

A European Supergrid ?

Eurelectric Conference

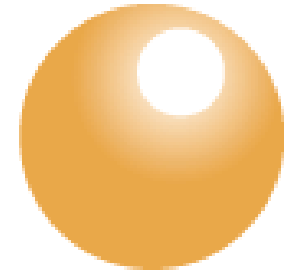
7 – 8 May 2009

Renewable Energy 2020

Opportunities and Challenges

power circle

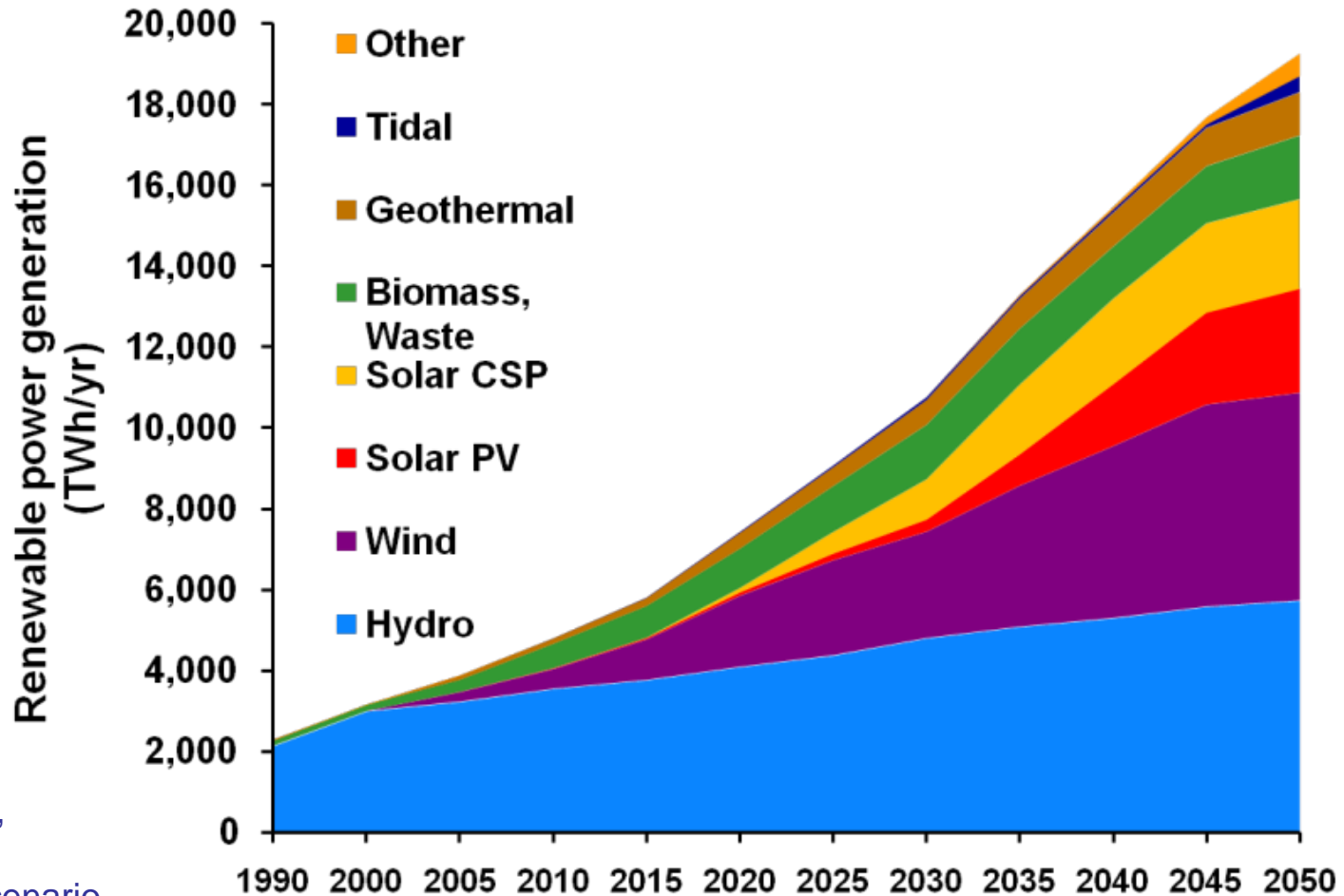
ELECTRICITY FOR SUSTAINABLE ENERGY



power circle
ELECTRICITY FOR SUSTAINABLE ENERGY



The Challenge, integration of renewable energy



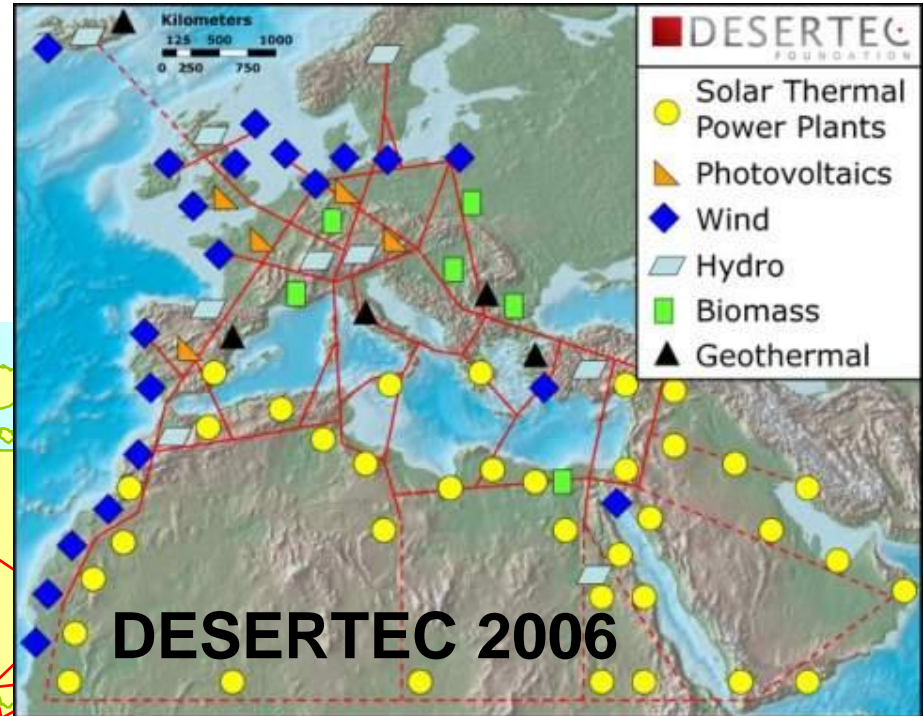
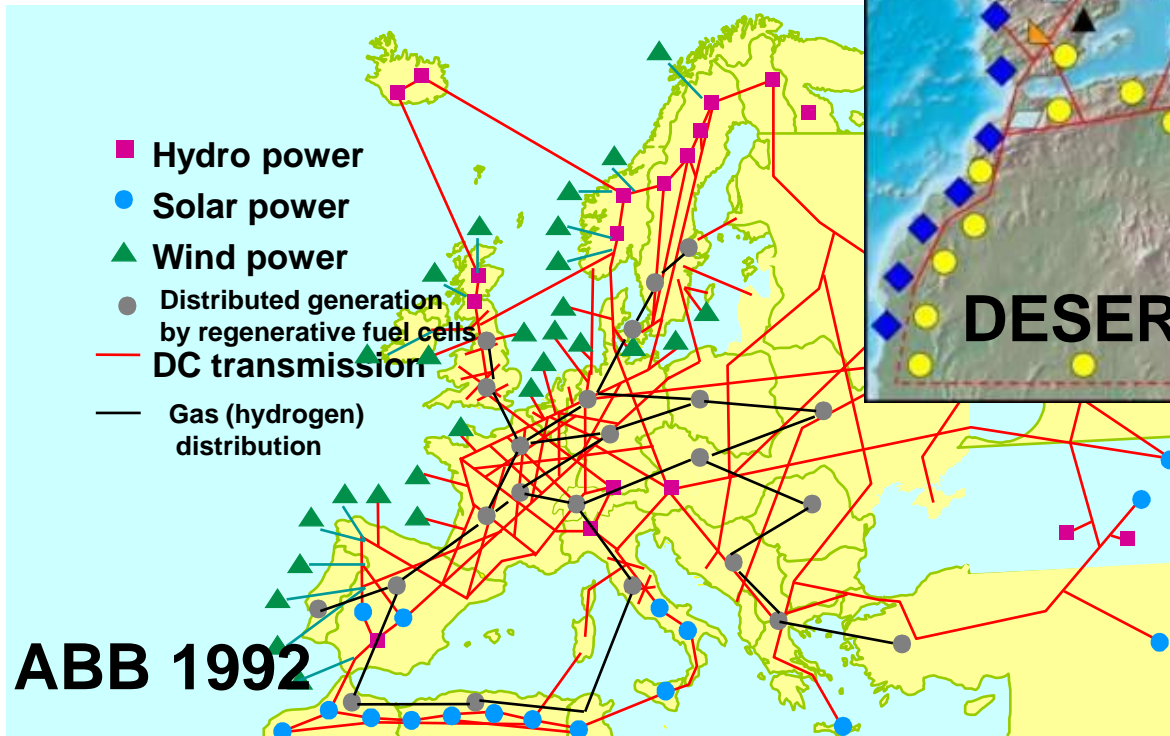
Source: IEA,
2008
Blue Map scenario

The Challenge: Opening of electricity market

- Optimal utilization of regional advantages
- Growth of interconnected systems
- Short-term changes in load flow
- Restricted access to information for system operators

The grids must become more flexible from structural as well as from operational point of view!

Vision of a European “Supergrid”



Off Shore Supergrid concept

- **Combine:**
 - Connection of off shore wind
 - Interconnections for trading
 - Sharing of back-up power
- **Benefits**
 - Reduced investment
 - Large geographic area gives more stable wind production



Source: Airtricity

Supergrid or Smartgrid ?

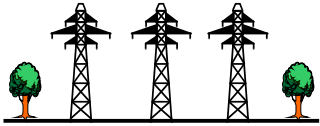


What is a SmartGrid?

