Planning and Control of Offshore Multiterminal VSC-HVDC (MTDC) Transmission Grids

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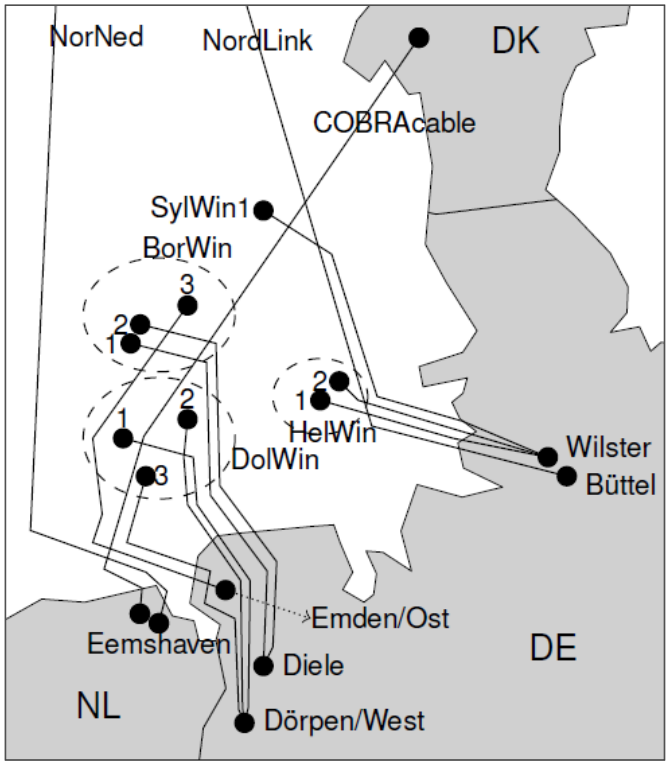
Location	Department of Energy Technology, Aalborg University
Name presenter	Roni Irnawan

Closer look at the North Sea region

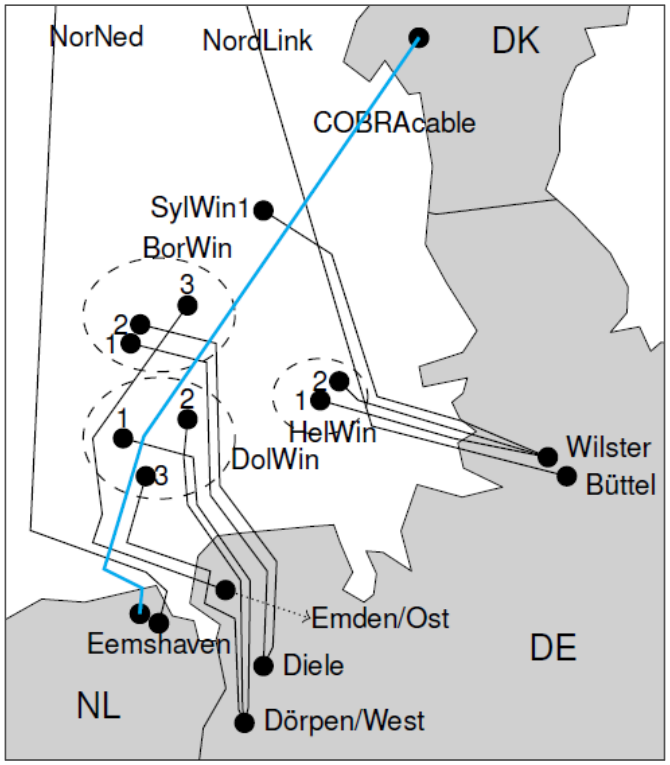
HVDC links in operation by 2020



- By 2020, there will be 12 HVDC links in operation
  - Some of the cable routes are located close to or crossing each other
  - 7 of them are VSC-HVDC with ±320 kV
    - In the future, the first offshore MTDC in Europe might emerge by interconnecting these VSCs

Closer look at the North Sea region

HVDC links in operation by 2020



- At a later stage, COBRAcable is planned to be operated as MTDC system
  - Hosting additional converter(s) along its cable
  - **How to prepare COBRAcable for future expansion?**

COBRAcable research project

What?

- Joint research project between Aalborg University and Delft University of Technology
  - Executed in cooperation with Energinet.dk (Denmark) and TenneT TSO B.V (the Netherlands) under the COBRAcable project and co-financed by the European Commission under the European Energy Program for Recovery.

DEPARTMENT OF ENERGY TECHNOLOGY
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Delft University of Technology

ENERGINET.DK

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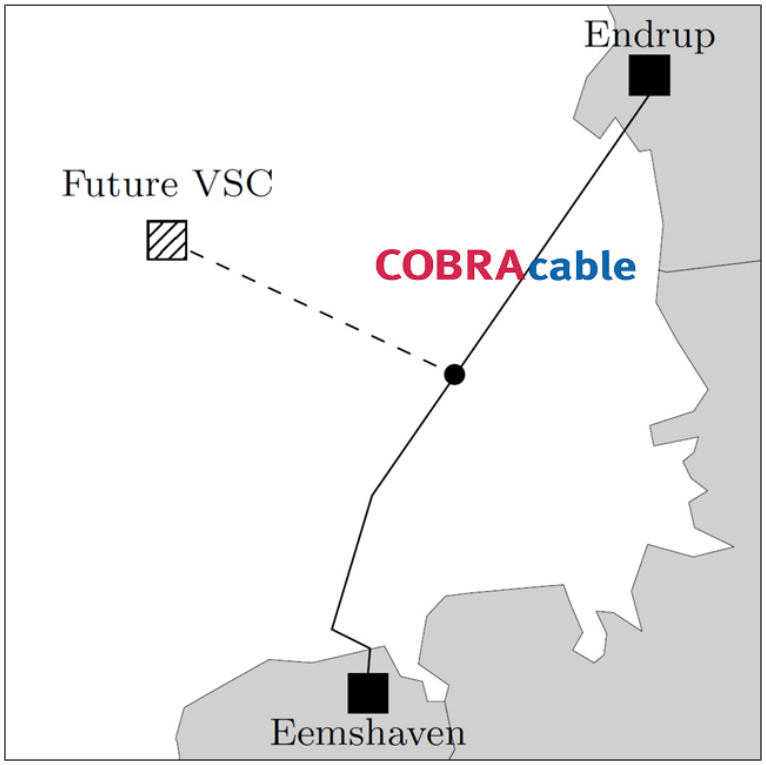
Taking power further

