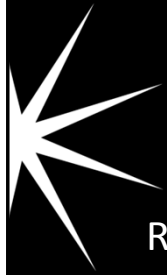


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Real-life experience obtained in during field test  
with hydrogen fuelled LT PEM  $\mu$ CHPs

*Laila Grahl-Madsen*

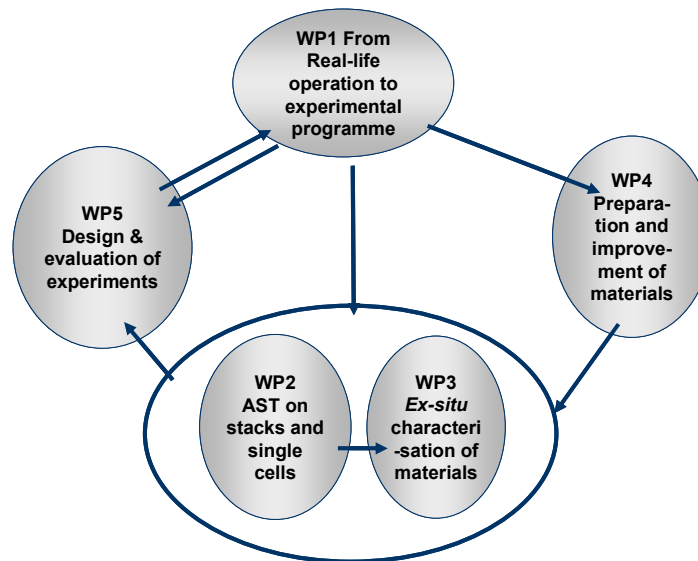
4<sup>th</sup> of April, 2013

**IRD**

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WP0 Project Management

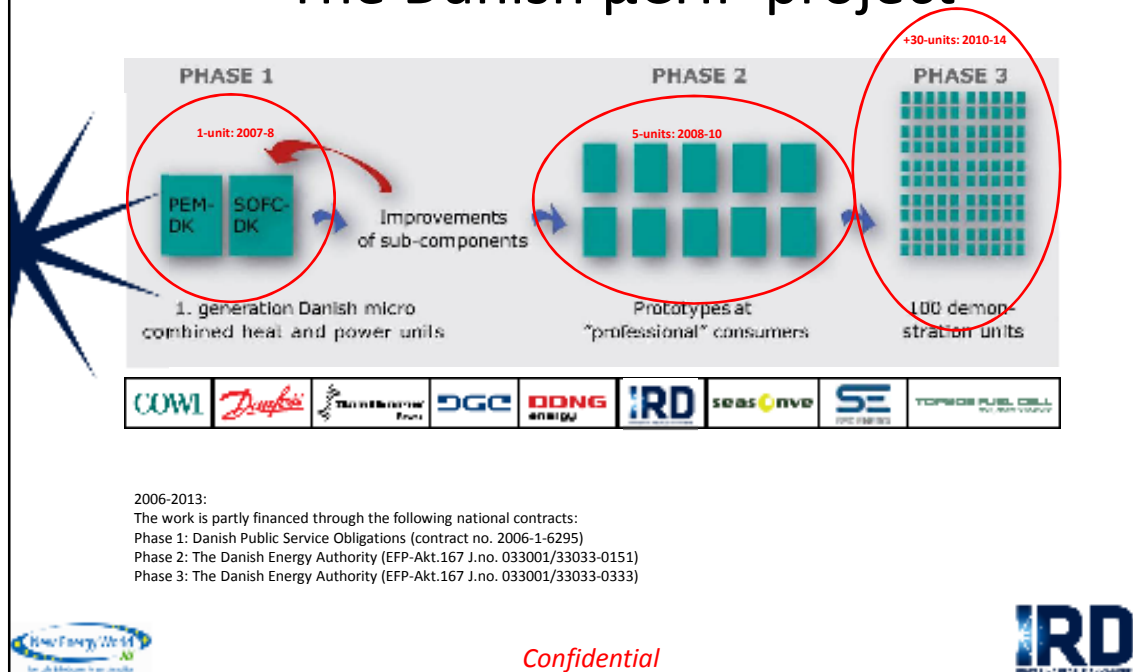


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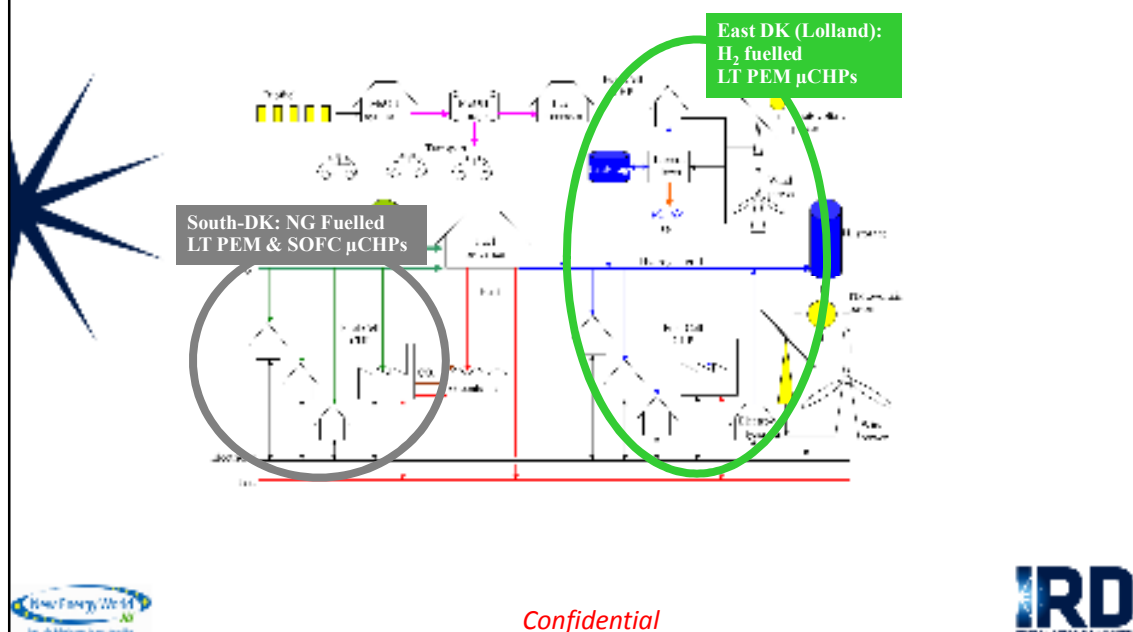
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# The Danish $\mu$ CHP project



