



From Technology Push to Market Pull

Oslo
Juni 21, 2011

Director - Aksel Mortensgaard
Danish Partnership for
Hydrogen and Fuel Cells

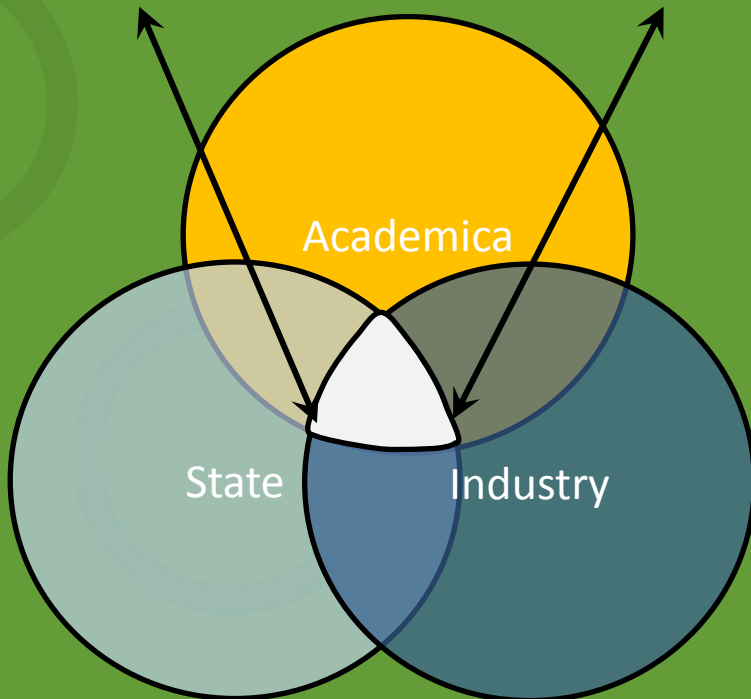
Agenda for the Presentation



- **The Danish Partnership**
- **Energy Policy setting the scene for Hydrogen and Fuel Cells – from push to pull**
- **Activities in Denmark**
- **Conclusion**

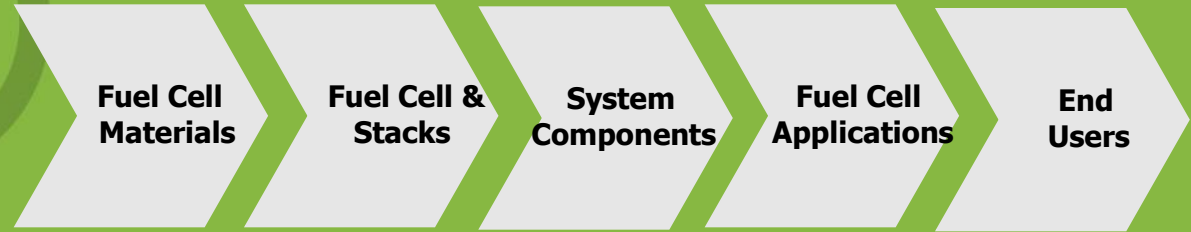
The Danish Partnership for Hydrogen and Fuel Cells

Trilateral Networks and Hybrid Organizations



- **Industry Lead Public and Private Collaboration**
- **Coordination, Integration & Added Value**
- **Provide National Strategies**
- **International Collaboration**

