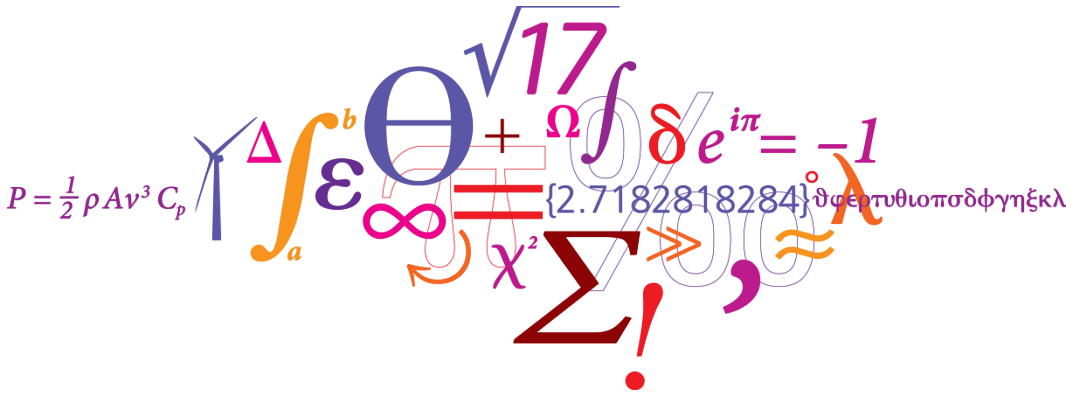
Overview on offshore grid development: four offshore grid scenarios for Baltic Sea

Nicolaos A. Cutululis



TWG - InteGRID concept

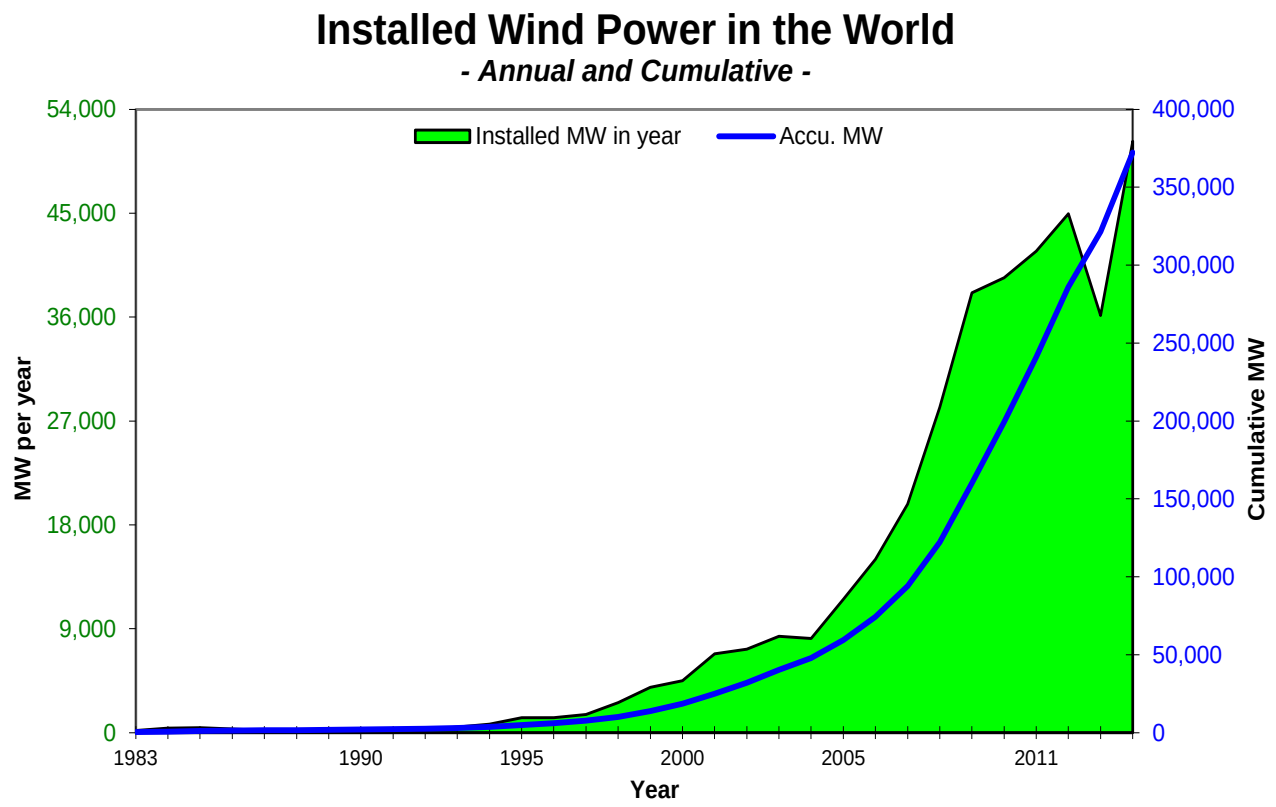
Gdansk, 4th October 2016

DTU Wind Energy
Department of Wind Energy

Outline

- Offshore wind development
- Offshore grid development
- Offshore grid design in the Baltic Sea

