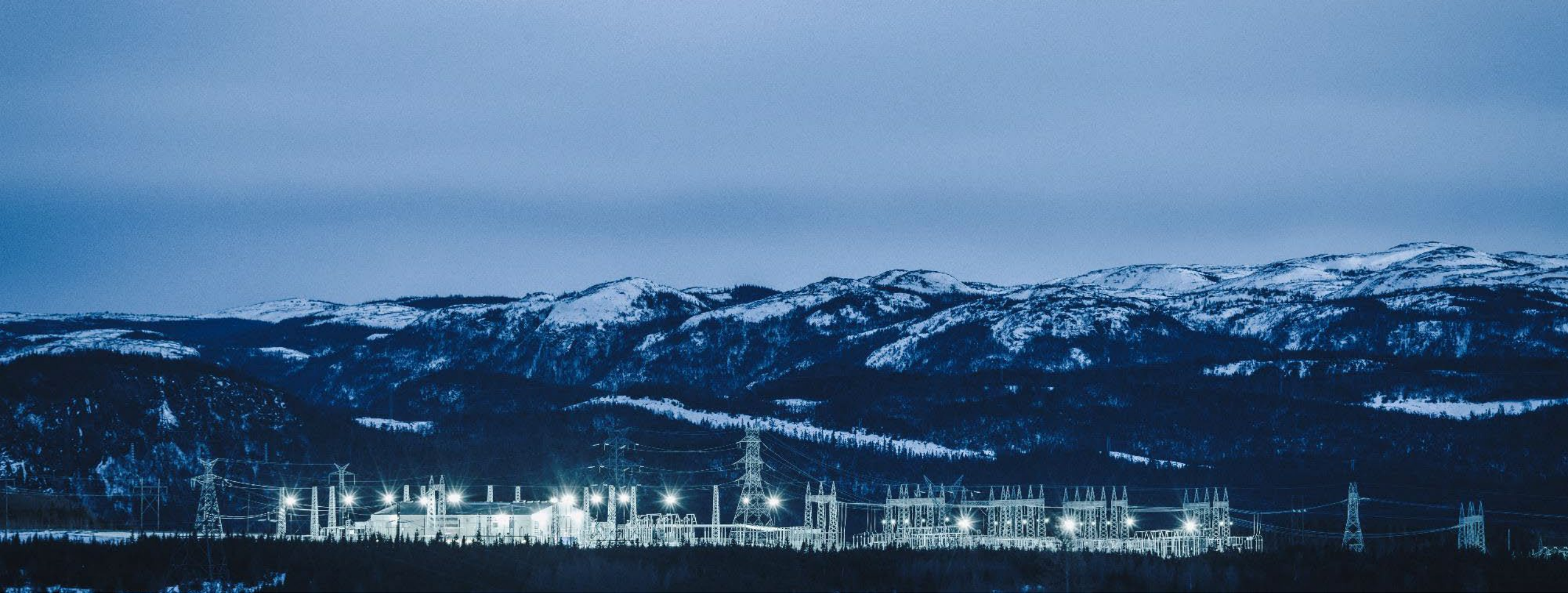


ATHANASIOS KRONTIRIS, ABB POWER GRIDS

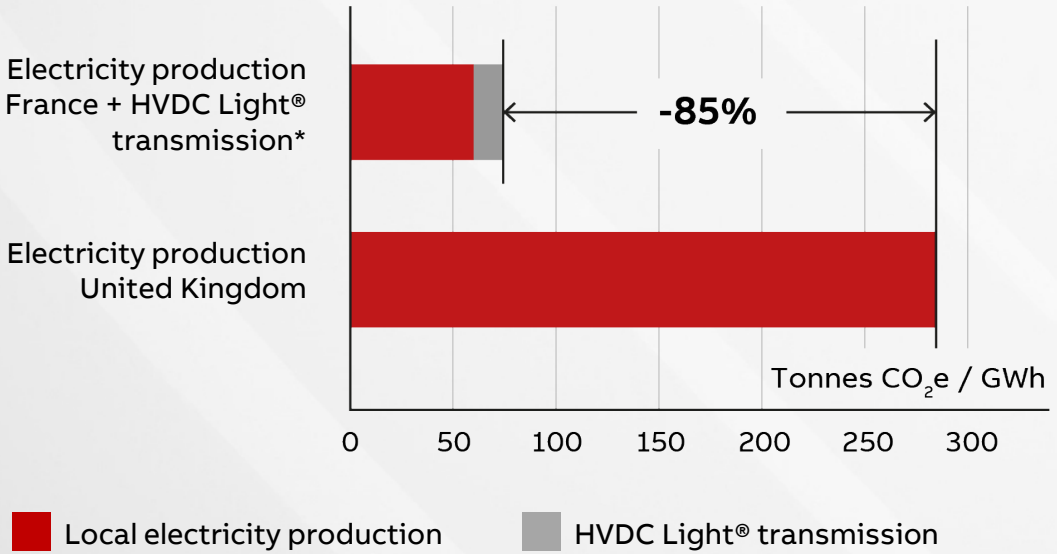
Options for system design