Danish Hydrogen & Fuel Cell Partnership



Research institutions



Industry



Danish Power Systems



Institutions

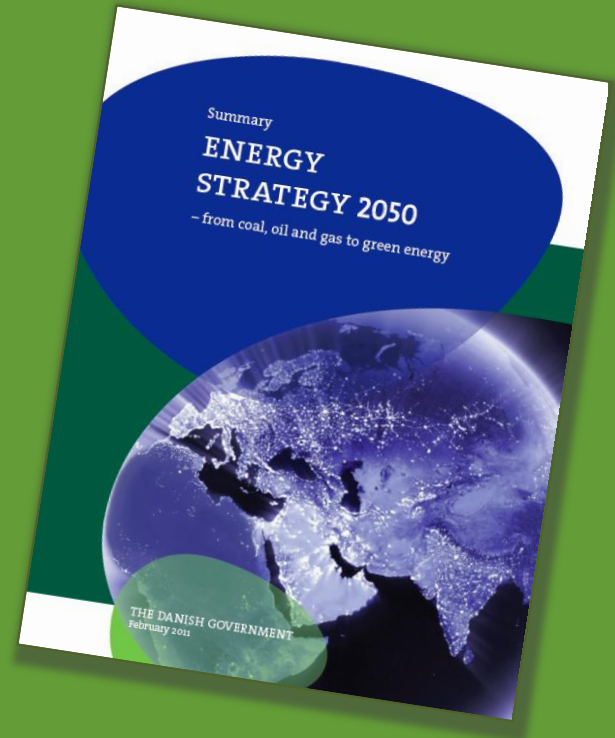


Public Authorities



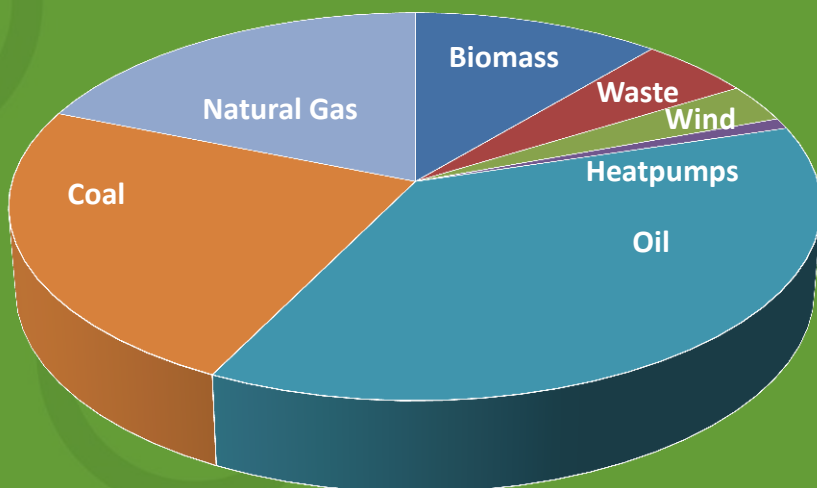
Governmental Policy - Independence of Fossil Fuels in 2050

- More electricity from wind power. Solar and wave power as a supplement
- Electrification of heating, process and transport
- Efficient utilization of biomass resources and biogas
- An intelligent energy system – Smart Grid
- Efficient use of energy
- Cost effective solutions

