The Hydrogen Demonstration Society @ Lolland island, Denmark

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IRD Fuel Cells A/S

10-Nov-2010
Brussels

DANISH MICRO COMBINED HEAT & POWER
Heat & Power from Fuel Cells

New Energy World JTI
fuel cells & hydrogen for sustainability

IRD Fuel Cell Technology

About IRD

IRD A/S is an independent high technology company devoted to Research & Development and production of fuel cells and fuel cell systems.

The product range comprises:

- PEM Fuel Cells (PEM FC)
- Direct Methanol Fuel Cells (DMFC)
- Complete Fuel Cell Systems

IRD was founded in 1995 and is now employing more than 35 highly competent colleagues within the Fuel Cell Industry

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About IRD

IRD is producing own MEA's:
- PEMFC (400 mW/cm^2 @ 0.7 V)
- DMFC: (120 mW/cm^2 @ 0.4 V)

IRD produces FC stacks:
- PEMFC: 0.5-3.0 kW
- DMFC: 0.1-1.0 kW





IRD is developing systems together with and for customers and partners

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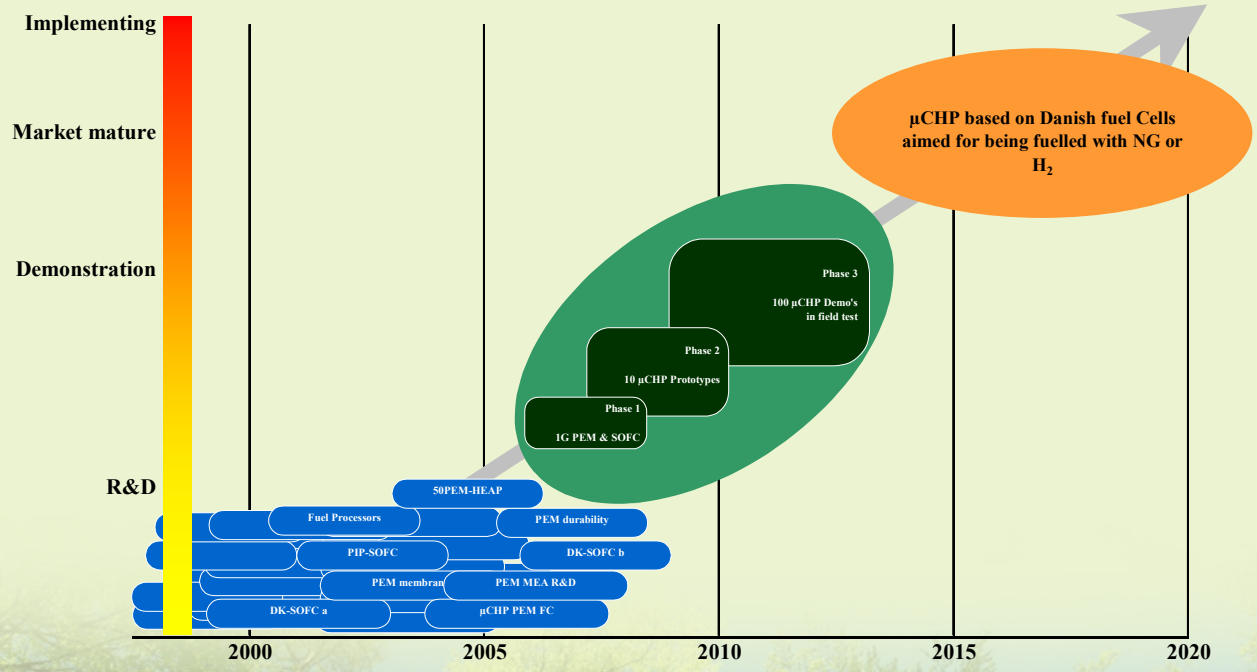
The Danish µCHP demo. project



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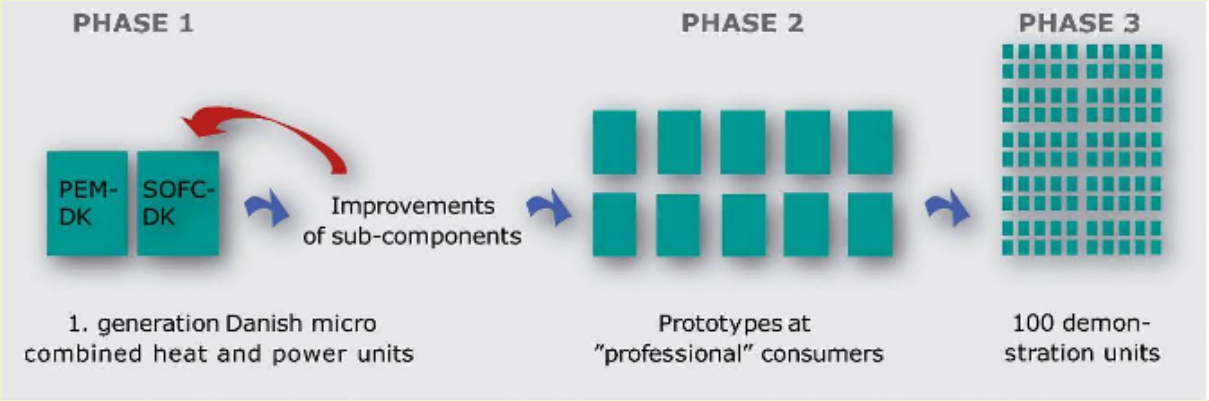

The work is partly financed through the following national contracts (in total 10 mio. €):
Phase 1: Danish Public Service Obligations (contract no. 2006-1-6295)
Phase 2: The Danish Energy Authority (EFP-Akt.167 J.no. 033001/33033-0151)
Phase 3: The Danish Energy Authority (EFP-Akt.167 J.no. 033001/33033-0333)

