






Mikael Dahlgren, ABB Corporate Research, 02 December 2011

# ABB – Technology providers perspective Energidagen – Chalmers Energyinitiative

# ABB

## Five global divisions

				
<b>Power Products</b>	<b>Power Systems</b>	<b>Discrete Automation and Motion</b>	<b>Low Voltage Products</b>	<b>Process Automation</b>
<b>\$10 billion</b> <b>34,500</b> <b>employees</b>	<b>\$6.8 billion</b> <b>19,100</b> <b>employees</b>	<b>\$5.6 billion</b> <b>27,200</b> <b>employees</b>	<b>\$4.5 billion</b> <b>21,300</b> <b>employees</b>	<b>\$7.4 billion</b> <b>28,400</b> <b>employees</b>

(2010 revenues)

### ABB's portfolio covers:

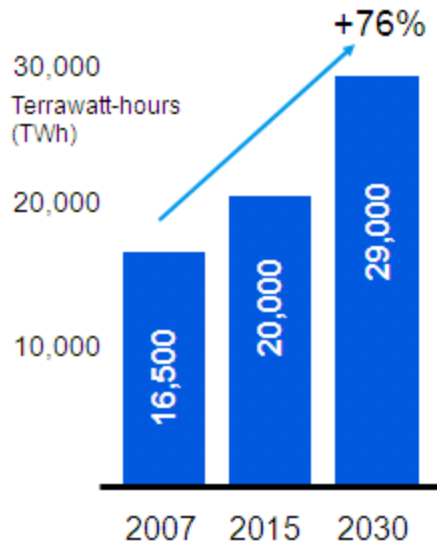
- Electricals, automation, controls and instrumentation for power generation and industrial processes
- Power transmission
- Distribution solutions
- Low-voltage products
- Motors and drives
- Intelligent building systems
- Robots and robot systems
- Services to improve customers productivity and reliability

# Electrical system is facing significant challenges

## Regulation key in promoting adoption

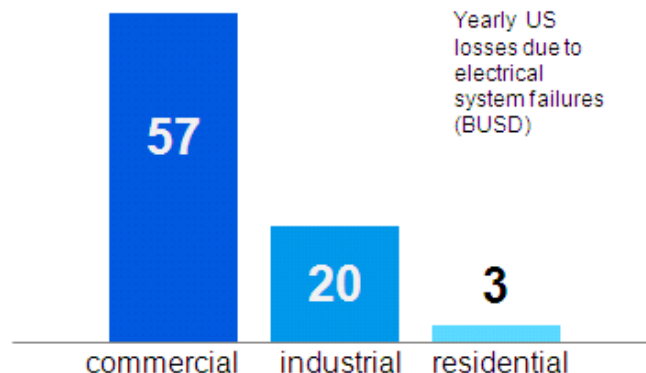
### Increasing demand

- Electricity consumption growing at twice the rate of overall energy.
- Highest growth rate in India (280%) and China (190%)



### Increased reliability

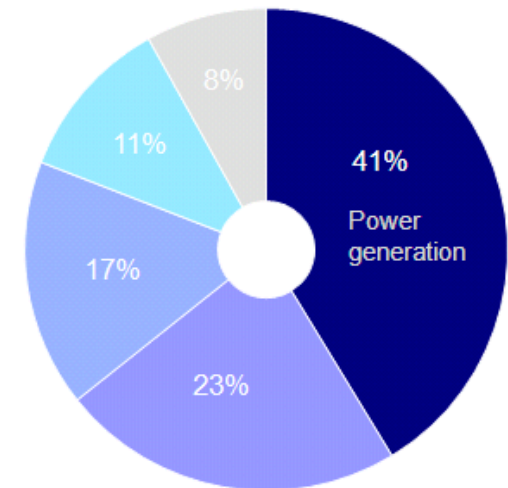
- As economies digitize, the cost of non-performance of electrical system is increasing.
- >70% of problems occur in distribution part.