Technology and Control & Protection

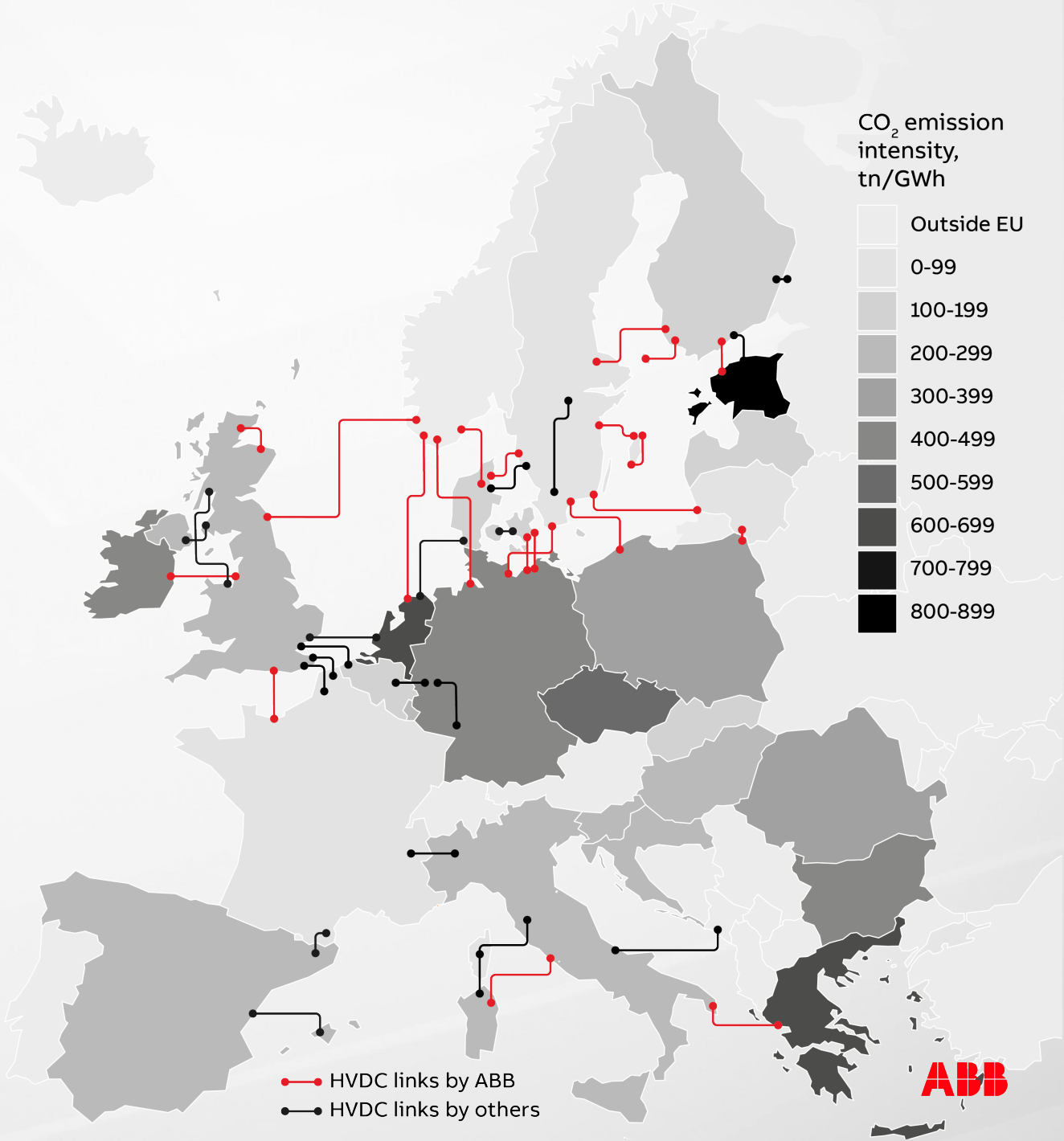
Environmental benefits
from HVDC Light® interconnectors