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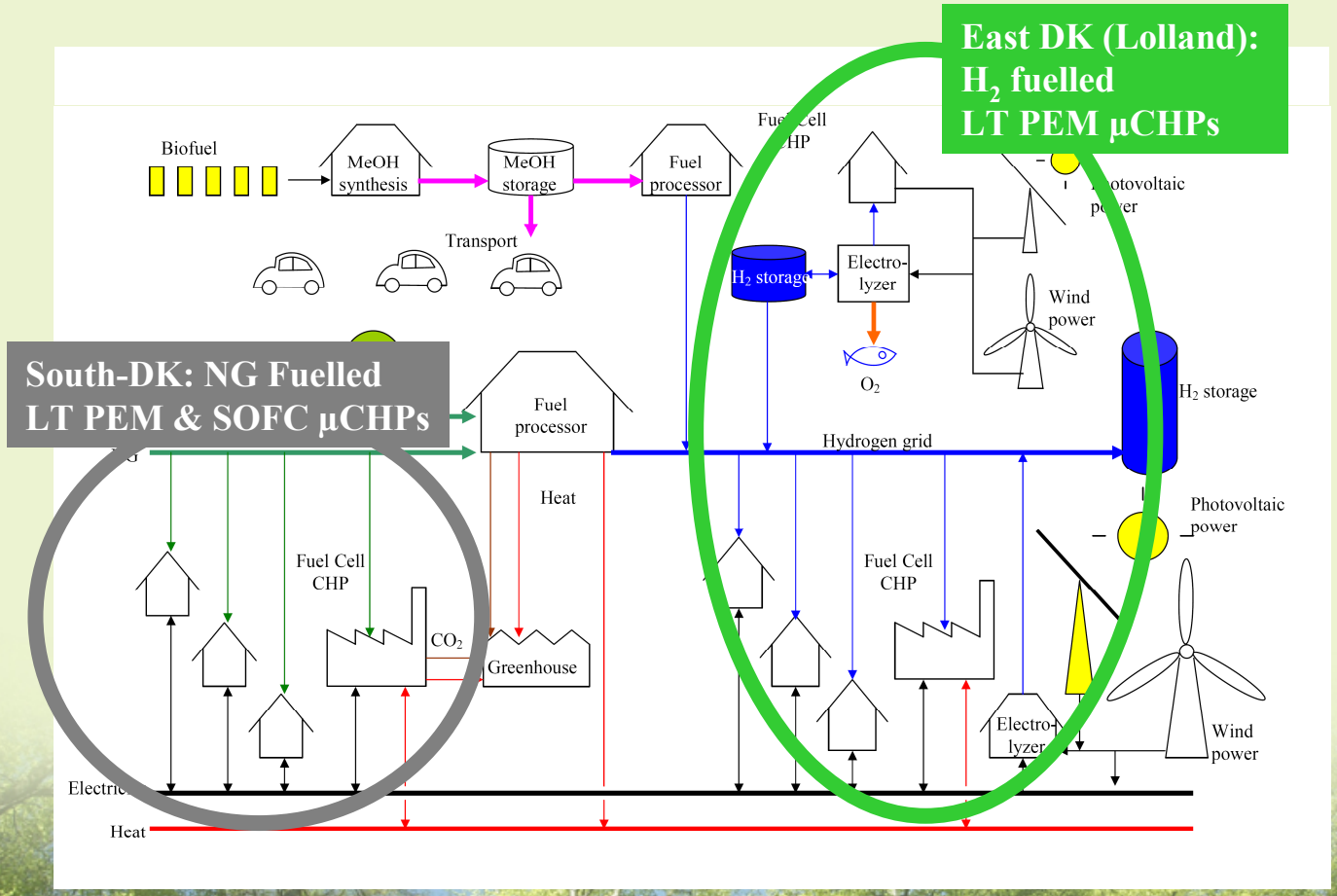

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The Danish µCHP Lolland team

IRD A/S is an independent high technology SME company devoted to R&D and production of fuel cells and fuel cell systems

Project responsibilities: Design and construction of all LT PEM µCHP units for field test in Vestenskov. Technical advicer e.g. on electrolyser, installation

SEAS-NVE is the biggest customer owned utility company in Denmark with 350,000 customers. Their core competences are grid operation and delivering electricity & communication services to the customers in Denmark

Project responsibilities: Phase 3: Coordinator of the full demo-project;
Host for the LT PEM µCHP field test in Vestenskov,
responsible for the H_2-generation and -supply

Lolland municipality covers ≈891 km^2 and has 47,000 inhabitants. The municipality is situated in the SE-part of Denmark. Lolland municipality strongly promotes regional sustainable energy & climate solutions. All the municipality energy projects is managed through their holding company, LOKE.

Project responsibilities: Legal issues e.g. district plan

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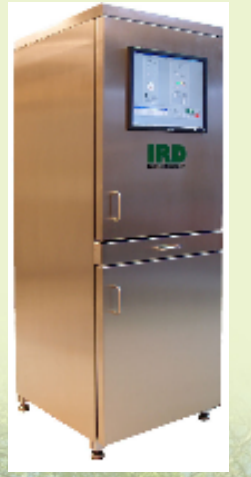
The IRD LT PEM µCHP

2008/9 The IRD β-µCHP unit has the following key characteristics:

Nominal power:	1.5 kW_{AC}
Power range:	0.9-2.0 kW_{AC}
Nominal heat:	1.5 kW_{TH}
Heat Range:	0.8-2.0 kW_{TH}

Efficiency (LHV) at nominal operation:

Electrical ($H_2 \rightarrow P_{DC}$)	52%
Electrical ($H_2 \rightarrow P_{AC}$)	47%
Combined efficiency	94%
Ready-mode Power:	40 W_{AC}