### Reduced CO<sub>2</sub> emissions

- Electricity generation is the highest and fastest rising source of CO<sub>2</sub> emissions.
- Electricity generation from coal in India 68% and China 81%

CO<sub>2</sub> Emission by Sector



# ABB technology in wind

## Everything except wind turbine

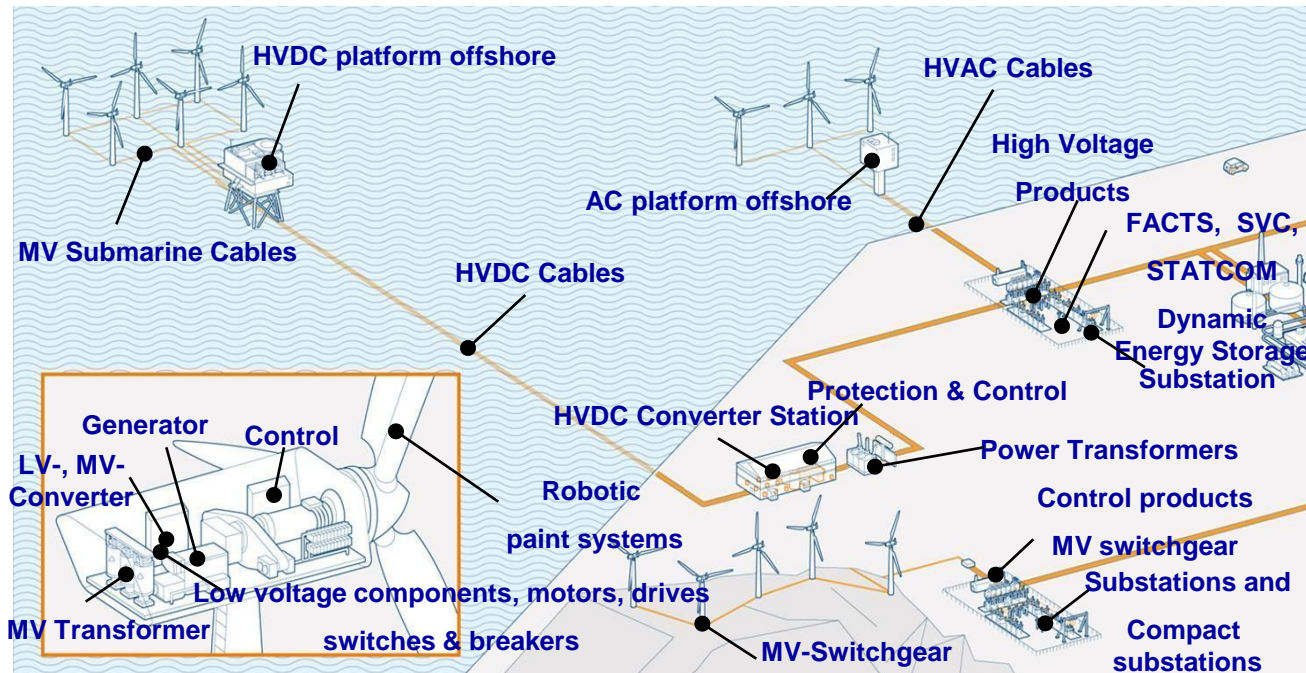
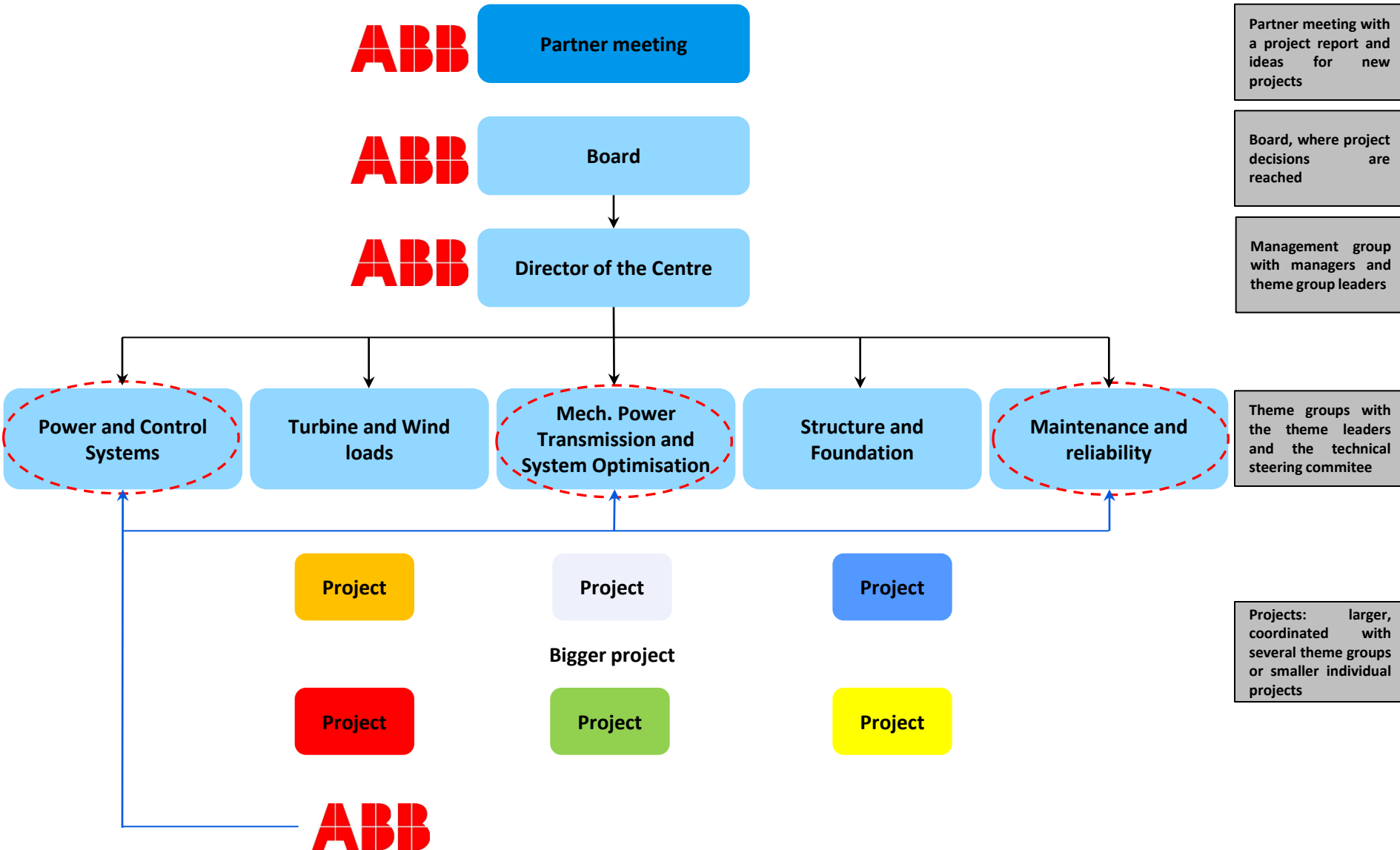


