Baltic InteGrid
Integrated Baltic Offshore Wind Electricity Grid Development

The Baltic InteGrid case studies on meshed grids in the South Baltic: Messages for policy and grid developers

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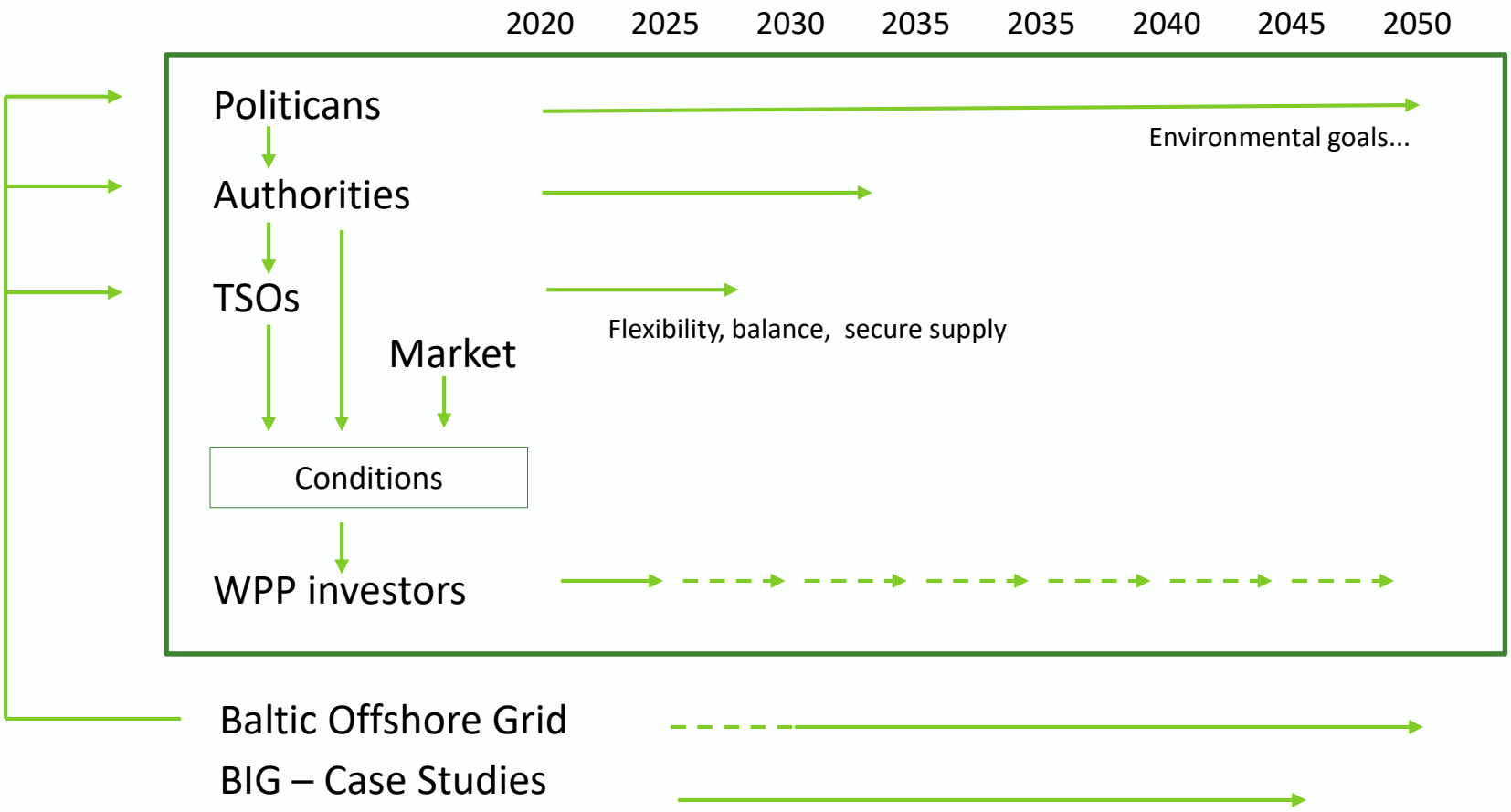
FNEZ

EU STRATEGY FOR THE BALTIC SEA REGION FLAGSHIP

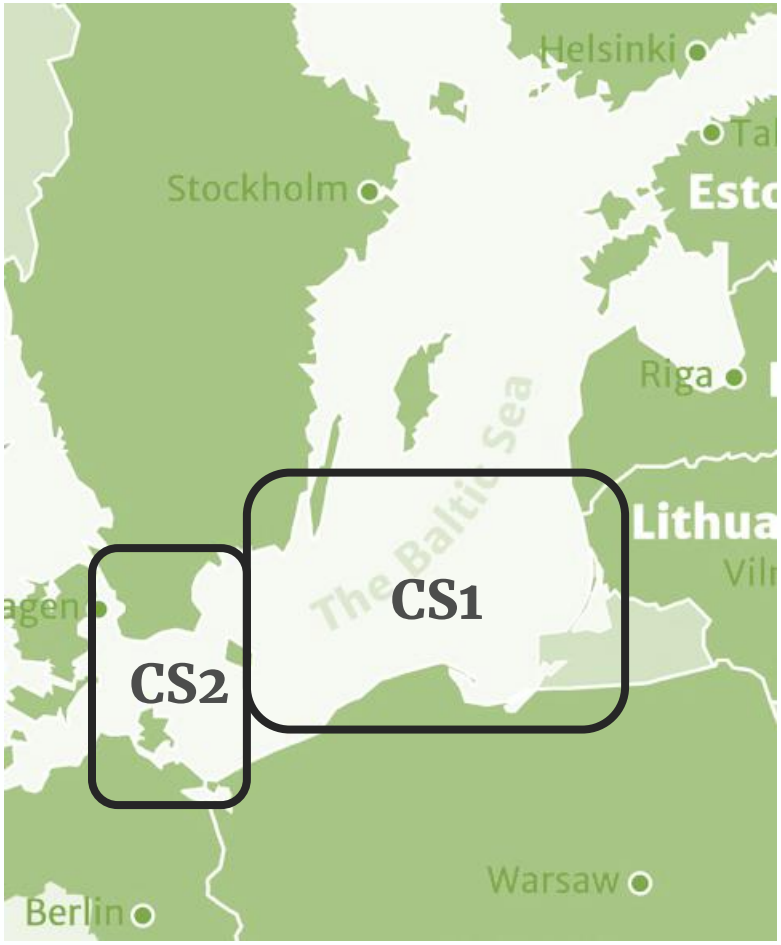
Interreg Baltic Sea Region

EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND

BIG influence – convince who, how and when?