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# The Danish $\mu$ CHP project



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# The East Group



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  $\mu$ CHP units for field test in Vestenskov. Technical adviser 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  $\mu$ CHP field test in Vestenskov,  
responsible for the  $H_2$ -generation and -supply



Lolland municipality covers  $\approx 891 \text{ km}^2$  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

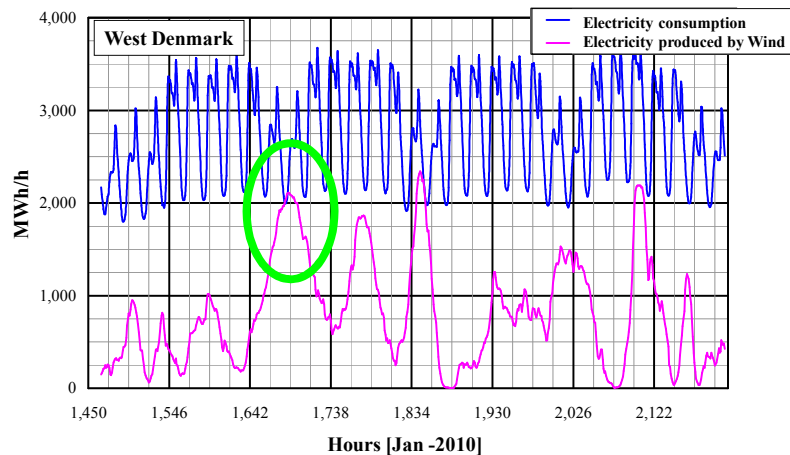


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## Electricity in DK an example.