2006/7 The IRD α-µCHP unit has the following key characteristics:

Nominal power:	1.5 kWAC
Power range:	0.9-2.0 kWAC
Nominal heat:	1.1 kWTH
Heat Range:	0.5-1.1 kWTH

Efficiency (LHV) at nominal operation:

Electrical ($H_2 \rightarrow P_{DC}$)	49%
Electrical ($H_2 \rightarrow P_{AC}$)	43%
Combined efficiency	75%
Stand-by-power:	85 W_{AC}
Ready-mode Power:	105 W_{AC}

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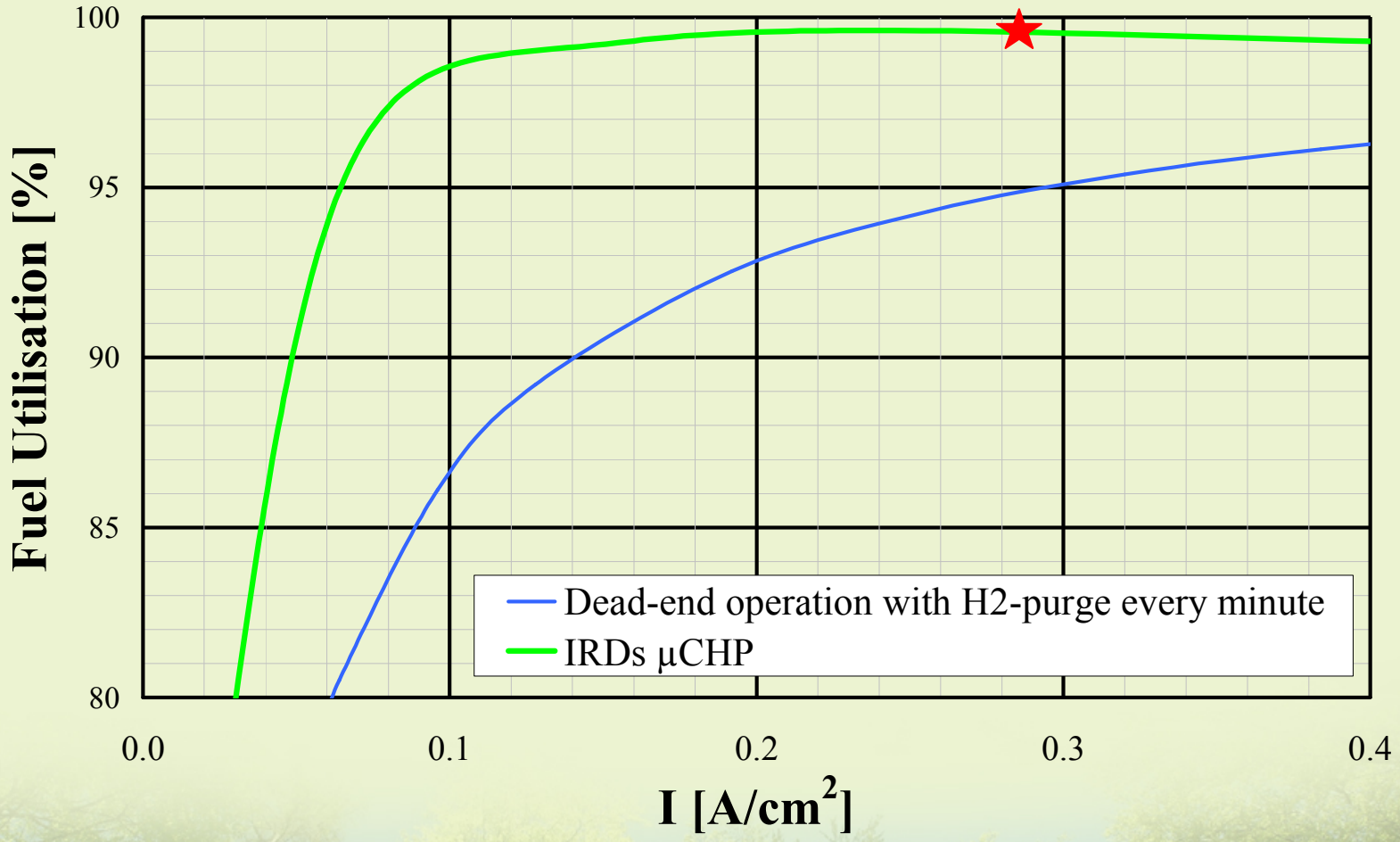
The IRD LT PEM µCHP

