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2016-11-17

PROMOTioN workshop

Grids with HVDC

Grids with HVDC

AGENDA

- Evolution of AC Grid
- Boundary conditions (Grid)
- ABB Grid vision / DC Grid initiatives
- Current HVDC requirements / References
- Grids outlook
- Portfolio
- MTDC / HVDC Breaker
- Real MTDC ready projects
- Ongoing EU projects

Grids with HVDC

Evolution of the AC Grid

Source:

https://de.wikipedia.org/wiki/Internationale_Elektrotechnische_Ausstellung_1891

14.11.2016



Source:

https://de.wikipedia.org/wiki/Drehstrom%C3%BCbertragung_Lauffen%E2%80%93Frankfurt

14.11.2016



From...

Lauffen – Frankfurt

- First AC transmission in Germany
- Point to Point AC connection

...to...

first meshing

...to...

Transmission zones/areas

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Evolution of the AC Grid

Grid of ENTSO-E
(European Network of
Transmission System
Operators for
Electricity).
01.07.2010

Source:
www.entsoe.eu

Download: 08.11.11

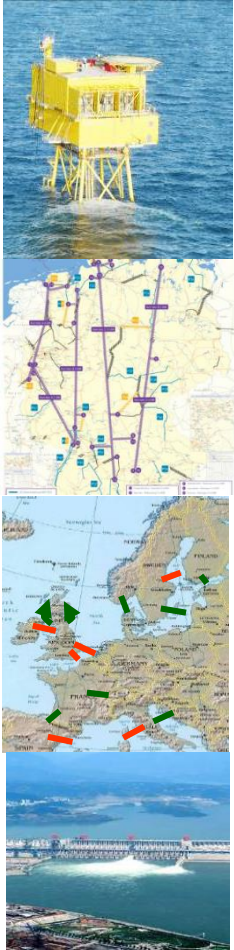


Advantages

- Possibility to transform
 - Easier electromechanical power transformation
 - Frequency is used for the whole system as reference variable
 - Easier to interrupt power
- creating meshed grids

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Boundary conditions



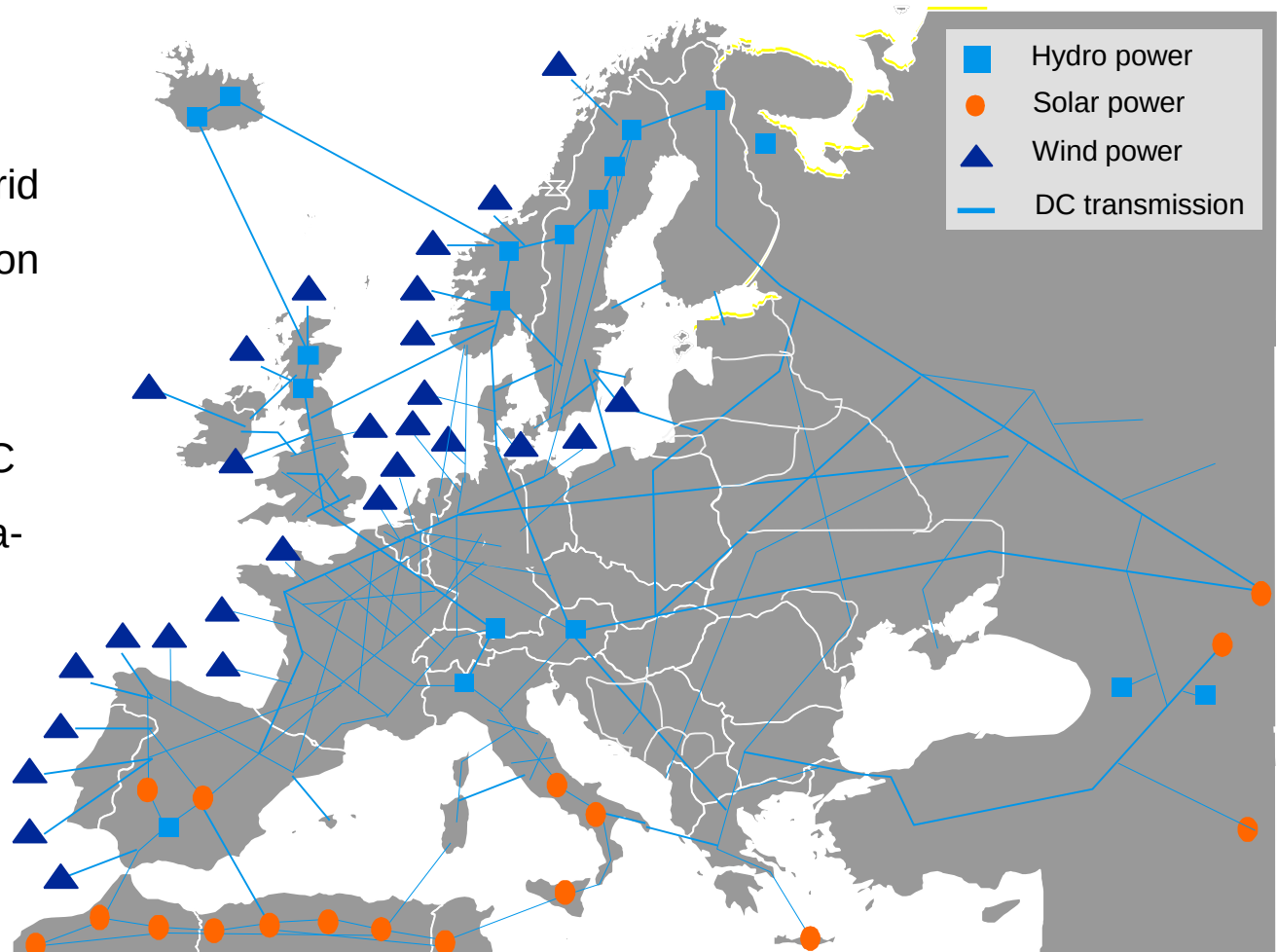
- There is only one grid
- HVDC is a sub system of that grid
- It can be:
 - A back-to-back station
 - An embedded link or multiterminal system
 - An interconnector between 2 or more regions
 - One or more links to connect remote generation to the load
 - A DC network