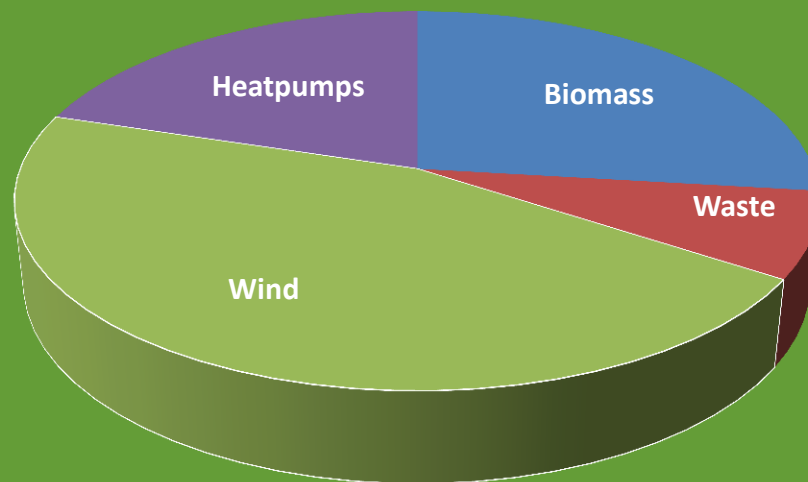


The Energy of the Future will come from Renewable Sources

2010

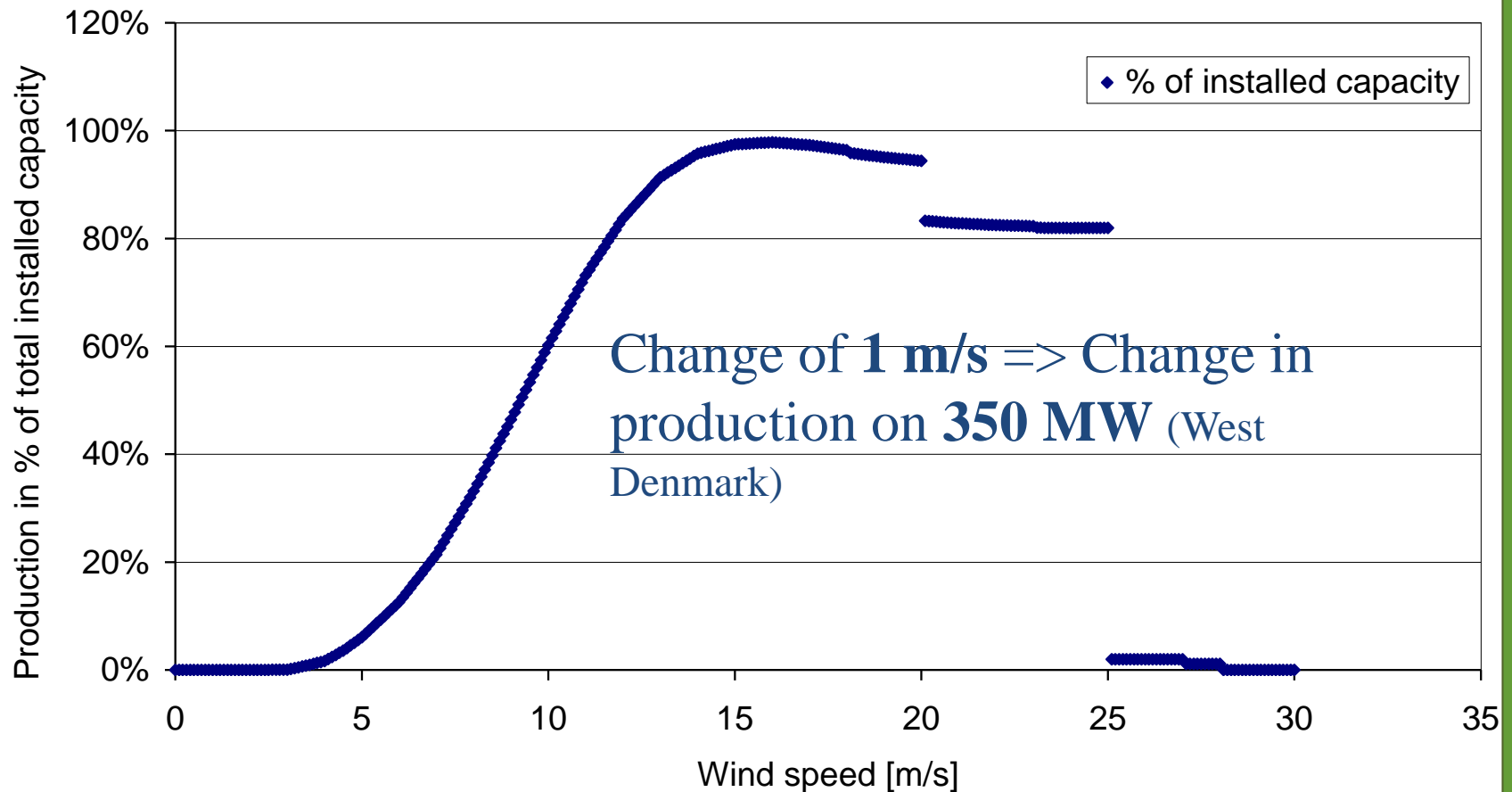


2050



Source: Danish Commission on Climate Change Policy

Change in Windspeed Causes Imbalance



The energy system – Shift of Paradigm

- Coherent energy systems
- Electricity the primary energy carrier for the future
- Flexible demand must follow flexible production

Share of electricity today

Transport

Heat

Cooling

Production

Services

Lightening

Grid for electricity, heat and gas

Energy conversion

Coal & Oil

N-gas

Wind

Biomass

Green gas

Solar

Energy fuel of today

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Grid for electricity, heat and gas