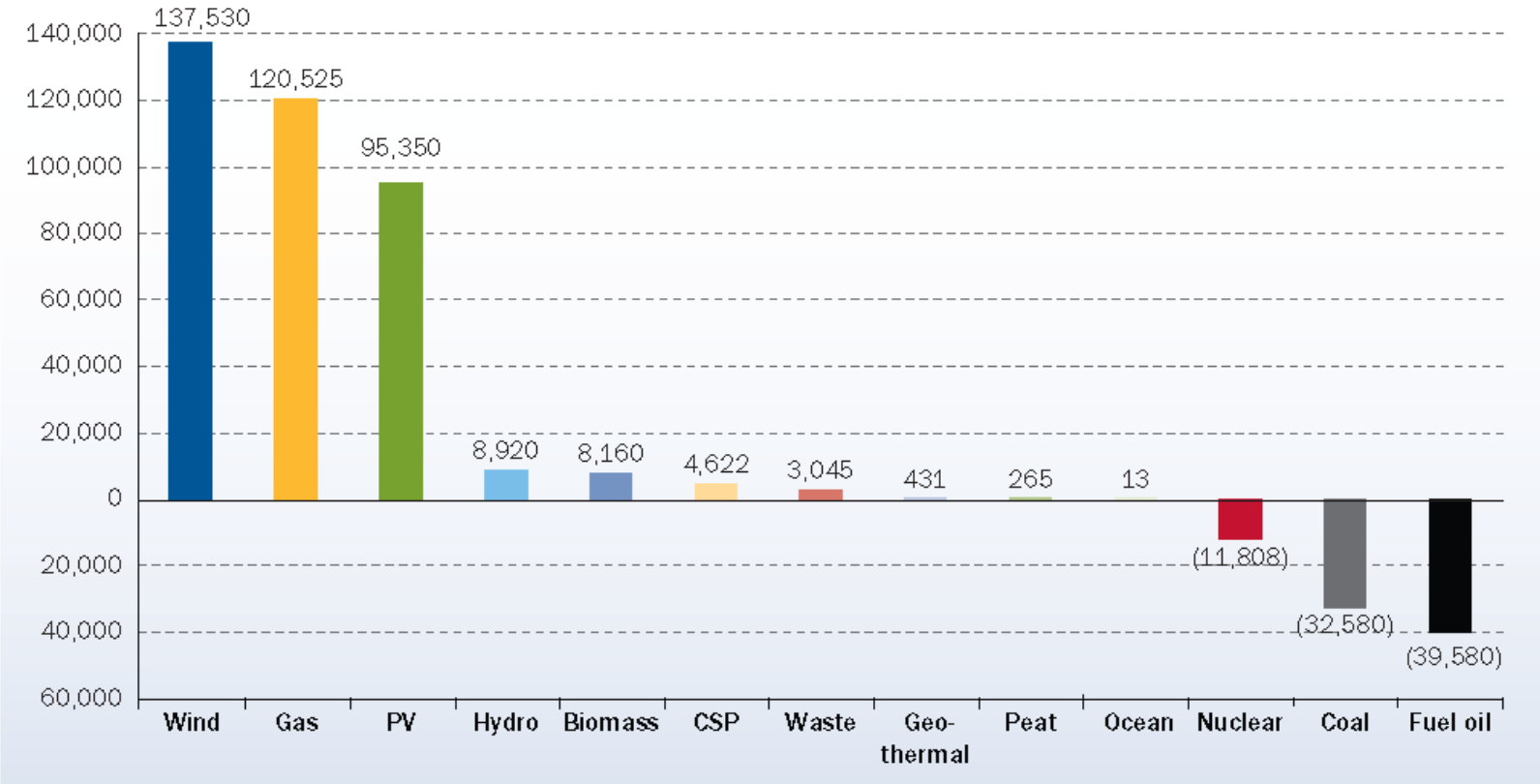
Annual and Cumulative Wind Energy Development, World Markets: 1983-2014



Source: Navigant Research, March 2015

Net changes in EU installed power capacity 1995-2015?

FIGURE 6: NET ELECTRICITY GENERATING INSTALLATIONS IN THE EU, 1995-2015 (MW)