Pre-feasibility study



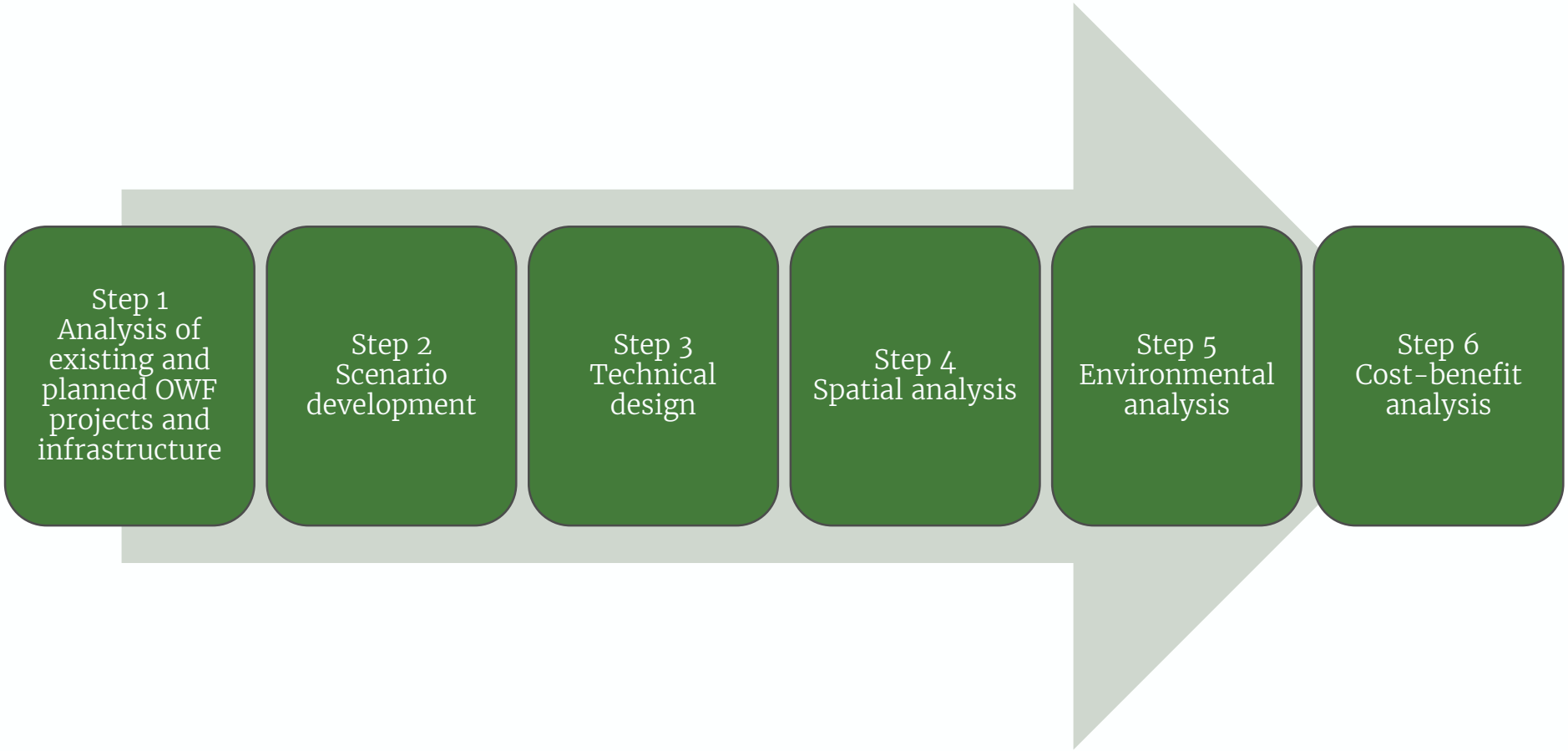
GOALS:

- **Compare an integrated and radial approach for planned OWFs and interconnectors**
- **Provide potential technical designs with general costs for different alternatives**
- **Facilitate flexible development of the transmission grid**
- **Provide general spatial alternatives**
- **Provide comparison of costs and benefits of different approaches**

NOT THE PURPOSE:

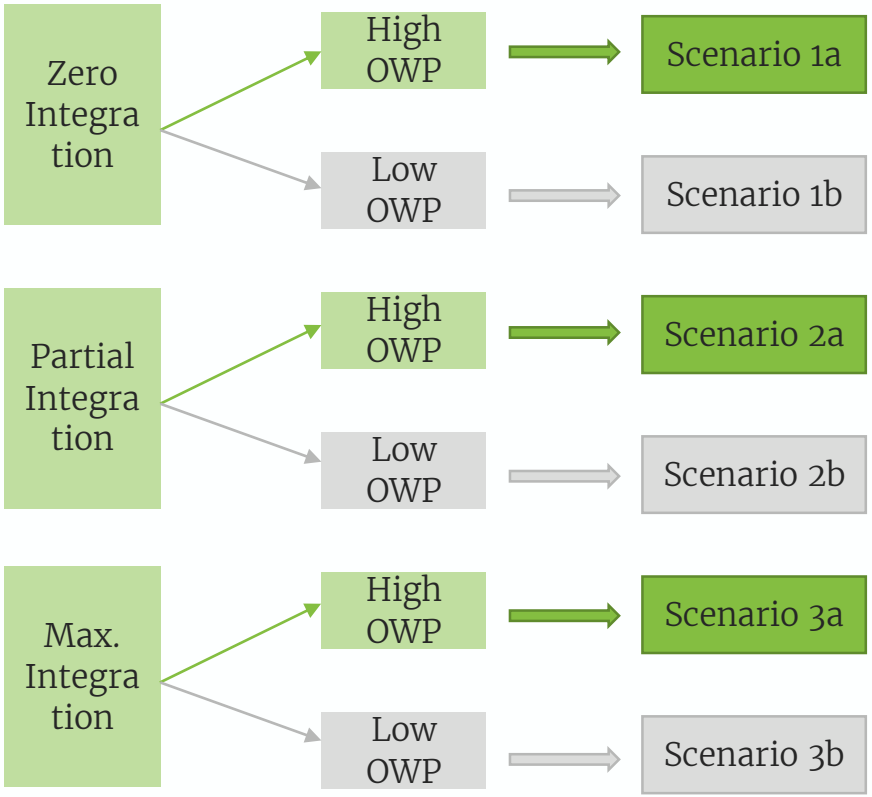
- **Provide final solutions – those will have to be subject of a full feasibility study and design process**
- **Provide prognosis for offshore wind development in the region – the PreFeasibility Studies rather focus on how to connect project already in the pipeline.**
- **Propose final corridors and layouts – these are also subject to detailed analysis.**

PFS Methodology



Outline

- Scenario based analysis
- 6 scenarios per Case Study
- Timeframe 2025 - 2045
- Snapshots with 5 year steps
- Each scenario analysed and compared
- Extremes represented (zero/max integration)