Energy conversion, Smart Grid & Storage

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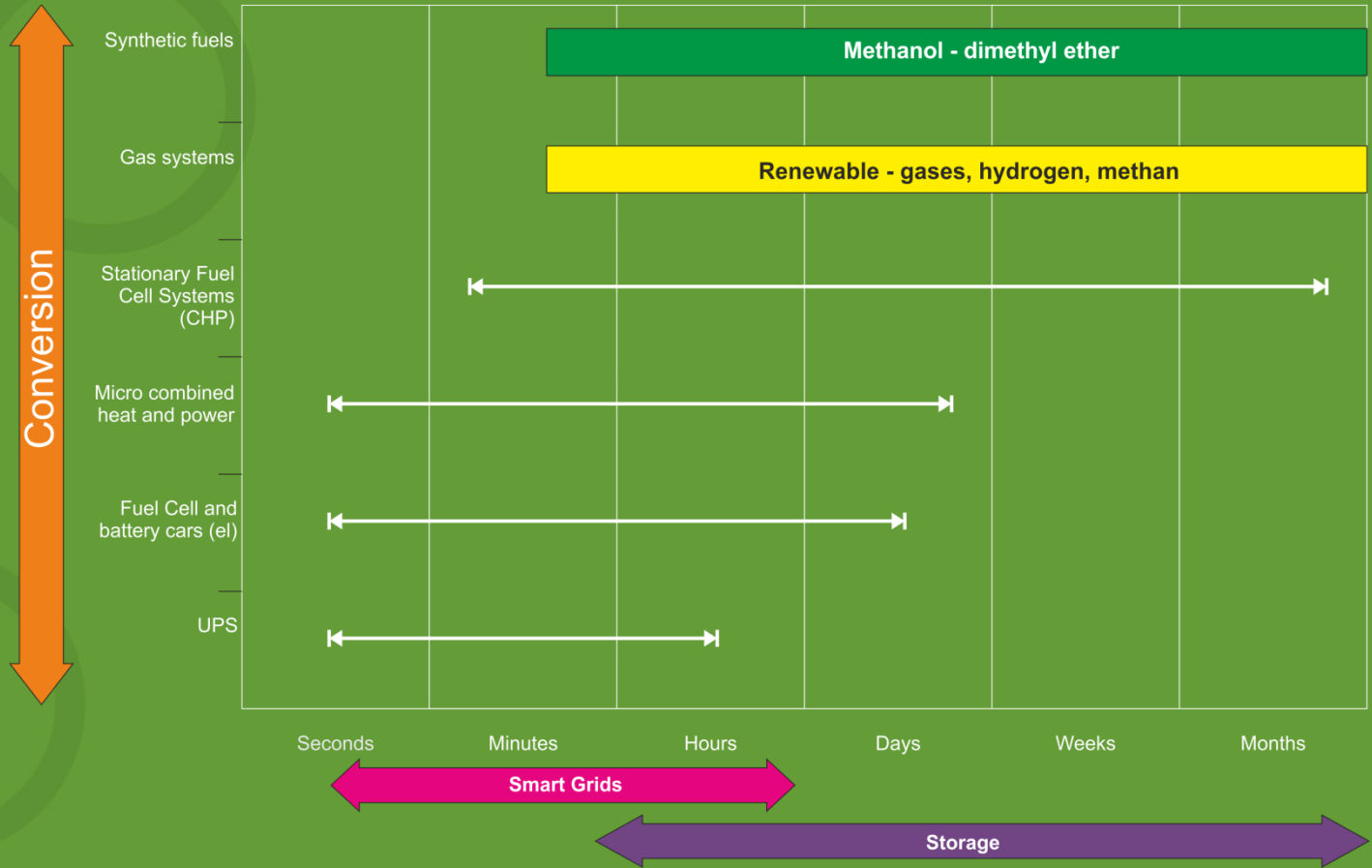
Solar

