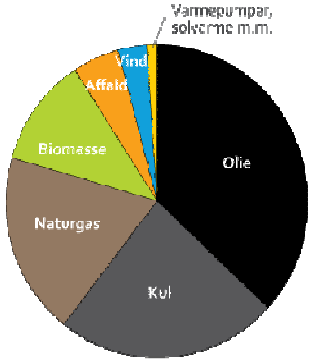
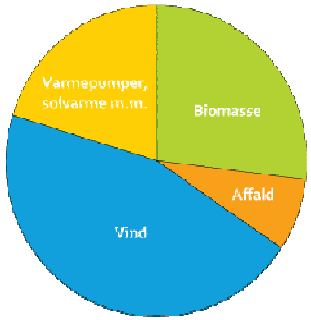
The Danish climate commission:
"The future is renewable energy"

2010



2050



EcoGrid EU
www.eu-ecogrid.net

EcoGrid EU Partners

DENMARK
Energinet.dk
Østkraft
DTU-CET

BELGIUM
ELIA
EANDES
ORES

GERMANY
Siemens
EnCT

SPAIN
LaBein

NORWAY
SINTEF ER
(Coordinator)

ESTONIA
Tallin University of Technology (TUT)

THE NETHERLANDS
ECN
IBM Benelux

AUSTRIA
Austrian Institute of Technology (AIT)