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DC grid initiatives competing for attention

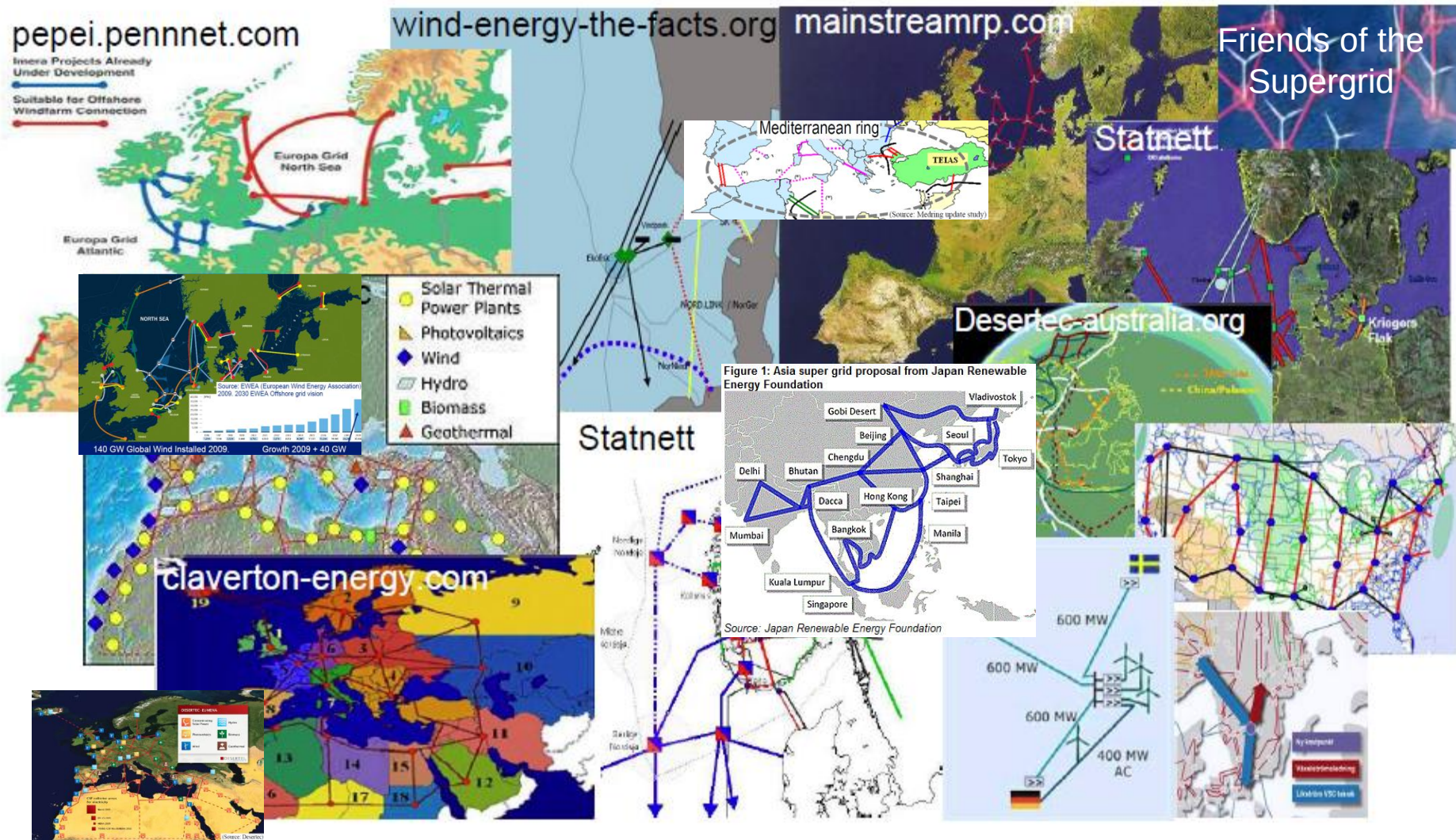
ABB's DC Grid Vision from 1992

- Extension of existing grid
- Stepwise implementation of HVDC
 - Embedded HVDC
 - Multiterminal HVDC
- Combination of Subsea- and Landcable as well as Overheadlines