Biomass

Wind

Energy fuel of the future

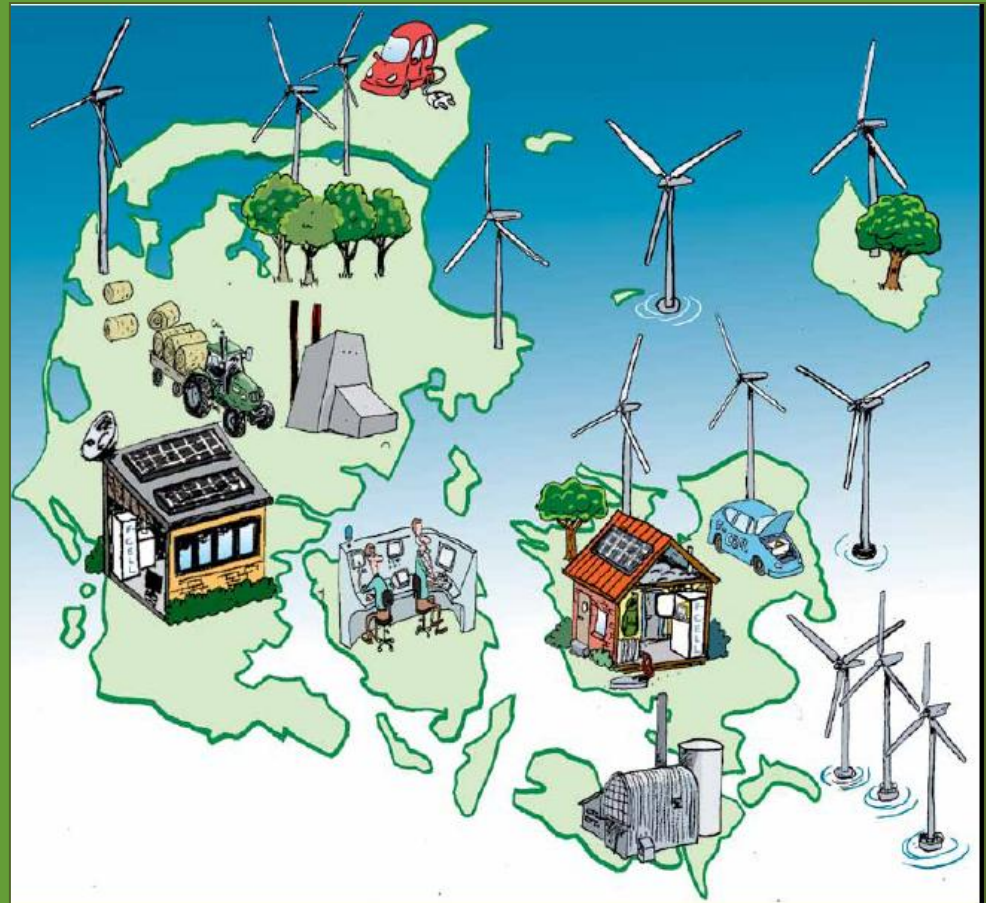
Flexibility in the Energy System