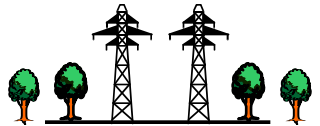
A SmartGrid is an electricity network that can intelligently integrate the actions of all users connected to it - generators, consumers and those that do both – in order to efficiently deliver sustainable, economic and secure electricity supplies.

Source: European Technology Platform Smartgrids

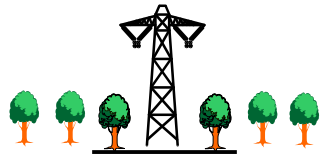
Transmission alternatives



Conventional HVAC ^C



HVAC with FACTS



HVDC ^C



HVDC Light

Traditional HVAC Transmission

FACTS

⇒ 30-50 % higher capacity and increased control by FACTS (Flexible AC Transmission Systems)

HVDC CSC

⇒ 200 – 300 % higher capacity and more control by HVDC (High Voltage DC Transmission)

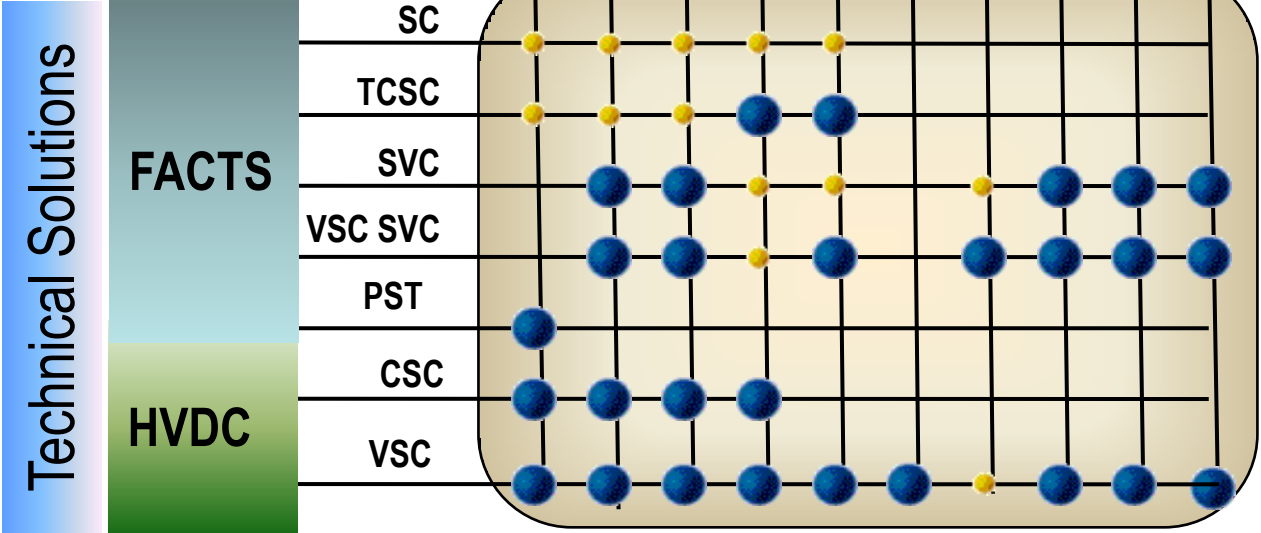
HVDC VSC

⇒ Superior control and underground option

Smartgrid transmission technologies

Technical Challenges

- dynamic support
- supply of passive grids
- power oscillations
- flicker compensation
- voltage control
- voltage quality
- reactive power support
- volatile loads
- load flow control
- unsymmetrical loads



Control is important, Nov 4 2006

..It is not unusual that in a highly meshed network, physical flows significantly differ from the exchange programs...