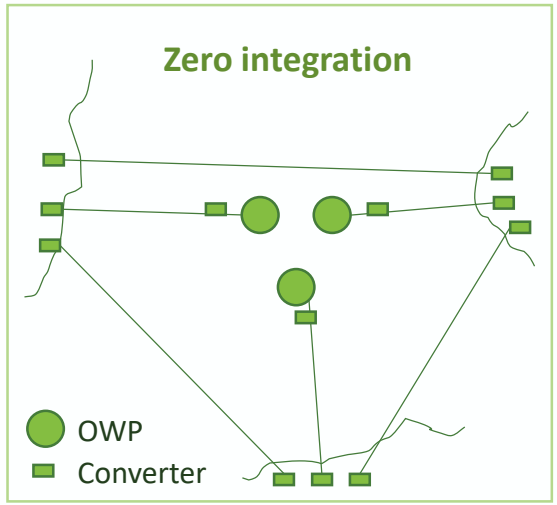
Scenarios

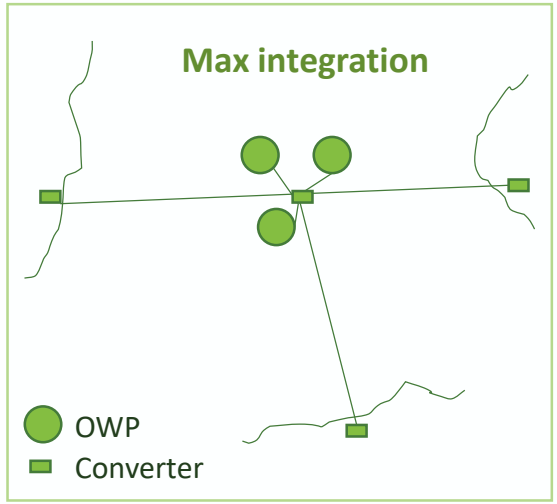
Integration level

Zero Integration

Partial Integration

Max. Integration

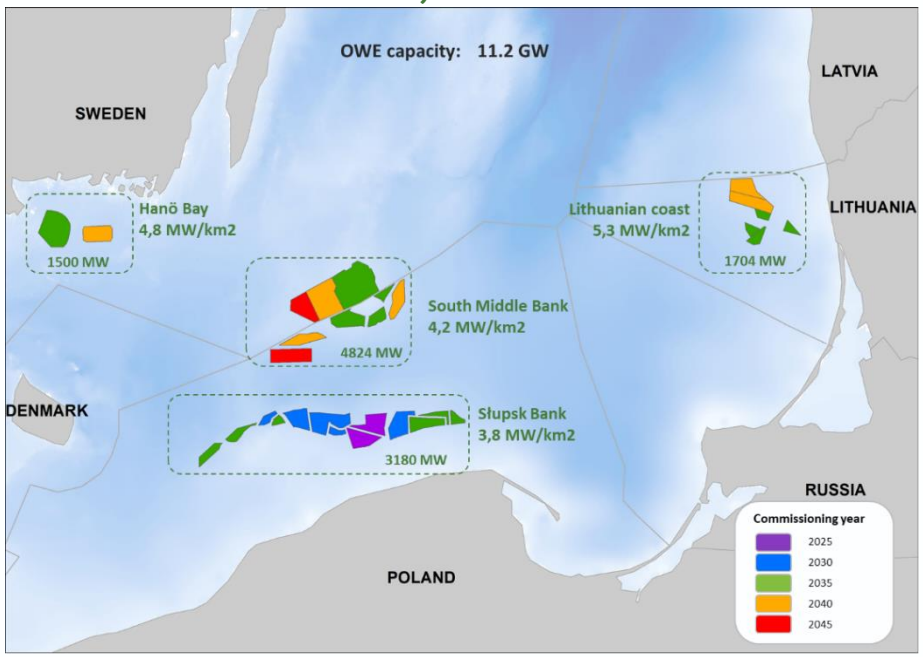




POLAND – SWEDEN - LITHUANIA

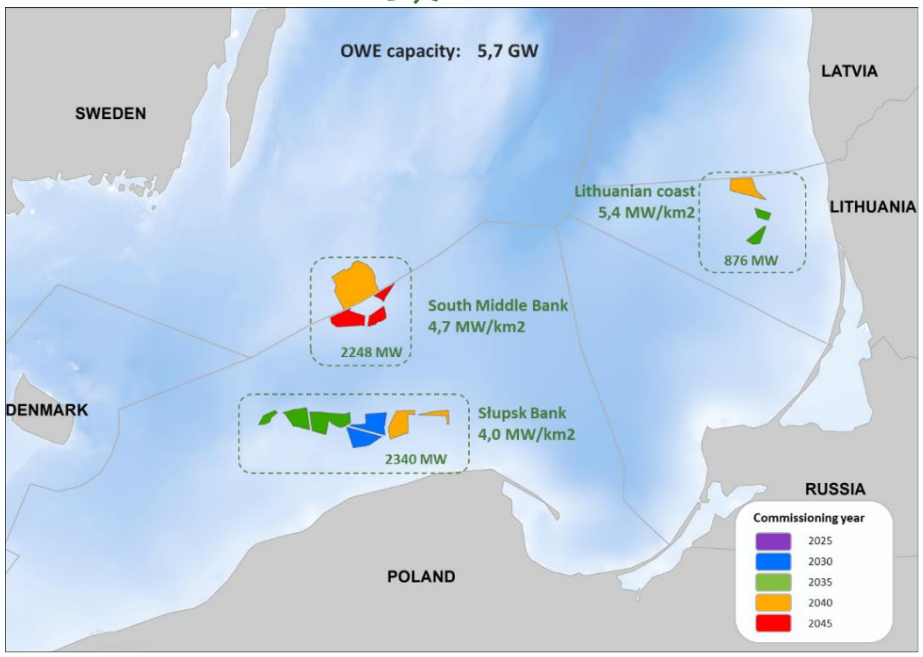
High OWP – 2045

11,2 GW



Low OWP – 2045

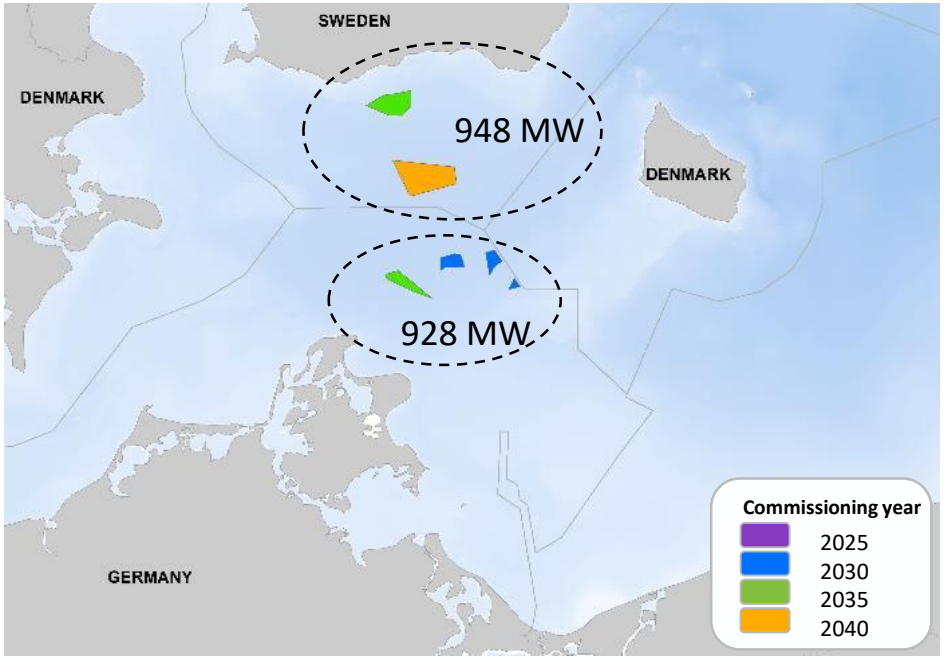
5,7 GW



GERMANY – SWEDEN – (DENMARK)