Hydrogen and Fuel Cell Technologies Part of Smart Grid

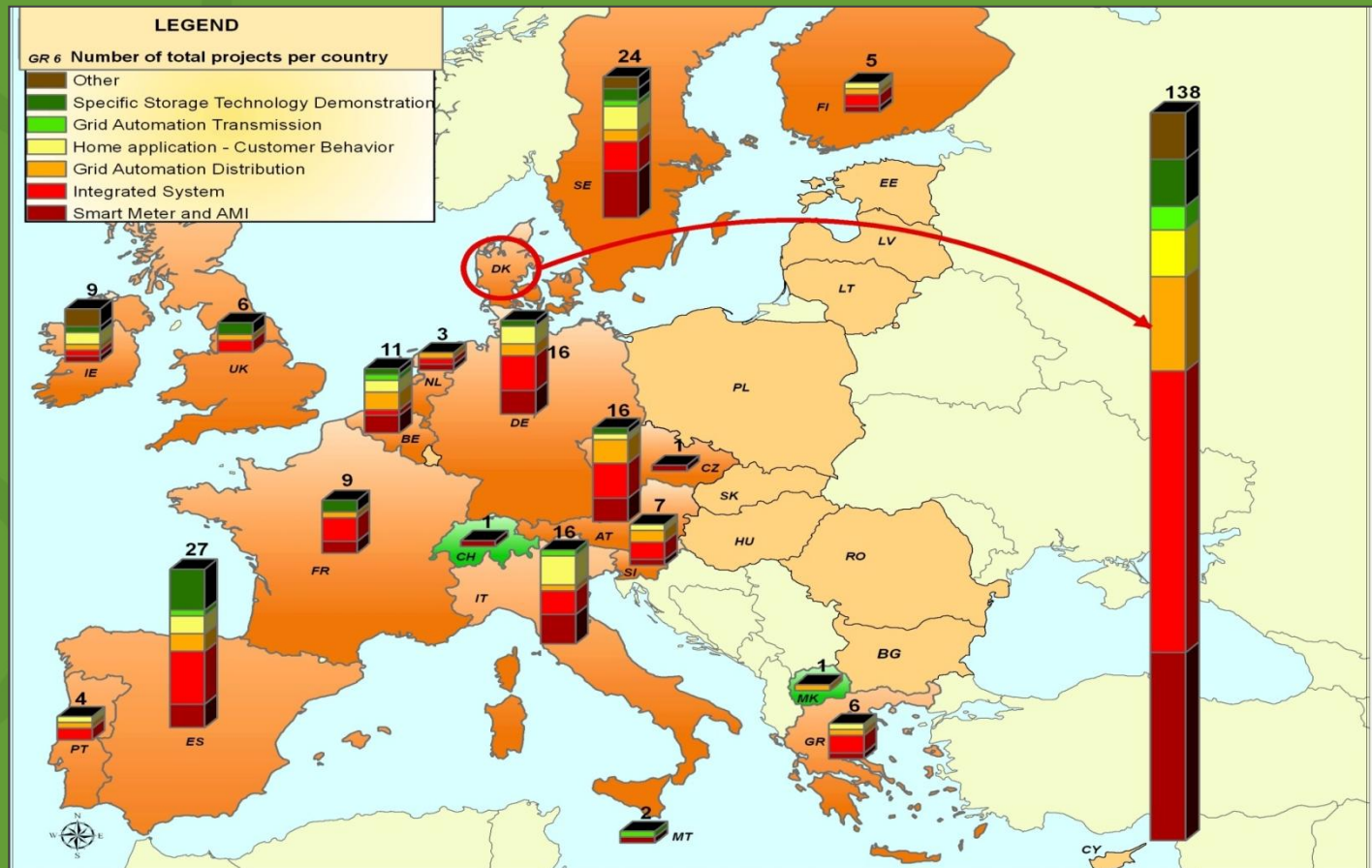
Capable to:

- Integrate more and more renewable energy.
- Up- and down regulate (virtuel Power plant)
- Stabilize the electric grid
- Reduce CO₂- emission
- Secure less dependency on external supply of electricity.

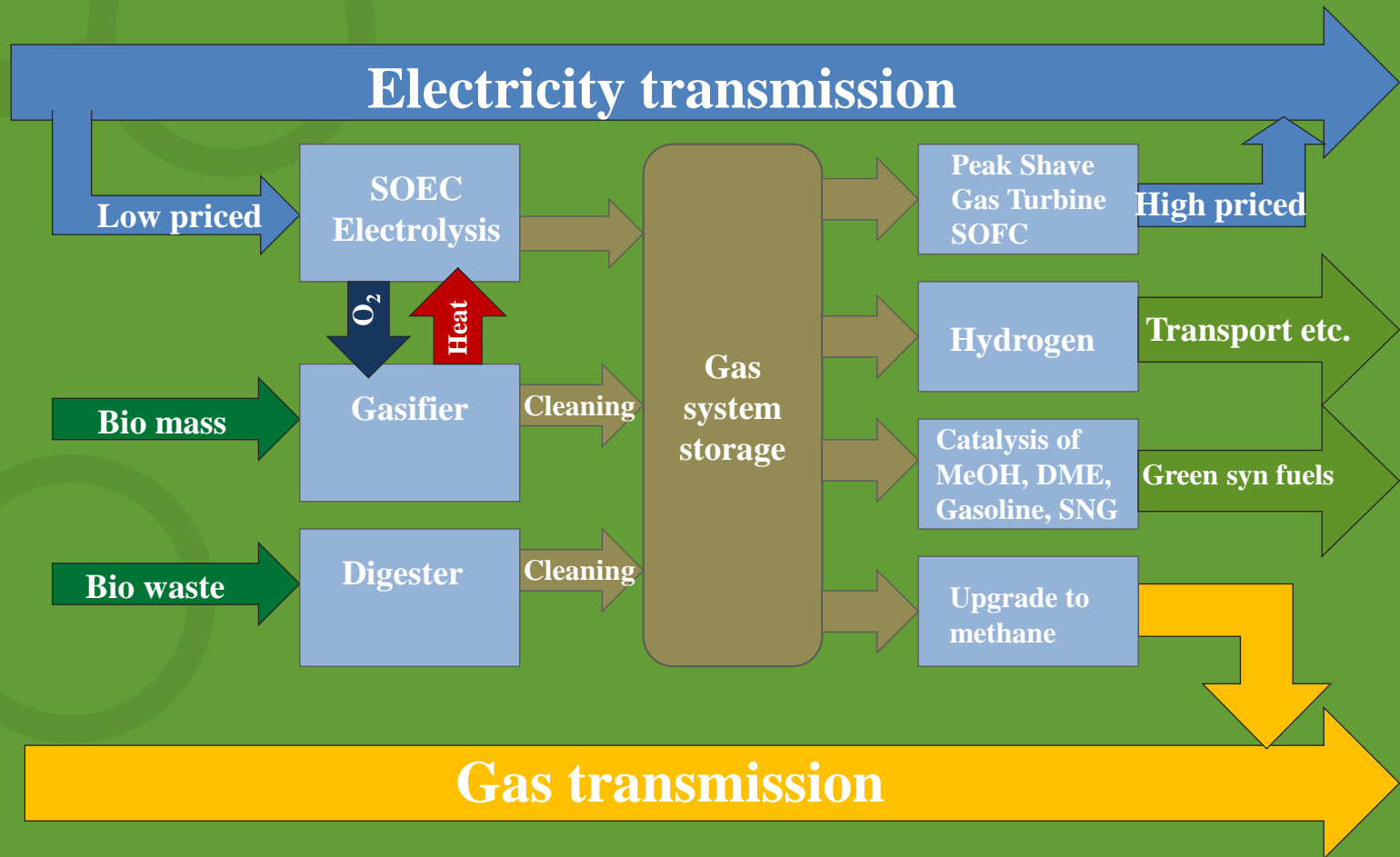


Smart Grids – Denmark is in the Lead

Number of project implementation sites per country



Interaction between Gas and Electricity in the Energy System



SOFC Manufacturing Facility in Denmark



- **Owner: Topsoe Fuel Cell A/S**
- **Area: 5000m²**
- **Capacity: 5 MW Annually**
- **Employees: In 2015/20 estimate to 2000**
- **Sub suppliers: Estimated to 20.000**

Early Market Entry - Tetra Backup Network in Denmark



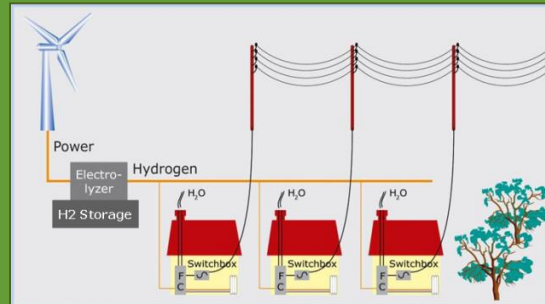
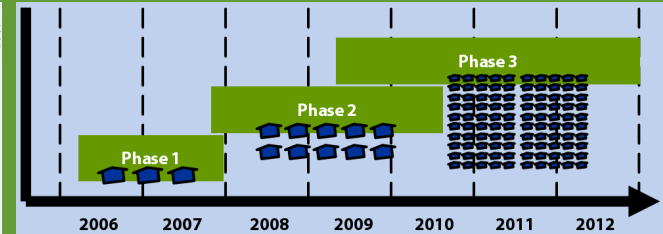
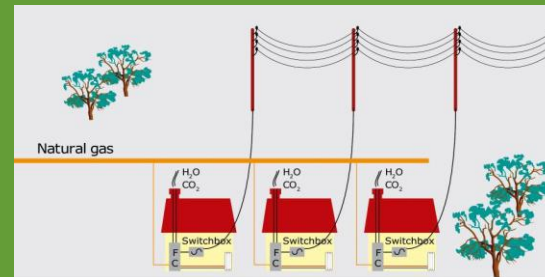
“Material Handling” køretøjer

- Dantruck A/S – export at 2 mia. kr./year
- Employees – more than 1000
- In addition GMR Machines
- Methanol fuel cells for charging