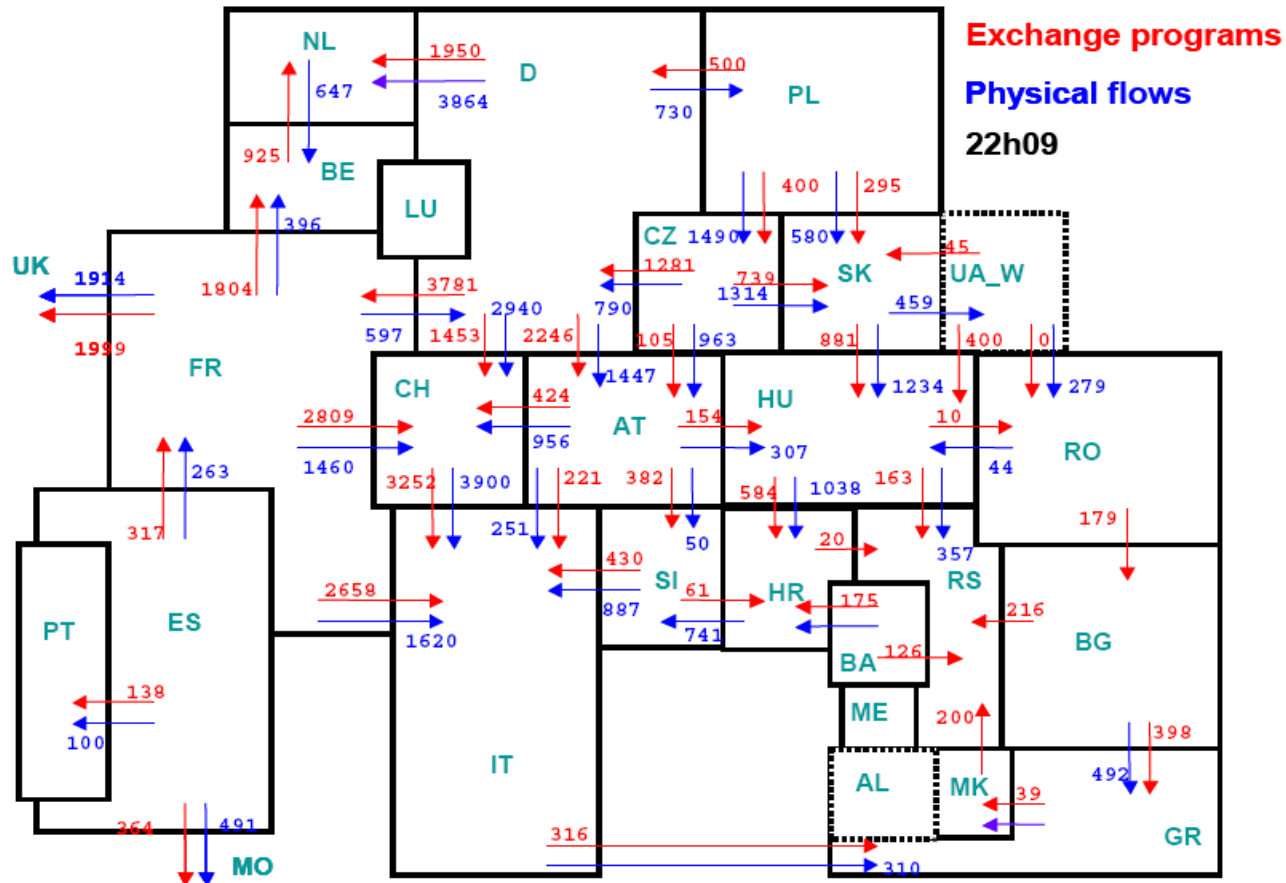
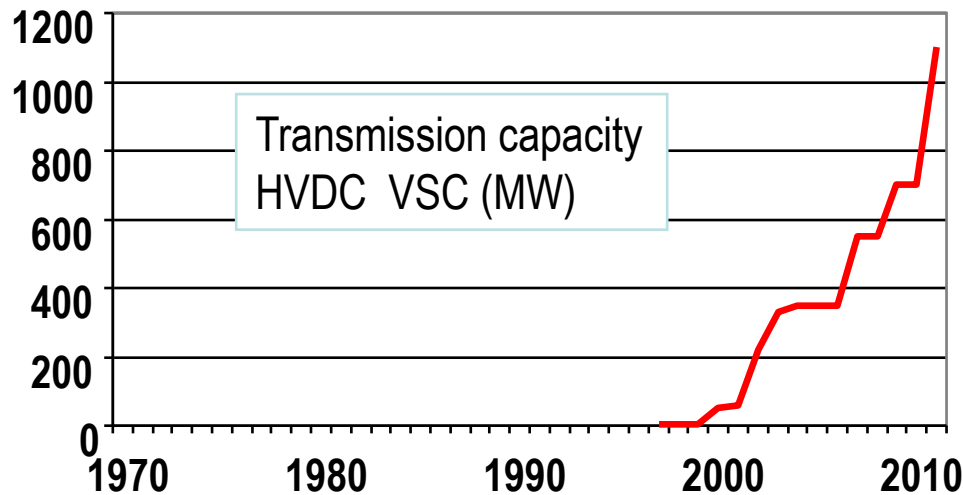
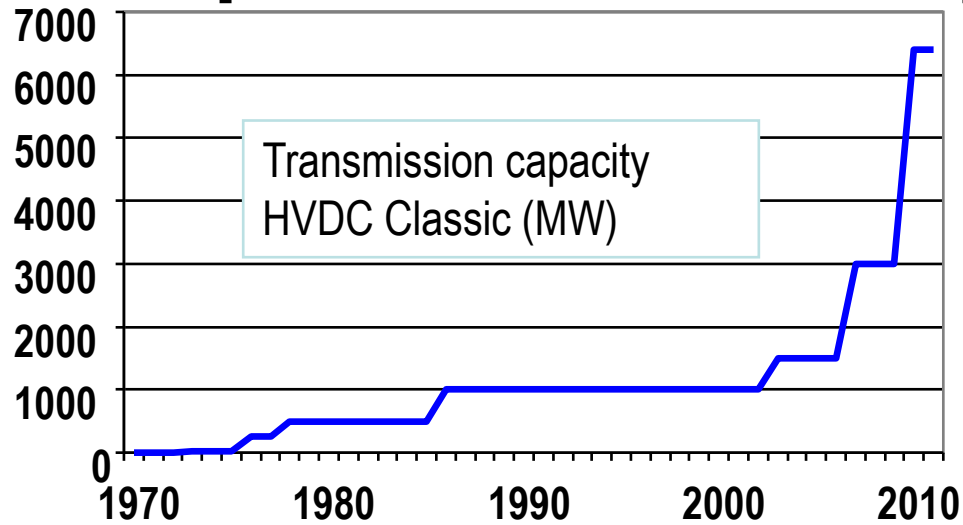