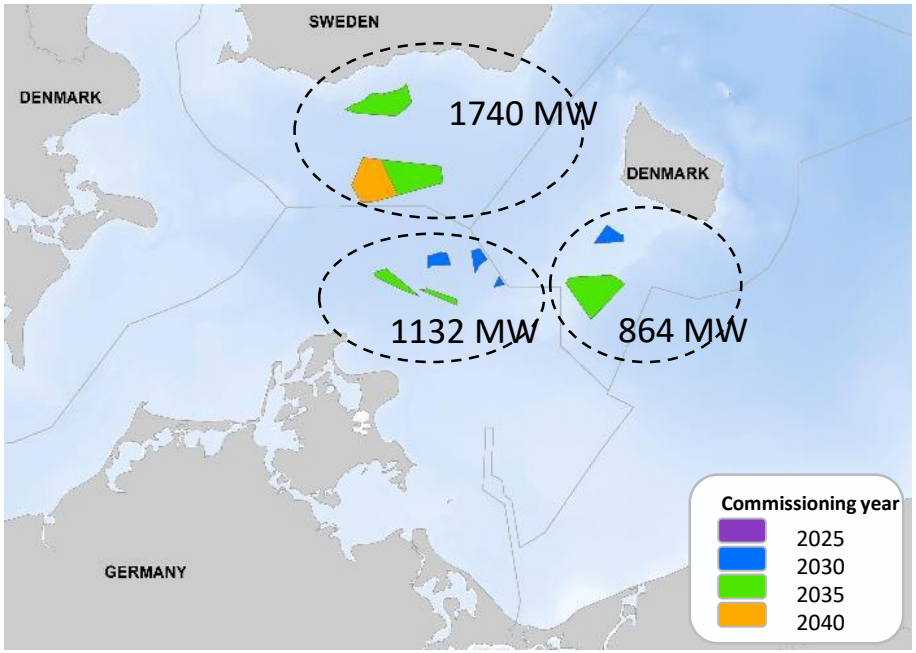
High OWP – 2045

1,9 GW

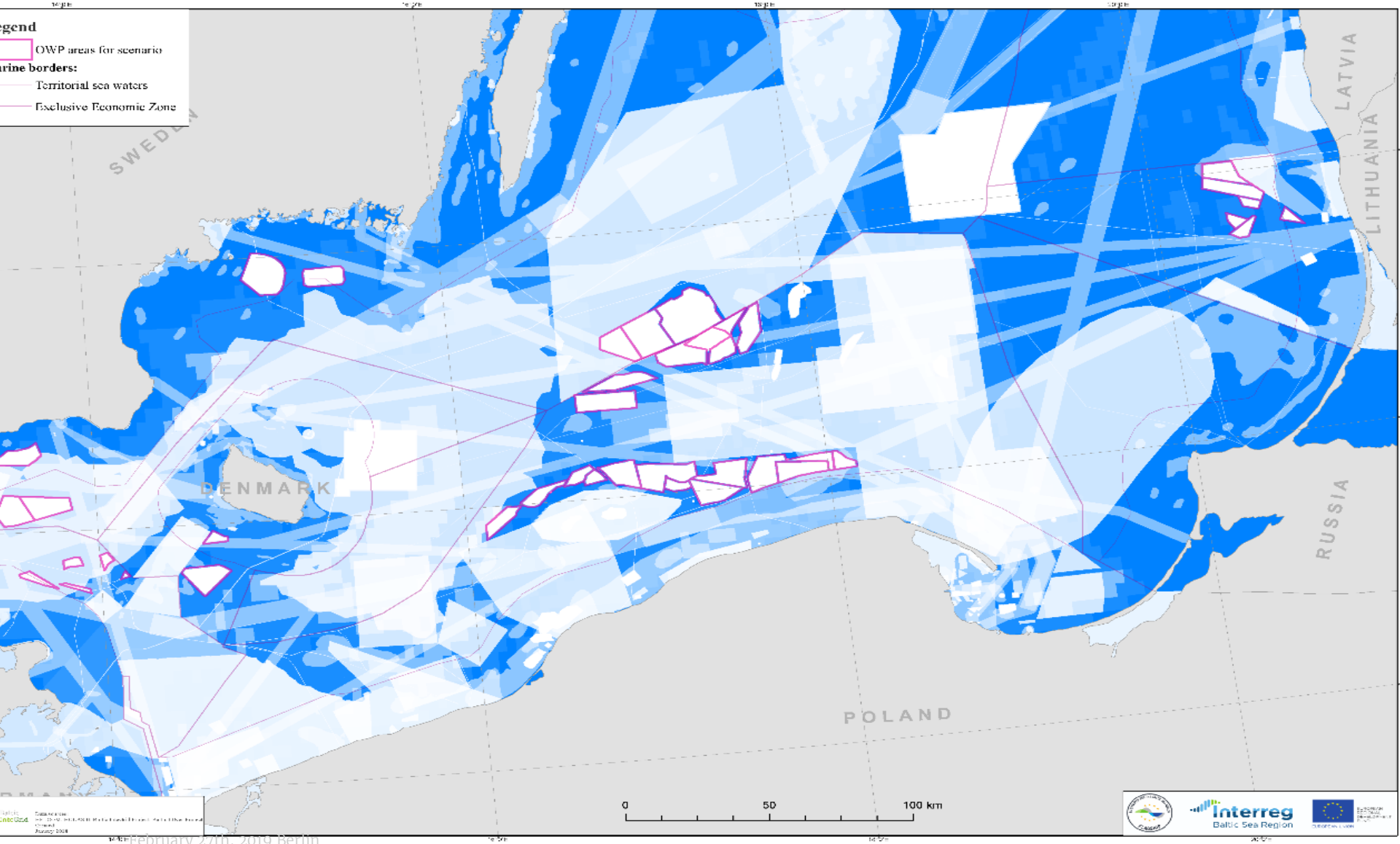


Low OWP – 2045

3,7 GW

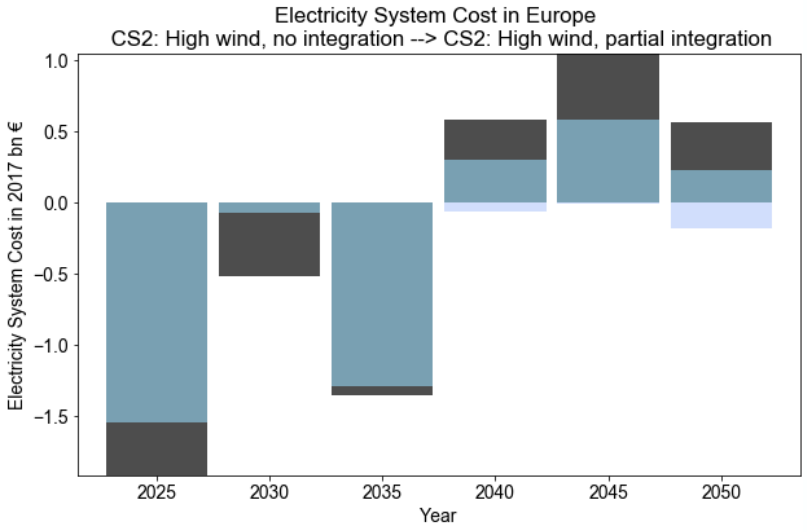


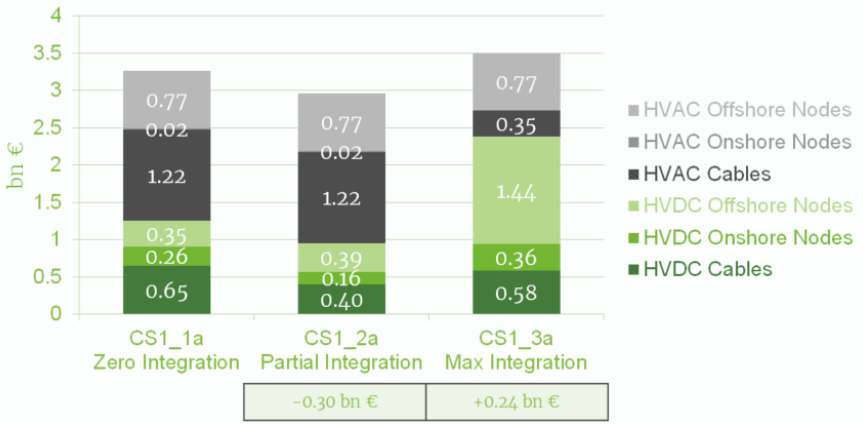
Spatial analysis



Approach

- CBA analysis based on the ENTSO-E methodology