Based on data from Energinet.dk

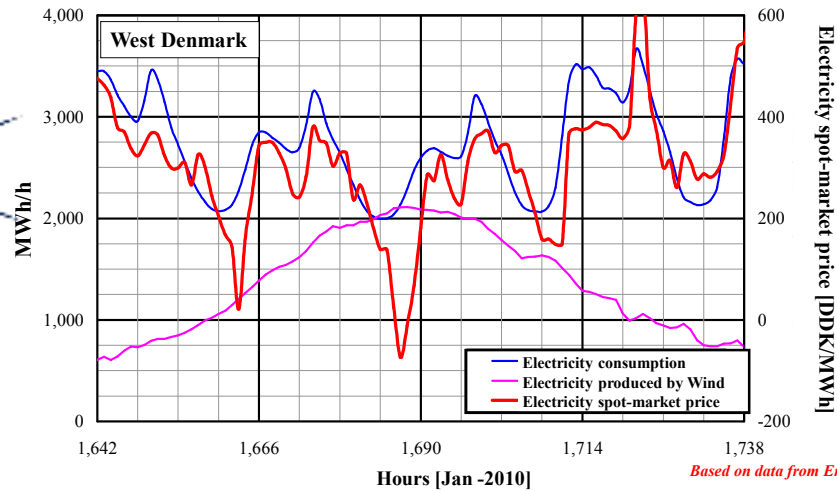


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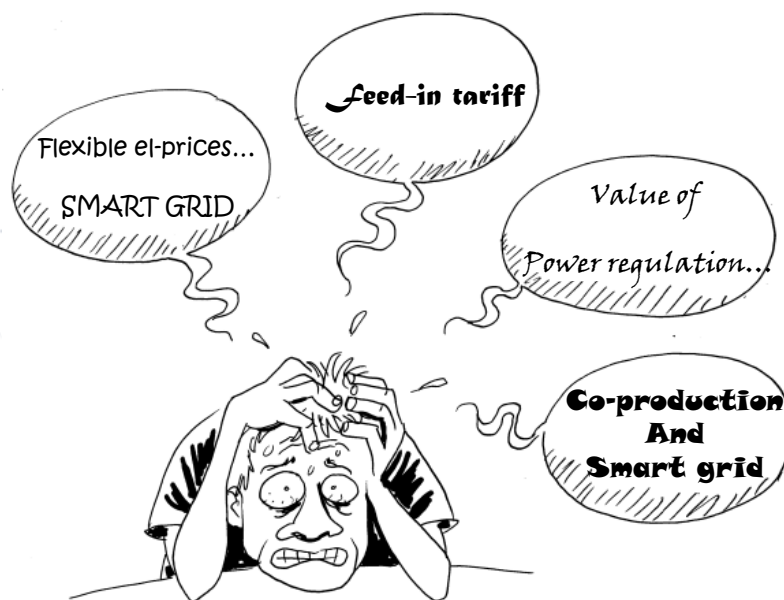
# Electricity in DK an example.



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## The LT PEM $\gamma$ - $\mu$ CHP



Nominal Power	1.5 kW <sub>AC</sub>
Power range	0.9 – 2.0 kW <sub>AC</sub>
Nominal Heat	1.5 kW <sub>TH</sub>
Heat range	0.8 – 2.0 kW <sub>TH</sub>
Electrical efficiency ( $H_2 \rightarrow P_{AC}$ )	47%
Heat efficiency ( $H_2 \rightarrow P_{TH}$ )	47%
Combined efficiency	94%
Ready-mode Power	15 W <sub>AC</sub>

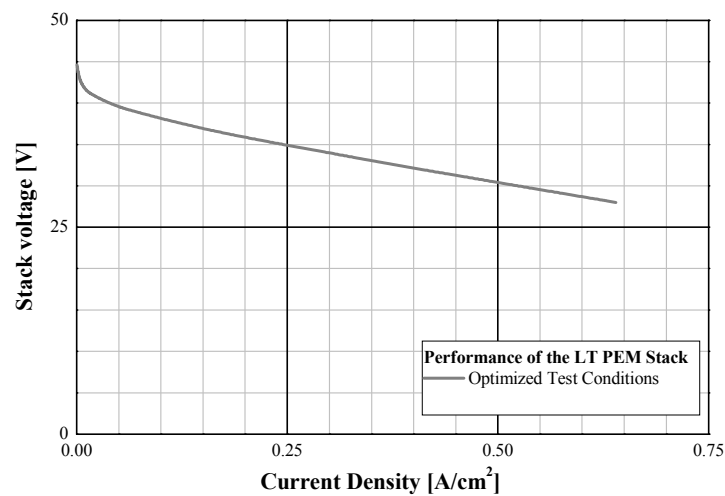


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## The LT PEM stack within the $\beta$ - $\mu$ CHP