Figure 2: Exchange programs (red) and physical flows (blue) on 4 November at 22:09

HVDC Technologies

- HVDC Classic (CSC)
 - In use since 1954, more than 100 systems delivered and 11 under construction
 - Overhead lines or Paper/Oil Cable (sea)
 - Suited for point to point systems
- HVDC VSC
 - In use since 1999, 9 delivered and 5 under construction
 - Overhead lines or PEX Cable (land or sea)
 - Suited for multi terminal systems

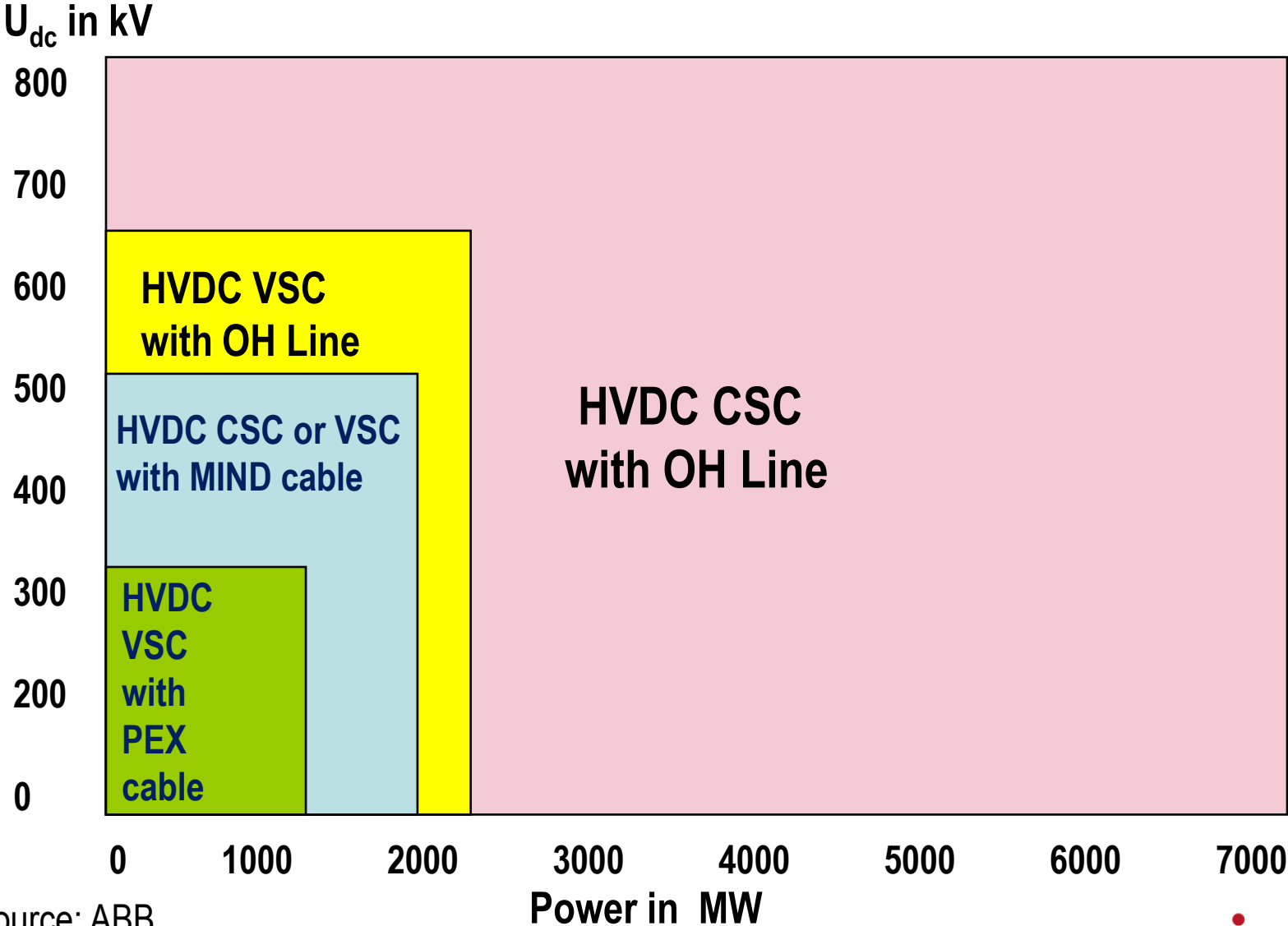
Development of HVDC capacity



Bipolar operation gives double capacity

Source: ABB

Capacity of HVDC Systems



Source: ABB

VSC HVDC under construction in EU



Nord E.ON 1

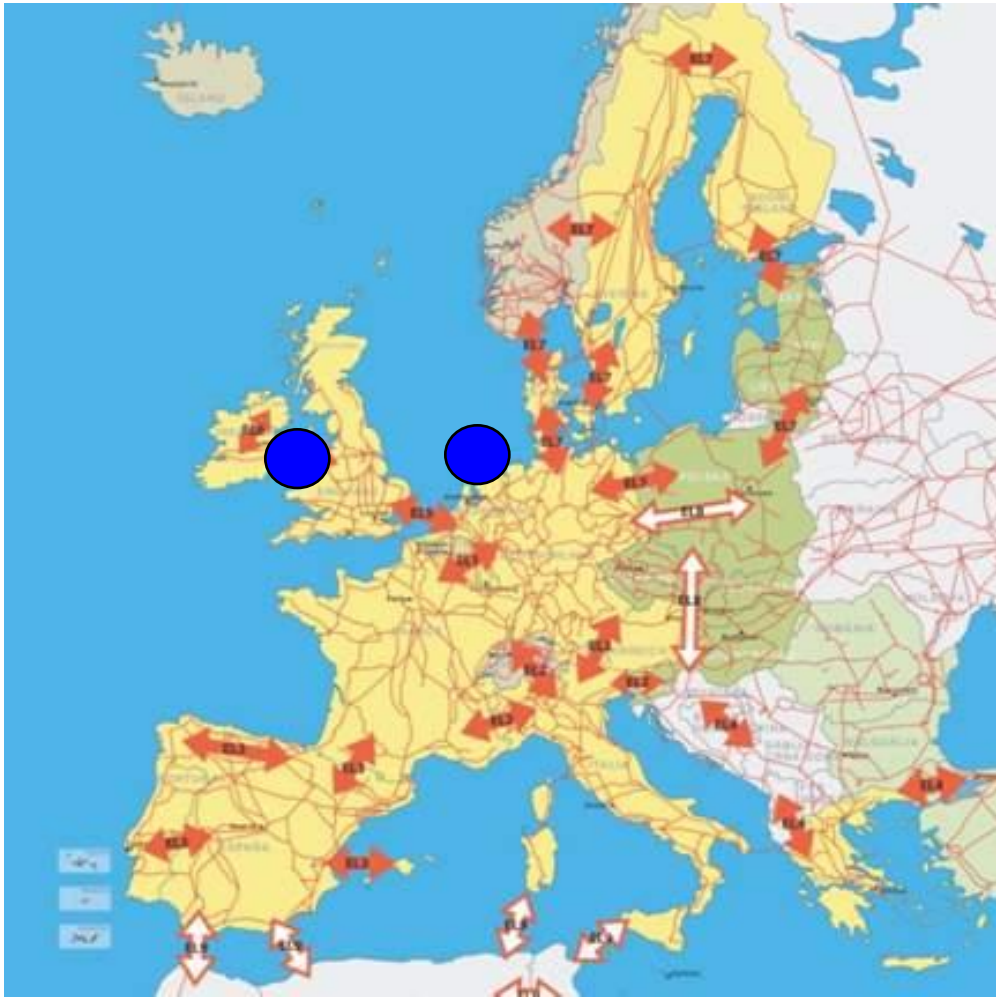
- 400 MW / 150 kV
- 128 km sea cable
- 75 km land cable



Eirgrid

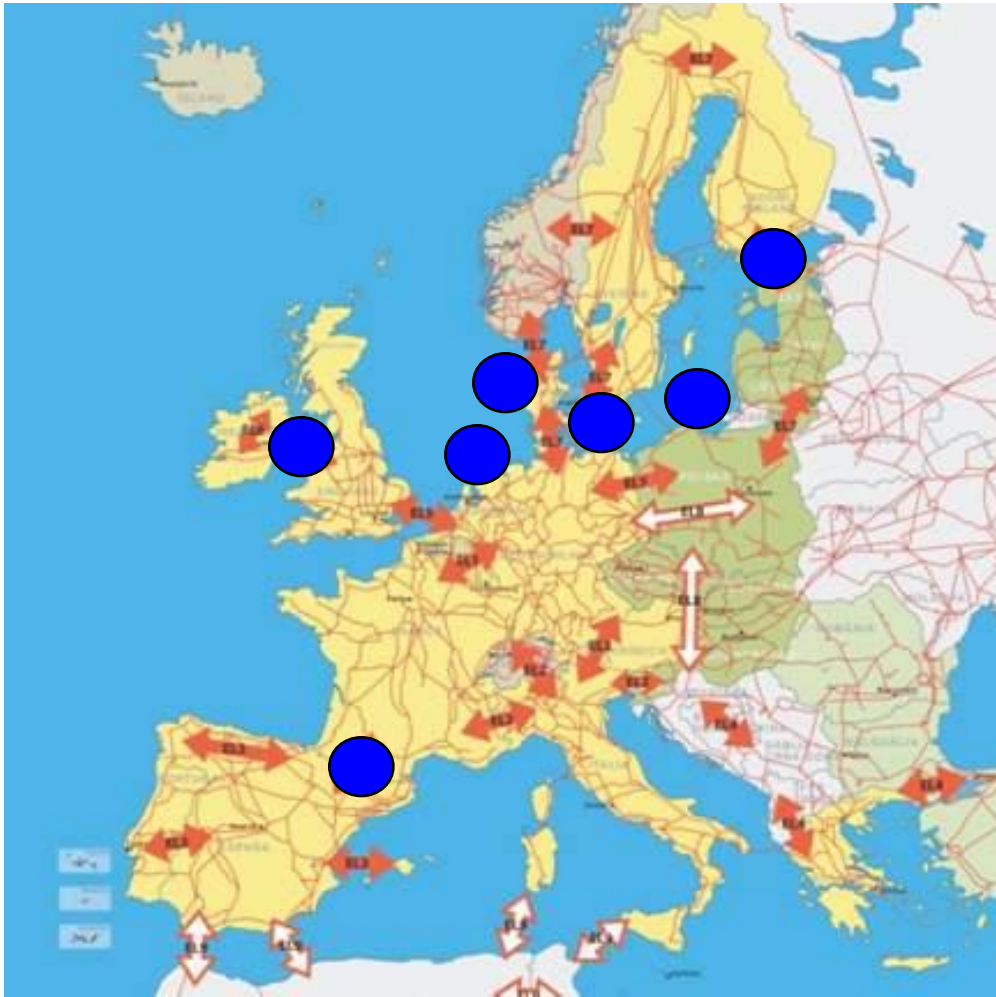
- 500 MW / 200 kV
- 186 km sea cable
- 70 km land cable