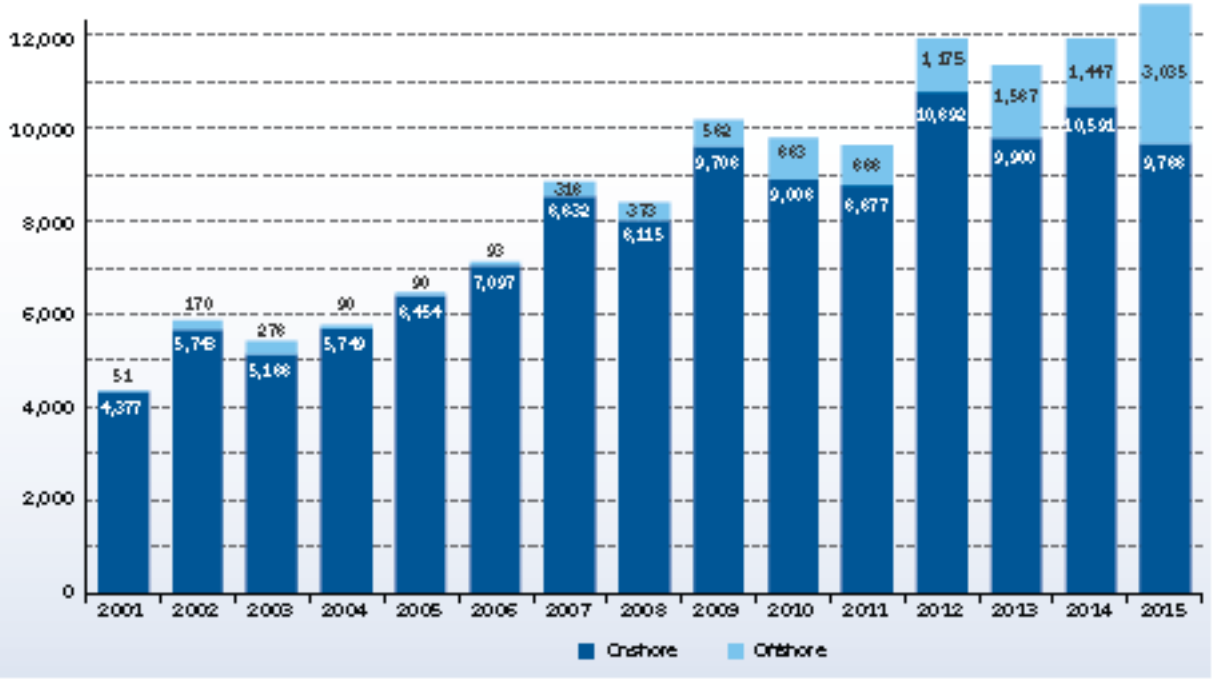
Source: Wind in Power, 2015 European Statistics, EWEA