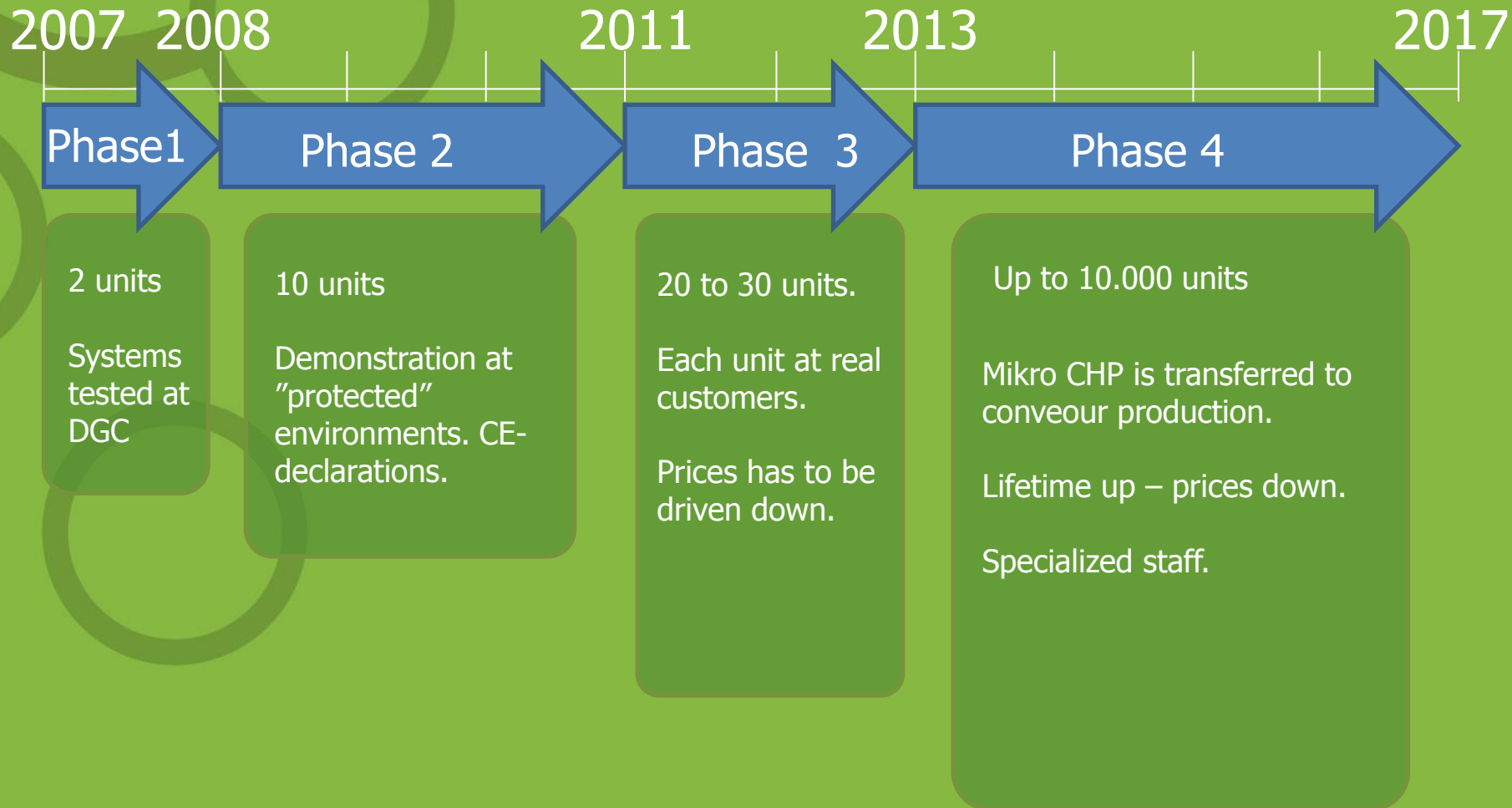


A Danish Demo Project on Fuel Cell Based MicroCHP

LT PEM/HT PEM/SOFC. Total: 100 μ CHP units
Project Economy: 20 million €



Market entry of micro-CHP (PEM,SOFC)



International Market

Micro Combined Heat & Power; Danish Export

Natural gas

22.5 - 40 bill. DKK/y
~15.000 - 25.000
Employees

Hydrogen

22.5 - 40 mia. DKK/y
~15.000 - 25.000
Employees

45 - 80 bill. DKK/y
~30.000 - 50.000
Employees

Decentralized Heat & Power

SOFC units < 2
MW:

Increase from 600
MW/y → 1 GW/y
i 2020

Future Hydrogen Infrastructure



DENMARK 2015 VISION

»In 2015 it shall be possible to buy hydrogen cars and refuel hydrogen all across Denmark.«

- In operation (7)
- Under construction (3)
- Under consideration (20)
- Clean Energy Partnership
- X km Road distance between stations



Conclusions

- **Denmark is having a strong national Partnership uniting all Danish stakeholders**
- **Political Denmark is having a strong emphasis on getting independent of fossil fuels.**
- **From Push to Pull - Hydrogen and fuel cell technologies necessary in the future**
- **Many activities is going on in Denmark. At the moment focus on deployment is important.**



HYDROGEN AND FUEL CELLS

The Danish Partnership

www.hydrogennet.dk