ABB offers broad range of products on electrical systems contributing to wind industry: from components inside wind turbines right up to the power transmission and distribution systems of the wind power plant

# SWPTC – Swedish Wind Power Technology Center

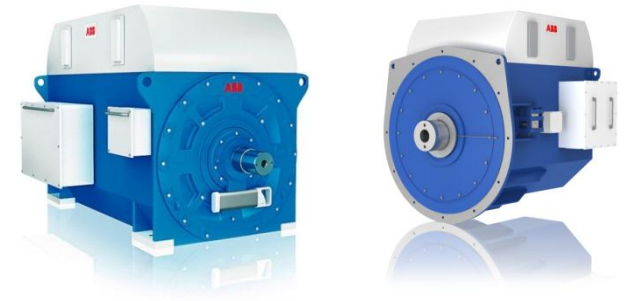
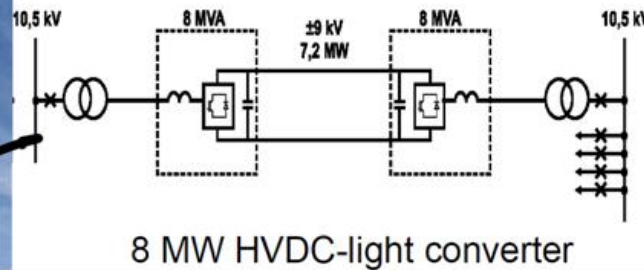
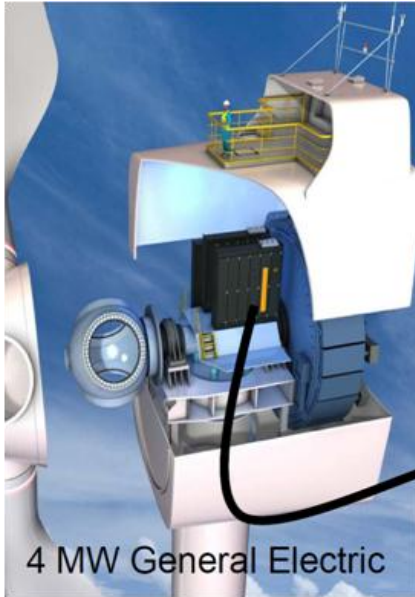