Offshore wind development

2001

Onshore:99%

Offshore:1%



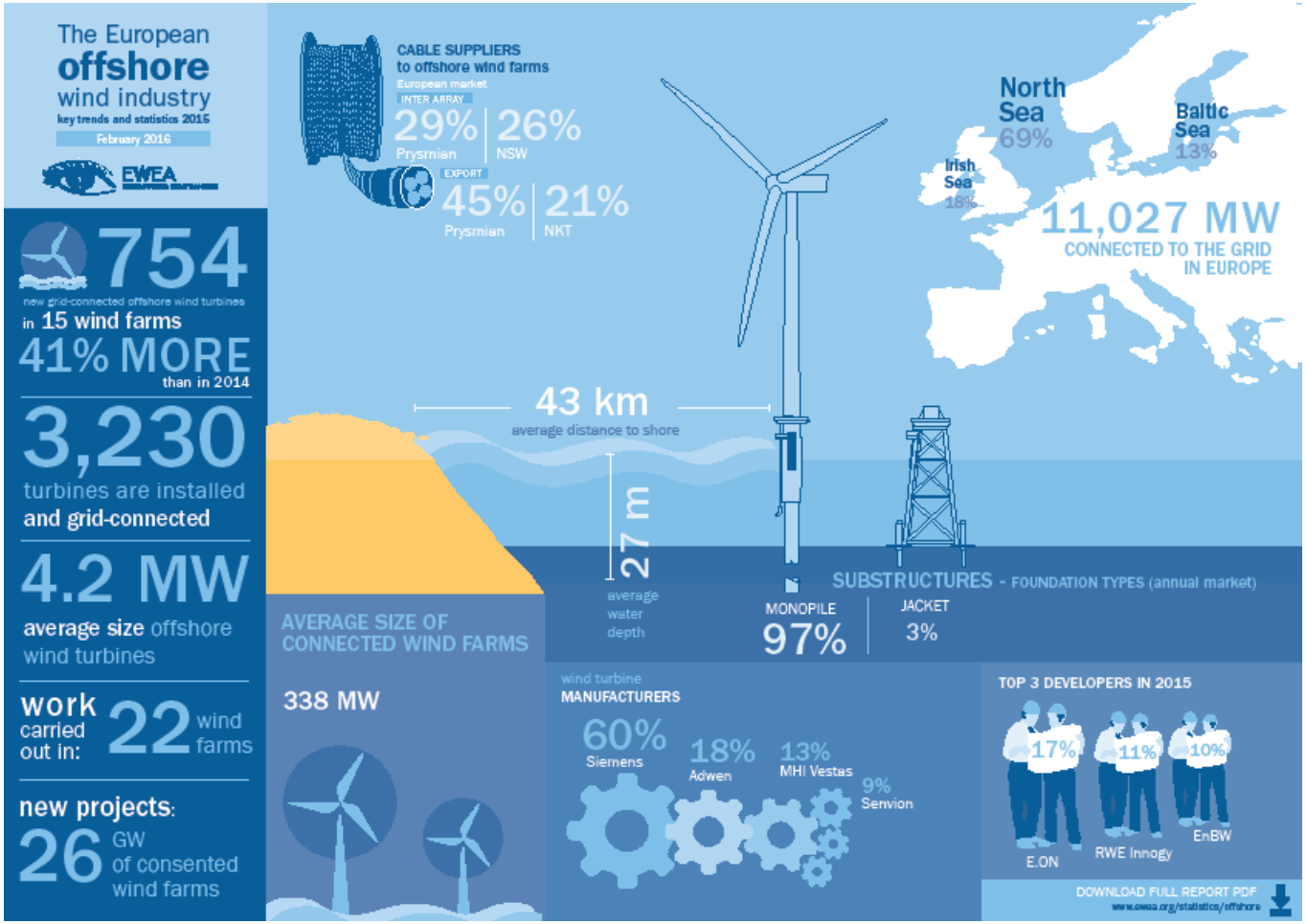
2015

Onshore:76%

Offshore:24%

Source: Wind in Power, 2015 European Statistics, EWEA

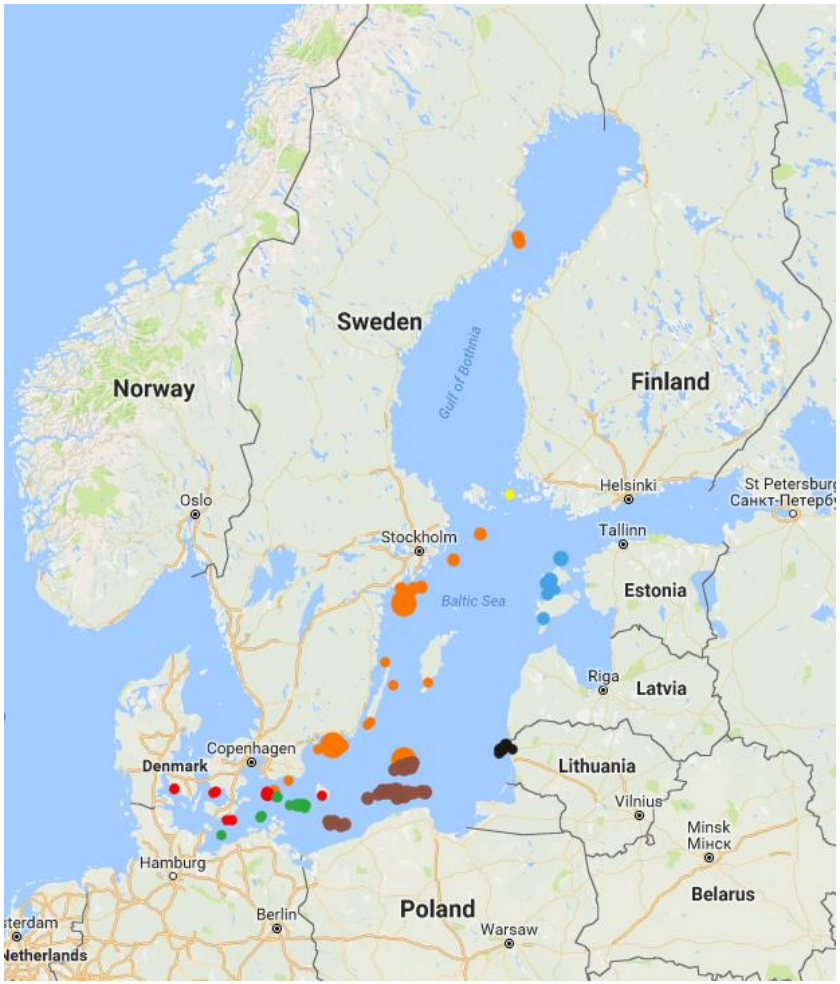