SWITZERLAND
IBM Research

Executive Subcontractors

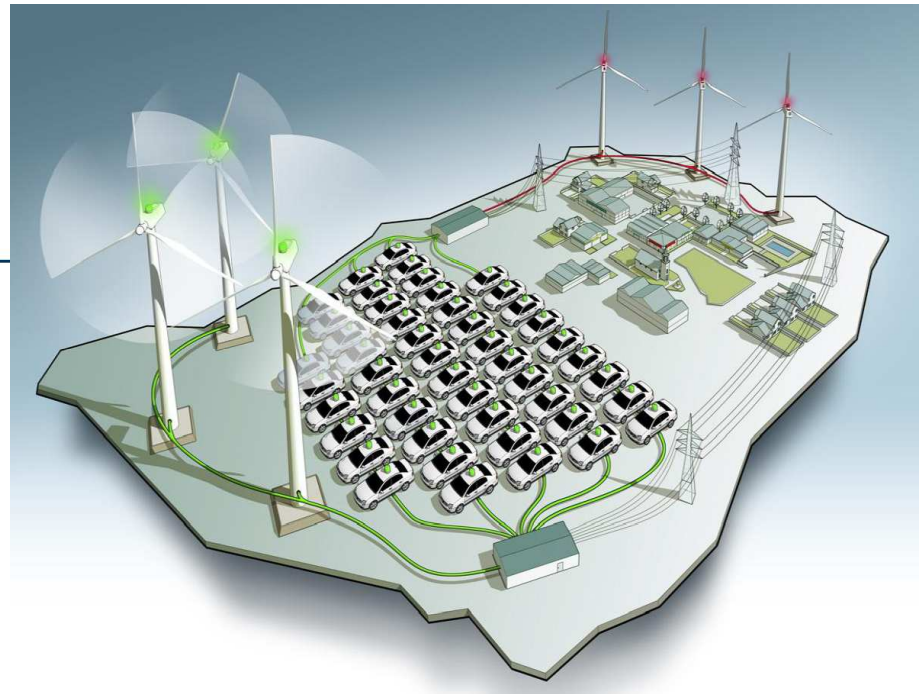
Sweden
Landis + Gyr

Denmark
Forbrugerrådet

Norway
Maj Dang Trong analyse

COOPERATION

EcoGrid EU
A Prototype for European Smart Grids



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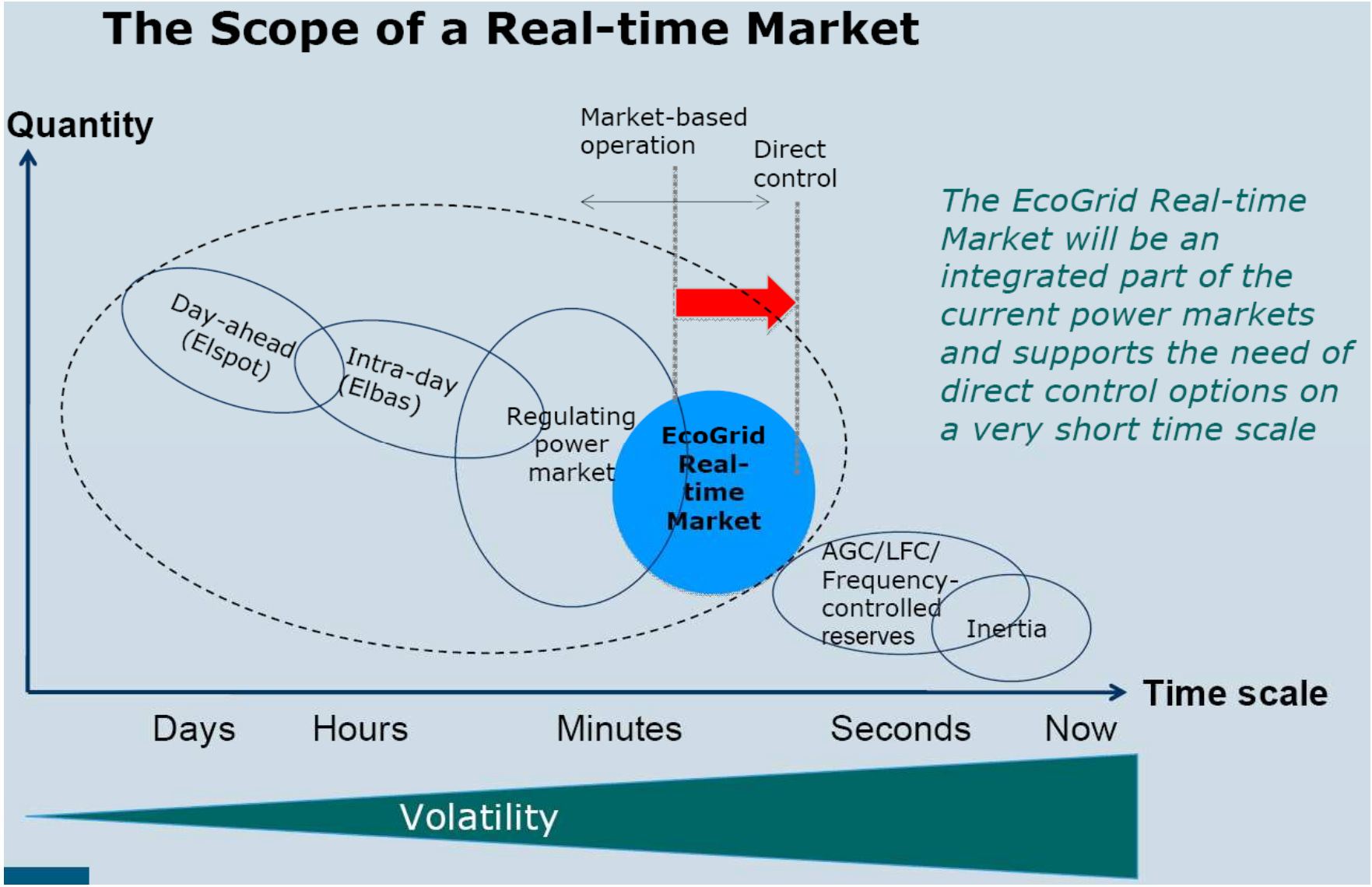
EcoGrid.EU Bornholm, Denmark



The EcoGrid Real-time Market will be an integrated part of the current power markets and supports the need of direct control options on a very short time scale

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What to be Demonstrated on Bornholm?