# Theme 1: Power and Control system

## Modelling of wind turbine electrical components

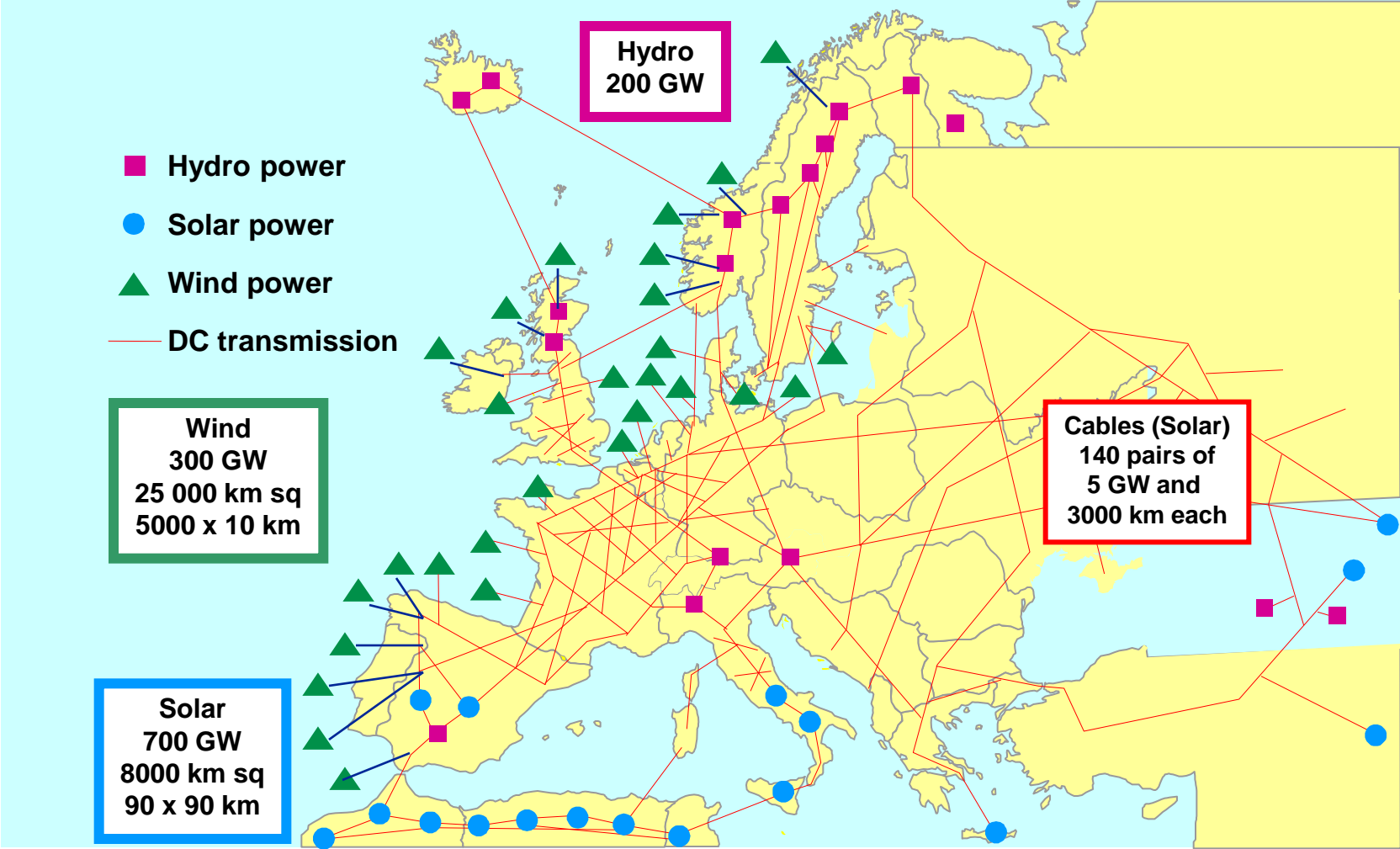
### Grid code modelling and testing

### Advanced control strategies (adaptive, predictive) for wind turbine control



# Europe 20XX Scenario with renewable energy sources ABB's HVDC grid vision in the 1990's

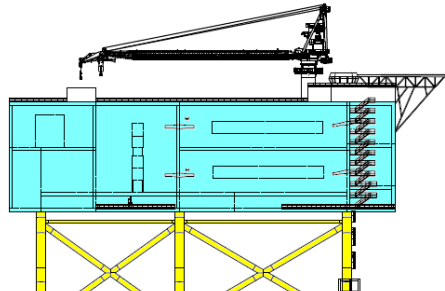
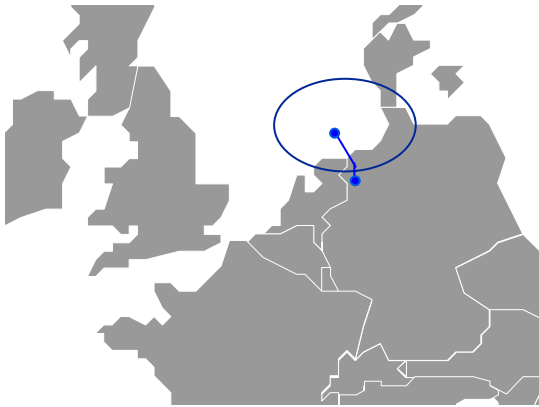
