What does a future offshore grid look like…

North Sea Power Wheel

Figure: G.W. Adamowitsch
OFFSHOREGRID PROJECT
Facts on Project Framework

PROJECT DNA
• Techno-economic study to identify an efficient offshore grid
• Cost-benefit analysis of different design options = First study that puts assumptions on solid numerical basis
• Budget 1.4 M€, 75% funded by EC
• May 2009 until October 2011

Consortium and Stakeholder Advisory Board
• 3E (Coordinator), Germany Energy Agency (dena), EWEA, Sintef, Senergy Econnect, NTUA, IEO Brec
RESULTS OF THE STUDY
An Overview

• Wind Energy Statistics – Insights into future needs
• Conventional power fleet development
  • *Hubs vs. individual connections* (incl. stranded investment calculations → German discussion)
• Concrete case study analysis (e.g. German wind farm teed into the cobra cable.)
• General *techno-economic guidelines* for abstract design modules
  • Tee-in connections
  • Hub-to-Hub connections
• *Techno-economic results* for two meshed offshore grid designs („Super Grids“)
• Check against current political and regulatory framework.

Concrete technical design recommendations.
Recommendations concerning regulatory frameworks, financing, policy.
COST BENEFIT ANALYSIS

What to compare?

Costs

Infrastructure costs:
• Offhore substation
• Onshore substation
• Subsea cables AC or DC

Taking into account
concrete cable ways, water
depth, voltage levels,
capacities....

Result of infrastructure cost
model.

Compare

Benefits

Lower system generation
costs due to better
interconnection = More
connection capacity allows
to generate where it is
cheapest.

Results of European Power
Market and Grid Flow
Model
OFFSHORE WIND ENERGY

Input Scenario

126 GW offshore wind energy in Europe in 2030 in 321 offshore wind farms
HUB CONNECTION VS INDIVIDUAL CONNECTION

Subcase 1

Hub vs Individual Comparison
HUB CONNECTION VS INDIVIDUAL CONNECTION

When Beneficial?

- 114 out of 321 wind farms will be clustered in hub connection
- Comparison with the individual connection scenario shows € 14 bn of savings.
HUB CASE
Additional analyses with 4 hub connection subcases
HUB CASES
Cost comparison of 4 hub connection subcases

- Additional analysis showed that the risk of stranded investment is low.
  Case of 3 wind farms 60-150km from shore
  - Costs of temporary oversizing are limited.
  - Hubs can be beneficial even if one of the wind farms is not built at all.
DESIGN CONCEPTS
Modular Building Stones of an Offshore Grid

- Hub-to-hub connection
- Interconnector Tee

- All typical design concepts can be reduced to these design modules

Cost-Benefit Comparison
Hub connection saves €14 bn.
Additional connections cost €5-8bn and bring benefits of €bn 16-21
The financial numbers speak clearly for an offshore grid.
DIRECT DESIGN AS AN EXAMPLE
Step 1

2x Direct Interconnector close to each other

2x Direct Interconnector close to each other

2x Direct Interconnector close to each other
DIRECT DESIGN AS AN EXAMPLE

Step 2
DIRECT DESIGN AS AN EXAMPLE

Step 3
OFFSHORE GRID RESULTS
Costs and Benefits – The Numbers

• Hub connection saves €14 bn.
• Additional connections cost €5-8bn and bring benefits of €bn 16-21
• The financial numbers speak clearly for an offshore grid.
OFFSHORE GRID POLICY RECOMMENDATIONS

Key Conclusion

• Apart from the techno-economic benefits laid-out in the offshore grid report, integrated solutions produce other benefits
  • Lower environmental impact
  • Improved redundancy and security of supply

• General recommendation to favour a meshed grid.

• Policy frameworks have to be designed accordingly
  • System perspective vs. operator perspective:
    – Any interconnector has negative impact on the economics of existing interconnectors.
    – Merchant interconnector concept encourages to obstruct new interconnections

• Classic case of regulatory economics
OFFSHORE WIND SUPPORT SCHEMES AND GRID CONNECTIONS

Compatibility needed

- Regulatory frameworks & support schemes pose problem
  → Should be made compatible, otherwise an integrated offshore grid will not be possible
OFFSHORE GRID RECOMMENDATIONS

Key Conclusion

- The following key benefits of an interconnected offshore grid are supported by the OffshoreGrid findings:
  - Can be highly beneficial from an economic perspective
  - Contributes to reaching the 20-20-20 target
  - Will increase the security of supply
  - Is a step towards an integrated electricity market
  - Helps to smooth fluctuations and integrate RES
  - Further connects northern storage capacities to the power system

The advantages of an offshore grid speak a clear language.

Now policy support as well as EU coordinated review of regulatory regimes is needed to implement innovative design solutions and create the beneficial offshore grid.
VISIT THE WEBSITE → WWW.OFFSHOREGRID.EU

Final report pdf version

Furthermore:

• Executive summary
• Annexes
• Maps
• Guidelines from Case-independent-model
• Other WP Deliverables
THANK YOU

For further information please contact:
Paul Kreutzkamp
E-Mail: paul.kreutzkamp@3e.eu
Tel.: +32 (2) 229 26 13