Building a European Smart Supergrid



Introduce VSC HVDC

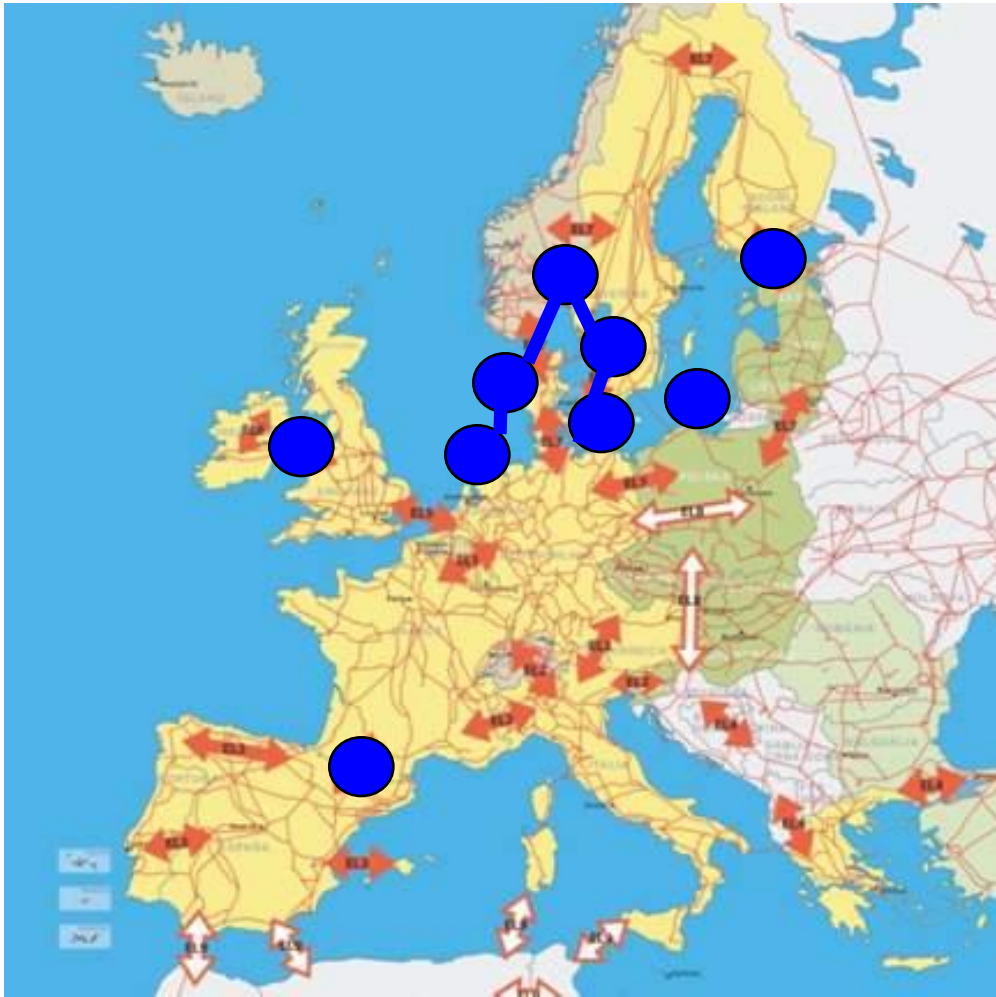
Building a European Smart Supergrid



Introduce VSC HVDC

Use EU stimulation package to expand to expand

Building a European Smart Supergrid



Introduce VSC HVDC

Use EU stimulation package to expand

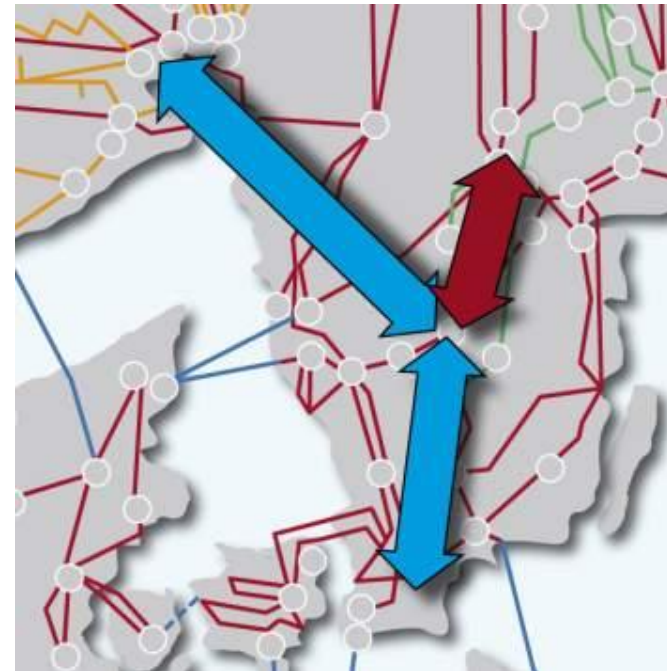
Start connecting individual projects

Smart Supergrid ideas

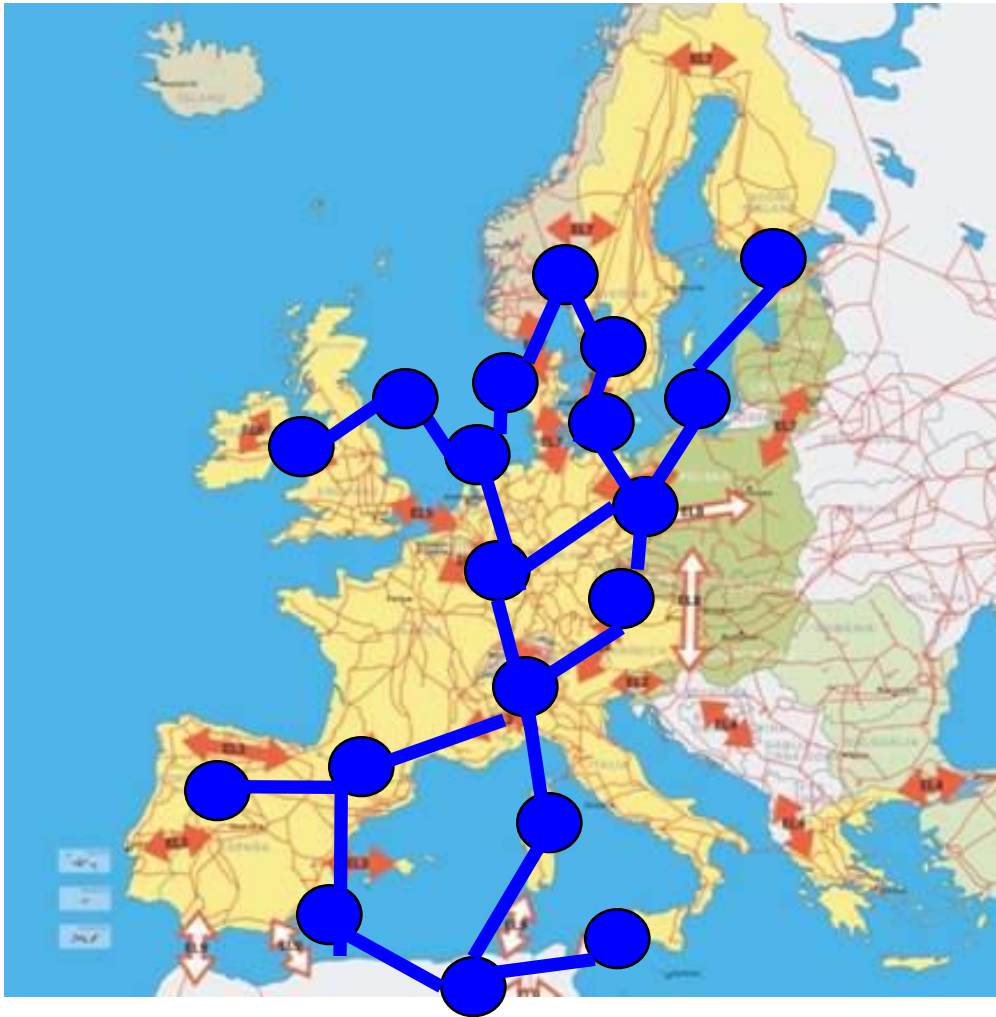
Kriegers Flak
SE, DK, DE



SouthWest Link
SE, NO



Building a European Smart Supergrid



Introduce VSC HVDC

**Use stimulation package
To expand**

**Start connecting
individual projects**

Build the grid

Critical issues

- Regulatory / Financial
 - Rules for investment
- Technical
 - Decide on technical parameters
 - Voltage
 - Protection schemes....

Building a Smart Supergrid for Europe

- Build on existing a.c. grid, selective reinforcements and upgrading with FACTS
- Stepwise introduction of VSC HVDC starting with individual projects
- Use combination of sub sea, underground and overhead lines

Opportunity for Europe to maintain the lead in renewable energy and transmission technology