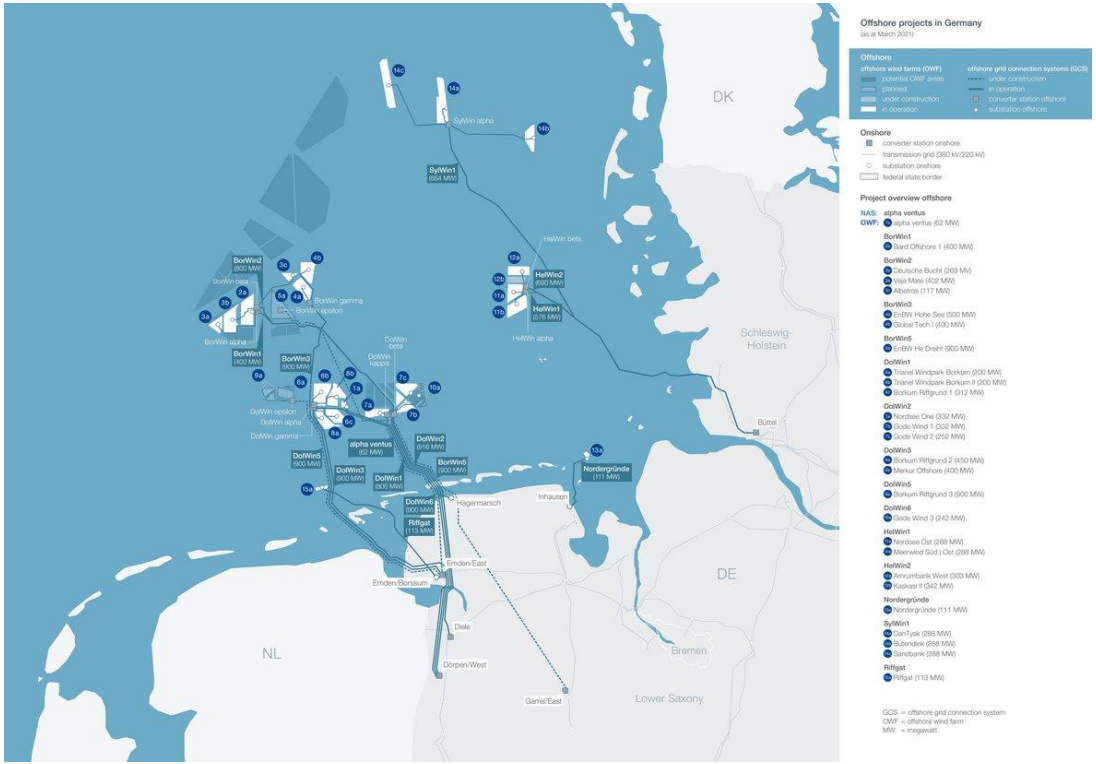
Towards a future wide spread hybrid AC DC system enabling to deliver climate neutrality

Wilhelm Winter, TenneT

Breaking the ice: Prerequisites for developing offshore grids



- Unlock the first kind Multi-Terminal Multi-Vender system by developing and testing a full industrial C&P System for extendable HVDC systems
- Indicate a proper financing framework to provide the sufficient de-risking initiative for full-scale multi-vendor HVDC system demonstration

Source: https://www.tennet.eu/our-grid/offshore-projects-germany/offshore-projects-germany/

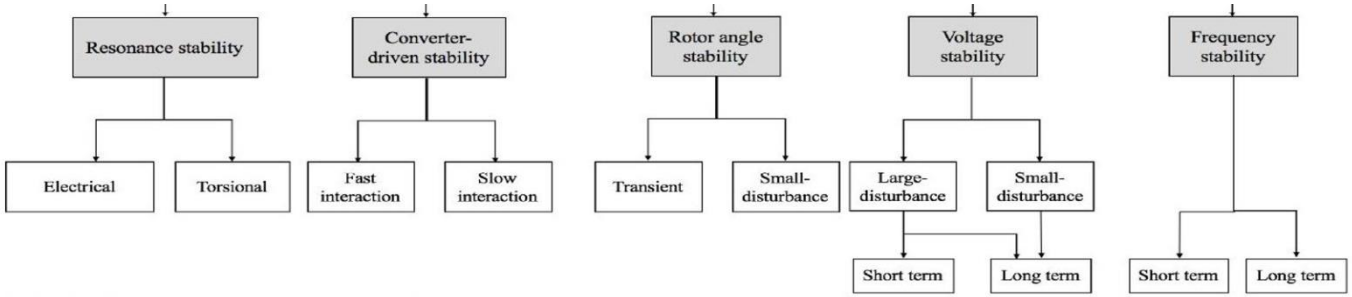
Keep the system stable - Stability management in power electronics dominated Power systems