One HVDC transmission link can reduce millions of tonnes of CO_2e per year*

Example: Interconnection France - United Kingdom

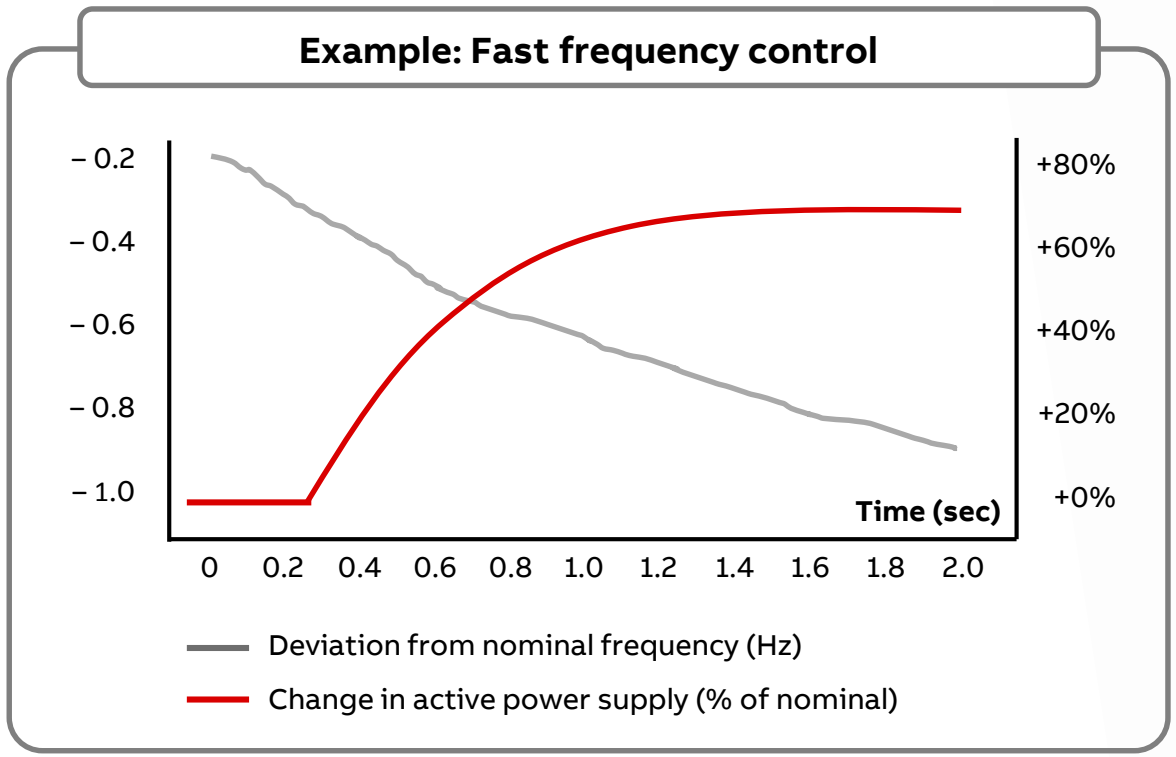