Fuel utilization: 99.2% @ Nominal operation (★)
eq. to λ_{H2}=1.01



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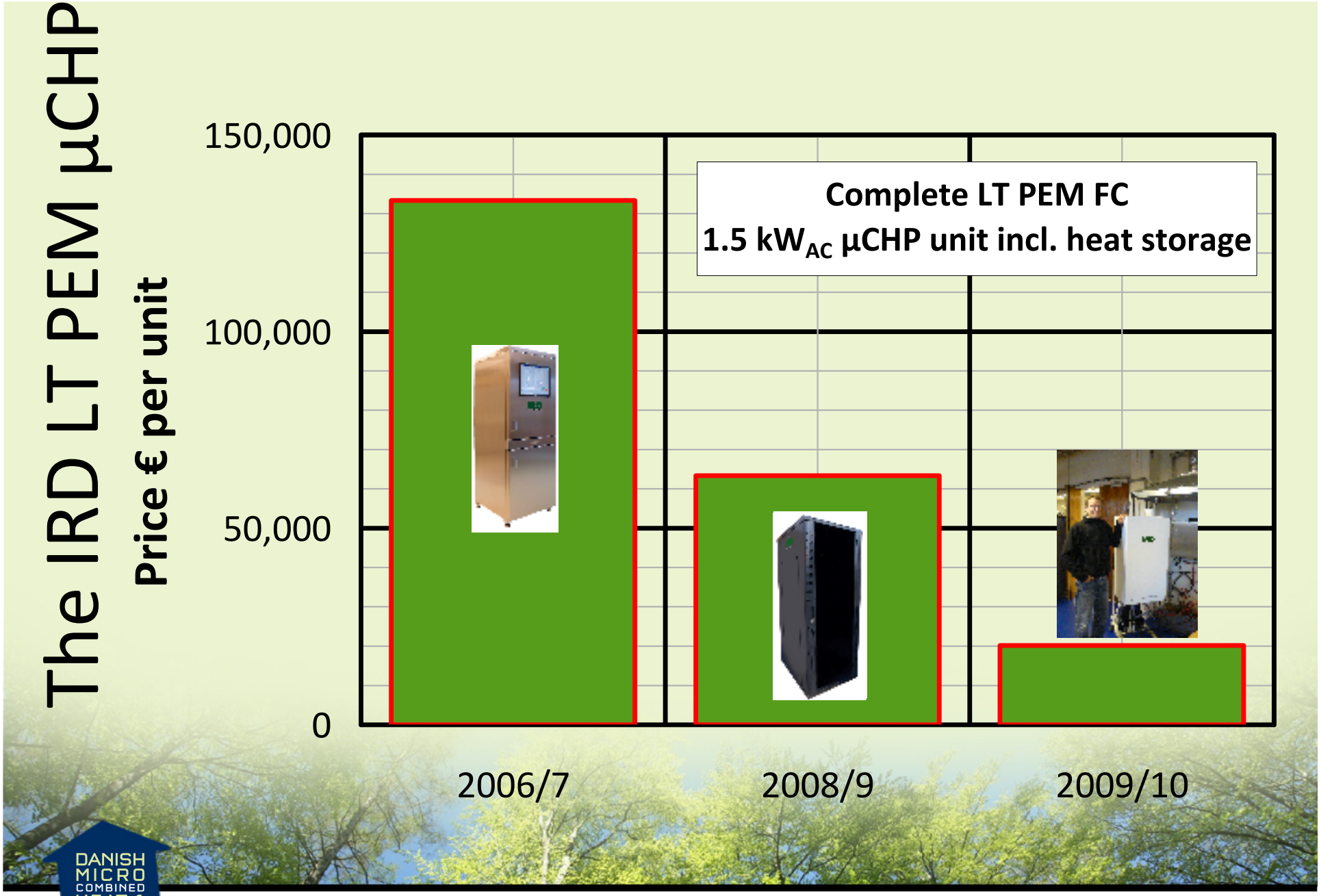

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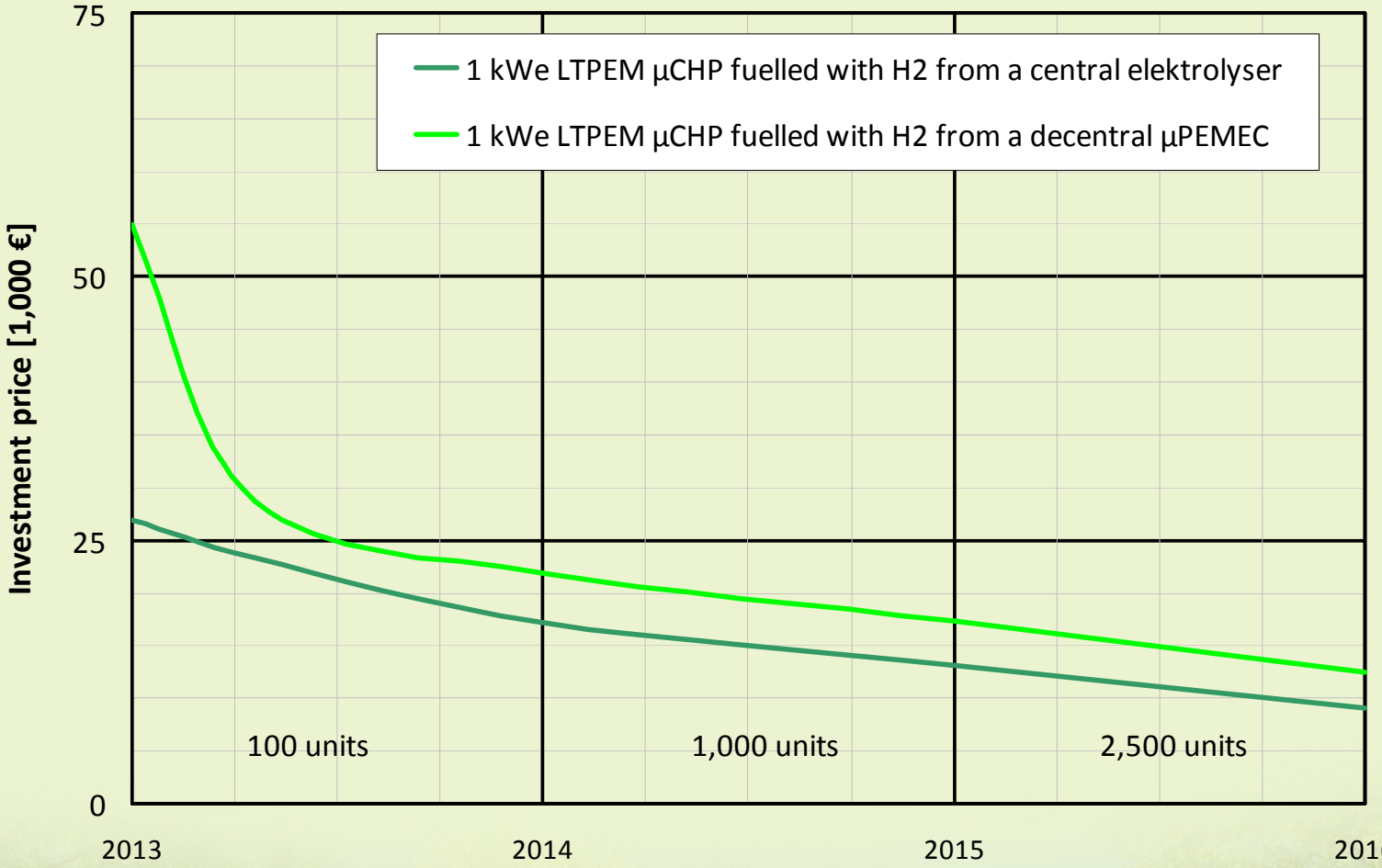