Offshore wind in 2015



Source: EWEA

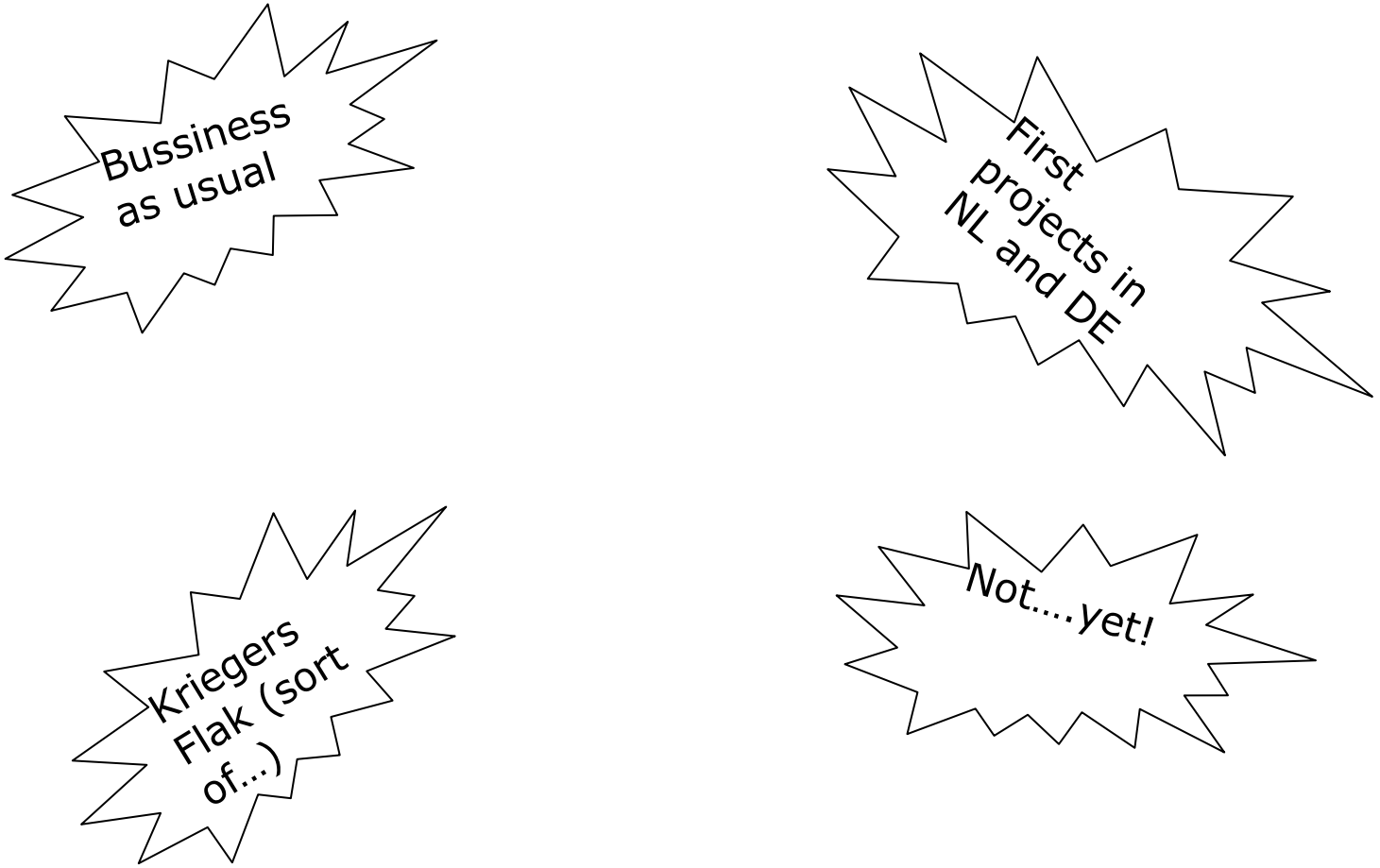
Offshore wind in Baltic

Present Scenario



Possible 2030 Scenario

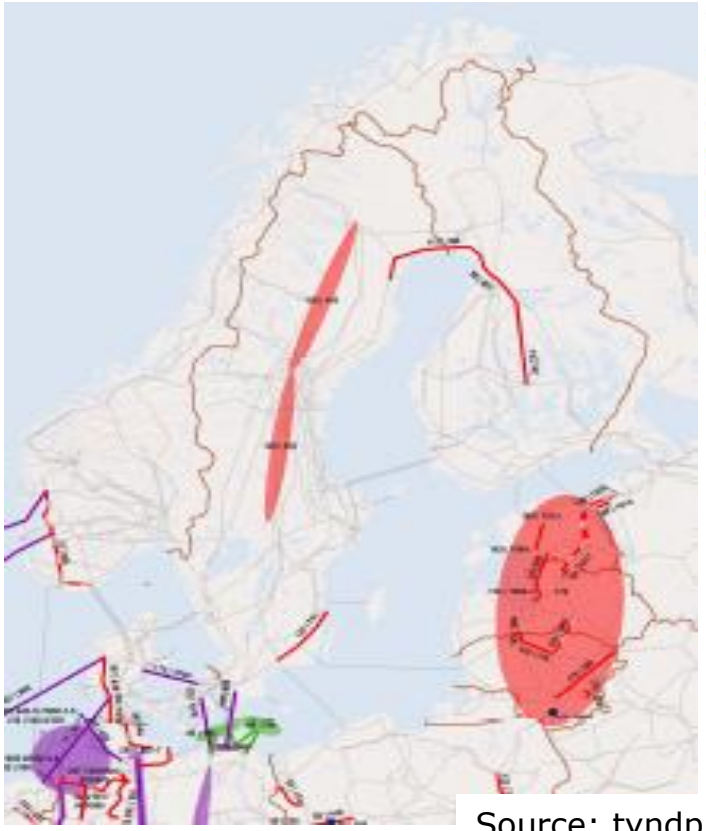
Offshore grid design strategies - NSCOGI