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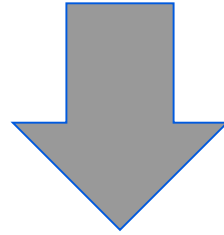
DC grid initiatives competing for attention



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Current requirements

- Network owner requires HVDC systems that are:
 - Customized
 - Optimized

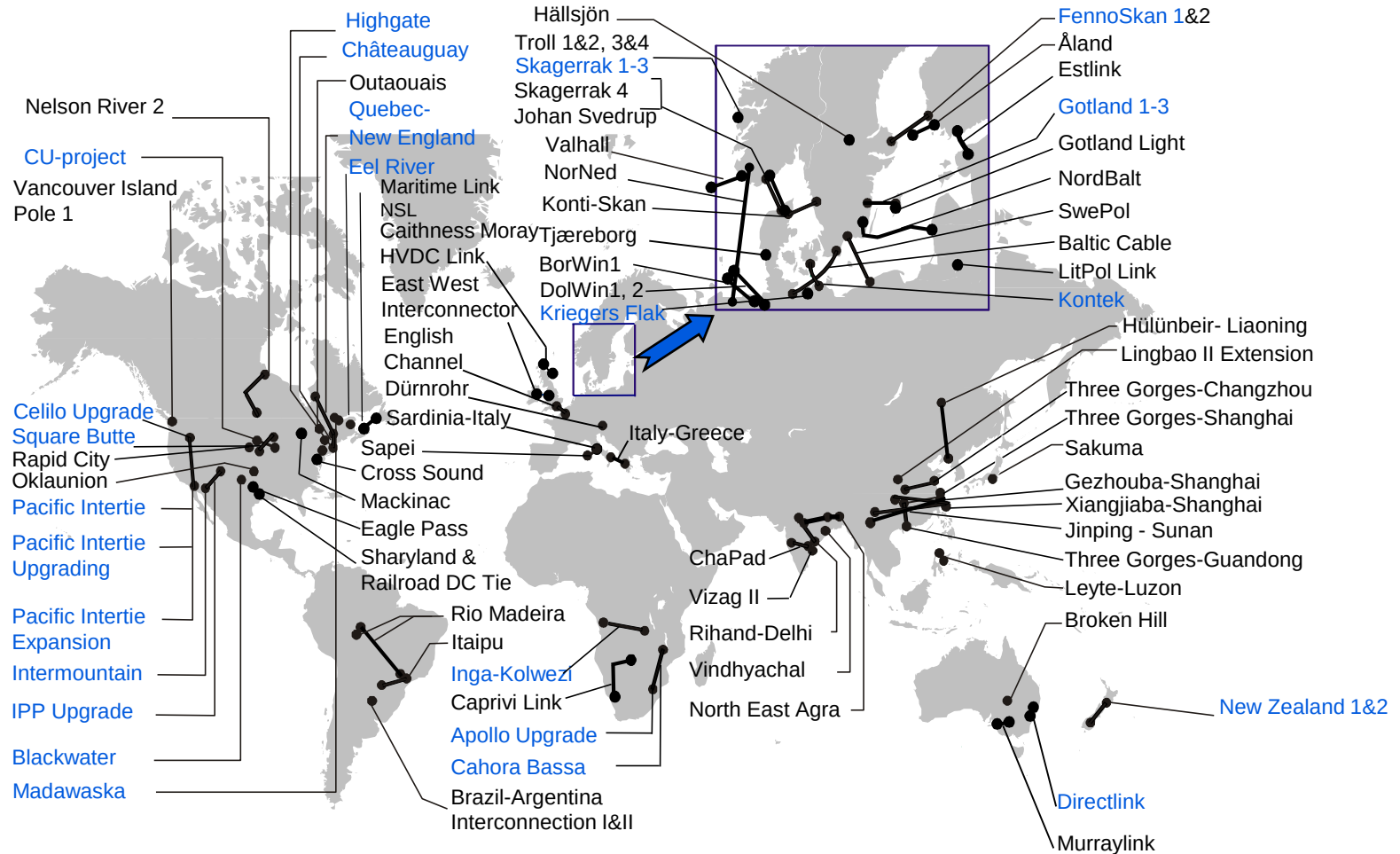


A grid with HVDC will be a step wise development based on the society's power need.

The technology therefor needs to be flexible and handle the connections of different technologies.