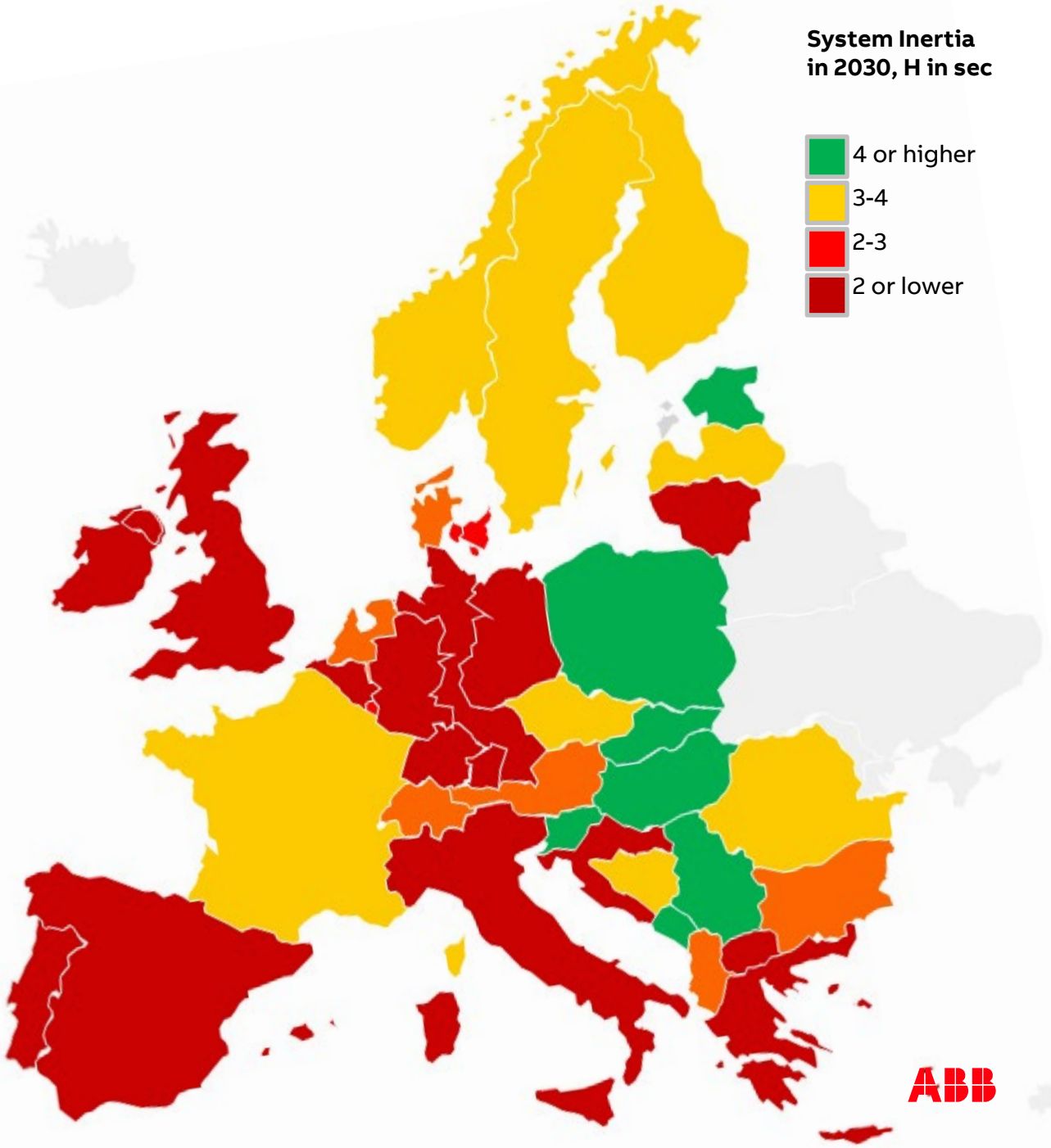
*) 900 MW HVDC Light® transmission substituting locally generated electricity, 2016 electricity mix data