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Status @ Lolland

- Vestenskov village has been choosen for the field test
- Field test in ordinary single family houses
- The β- & γ-µCHP is CE-certificated
- A commercial available alkaline electrolyzer is installed

Key numbers electrolyser:
· Gas Outlet Pressure up to a 8 bar(g)
· Max Hydrogen production 20 Nm^3/h
· Max Oxygen production 10 Nm^3/h
· Continuously H_2 production 16 Nm^3/h
· Continuously O_2 production 8 Nm^3/h
· Gas Purity 99,5 ± 0,1%
• Max electric energy consumption 104 kW

Key numbers H_2-storage:
• 25 Nm^3
• 0-6 bar(g)

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- Field test in ordinary single family houses
- The β- & γ-µCHP is CE-certificated
- A commercial available alkaline electrolyzer is installed
- A buried H_2-grid has been established
- Phase 2 has been completed

Faults, adjustment

Phase 3 is on-going:

- the 1st of 35 field test units is presently being installed

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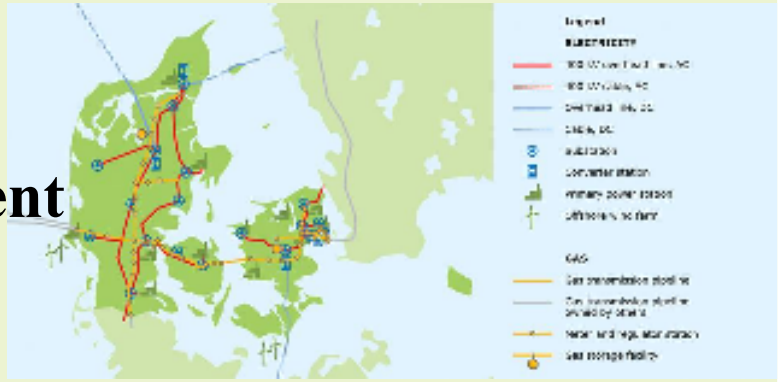
Why hydrogen?



The Danish Power System is Different

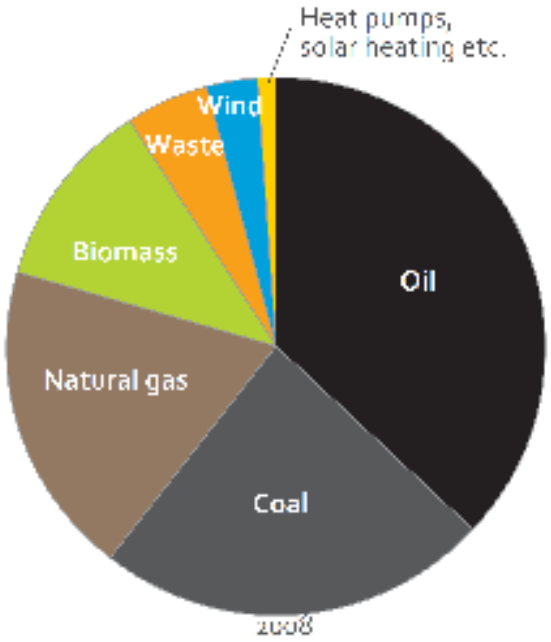
- **44% connected on distribution level**
- **24% wind power installed (presently ≈3,000+ MW)**
- **Load: 2.130 – 6.300 MW**
- **Many hours where RE covers the entire demand!**

http://www.klimakommissionen.dk/en-US/AbouttheCommission/TheDanishClimateCommissionreport/Documents/green energy GB screen 1page v2.pdf

Production of renewable energy

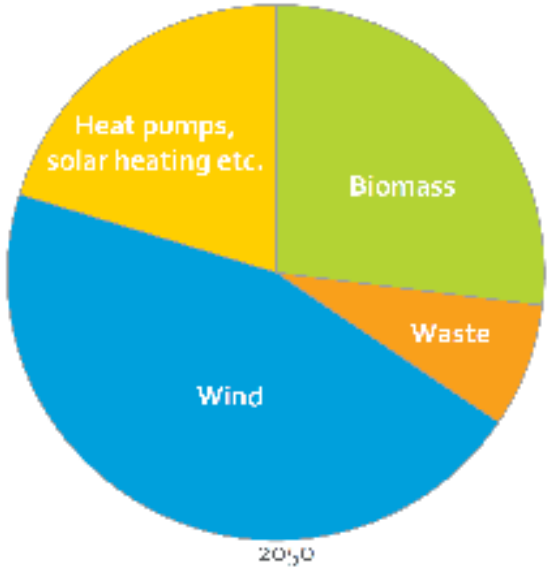
1. Many-fold increase in wind-power capacity.
2. Biomass will play a pivotal role.
3. Other renewable energy sources will serve as a supplement.

Figure 2.3: Energy sources in 2008 and possible break-down of energy sources in 2050[2].