ENTSO-E TYNDP 2014

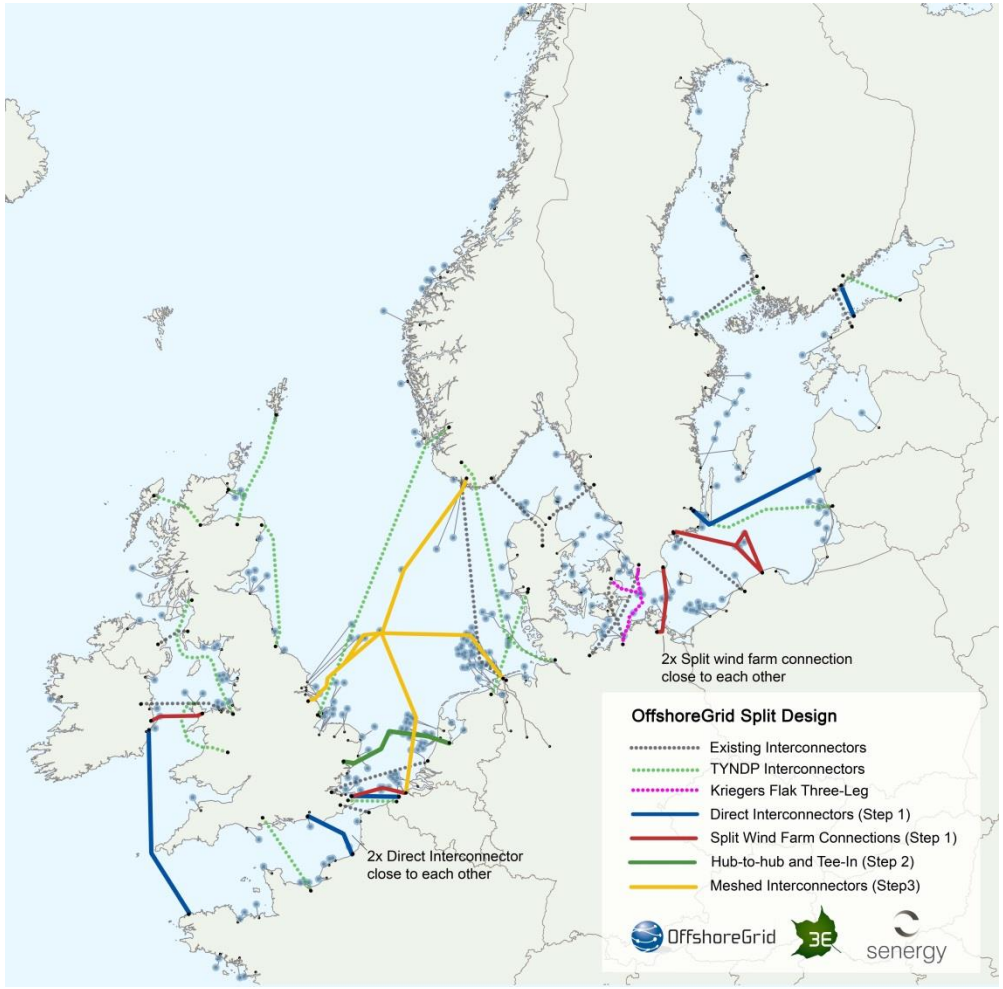
2014-2018

2019-2030



Source: tyndp.entsoe.eu/

Offshore grid scenarios - Baltic



October 2011

Offshore grid scenarios – Baltic

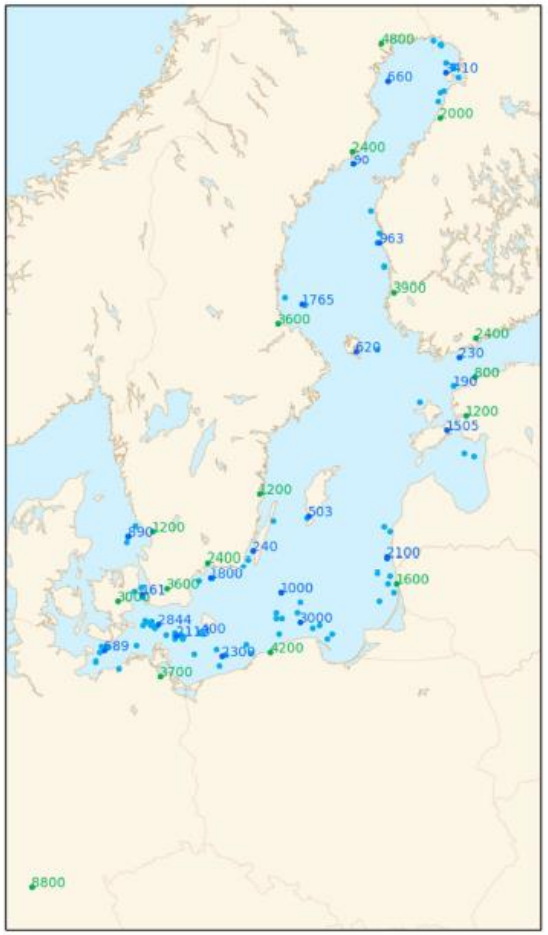
OffshoreDC project:

Niina Helistö, Vin Cent Tai**, Electricity market and power flow impact of wind power and DC grids in the Baltic Sea**, December 2015

- The aim of this study is to identify electricity market and power system impacts of offshore wind power and different offshore grid designs, ranging from single radial connections from each offshore wind power plant to a fully meshed offshore transmission grid.
- The purpose is to analyse the offshore grids themselves with wind power, but also the impact of offshore grids on the main power grids onshore, and define the operating frames the onshore power systems set for offshore grid options.
- The overall objective of the feasibility studies is to build more cost-efficient offshore wind power plants and interconnectors