COBRAcable research project

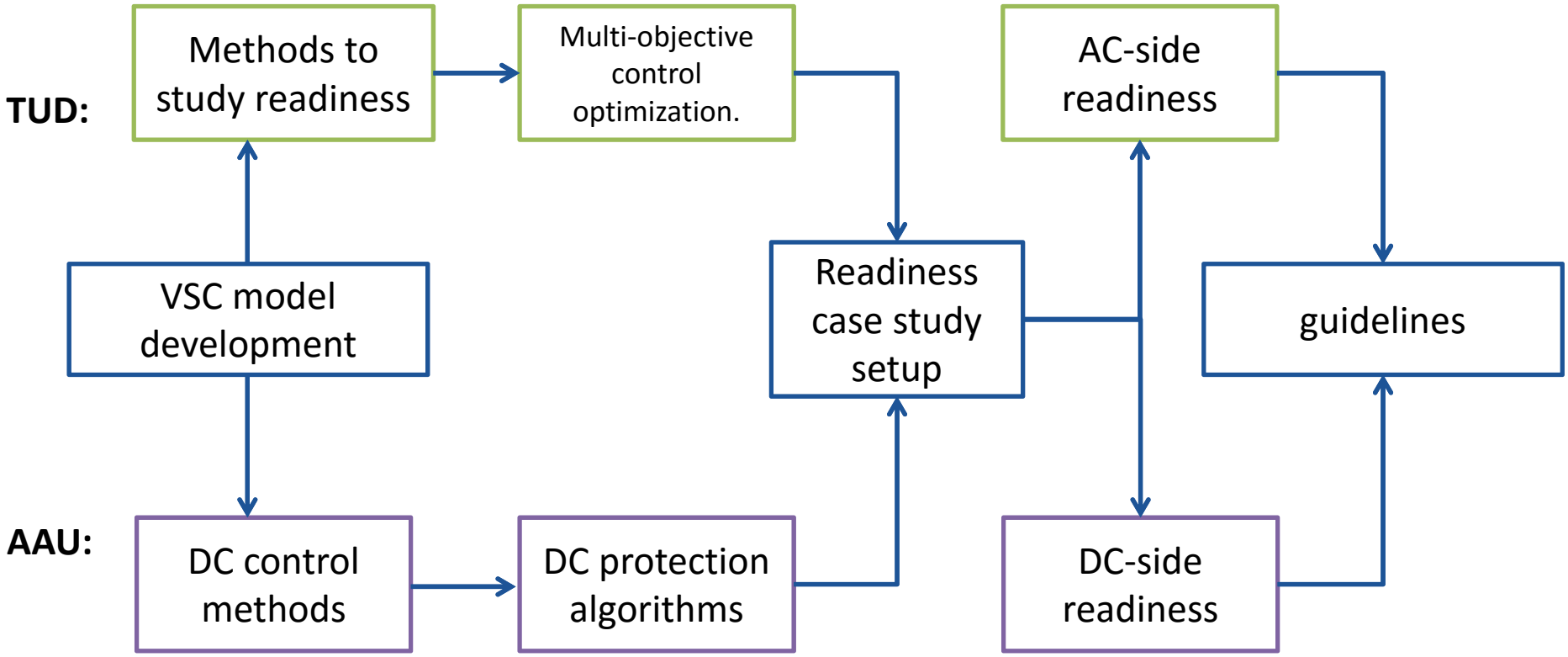
Objective?



- Provide guidelines for future connections of converter(s) to the existing COBRAcable
  - Possible case is depicted on the left
  - ”Plug & play” principle
    - only allow **to adapt** the existing control and protective devices, **not replace**

COBRAcable research project

How?



Publications

Published

1. R. Irnawan, F. F. da Silva, C. L. Bak, and T. C. Bregnhøj, "An initial topology of multi-terminal HVDC transmission system in Europe: A case study of the North-Sea region," in *2016 IEEE International Energy Conference (ENERGYCON)*, Leuven, Belgium, Apr 2016
2. —, "A categorization of converter station controllers within multi-terminal DC transmission systems," in *2016 IEEE/PES Transmission and Distribution Conference and Exposition (T&D)*, Dallas, TX, May 2016
3. —,"DC power flow control for radial offshore multi-terminal HVDC transmission system by considering steady-state DC voltage operation range," in *The 13th IET international conference on AC and DC Power Transmission*, Manchester, UK, Feb 2017
4. —, "Evaluation of half-bridge modular multilevel converter model for VSC-HVDC transient stability studies," in *The 13th IET international conference on AC and DC Power Transmission*, Manchester, UK, Feb 2017

Publications

Submitted

1. R. Irnawan, F. F. da Silva, C. L. Bak, and T. C. Bregnhøj, “Steady-state operational range evolution from a two-terminal to a multiterminal HVDC transmission system,” in *2017 CIGRE Symposium*, Dublin, Ireland, May 2017

COBRAcable research project

Further information:

www.cobracable.et.aau.dk

Thank you!!!

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European Energy Programme for Recovery

COBRAcable