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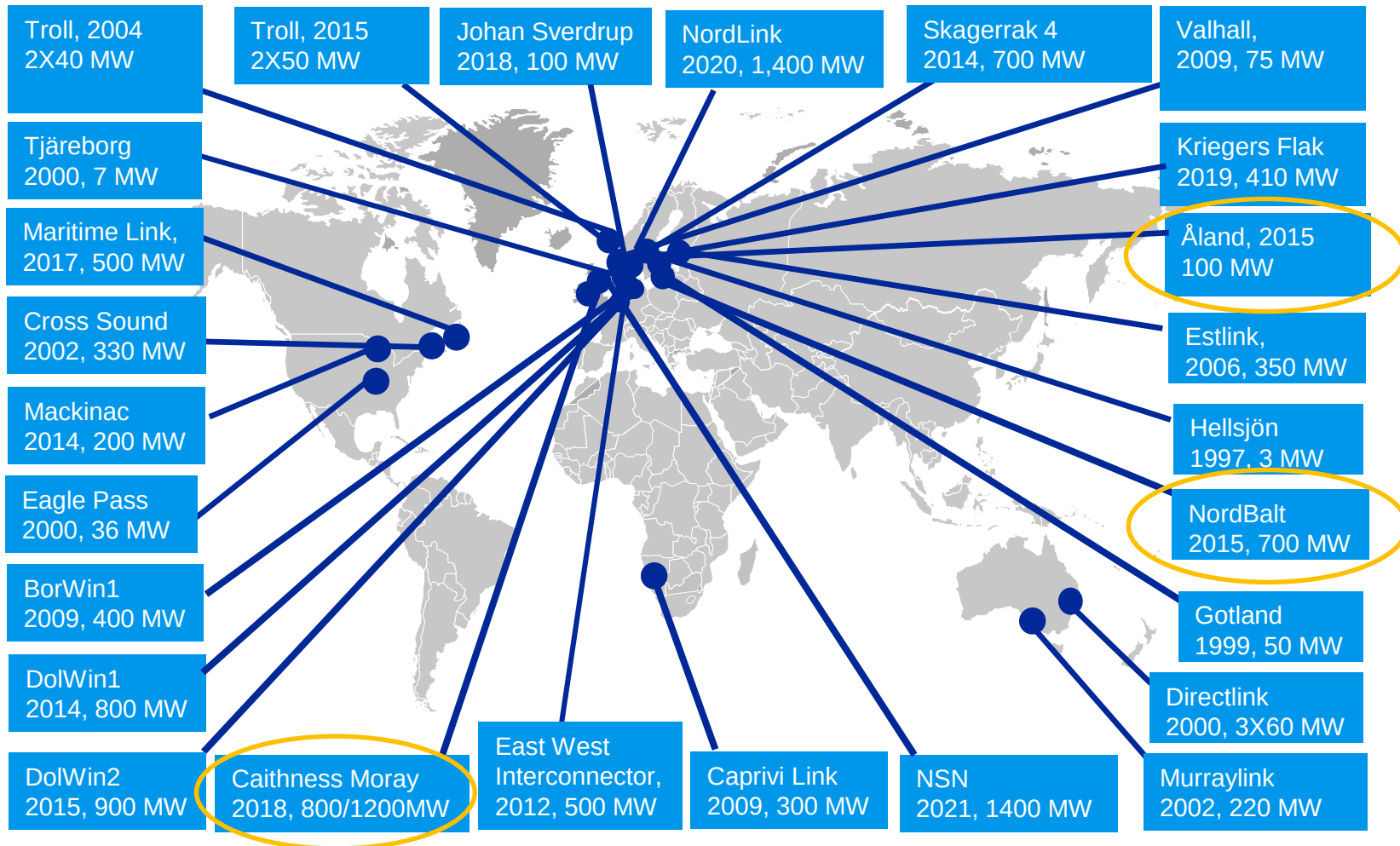
ABB has supplied to more than half of the 190 HVDC projects