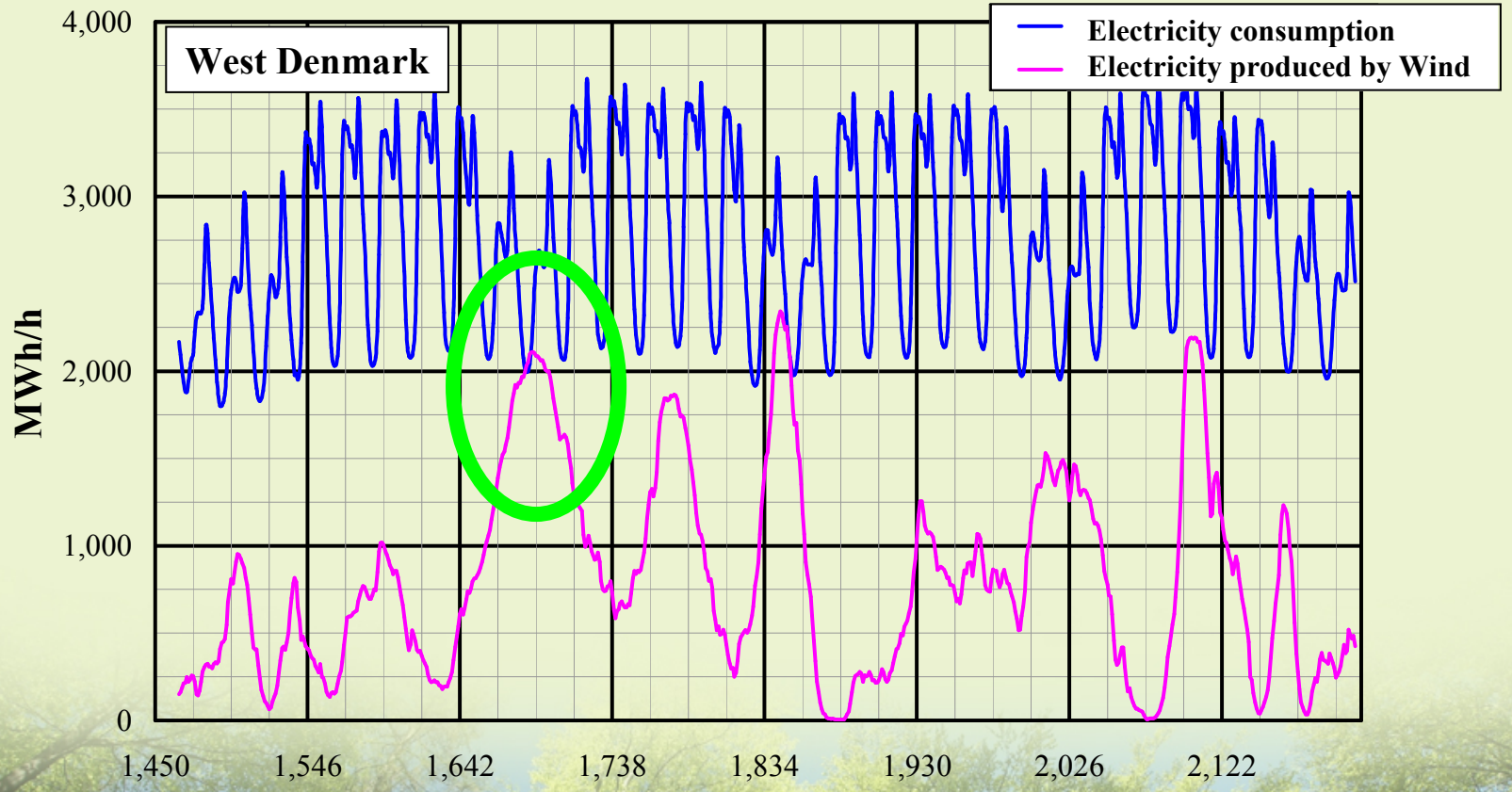


New intelligent energy system

4. Intelligent electricity consumption will ensure incorporation of renewable energy.
5. The northern European electricity market will be further integrated.
6. The transport sector will be converted to electricity and bioenergy.
7. Small-scale heating with electric heat pumps will be more widespread.



Why hydrogen?