Power Generation

Wind Power

CHP (biomass)

2 MW Biogas

Photovoltaic (solar)

EcoGrid EU is a full scale demonstration of a real-time market place including a very broad mix of distri-buted energy resources

Demand side/Storage options

"Intelligent" control of household appliances

Electric Vehicles

Heat Pumps with Smart Grids applications

Micro CHP

Electricity storage in District Heating

Budget 24 M€

Synergies with other Bornholm activities, e.g. EV roll-out and infrastructure demonstration (EDISON), heat pump roll-out program, PV roll-out, 200 smart heating/coolers controllers demonstration

COOPERATION

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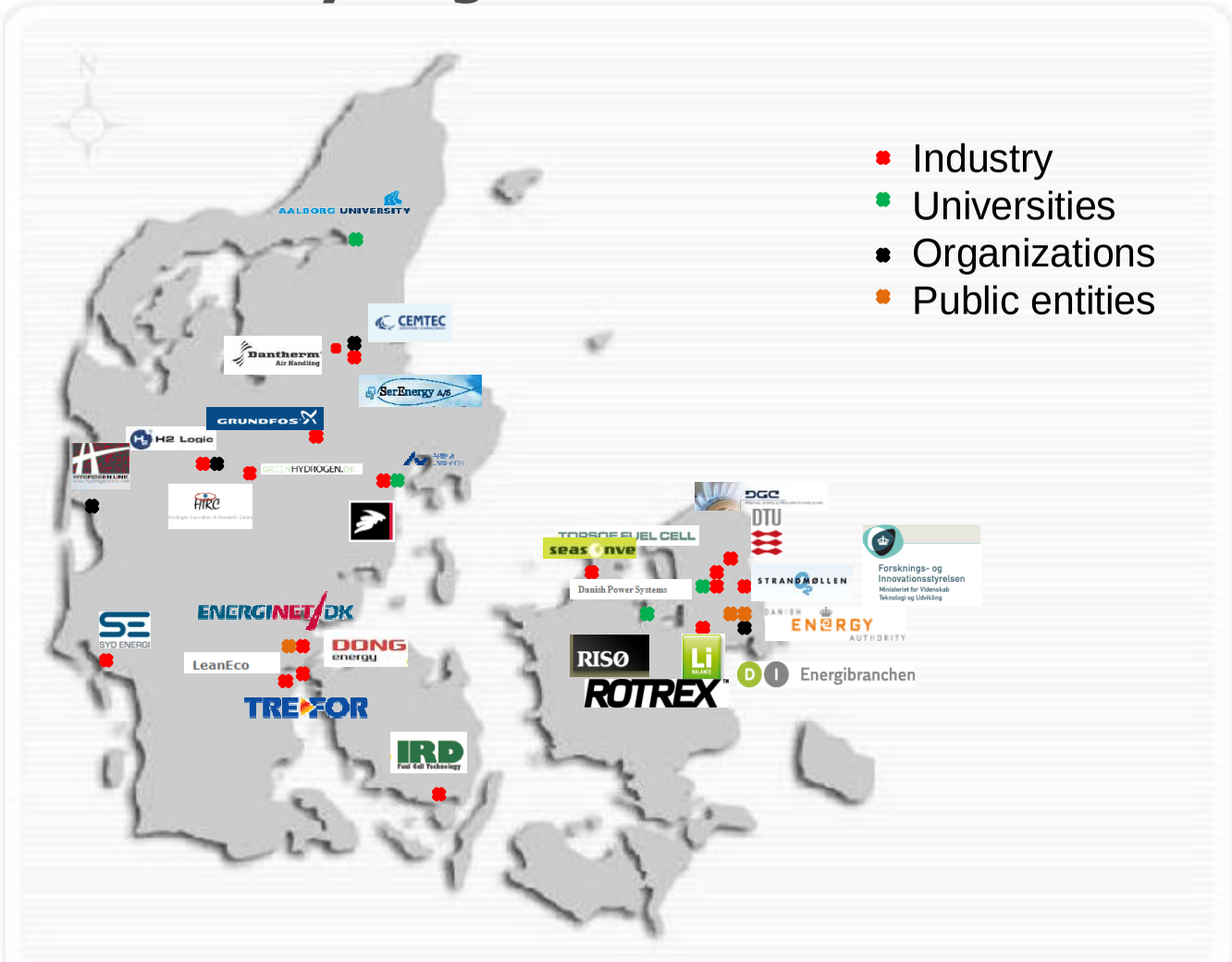
The Danish Partnership for Hydrogen & Fuel Cells