Net Present Value Difference compared to Base Case

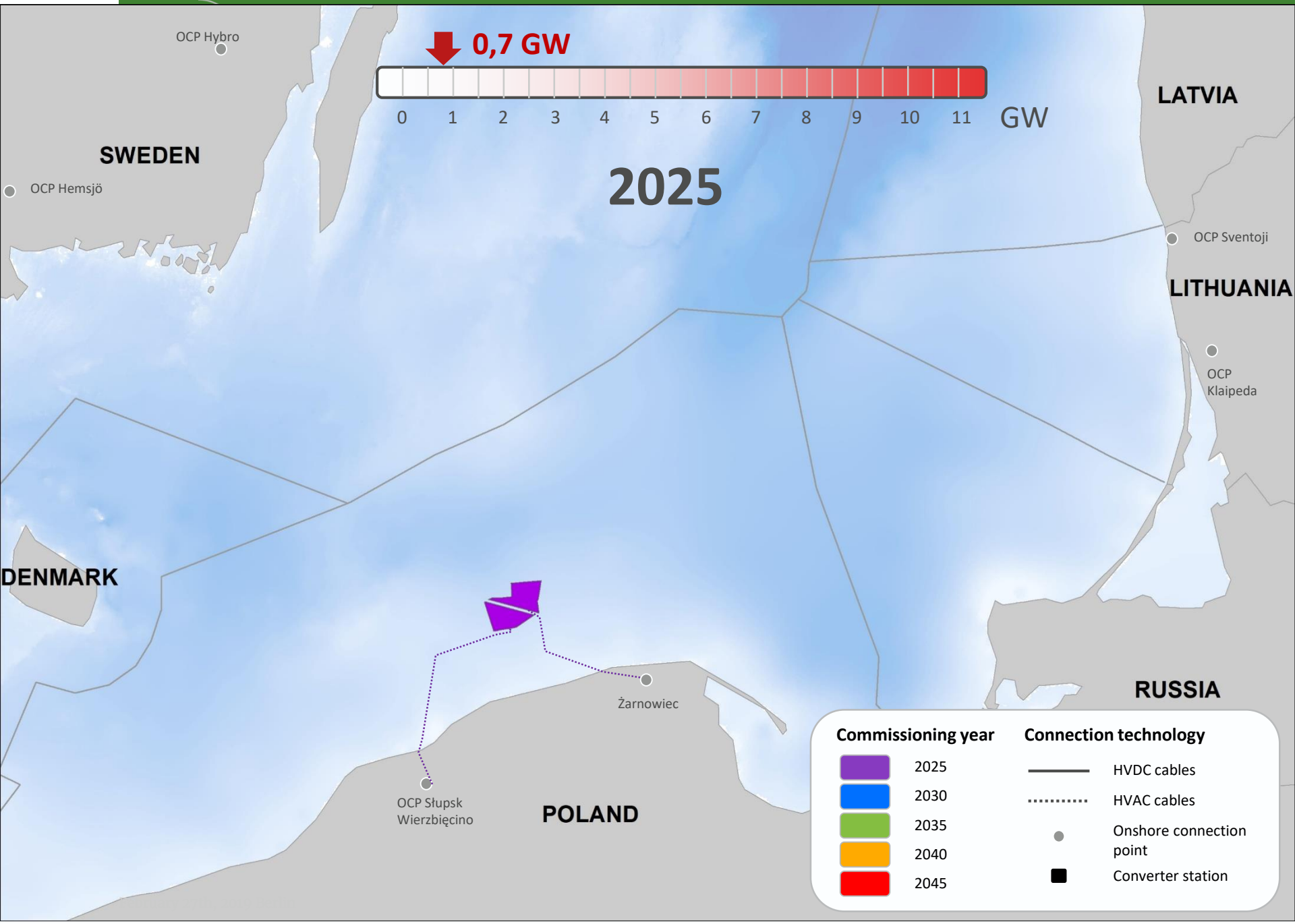
Most favorable scenario:

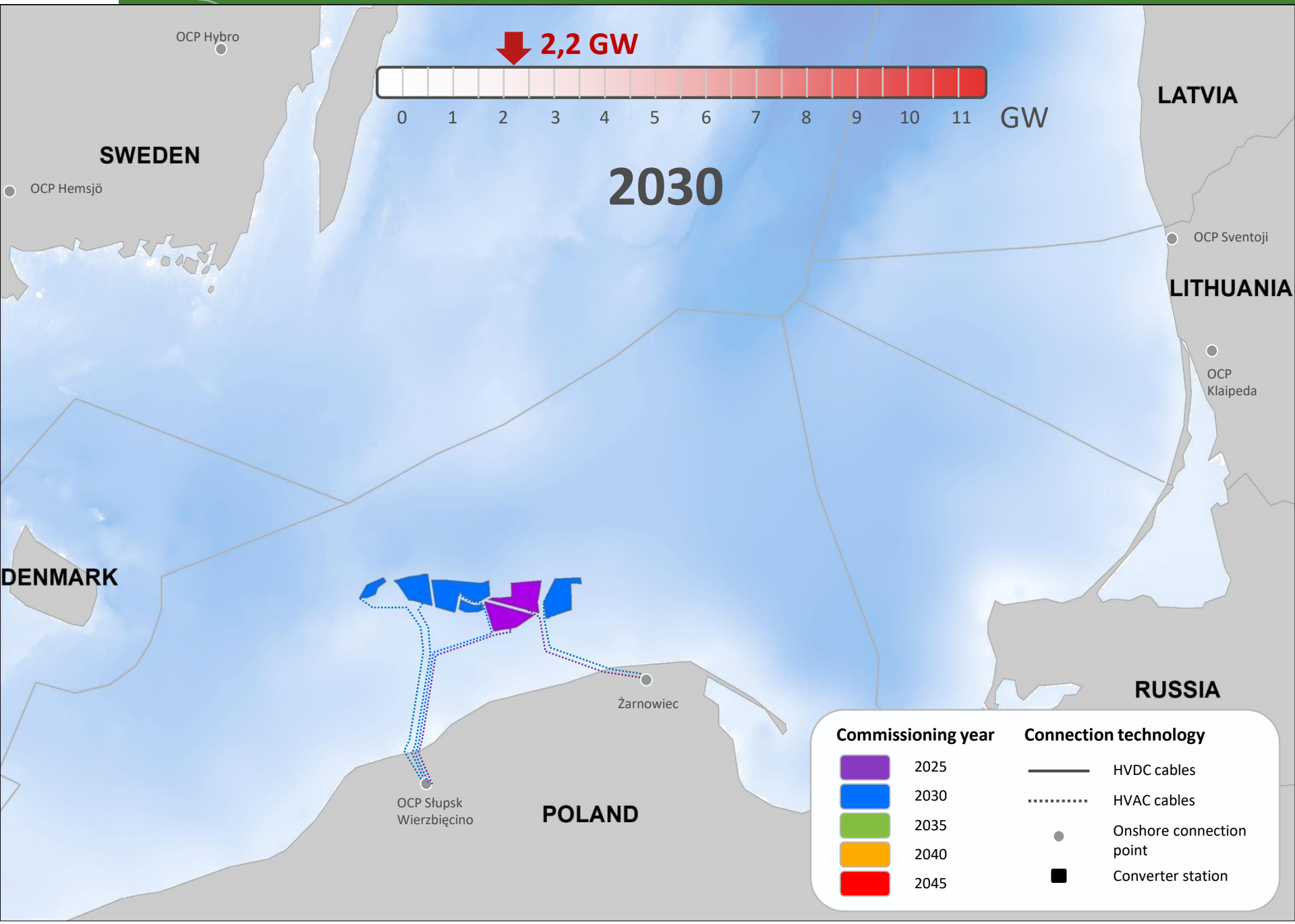
	Case Study 1 (SE/PO/LT)	Case Study 2 (DE/SE/DK)
High OWP	Partial Integration	Maximum Integration
Low OWP	Maximum Integration	Zero Integration