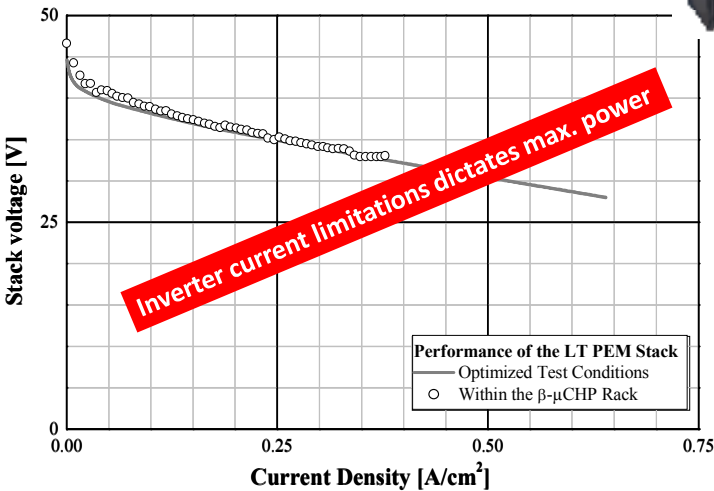


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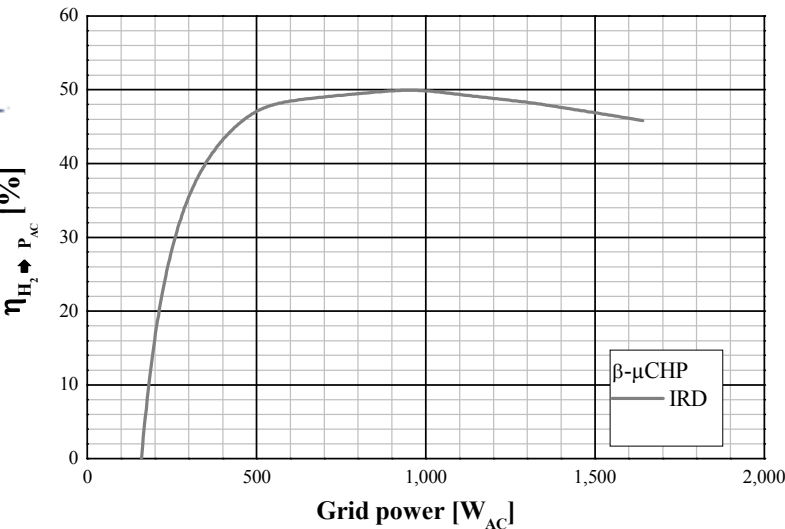
The LT PEM stack within the  $\beta$ - $\mu$ CHP



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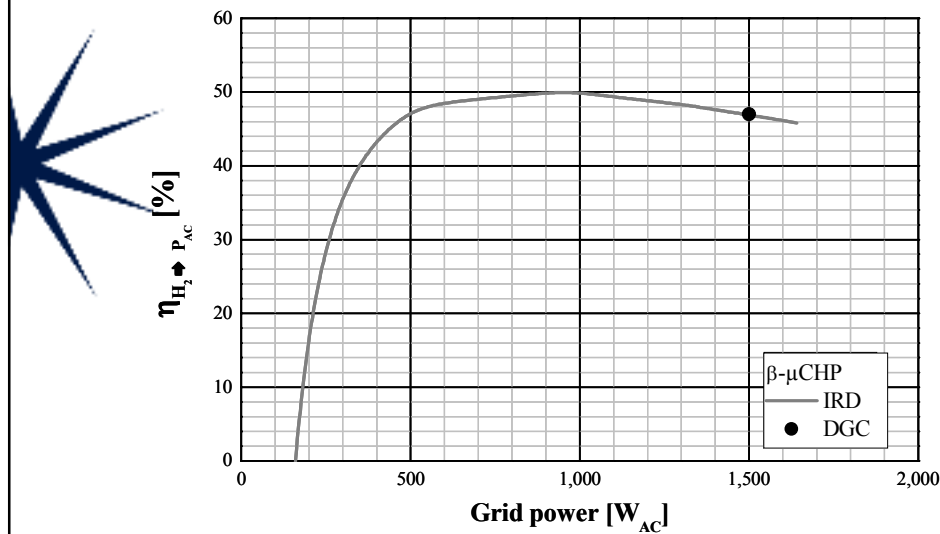
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## Phase 2 &3 field test



Key numbers electrolyser:

- Gas Outlet Pressure up to a 8 bar(g)
- Max Hydrogen production 20 Nm<sup>3</sup>/h
- Max Oxygen production 10 Nm<sup>3</sup>/h
- Continuously H<sub>2</sub> production 16 Nm<sup>3</sup>/h
- Continuously O<sub>2</sub> production 8 Nm<sup>3</sup>/h
- Gas Purity 99,5 0,1%
- Max electric energy consumption 104 kW
- Dew point -20°C

Key numbers H<sub>2</sub>-storage:

- 25 Nm<sup>3</sup>
- 0-6 bar(g)