www.hydrogennet.dk

PARTNERSKABET FOR BRINT OG BRÆNDSELSCELLER

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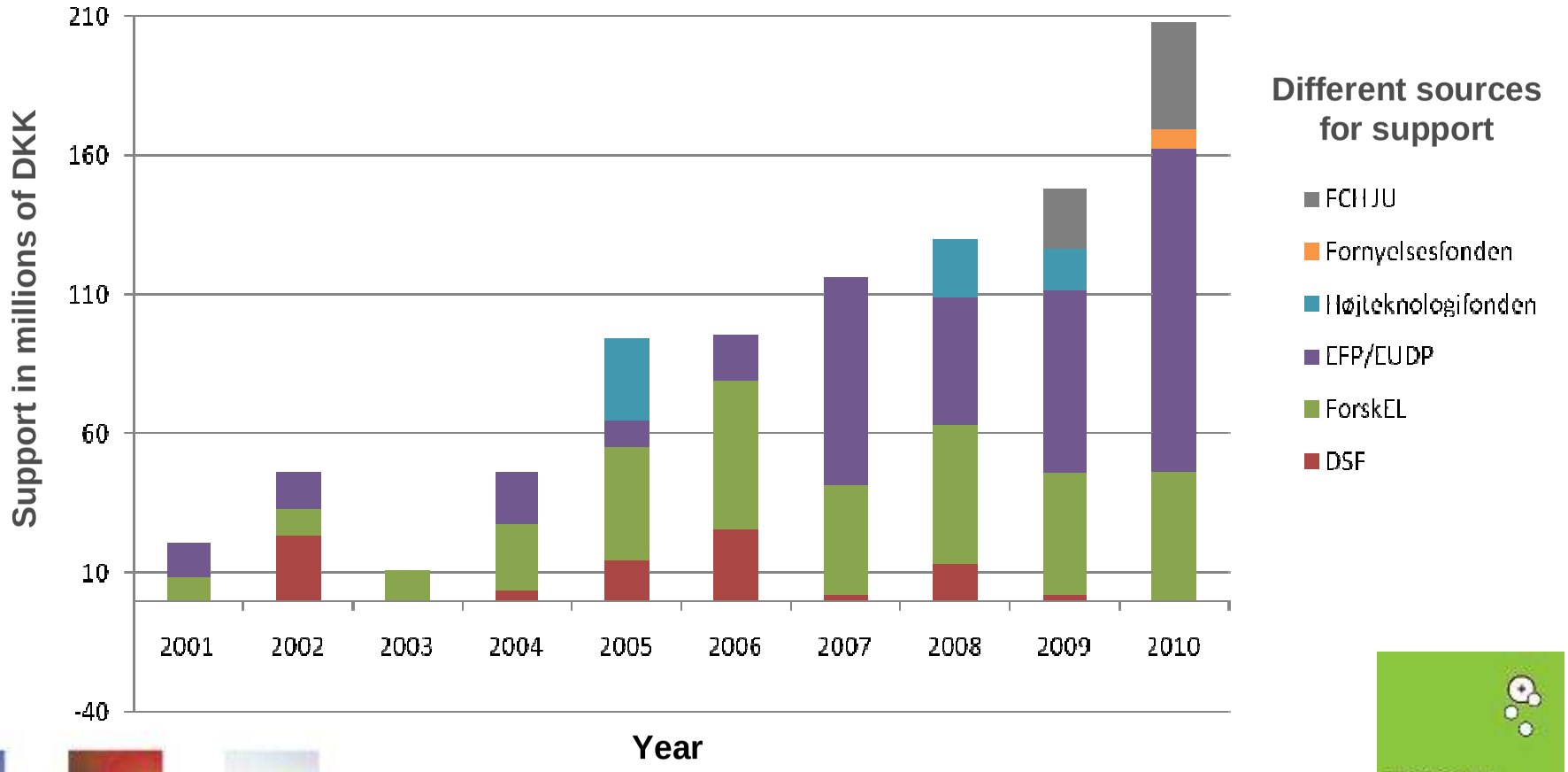
Dantherm Power at HTAC