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# DolWin1 Offshore Wind Power Connector

## 800 MW, $\pm 320$ kV DC

Customer: transpower  
Year of commissioning: 2013

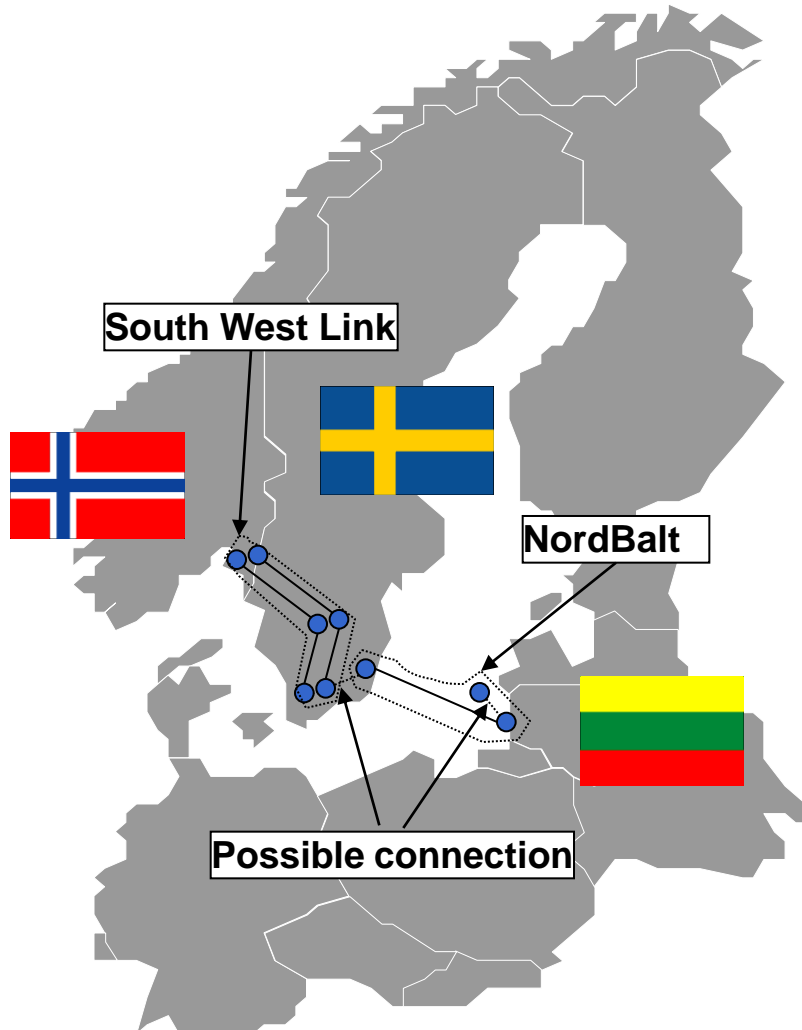


- 165 km long subsea and underground power connection to offshore wind farm
- Robust grid connection
- *Turnkey 800 MW HVDC Light system*
- *First  $\pm 320$  kV extruded cable delivery*