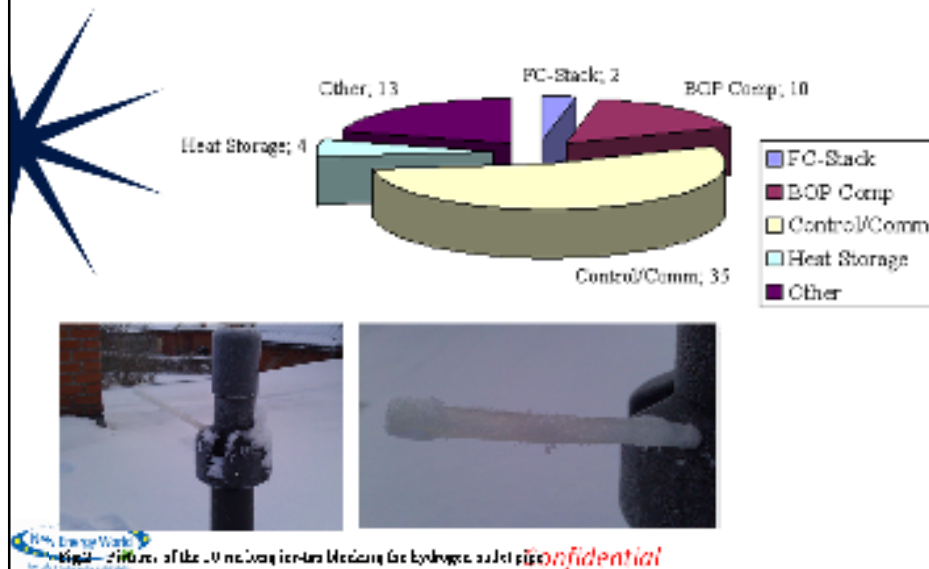
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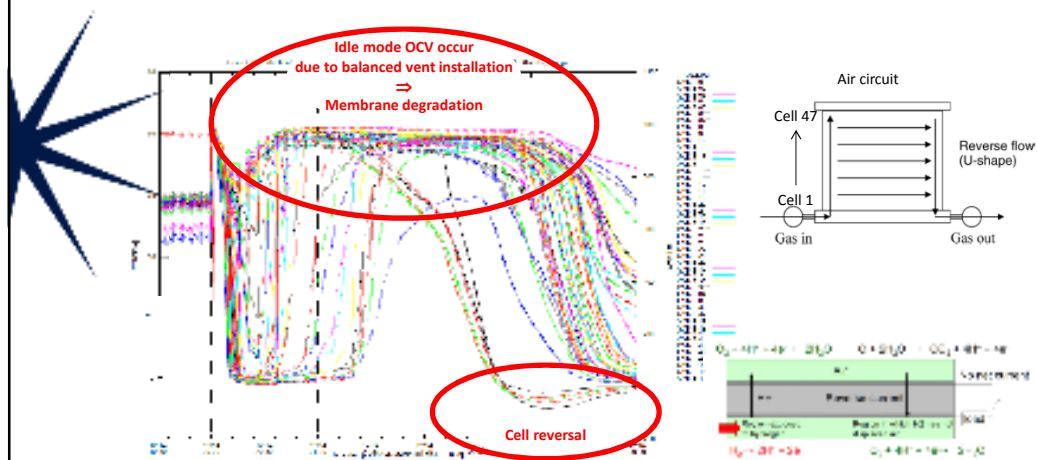
## Phase 2 field test

Faults, adjustments etc Vestenskov Sites



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The H<sub>2</sub>-fuelled  $\mu$ CHP: An example on how to quickly reach sudden MEA death