Public support for hydrogen and fuel cells granted from 2001 till 2010



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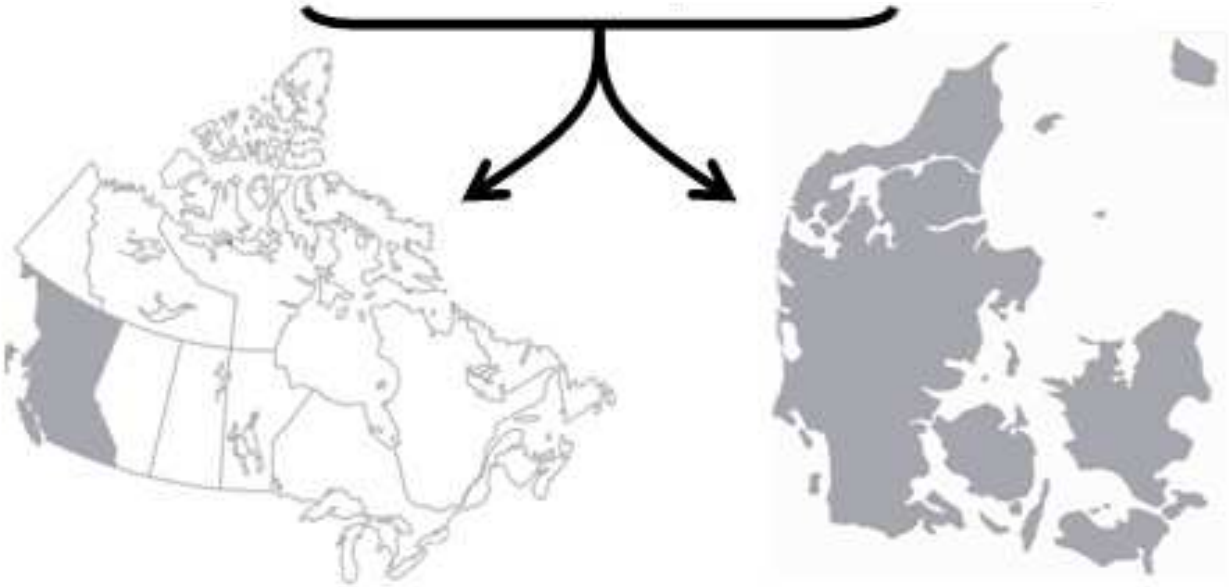
CANDAN

Canadian/Danish Joint Fuel Cell Initiative

UPS and power backup **Niche transport and H_2 fuelling**



Pilot testing and large scale demonstration in Canada and Denmark

Project sponsor: eUDP

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CanDan – History and Purpose

History
Established between Canadian and Danish leading fuel cell universities and companies in September 2006 based on existing collaboration relations

Purpose
CanDan is combining Canadian Fuel Cell knowledge with Danish System knowledge in joint fuel cell system R&D, pilot and demonstration projects with the purpose of commercializing fuel cell systems for early markets such as Power Backup and Industrial Electric vehicles.