# Example of possible HVDC grid in Europe

## Multi-terminal enabled

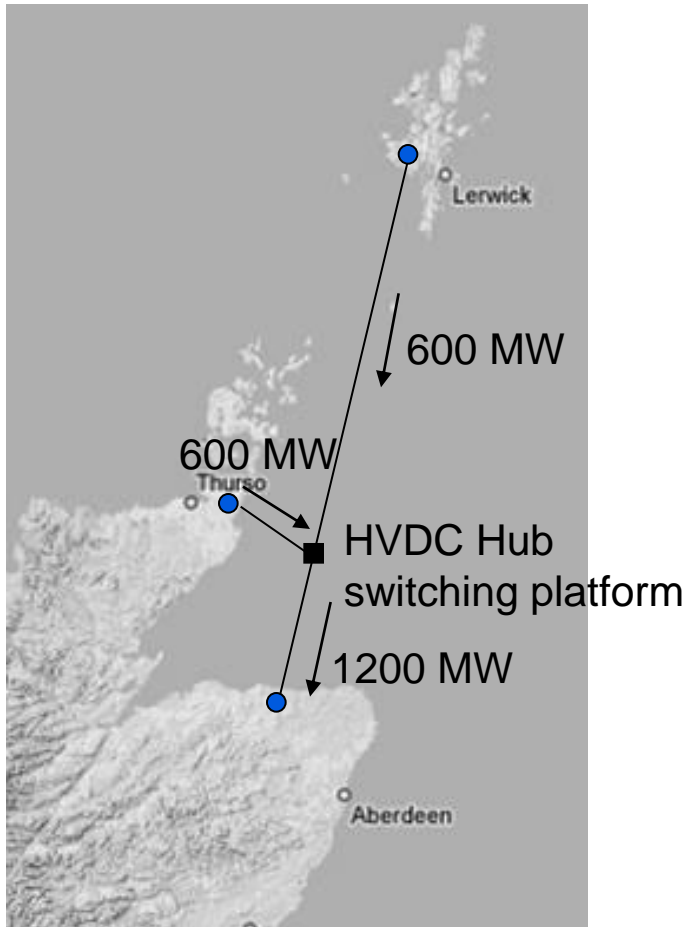


### Nordic and Baltic countries

- South West Link
  - 1'st stage: 2 terminals à 2 x 700 MW
  - 2'nd stage: 3 terminals à 2 x 700 MW
- *NordBalt*
  - 1'st stage: 2 terminals à 700 MW
    - *Multi-terminal enabled*
  - Possible 2'nd stage: 3 terminals à 700 MW
- Possible future HVDC Grid
  - 6 terminals: 700 MW à 300 kV