60 HVDC Classic Projects since 1954
25 HVDC Upgrades since 1990
26 HVDC Light Projects since 1997

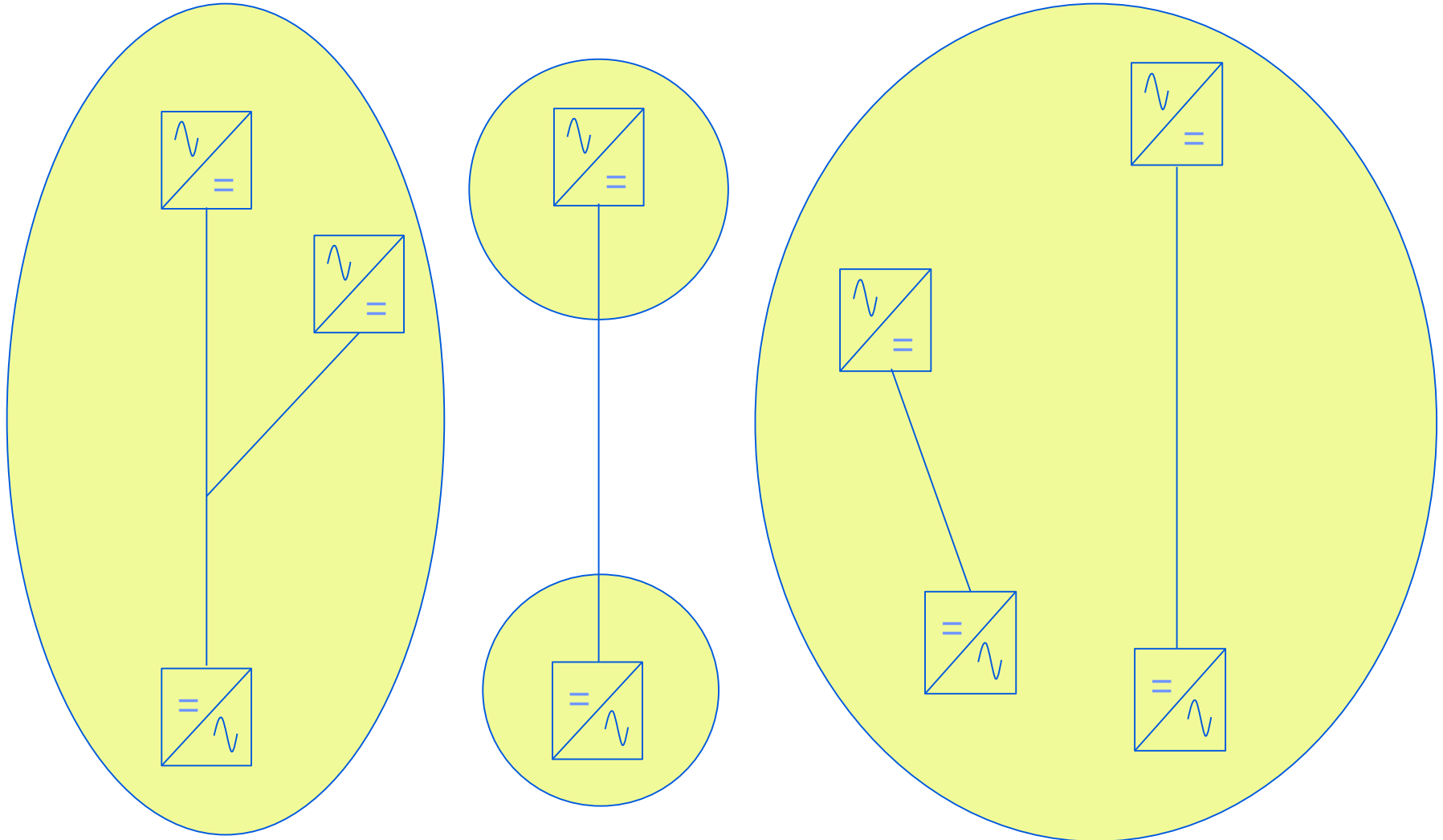