Based on data from Energinet.dk

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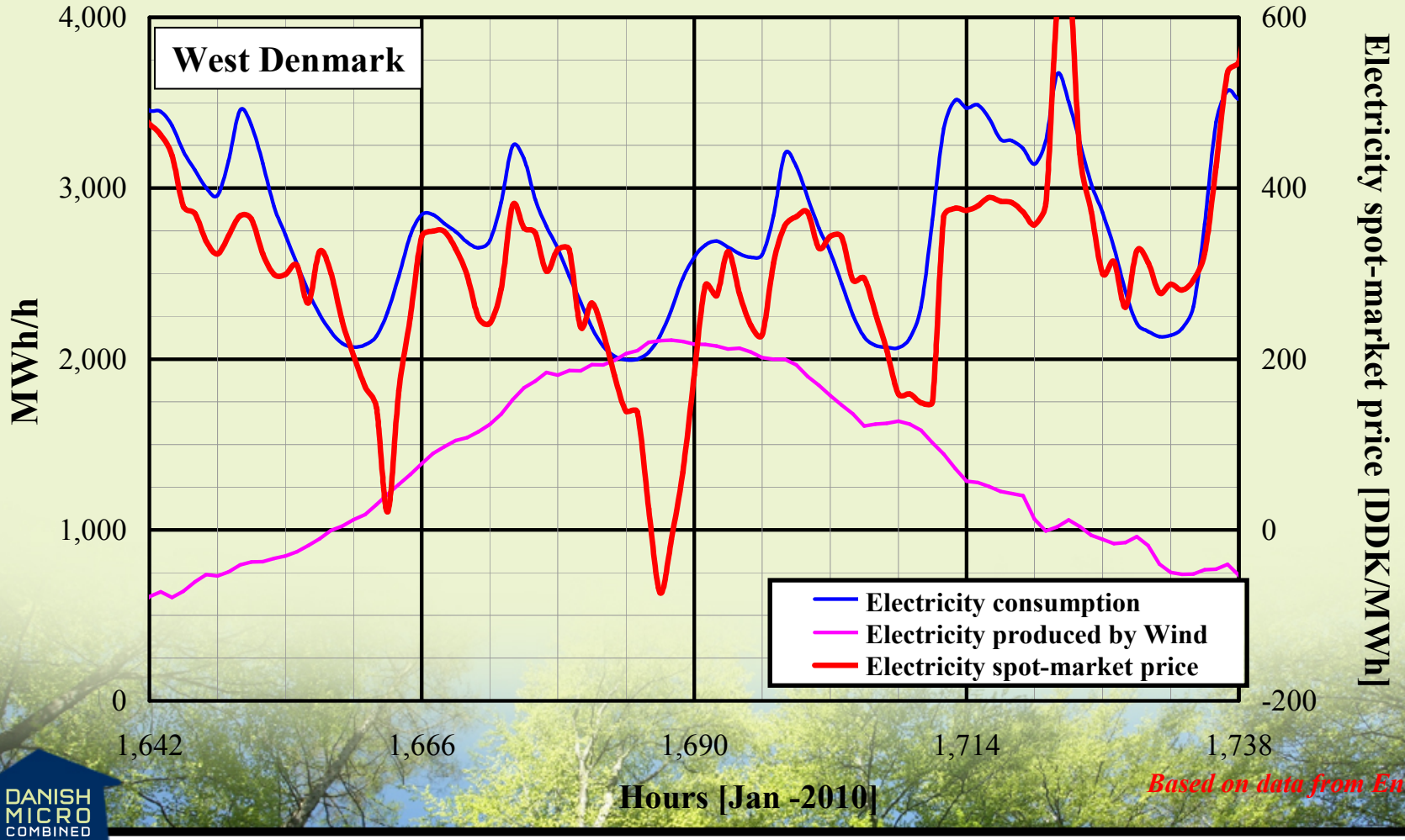

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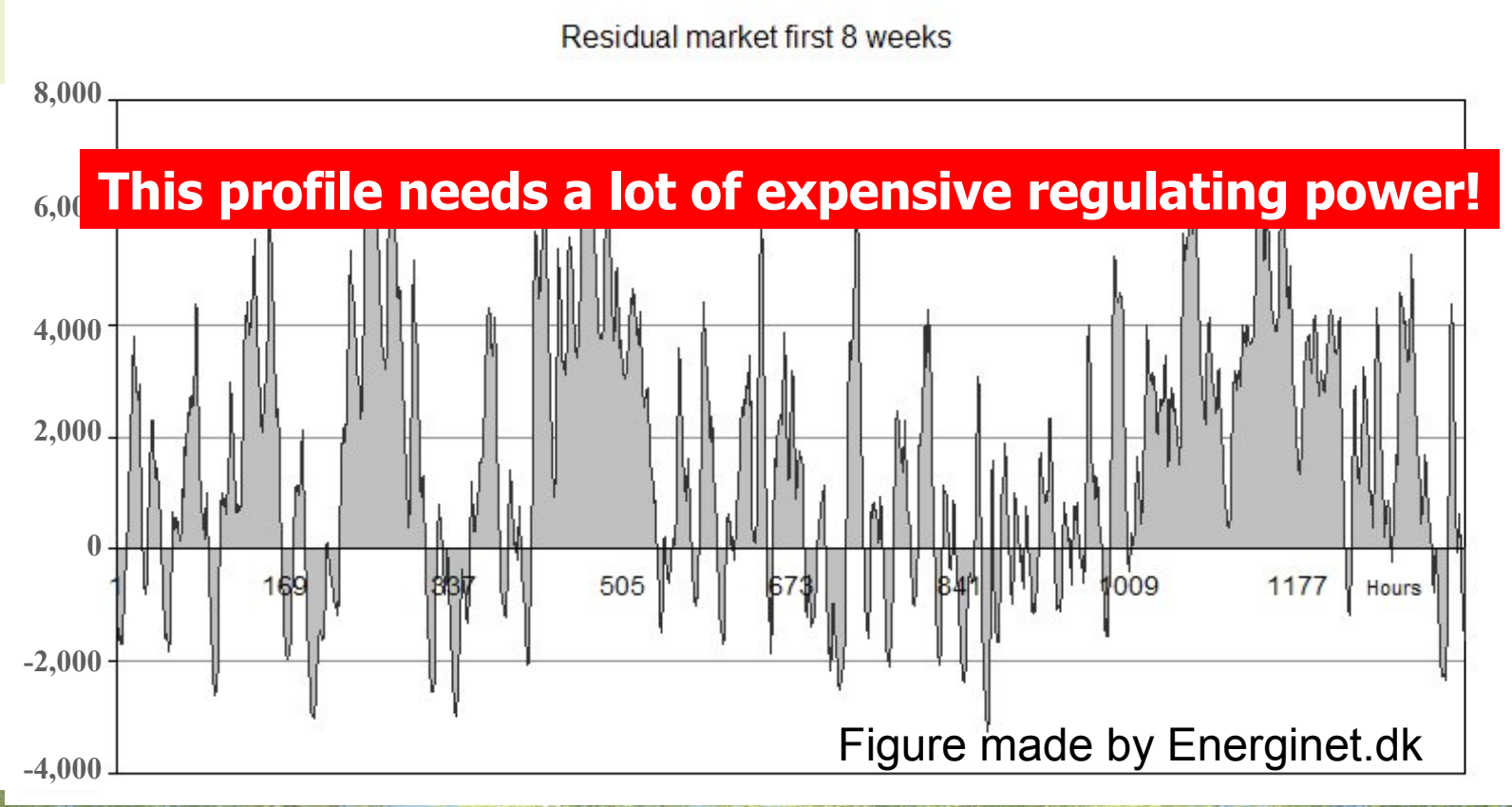