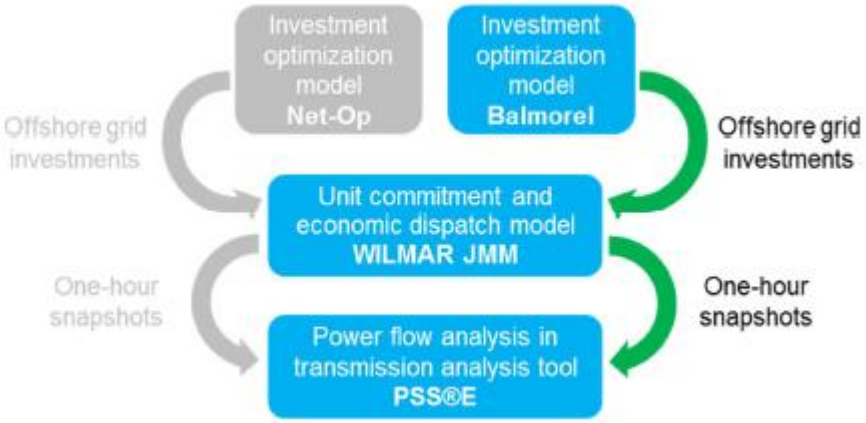
OffshoreDC study – Baltic sea

- Based on EU FP7 TWENTIES project scenarios for wind power development
- 27 GW of wind power by 2030
- Countries: Denmark, Norway, Sweden, Finland, Estonia, Latvia, Lithuania, Poland and Germany



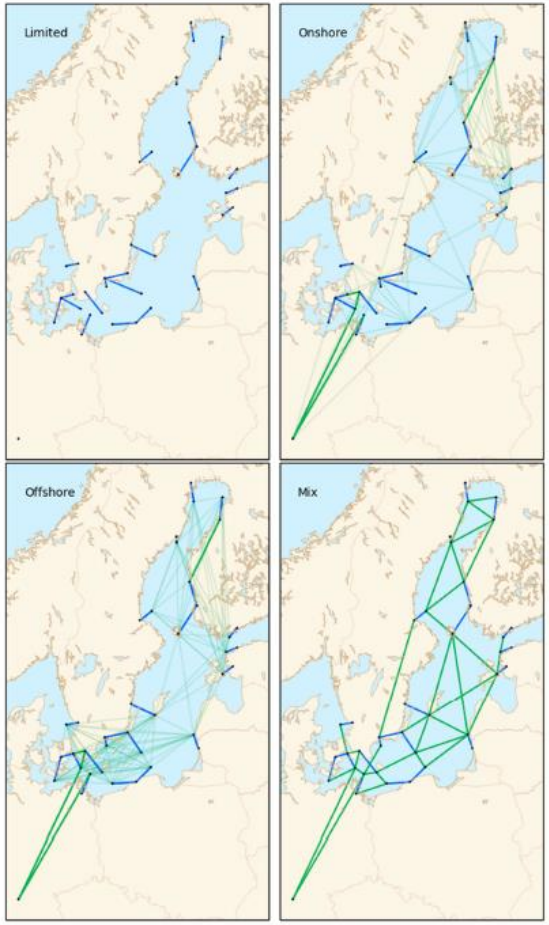
OffshoreDC study – Baltic sea

- **BALMOREL** - Generation investment planning model
- Power balance computation as determined by a unit commitment and economic dispatch model **WILMAR** Join Market Model (WILMAR JMM) and
- Network analysis performed with **PSS®E**.