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HVDC Light technology



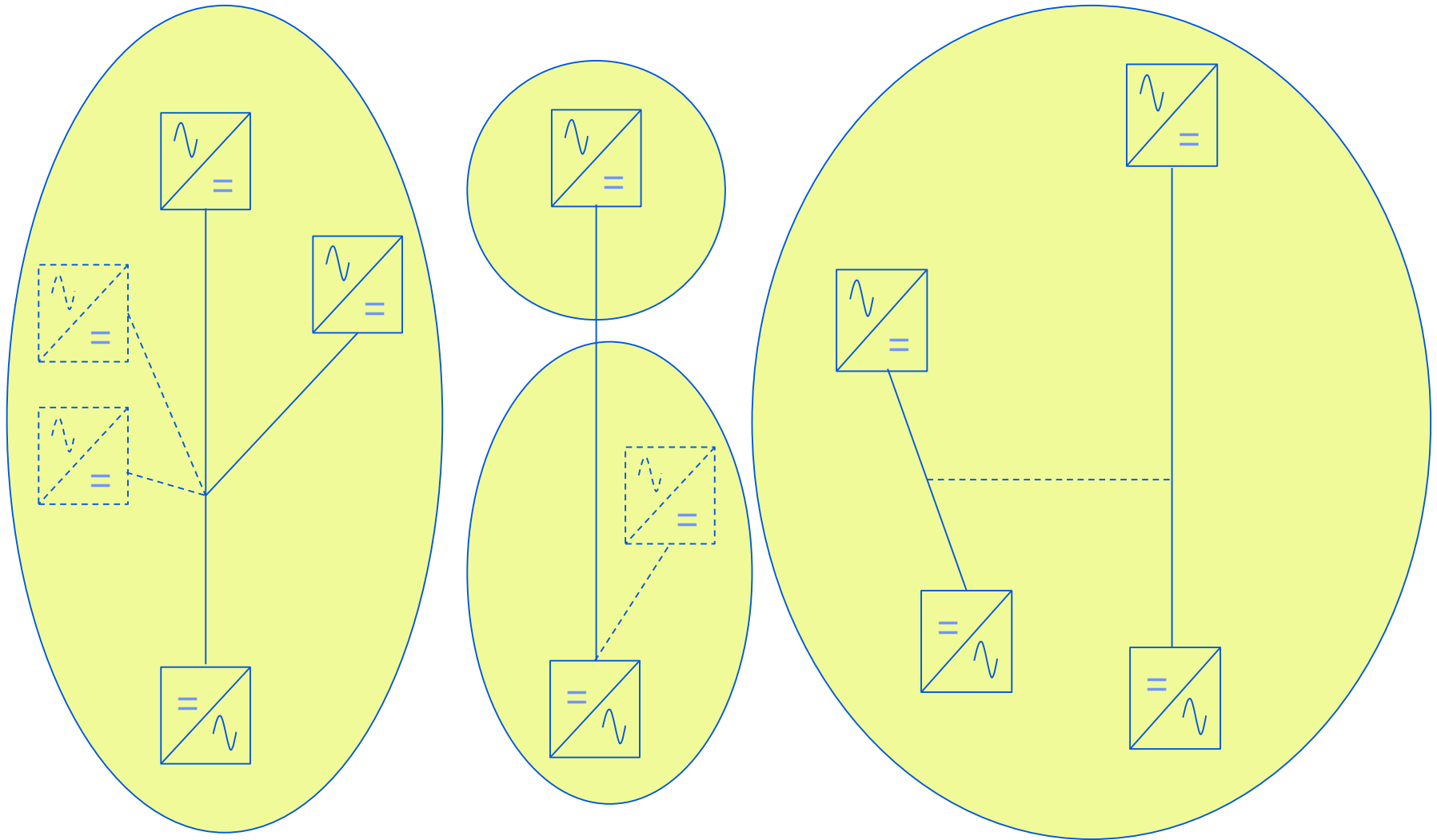
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From today...