Stability benefits
from HVDC Light® interconnectors

Frequency reserves can be shared between regions via HVDC transmission links

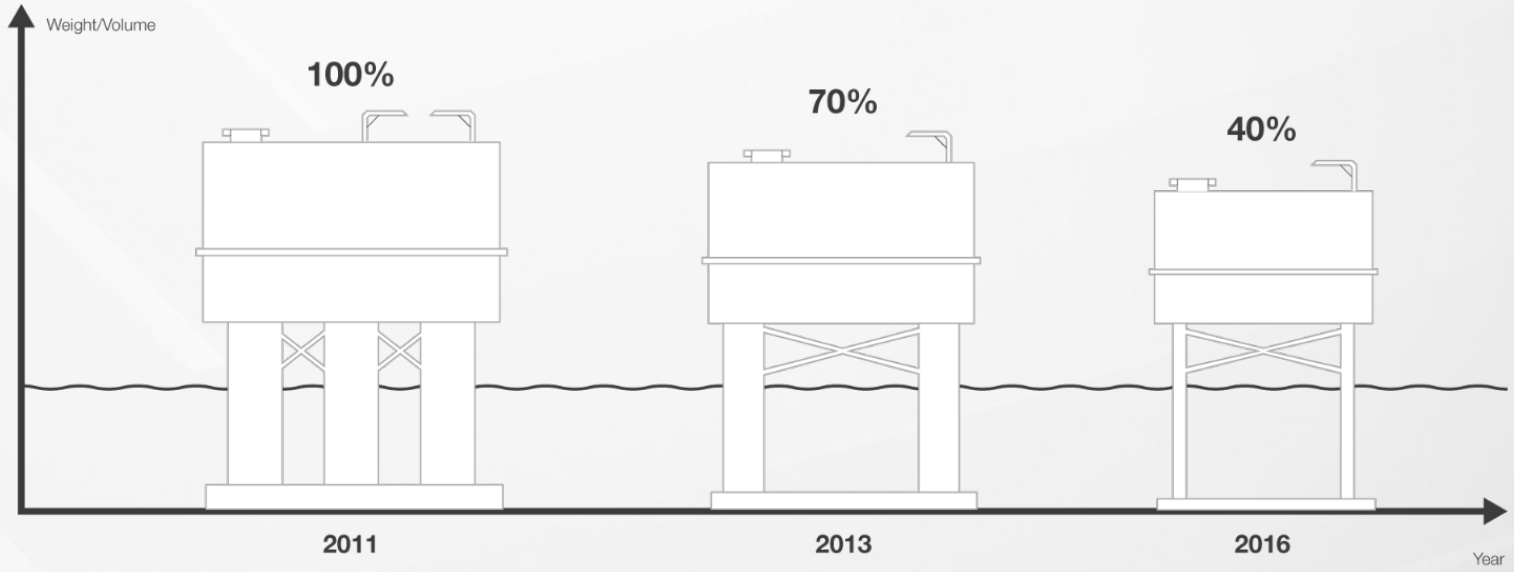




Offshore Wind Connections

Optimization of equipment enables platforms with 60% reduction in weight/volume

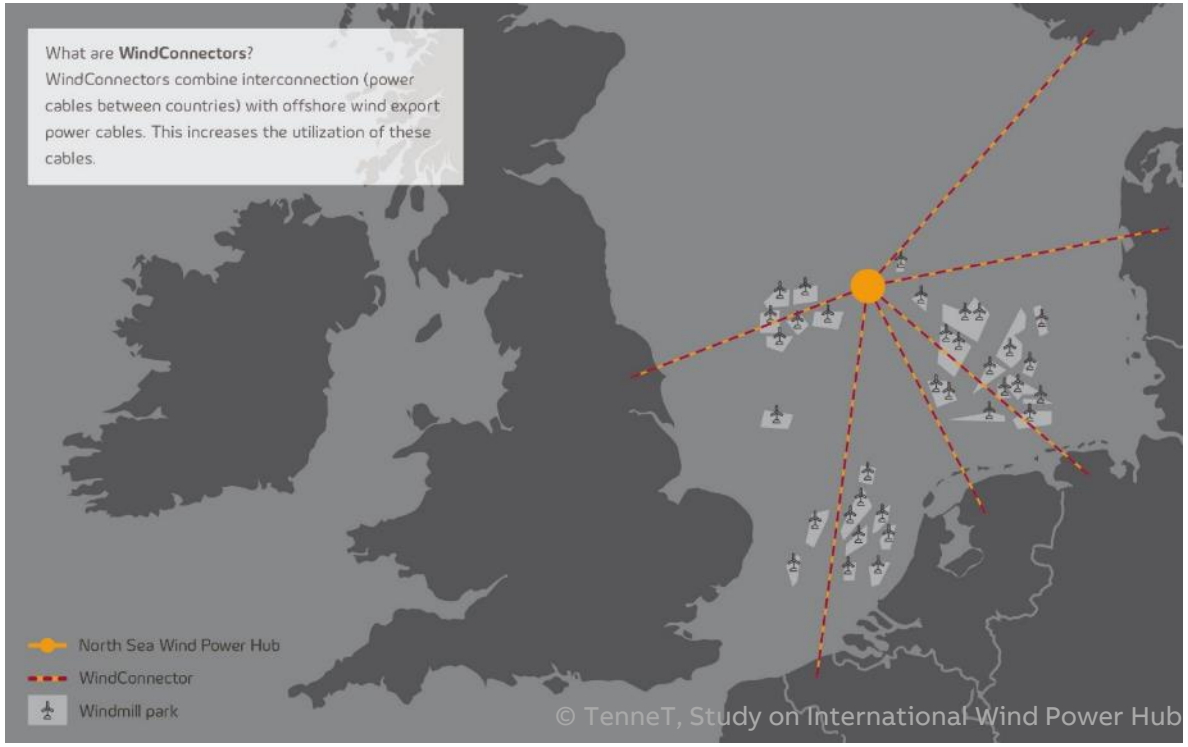
- Compact main circuit equipment
- Optimized redundancy with maintained availability
- Minimize number of active platform systems
- No permanent living quarters
- Layout optimization



Hybrid interconnections

Connecting markets and integrating Offshore Wind

Example: North Sea Power Hub



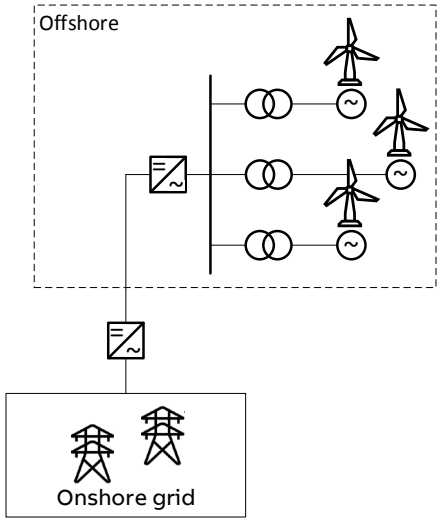
Advantages

- Strengthens European energy markets
- Increases security of supply across Europe
- Allows higher utilization of infrastructure
- Supports larger volumes of offshore wind