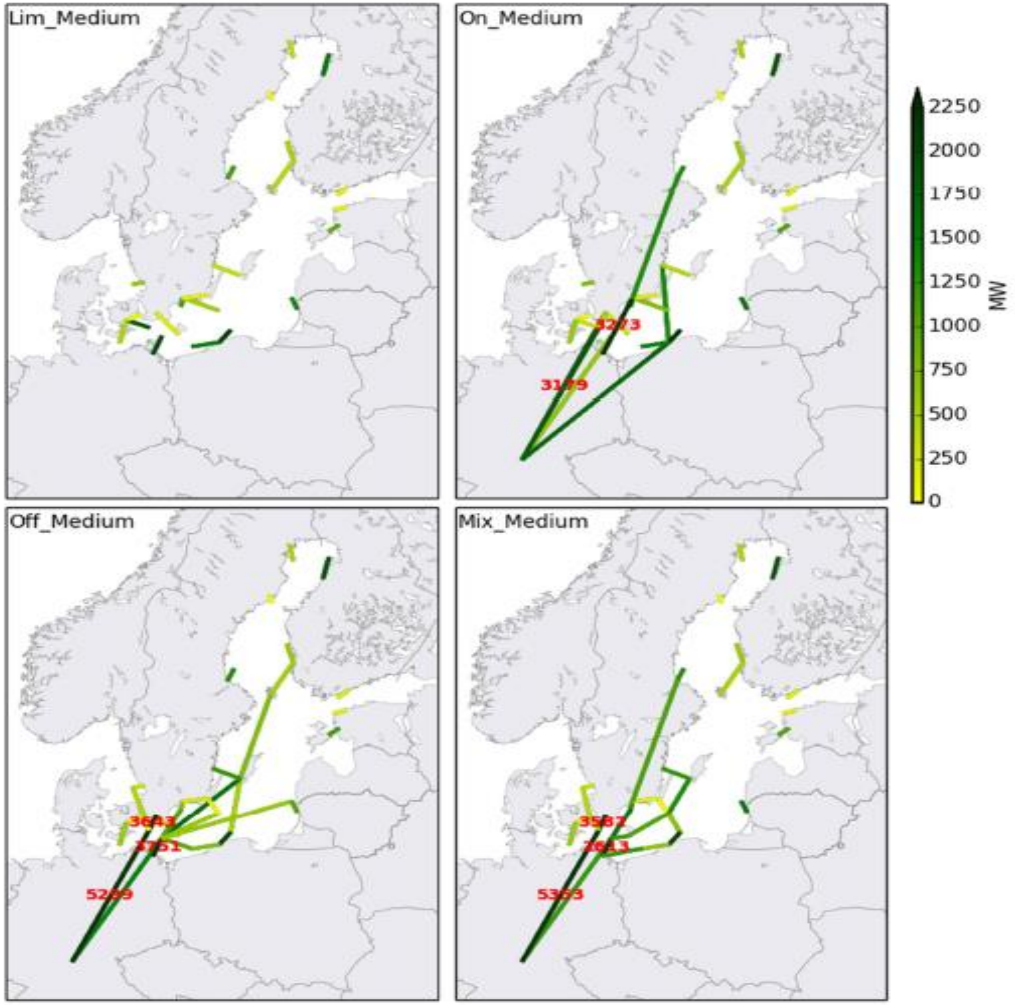


OffshoreDC study – Baltic sea

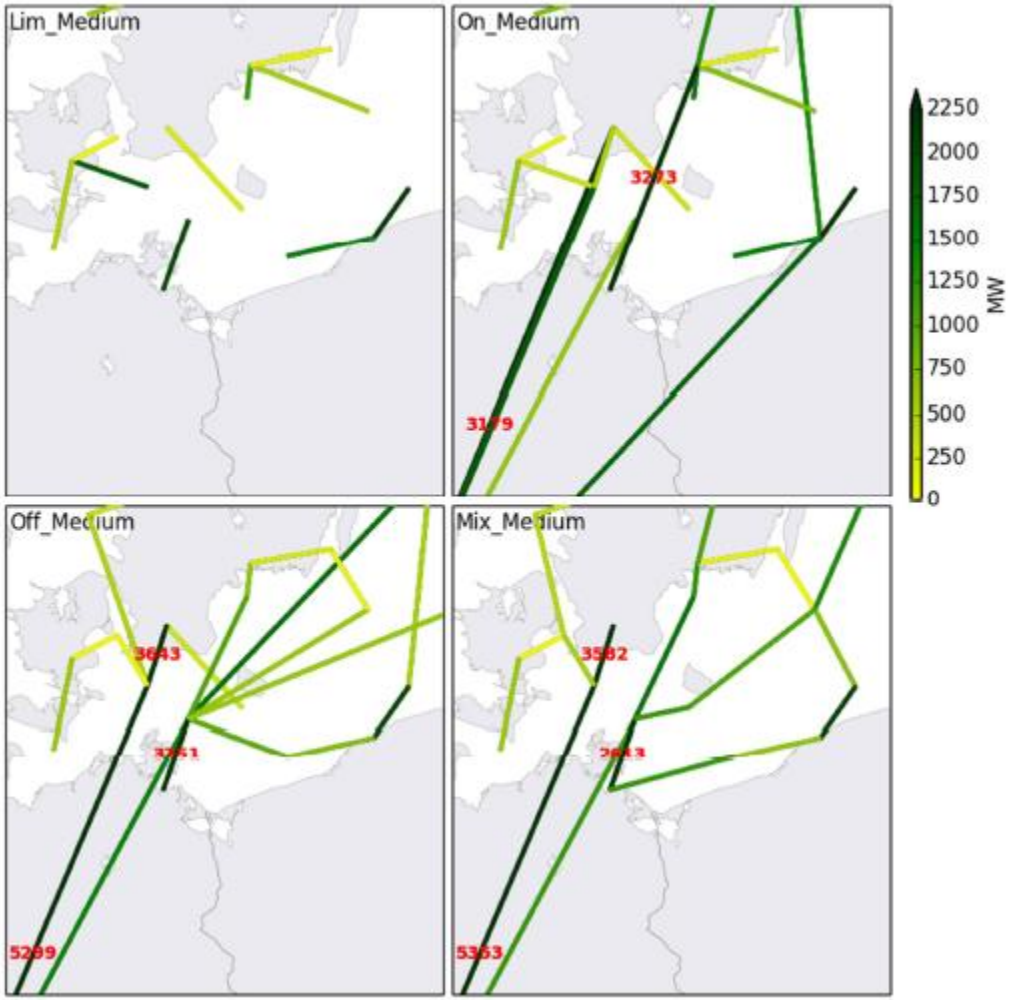
- Four topologies:
  - Limited
  - Onshore
  - Offshore
  - Mix



OffshoreDC study – Baltic sea



OffshoreDC study – Baltic sea



Summary

- Offshore wind power development is at an early stage
- Offshore transmission (grids) is being built!
- Any offshore grid design will depend a lot on the scenarios considered
- Baltic Sea has the potential to be the next “North Sea” in terms of offshore wind and grids development