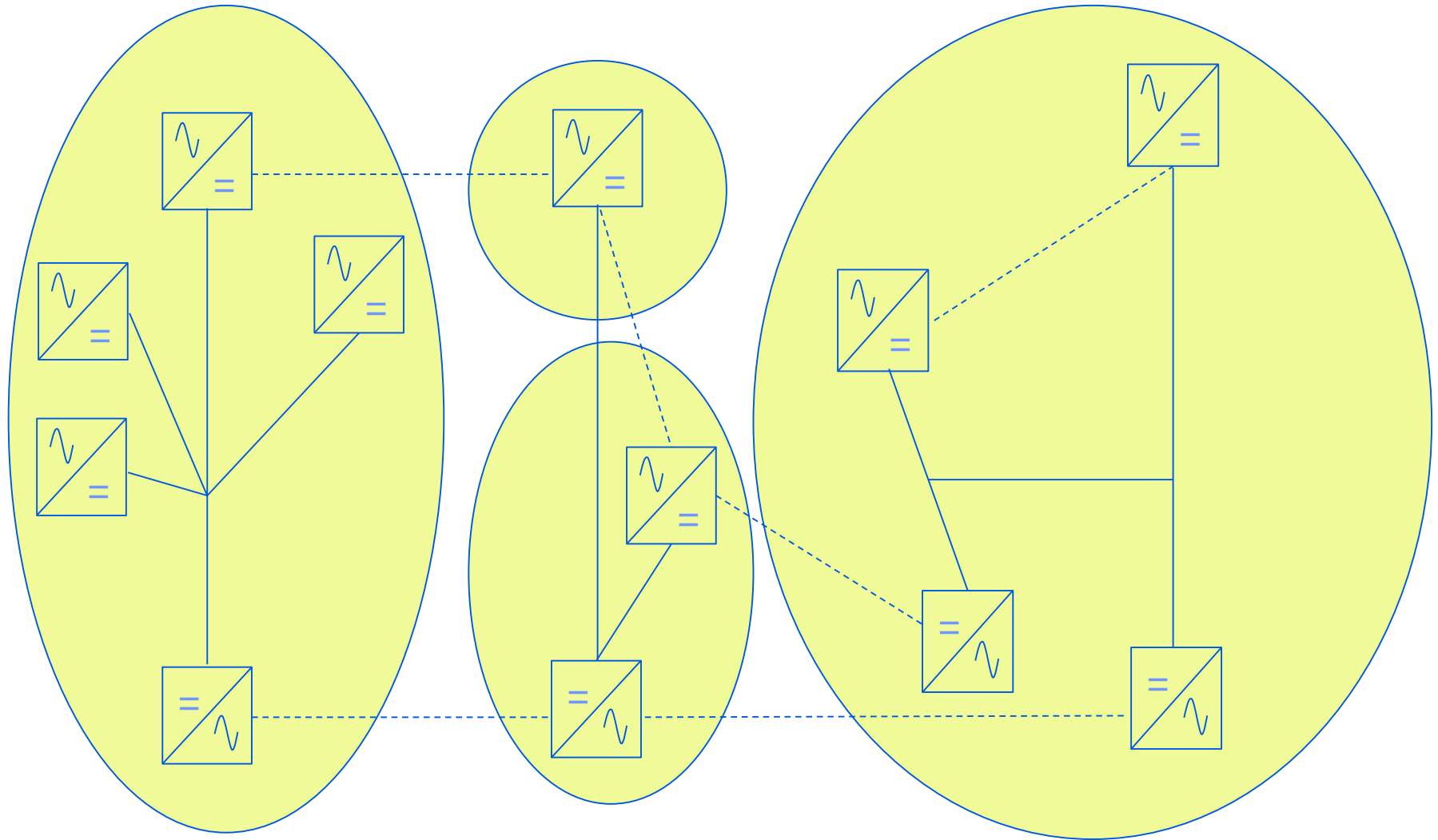
Grids with HVDC

...to...



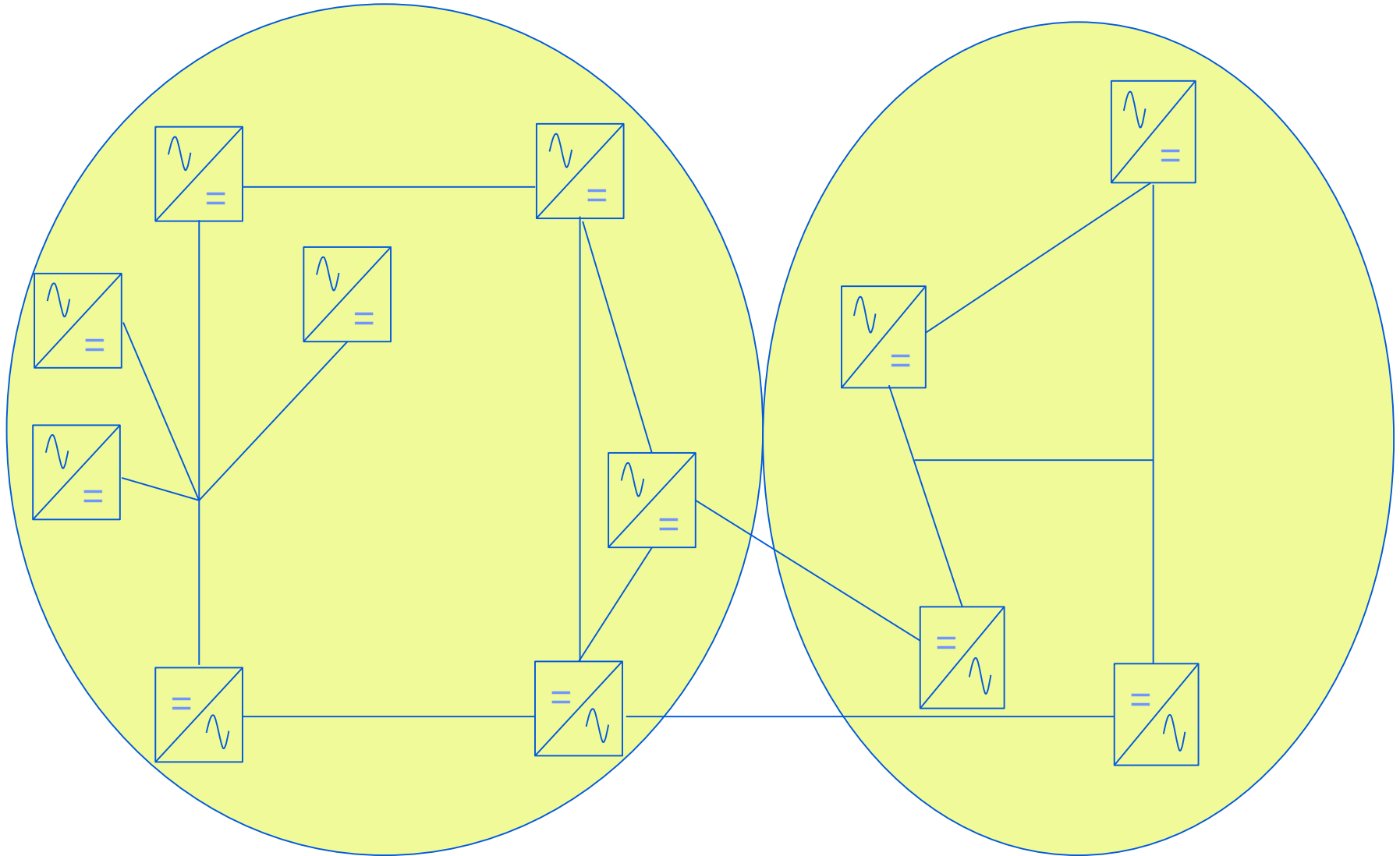
Grids with HVDC

...to...