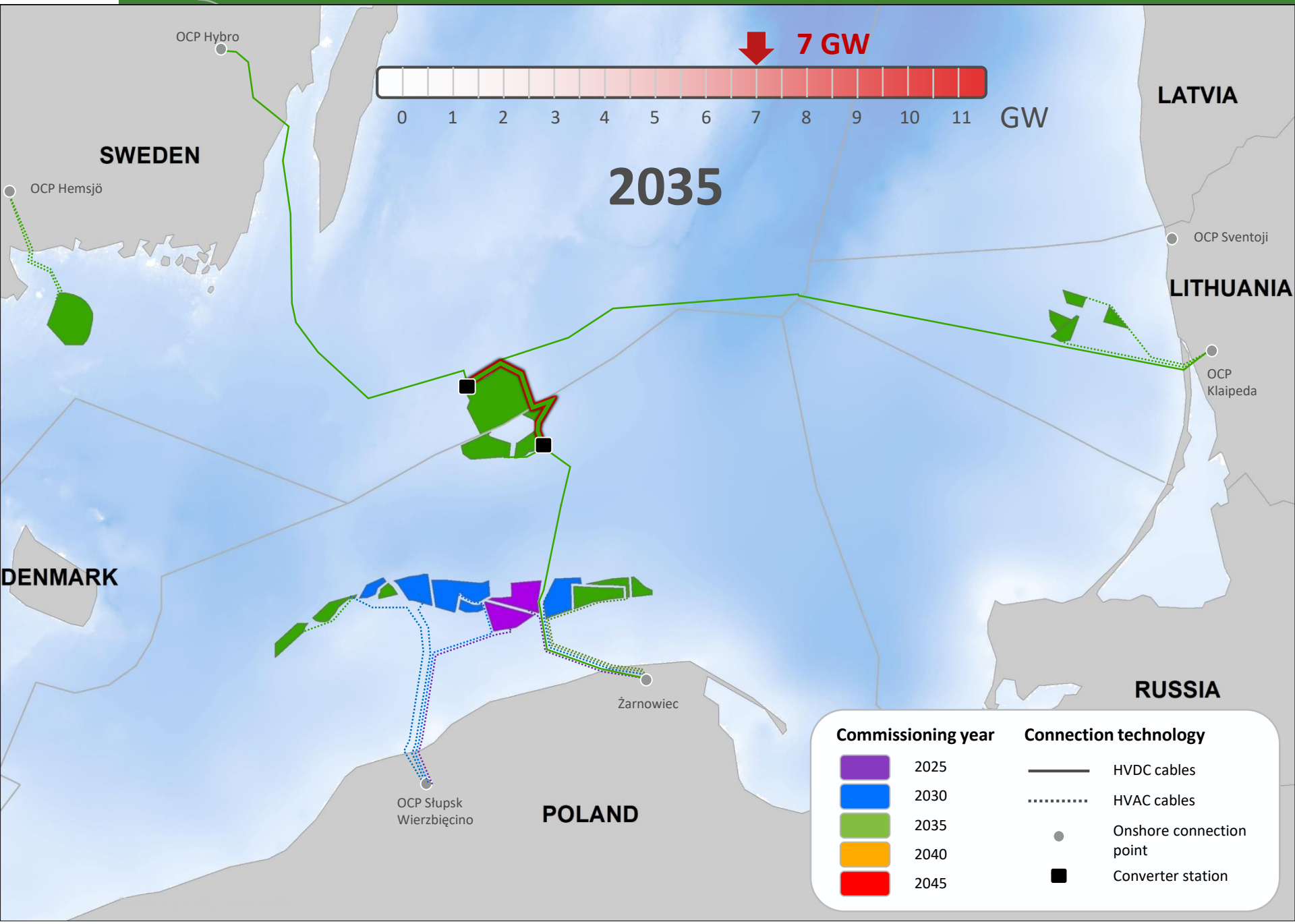
How could it look like?