Figure made by Energinet.dk

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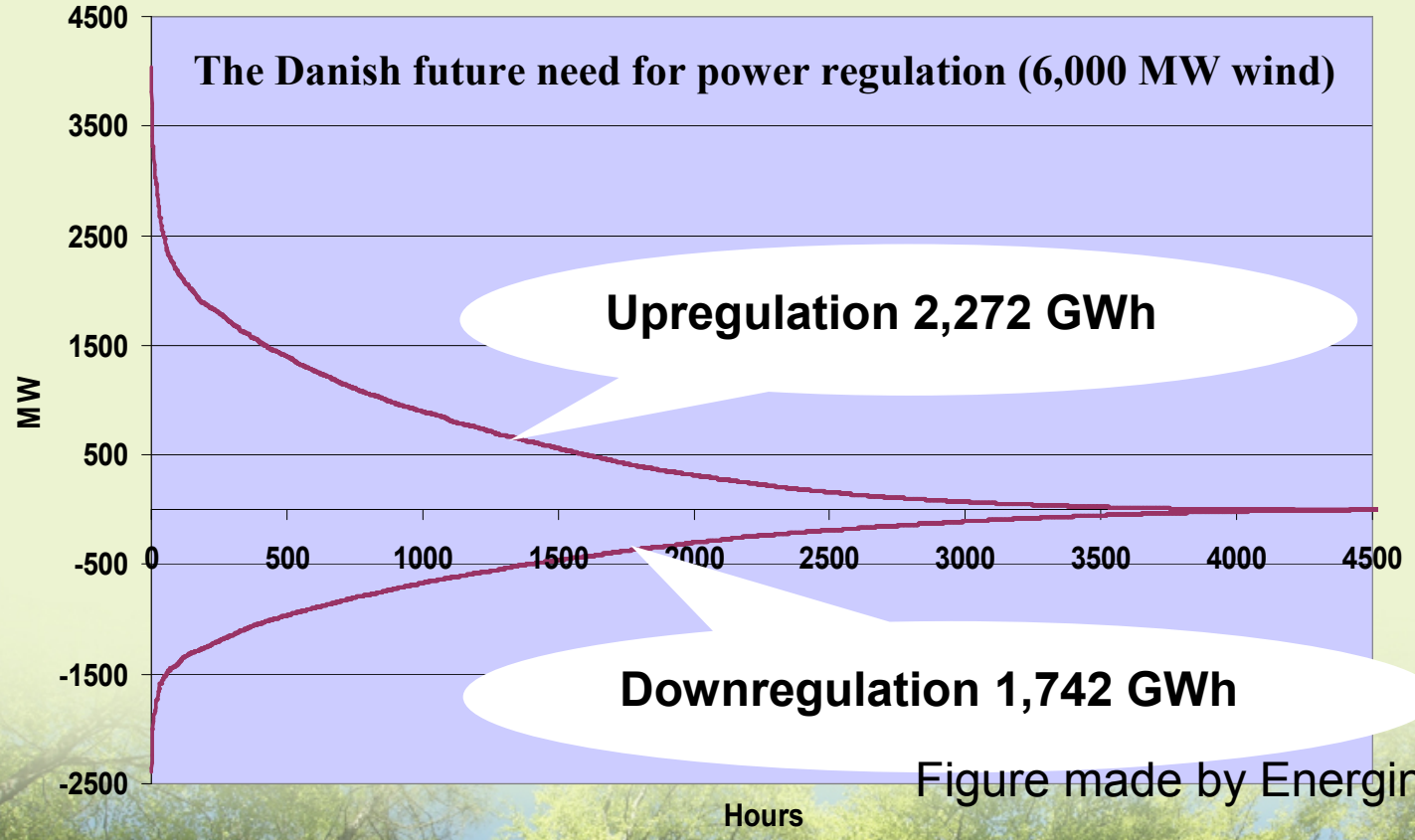

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Hydrogen is one of the future solutions

Technologies and requirements to regulation

Response times

- Batteries, FC's, Electrolysis = Seconds and minutes
- Air Storage (CAES) = Minutes and hours
- Heating Systems = Hours and days
- Flexible consumption = Whole spectrum

The faster reaction time the more money to be made!

Future solutions

- Electric Vehicles that can use/supply electricity to the grid
- µCHP that can (use)supply electricity to the grid
- Consumption on/off
- Production of hydrogen/syngas/synthetic natural gas/biofuels

Advantages of hydrogen fuelled LT PEMFC µCHPs

- Suitable for regulation (fast response)
- Less power grid loss (≈6%)
- Less need in grid investments for heat distribution
- A reduction in the need for new investments in central power plants (will be replaced by virtual power plants)
- A CO_2 reduction of up to 5 tons per year per 'single family house' is estimated when 'green' fuel from renewables are use e.g. hydrogen from Wind

When are FC H_2-fuelled µCHPs commercial available?

The technology will be commercial when:

- The technology is cost competitive with other technologies
- Hydrogen is an affordable fuel
- The lifetime targets for stationary applications is met

This can be moved forward by:

- Implementation of further RE like wind power
- Higher CO_2 taxes
- Public economic support to FC based µCHPs

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The FCH JU has already these focuses e.g. through support to the KeePEMAlive *(Grant agreement no.: 245113)* & the PrimoLyzer *(Grant agreement no.: 245228)* projects

Thank you for your attention !

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