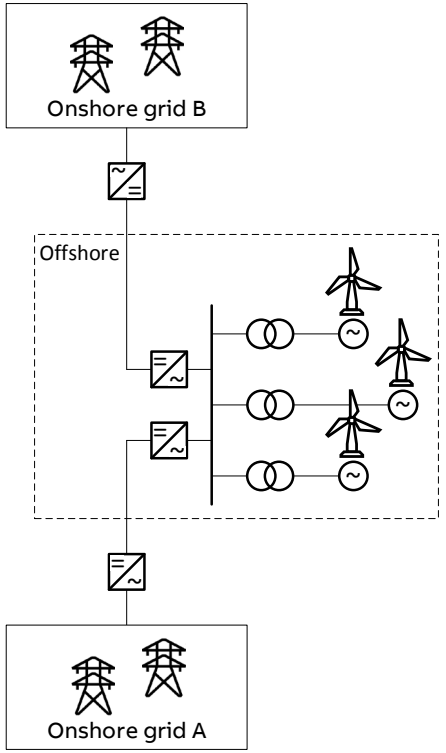
Hybrid interconnections

System architecture

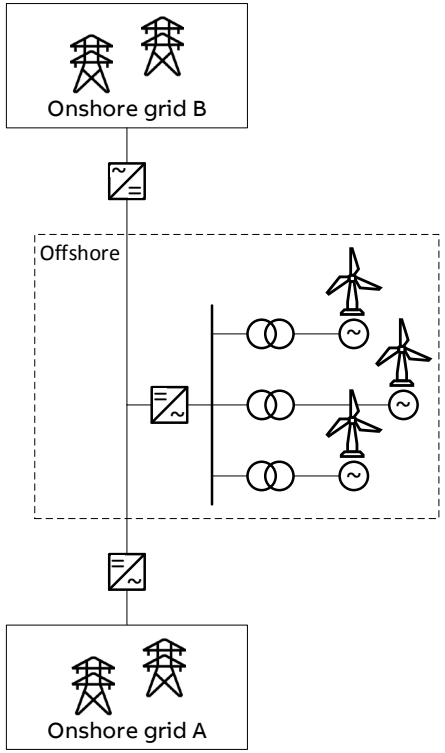
Point to point HVDC



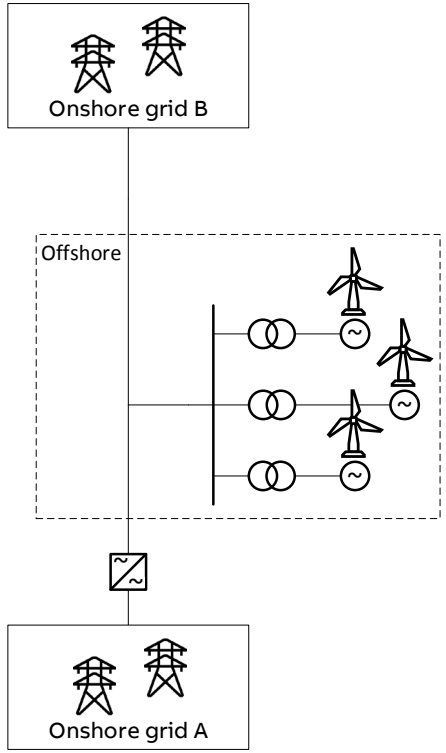
Parallel HVDC



Multi-terminal HVDC



Mixed HVDC / HVAC



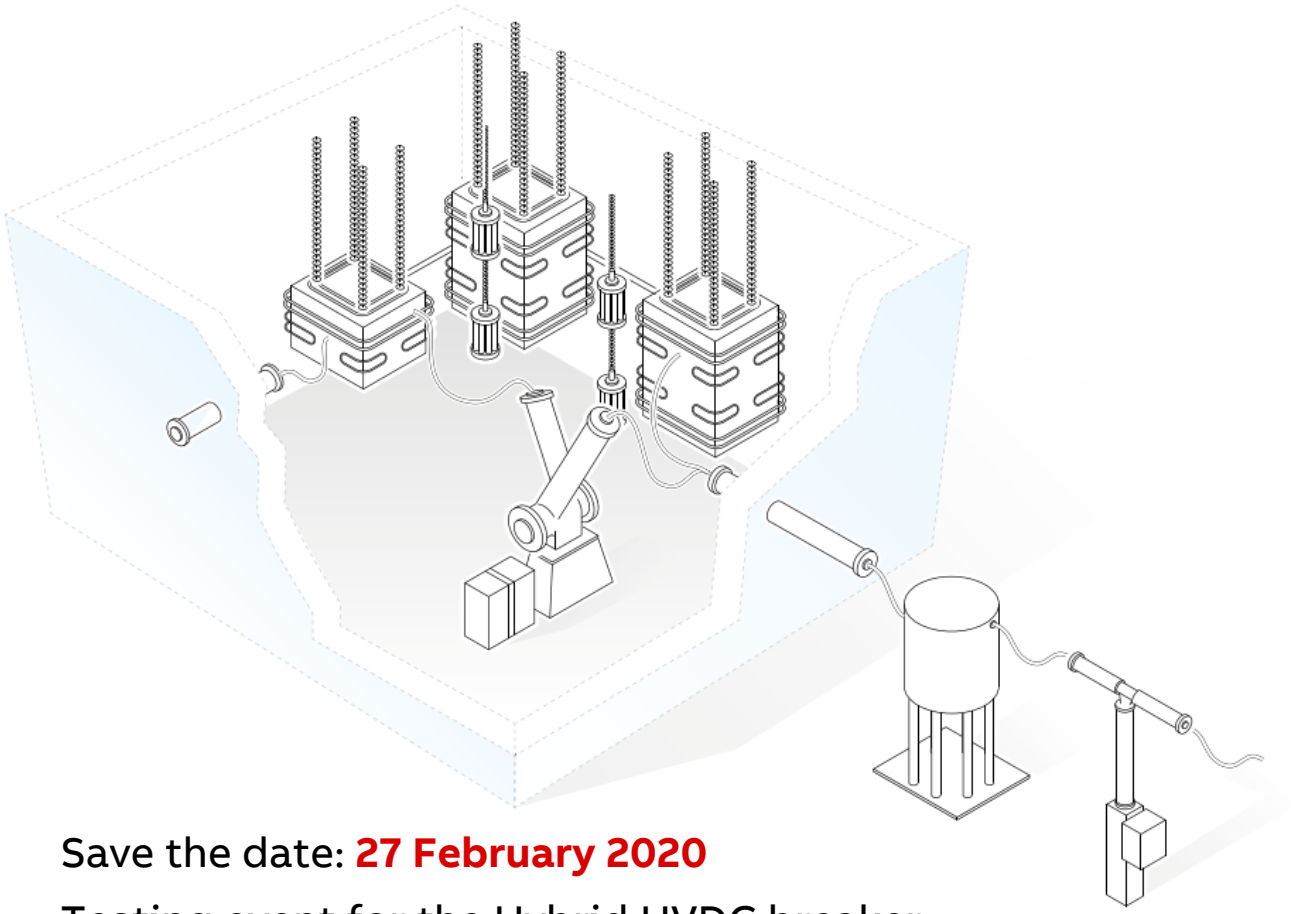
Options for system design

Where are we now?

- VSC HVDC technology is sufficient for the needs of Europe
- Projects up to 500 kV voltage and 3000 MW power
- Robust execution of Offshore Wind Connection
- Multi-terminal HVDC systems are feasible
- Tested HVDC breaker prototypes

What's next?

- Interconnections are essential to integrate targeted volumes of RES (Point-to-Point and hybrid/multi-terminal)
- Practical experience in building a multi-terminal, multi-vendor HVDC system in Europe



Save the date: **27 February 2020**

Testing event for the Hybrid HVDC breaker from ABB at CESI test center in Arnhem, NL

HVDC Seminar 2020, June 2 & 3, 2020
Industry leaders & Network planners forum

We invite you to experience a unique forum for a more complete understanding of HVDC systems and the benefits for the ongoing grid transformation.

Are you system owner, regulator, or working as developer or grid planner? Then, you should join us.

Program

Day 1

Stockholm Waterfront Congress Center

- Future of ABB Power Grids
- Evolving grids
  Guest speaker: Ulrich Stribaek, Wind Europe
- Introduction to ABB HVDC

Industry Outlook Stream

- HVDC projects review
- How to manage lifecycle of your HVDC station

Technology/Application Stream

- Developing applications for HVDC
- Grid planning

Day 2

ABB HVDC Lead Center, Ludvika

- Visit Ludvika to go deeper into HVDC technology from ABB
- Guided tour at HVDC & test halls