Actions so far
CanDan 1 – 1.5 – 2: A joint $15 million research, development and pilot testing project on fuel cell systems. Focus on early transport and backup power applications in Denmark and Canada supported by the Danish Energy Authority and Canadian Government.

CanDan 1&2 – Funding structure

- End-user product purchases
- Company development costs
- End-user development costs

- Danish Federal funding
- Canadian Federal funding
- Province of British Columbia

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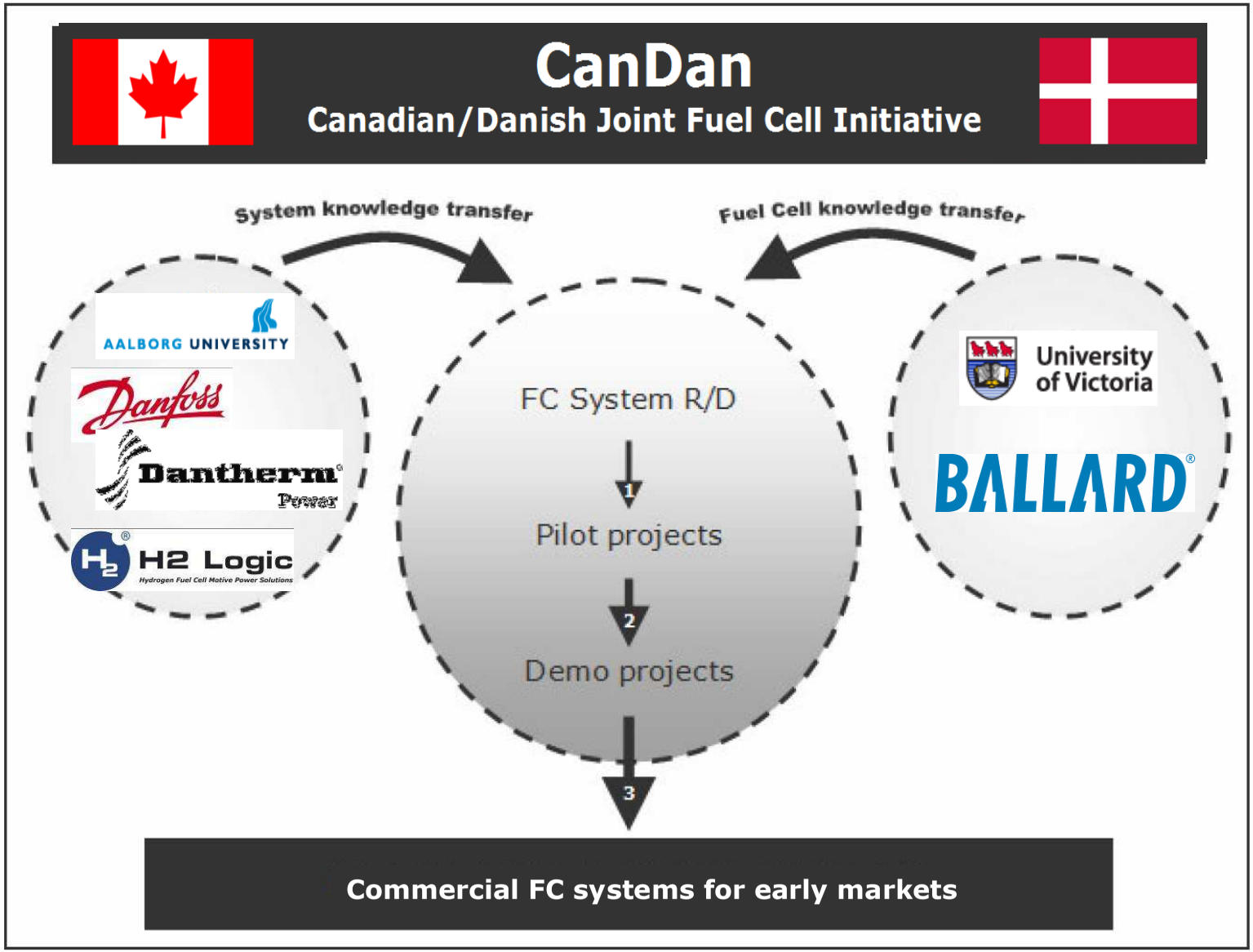
CanDan – principle