Observed development

- ❑ More HVDC systems & PE
- ❑ Low inertia and uneven distribution
- ❑ High RoCoF and low frequency nadir
- ❑ System split is a treat
- ❑ Change in of characteristics in generation and demand

Mitigation measures for a future and stable European power system

- ➢ Development of tools for assessment and simulation of dynamic behaviour
- ➢ Development of procedures for long- mid and short-term planning and real-time operation
- ➢ Development of systems for more preventive and curative actions
- ➢ Coordinated response Power Electronic Equipment
- ➢ Development of resources for further system services needed
- ➢ Development of market designs

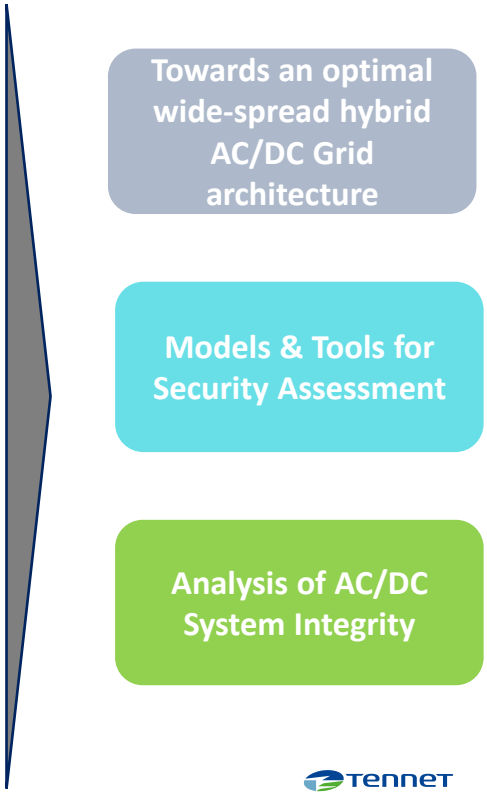


Further assessment of a wide spread hybrid AC DC system – Develop large Offshore HVDC grids in Europe

- Assess most suitable HVDC **grid architecture concepts** (e.g. multi terminal, hub operation, etc.) for best back boning and supporting the AC grid
- Assess **system reliability and resilience** of the hybrid AC DC system

- Contribute **to increase TRL** of new HVDC components **where necessary** and **achieve market readiness**
- Use HVDC technology as a firewall blocking the spread of disturbances while permitting the interchange of electrical power.

- Master HVDC technologies to **enable new business horizons** for European companies in the global clean energy markets.
- Achieve climate neutrality of the electricity generation sector **allowing the integration of large share of renewables** while addressing the security of supply



Conclusion & Outlook

- **Unlock towards a future wide spread hybrid AC DC system**
  - Open for the first European first of its kind Multi-Vendor project
- **Provide** an adequate environment for **relevant research and innovation actions** developing Multi-Vendor Multi-Terminal HVDC grids and stable hybrid AC DC systems
- **Enable knowledge sharing and expandability** of back bone wide spread HVDC grids across various countries
- Make **DC grids as easy as AC grids** connecting generation and demand at the DC connection point
- Derive recommendations for developing or amending **Connection Network Codes**.

TenneT has been implementing grid connections for offshore wind farms in the North Sea since 2006. These include BorWin1, the world's first direct current link between an offshore wind farm and the onshore power grid, which is over 200 kilometres long and has been in operation since 2015. In addition to the twelve grid connections already completed, TenneT will install four more offshore grid connections by 2027, so that more than 10 GW of offshore wind energy from the North Sea will then be available. Clean wind energy for 12,5 million households in Germany.