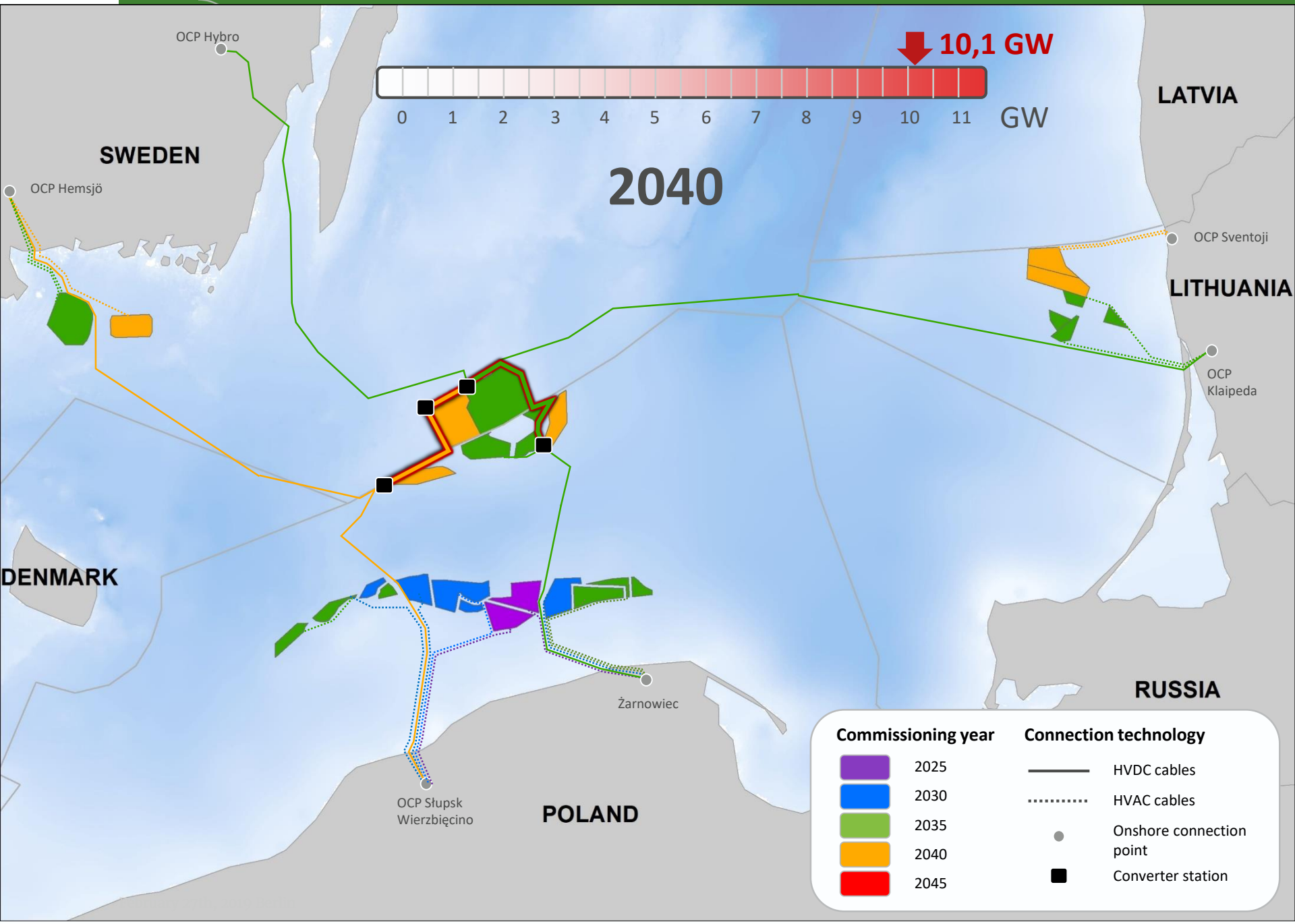
Case Study 1

(High OWP – partial integration scenario)


0,7 GW
0 1 2 3 4 5 6 7 8 9 10 11 GW
2025
OCP Hybro
SWEDEN
OCP Hemsjö
LATVIA
OCP Sventoji
LITHUANIA
OCP Klaipeda
DENMARK
Żarnowiec
RUSSIA
OCP Słupsk Wierzbięcino
POLAND
Commissioning year
2025
2030
2035
2040
2045
Connection technology
HVDC cables
HVAC cables
Onshore connection point
Converter station


2,2 GW
0 1 2 3 4 5 6 7 8 9 10 11 GW
2030
OCP Hybro
SWEDEN
OCP Hemsjö
LATVIA
OCP Sventoji
LITHUANIA
OCP Klaipeda
DENMARK
Żarnowiec
RUSSIA
OCP Słupsk Wierzbięcino
POLAND
Commissioning year
2025
2030
2035
2040
2045
Connection technology
HVDC cables
HVAC cables
Onshore connection point
Converter station


7 GW
0 1 2 3 4 5 6 7 8 9 10 11 GW
2035
OCP Hybro
SWEDEN
OCP Hemsjö
LATVIA
OCP Sventoji
LITHUANIA
OCP Klaipeda
DENMARK
Żarnowiec
RUSSIA
OCP Słupsk Wierzbięcino
POLAND
Commissioning year
2025
2030
2035
2040
2045
Connection technology
HVDC cables
HVAC cables
Onshore connection point
Converter station


10,1 GW
0 1 2 3 4 5 6 7 8 9 10 11 GW
2040
OCP Hybro
SWEDEN
OCP Hemsjö
LATVIA
OCP Sventoji
LITHUANIA
OCP Klaipeda
DENMARK
Żarnowiec
RUSSIA
OCP Słupsk Wierzbięcino
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2025
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2045
Connection technology
HVDC cables
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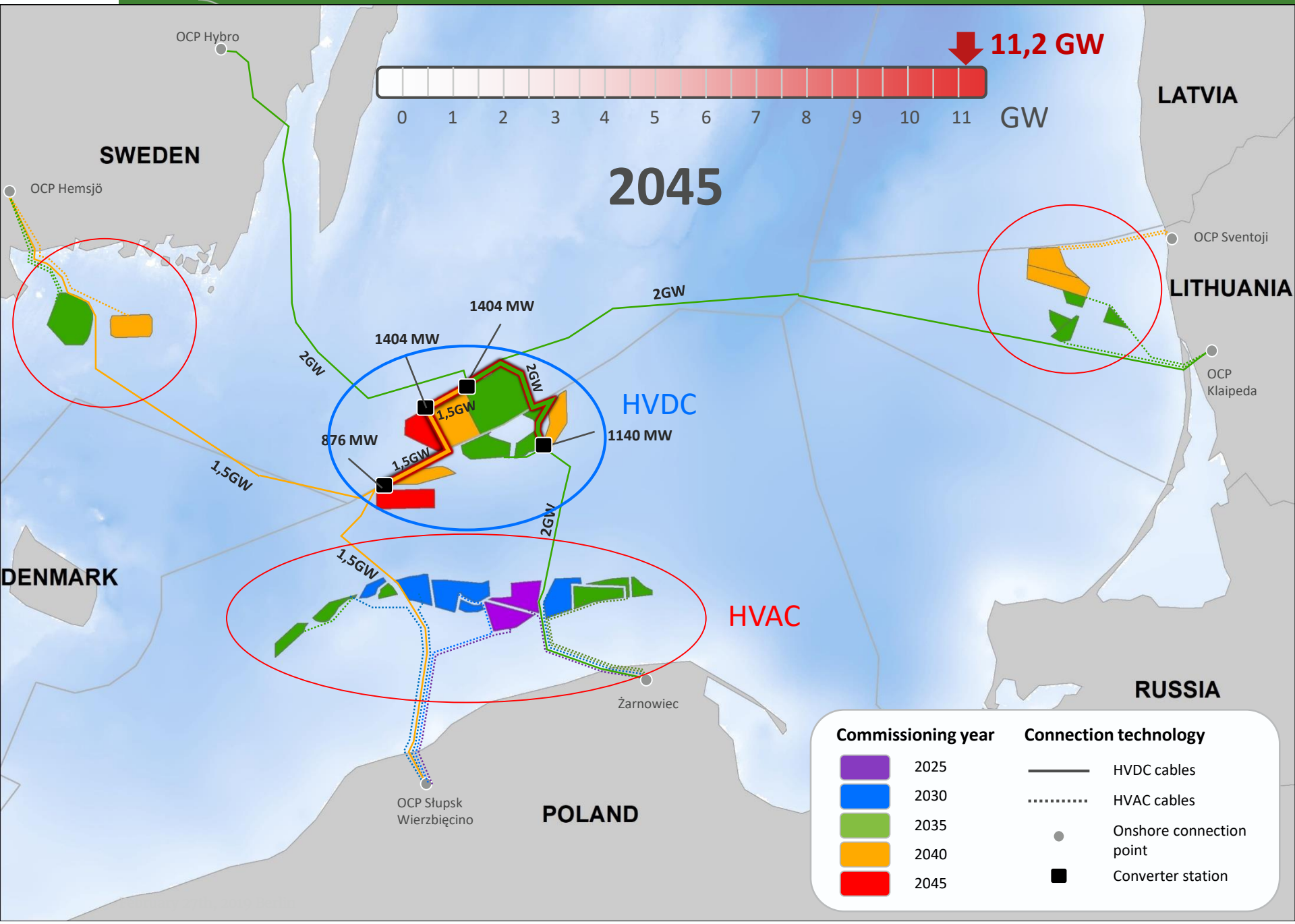
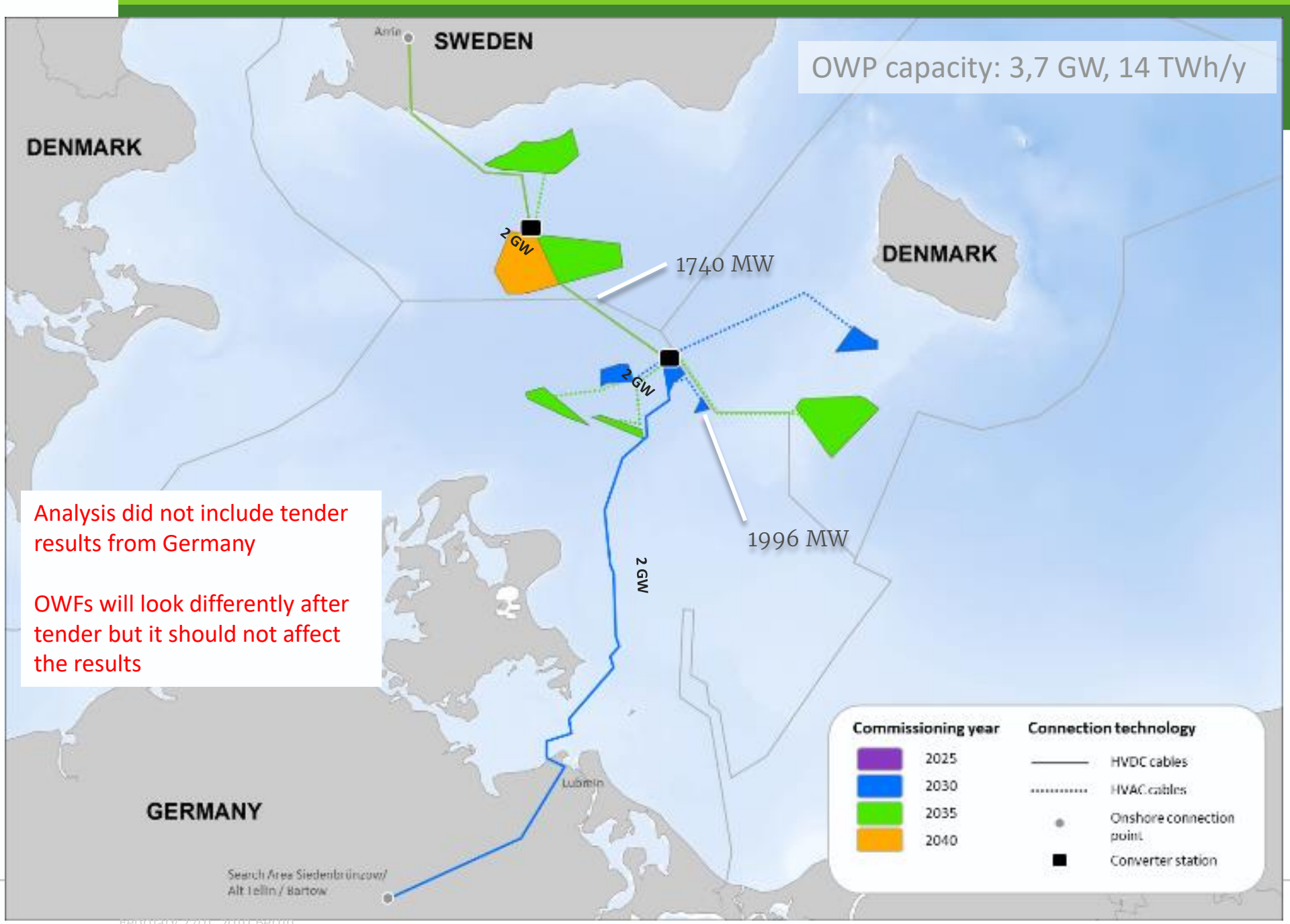
Onshore connection point
Converter station


