First steps towards an integrated offshore grid

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Introduction: Benefits studied by European Commission

Cost reduction in 20 year (nominal):

- €30-97B
  - ~15-45 wind farms

- CO2 reduction 22-45MT/y
  - ~All coal plants NL

*Assignment by European Union: written by PWC, Ecofys, Tractabel*
Introduction: Offshore Wind farms
Introduction: Interesting connection points
Introduction: Interesting connection points

Design 2015

Design 2019

Design chosen

EU Support 2015
Cost reduction - Feasibility Studies

Studies

- WP1: feasibility study UK
- UK-BE-NL
- UK-NO
- DE-DK-NL

Cost reduction

- NORTHEAGRID
- Offshore Electricity Grid Implementation in the North Sea

- SYNERGIES AT SEA
- WP1: feasibility study UK-NL
Cost reduction: Feasibility Studies 1*3: European Commission

**Studies**

- WP1: feasibility study UK-NL
- UK-BE-NL
- UK-NO
- DE-NL

**Cost reduction**

- Annual: 4.900-1.500M€
- Nominal 20y: 30-97B€

**Generation Investment Cost Saving**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Cost Saving (b€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1</td>
<td>-3.4 b€</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>-4.8 b€</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>-7.8 b€</td>
</tr>
</tbody>
</table>

**Reduction of CO₂ emissions**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Reduction (Mt)</th>
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</thead>
<tbody>
<tr>
<td>Scenario 1</td>
<td>-25.3 Mt</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>-22.0 Mt</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>-45.3 Mt</td>
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</tbody>
</table>

**Reduction of generation costs**

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<th>Scenario</th>
<th>Cost Saving (b€)</th>
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<tbody>
<tr>
<td>Scenario 1</td>
<td>-5.1 b€</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>-1.5 b€</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>-3.4 b€</td>
</tr>
</tbody>
</table>

**Cost reduction 20y (nominal): ~30 - 97B€**

*Assignment by European union: written by PWC, Ecofys & Tractabel, 2014*
Cost reduction: Feasibility Studies 2*3: North Sea Grid

Studies

- UK-BE-NL
- UK-NO
- DE-NL

Cost reduction

- Annual: 4,900-1,500 M€
- Nominal 20y: 30-97 B€
- 1 connection: 350-1,213 M€

WP1: feasibility study UK-NL


DK-DE-NL

1213 M€ NPV

UK-BE-NL

650 M€ NPV

NO-UK

350 M€ NPV

NPV: 350 – 1,213 M€
Cost reduction: Feasibility Studies 3*3: Synergies At Sea WP1

Studies

- UK-DE-NL
- UK-NL
- UK-BE-NL

Cost reduction

Annual: 4.900-1.500M€
Nominal 20y: 30-97B€

1 connection: 350-1.213M€
1 connection: 100-200M€

Case specific, for the profitable cases:

NPV: 100 - 200M€

*Nuon/Vattenfall, Groningen Centre of Energy law & ECN. 2015.
Cost reduction: How does that work?

1. Interconnection = cost reduction

2. Wind farms & interconnections = more cost reduction
Cost reduction: Interconnection leads to more efficient generation

Merit order UK
- Installed capacity [MW]
- 60€/MwH
- Average 45€/MwH

Merit order NL
- Installed capacity [MW]
- 30€/MwH

No interconnection
Cost reduction: Interconnection leads to more efficient generation

- Lower av. Price: use of most efficient power plants
- Avoided investments new power plants
- Better implementation renewables
Cost reduction: Interconnection via wind farms leads to faster and higher returns

Cheaper

Faster and more development of interconnection

Redundant connection wind farm
## Possibilities and Challenges

<table>
<thead>
<tr>
<th>Economic benefits</th>
<th>Technology</th>
<th>Regulatory</th>
<th>Interests</th>
<th>Mandates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- Technology ready for first steps</td>
<td>- A transnational grid cannot be developed under the current framework</td>
<td>- Problems known and varies per project.</td>
<td>- Opportunities are lost</td>
</tr>
<tr>
<td></td>
<td>- Further development delayed due to ‘lack of market’</td>
<td>- Problems known and identified*</td>
<td></td>
<td>- Planning wind farm is leading</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Who is going to take action??</td>
<td></td>
<td>- Action needed: national governments</td>
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<td></td>
<td>- Interconnection needs to be integral part of offshore wind policy</td>
</tr>
</tbody>
</table>

*Studies e.g.: Synergies At Sea, North Sea Grid, 2015

Institution: Groningen Centre of Energy Law
Problem: Opportunities leaking away

EU-level

National level

European Commission

ENTSO-E

Government

Grid Operator

Developers

Preparing framework

- Studies
- Adjusting regulation
- Harmonisation
- Support Mechanism

Close the loop

Opportunities lost:

Mandate to implement option in offshore substations
Close the loop: Study benefits for all offshore substations

Agreement north-sea member states:
- Study all options

Assignment: Feasibility study all substations

Decision:
- Start project
- Don't start project
- EU support needed

Feasibility study
Outcome, e.g.:
Cost optionality: 1M€
Cost connection: 50M€
Benefits: 175M€
Chance of success: 50%

Build optionality
Prepare EU support proposal
Decision on support
Support granted

Start project
Summary

Offshore grid:
- Ready to take the first steps
- Significant benefits: leaking away

Solution
- Close the loop: Interconnection integral part of offshore wind
- Study benefits and build optionalities: No regret approach

And now?

Start acting: Key advantage of offshore wind
Thank you!