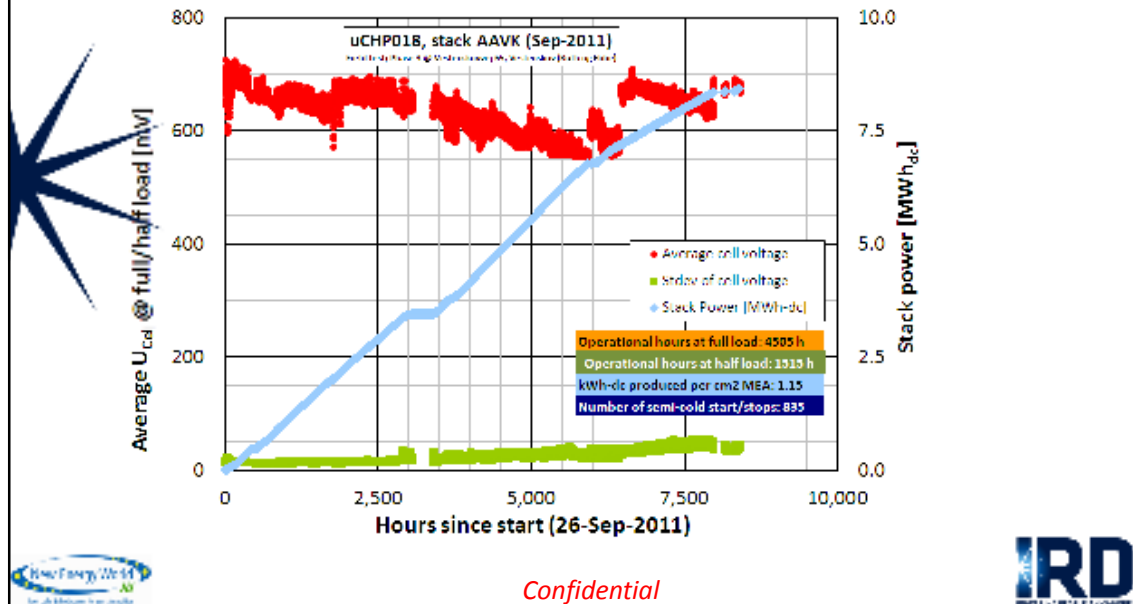
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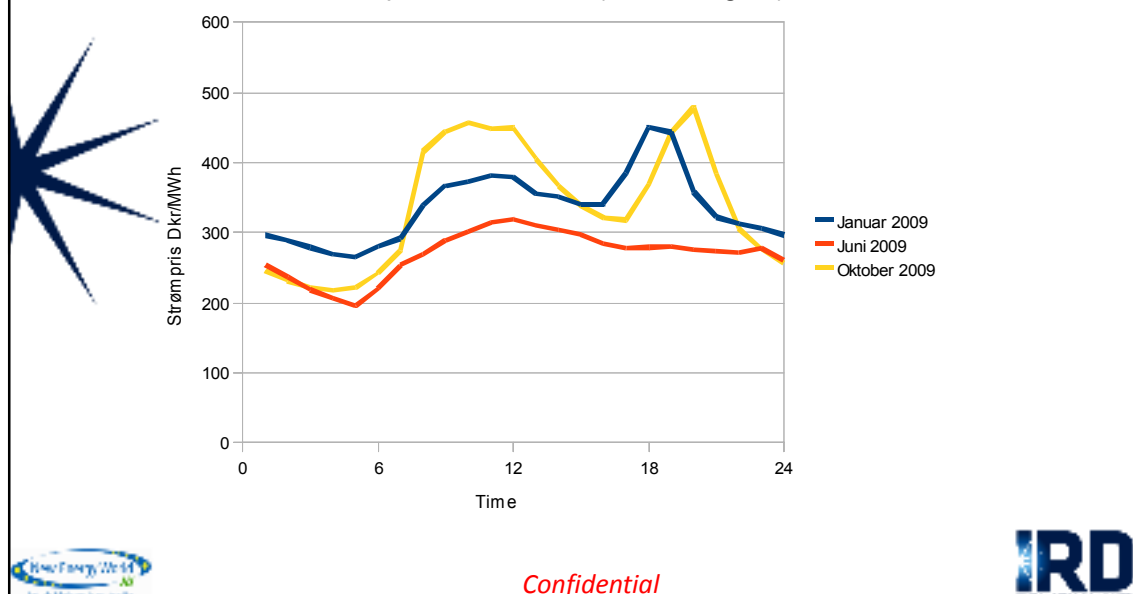
# The Danish $\mu$ CHP project