11,2 GW
0 1 2 3 4 5 6 7 8 9 10 11 GW
2045
OCP Hybro
SWEDEN
OCP Hemsjö
LATVIA
OCP Sventoji
LITHUANIA
OCP Klaipeda
2GW
1404 MW
1404 MW
2GW
2GW
1,5GW
HVDC
876 MW
1140 MW
1,5GW
1,5GW
2GW
1,5GW
DENMARK
HVAC
Żarnowiec
RUSSIA
OCP Słupsk Wierzbięcino
POLAND
Commissioning year
2025
2030
2035
2040
2045
Connection technology
HVDC cables
HVAC cables
Onshore connection point
Converter station

How could it look like?

Case Study 2

(High OWP – maximum integration scenario)

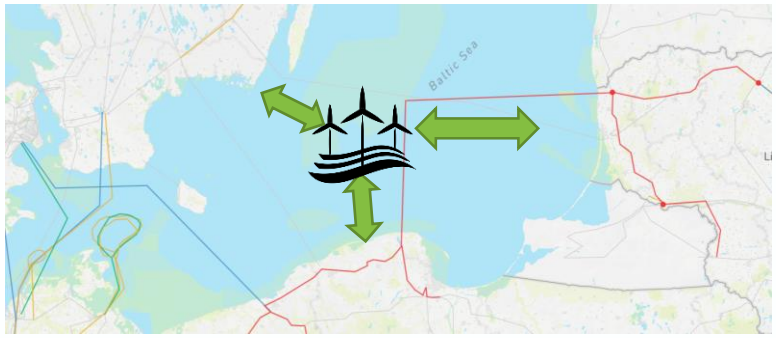

OWP capacity: 3,7 GW, 14 TWh/y
SWEDEN
DENMARK
DENMARK
2 GW
1740 MW
2 GW
1996 MW
2 GW
Analysis did not include tender results from Germany
OWFs will look differently after tender but it should not affect the results
GERMANY
Lubmin
Search Area Siedenbrünzow/ Alt Tellin / Bartow
Commissioning year
2025
2030
2035
2040
Connection technology
HVDC cables
HVAC cables
Onshore connection point
Converter station

Conclusions from the Pre-feasibility Study

1. A higher degree of integration for scenarios with high offshore wind capacity (higher benefits over system costs)
2. CBA has to be performed on a case-by-case basis
3. A higher level of integration supports additional non-monetarized benefits (e.g. security of supply)
4. Technology is there!
5. More coordination is required in the meshed grid
6. Meshed grid is 3-6 times less cables

Key messages for policy and grid developers

- High potential for a meshed grid between Poland–Sweden–Lithuania and Germany–Sweden – proven by CBA analysis



- TYNDP will play a crucial in coordination! Revision of the scenarios is needed
- Review planned interconnectors after 2030 for potential integration with OWFs (e.g. Hansa Power Bridge 2, DKE-PL1, Fenno-Skan1 renewal, DKE-DE (Kontek2) – examples exist („New Great Britain -Netherlands interconnection")
- Communication platform between investors, TSOs and politicians → Baltic Offshore Grid Forum
- Meshed grid supports better use of sea space and landfall

Contact & Disclaimer

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Additional slides

Opportunities and threats for meshed grid in the Baltic Sea

Opportunities

- **High OWF potential and rapid development** (9 GW by 2030 and 35 GW by 2050)
- **OWE supported by** EU CO2 targets, increasing costs of CO2 emission allowances, new RES goals, decreasing technology costs and high industrial potential
- **Projects at early stage of development** (changes still possible)
- **Planned OWF projects at South Middle** (Polish and Swedish)
- **Harmony link** - can pave the way for new interconnector
- Potential for projects between Germany and Sweden.
- **Use of hydropower potential** in Nordic countries
- **Financing opportunities** through Connecting Europe Facility

Threats

- **If no coordinative action taken:**
  - **inefficient wind farm cluster designs,** resulting in higher costs for the end-consumer and potential spatial conflicts.
  - **locking-in to solutions that rule out integration of OWFs in the future** = miss out on the cost reduction opportunities and/or reduce the potential of OWE in the region.
- **New project development takes 10 years for a new cable – early discussions with investors needed**
- **Lack of coordination and not alligned interests between Member States**