# Example of possible HVDC grid in Europe

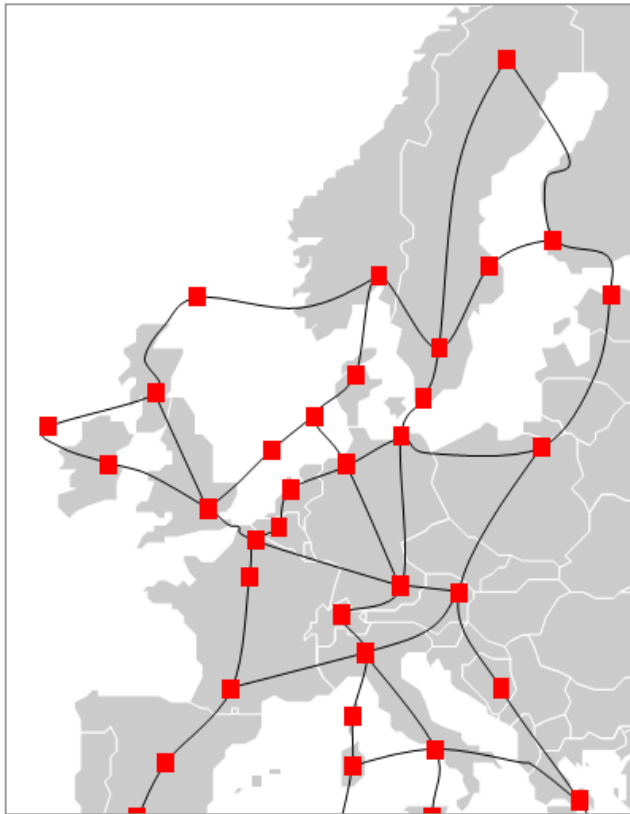
## Multi-terminal enabled



## UK

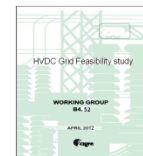
- Shetland
  - 1's stage – 3 terminal terminals  
1200 MW
  - Future up to 6 additional stations

# What is an interregional DC grid?



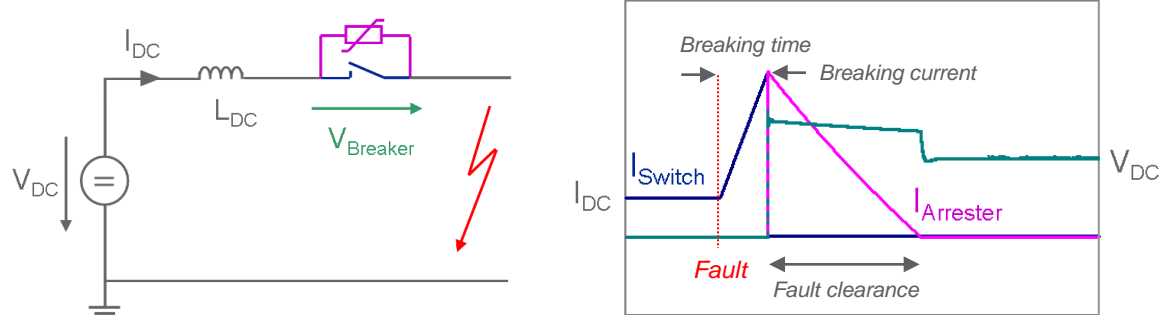
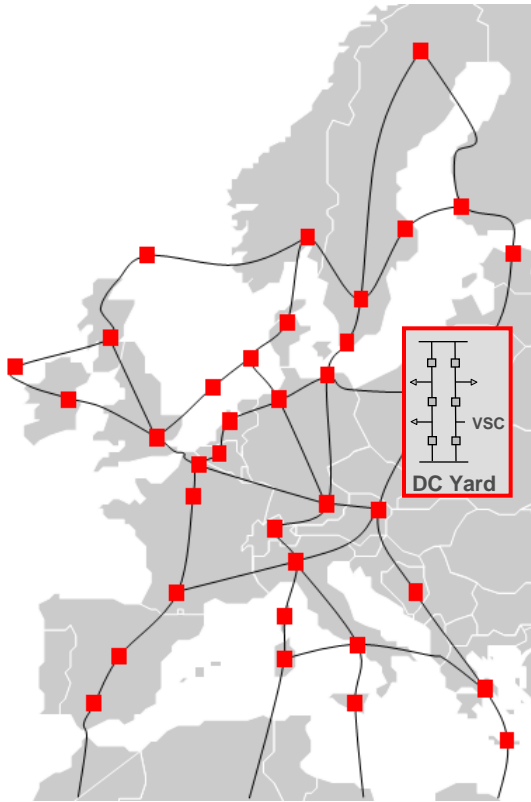
Regulatory issues such as how to manage such new grids need to be solved

- An interregional HVDC grid is defined as a system that needs several protection zones for DC earth faults, has the same voltage level and very high power rating
- *New developments needed, e.g.:*
  - *HVDC breakers and fast protections*
  - *Grid Power flow control*
- Long-term development, e.g.
  - High voltage DC/DC converters for connecting different regional systems
  - *On-going Cigré WG B4.52 "HVDC Grid Feasibility study".*



# DC Breaker

## DC Grid Requirements



- Low surge impedance of cable based DC grids results in fast and deep fault penetration
- Fast isolation of faulted parts keeps DC voltage at reasonable levels to maintain operation of converter stations
- Fast DC Breakers with breaking times in ms range required to avoid voltage collapse in DC grid

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