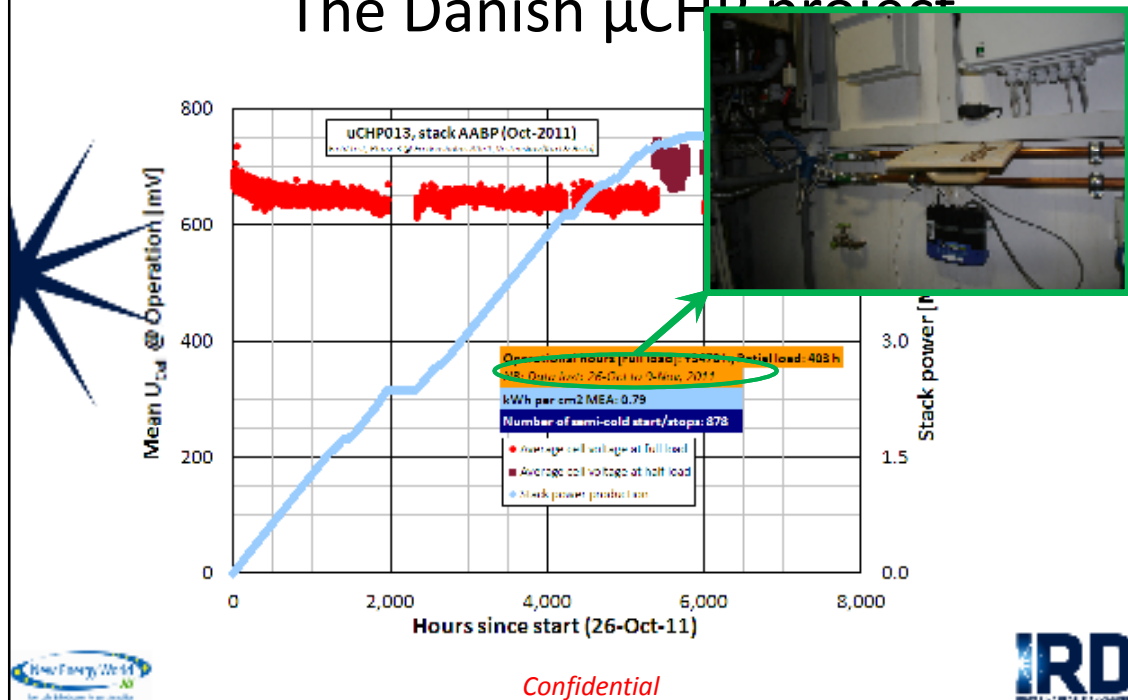
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# The Danish $\mu$ CHP project

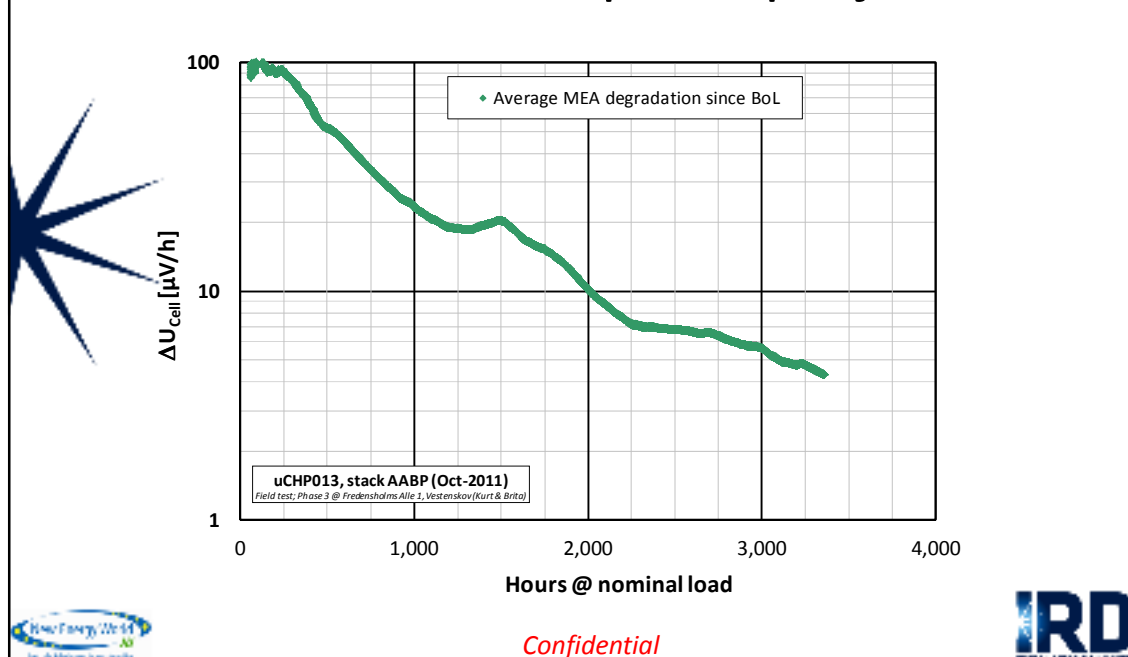
Strømpris DK ØST 2009 (kilde: Energinet)