Grids with HVDC

...to finally



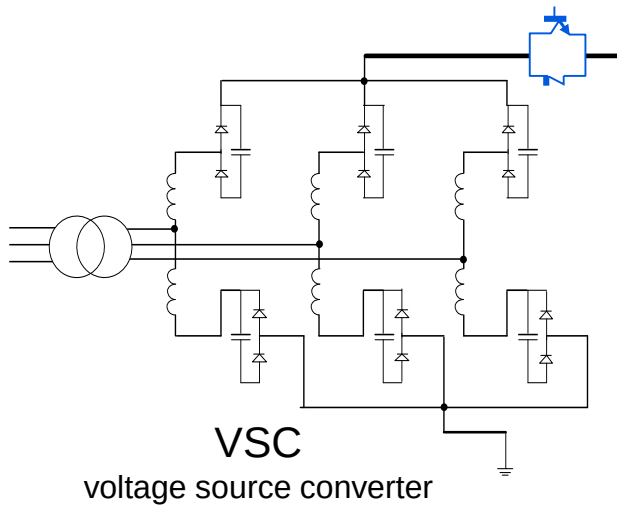
Grids with HVDC Portfolio

- Monopolar symmetric cable systems:
 - MTDC ready
 - MTDC without HVDC Breakers
 - MTDC with Breakers
- Bipole asymmetric system:
 - Double bipole p-t-p with parallel AC and DC OHL and HVDC Breakers

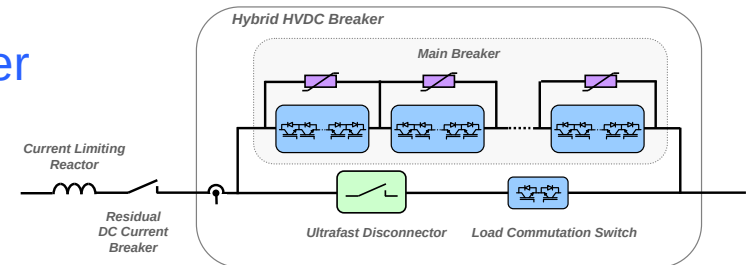
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HVDC Breaker – The ultrafast low-loss solution

The ABB HVDC breaker is modulized so that the design can be fitted to the system requirements. It has been prototype tested for 500 kV and 16 kA.



HVDC Breaker



Hybrid concept: Mechanics and power electronics

Artist impression

Flexible multiple protection zone HVDC can be designed and planned for

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Real MTDC ready projects – Multi terminal specifics

- Experience with multi terminal projects
 - Ålink – 2+ terminal 100 MW VSC technology
 - NordBalt – 2+ terminal 700 MW VSC technology
 - Caithness Moray – 2+ terminal 1,200 MW VSC technology



- Why ABB was chosen?
 - Ability to supply multi-terminal ready system
 - Project execution strategy
 - HVDC Light was chosen for its premier power quality features

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Technical Discussion – Multi terminal ready experience

- It is possible to identify different levels of “preparedness”:
 1. Multi terminal prepared:
 - Data for additional converter in the RFQ can be minimum
 - Space for equipment needed in next phase (control cubicles, arresters, etc.) is part of the first phase
 2. Multi terminal ready (“plug & play”)
 - All equipment designed for the final configuration for cost optimizing the complete system
 - All data for the 3rd converter needs to be included in the RFQ

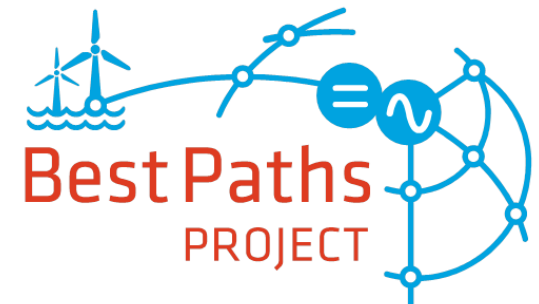


This would today be applicable process for a larger MTDC or a DC Grid. Further development of control systems and components will support an expandable HVDC system.

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Ongoing European projects - Best Paths

- Run demonstration projects on how to remove barriers for large-scale penetration of renewables in the European transmission network
- DEMO2 (multi-vendor interoperability): WP4, Off-line simulations and WP9: Real-time simulations
- Focus on interoperability issues using control systems from ABB, GE and Siemens
- Project time schedule: 1st of Oct 2014 – 30th of Sept 2018



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Ongoing European projects - PROMOTioN

- The goal is to develop and demonstrate three key technologies:
 - Diode rectifier offshore converters,
 - Multi-vendor HVDC (high-voltage direct current) grid protection system
 - The full power testing of HVDC circuit breakers
- A regulatory and financial framework will be developed for the coordinated planning, construction and operation of integrated offshore infrastructures, including an offshore grid deployment plan (roadmap) for the future offshore grid system in Europe.

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Summary

- Current HVDC projects do consider p-t-p connections
- DC Grid will be a stepwise process
- HVDC Breakers are needed for sectionalizing

ABIB