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CanDan Power Backup demo examples 1.

100 kWe fuel cell power solution for BC Hydro's Hydrogen-Assisted Renewable Power (HARP) initiative in Bella Coola

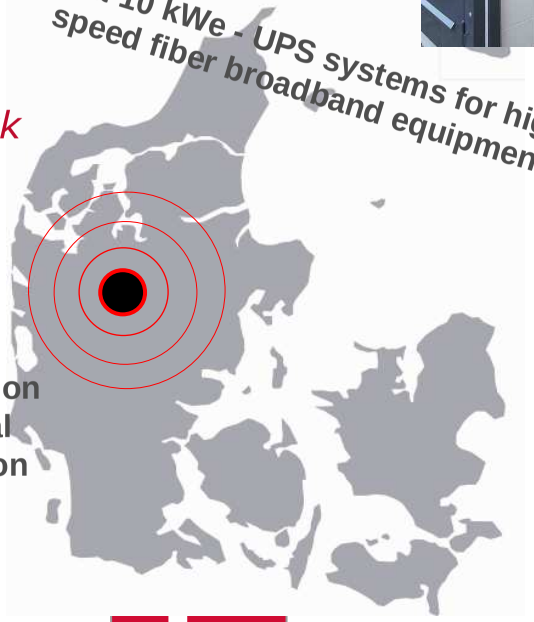
~300kWe installed

In 2 areas

In 1 network

McKesson

A 6 kW fuel cell power solution with electrolyzes and metal hydride storage at McKesson



5 & 10 kWe - UPS systems for high-speed fiber broadband equipment.

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CanDan Power Backup demo examples 2.

Telecom shelter installations

Operator 1.

Supply of 15 temporary power sites in Ontario and Quebec. Temporary power is defined as power for the temporary period of time from installation of base station until connection to the electrical grid is established. Usually 3 – 6 months.

Operator 2.

16 kW installed for large operator in Canada.
Battery free backup power system for use in big telecom shelters. 3 racks with each 3 pcs 1,7 kW standard units.
Works as free cooling ventilation system also in stand by mode

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CanDan – step overview

2007 | 2008 | 2009 | 2010 | 2011 | 2012→

CanDan1
US$3,2 million

R&D 1. Gen.
FC System

Successful

Pilot testing
11 Power Backup systems
7 vehicles, ~6 dispensers

2010 CanDan Merger

BALLARD, Danfoss, Dantherm → Dantherm Power

CanDan2
US$12 million

R&D 2. Gen.
FC System

Demonstration
~300 kWe Power Backup systems
~xx vehicles, x dispensers

ONGOING

CanDan3
CanDan4
CanDan5
US$XX million

R&D 3. Gen.
FC System

FINANCED
JUST STARTED

Pre-Commercial deployment
1000+ Power Backup systems

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Dantherm Power at HTAC

Proposal for DOE:

Join a

USA – Danish RD&D program! [*USDan*]

Why:

- An international approach are needed to create the paradigm shift to fuel cells and hydrogen
- Promote the development of the fuel cell industry
- Develop the global fuel cell technology and market
- The Canadian - Danish example has proven the concept

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Dantherm Power at HTAC

Thank you for your attention!

Dr. Per Balslev
peb@dantherm.com
www.dantherm-power.com

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