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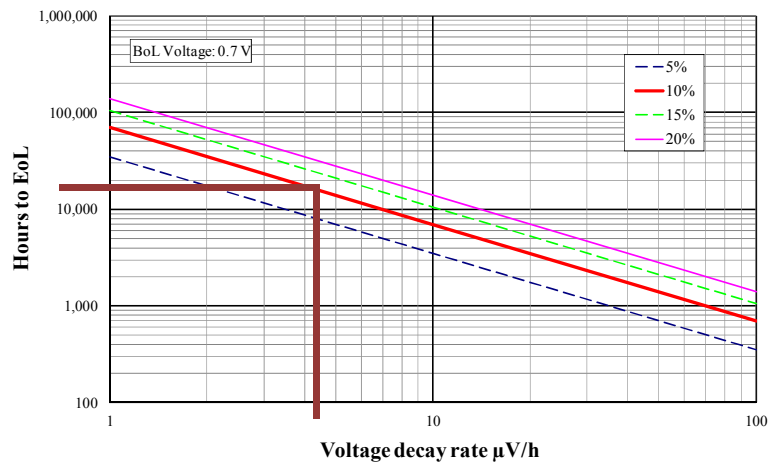
The Danish  $\mu$ CHP project

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The Danish  $\mu$ CHP project

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# The Danish $\mu$ CHP project

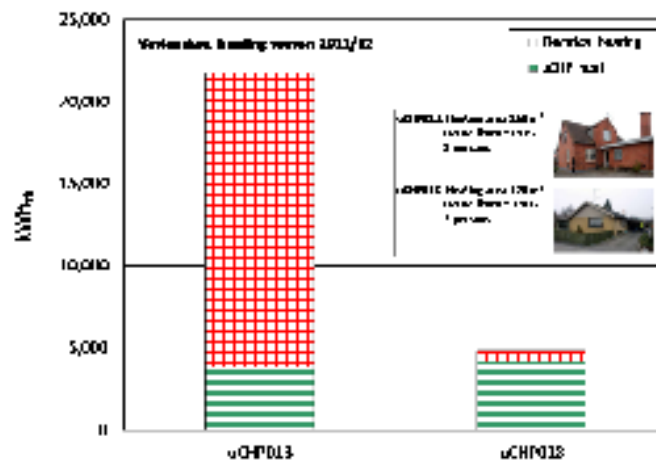


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# The Danish $\mu$ CHP project

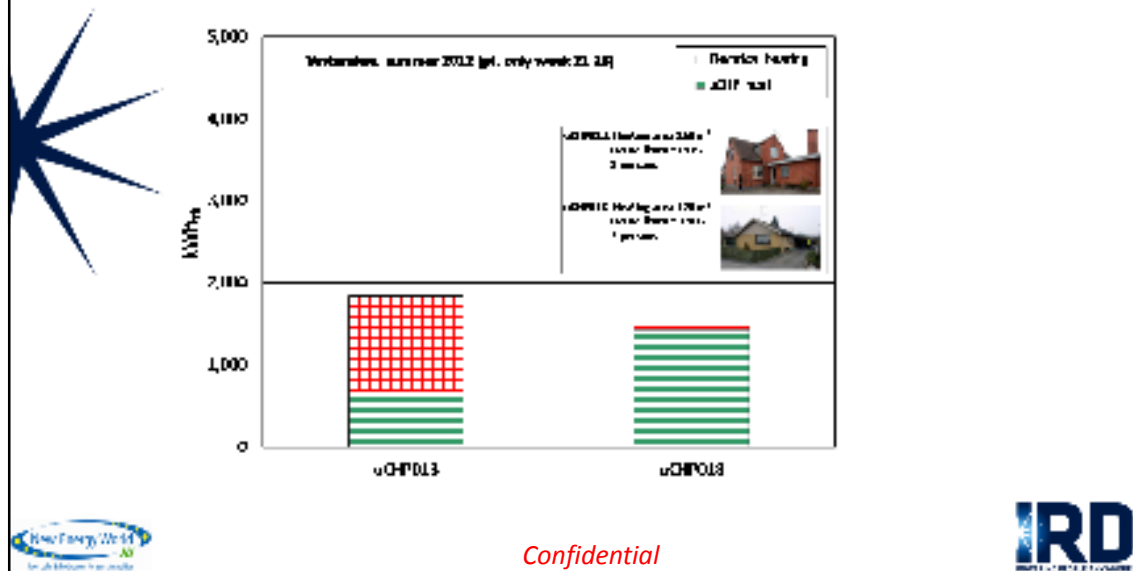


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# The Danish $\mu$ CHP project



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2006-2013:  
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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)

2009-2012:  
The CanDan HUX (Energinet.dk 2009-1-10245)

2010-2013:  
KeePEMAlive (FCH-JU-2008-1 GA 245113 & Energinet.dk 2010-1-10444)

2011-2014:  
Competitive  $\mu$ CHP for H2omes (EUDP-11-I J.No. 64011-0051)

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