

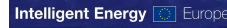


# OffshoreGrid

## Results of the OffshoreGrid Study

Achim Woyte, Jan De Decker, (3E)  
Peter McGarley, Simon Cowdroy (Senergy Econnect)  
Leif Warland, Harald Svendsen (SINTEF Energy Research)

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[www.OffshoreGrid.eu](http://www.OffshoreGrid.eu)



## Outline

- The IEE Study OffshoreGrid
- Cost-benefit analysis: three design problems
  - Clustering at hubs versus radial connections to shore
  - Connecting wind farms to planned interconnectors
  - Integrating wind farm hubs with interconnectors
- Implications on support schemes
- Conclusion



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## IEE OffshoreGrid

### PROJECT FACTS

- Techno-economic study
- Cost-benefit analysis of different design options
- Budget 1.4 M€, 75% funded by Intelligent Energy – Europe
- Duration: 5/2009 – 10/2011
- Coordinator 3E, 8 partners, consultancy & applied research



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## Project Approach

### PREPARATION

- Scenarios 2020 / 2030 :
  - offshore & onshore wind
  - onshore reinforcements
  - energy economics
  - regulatory framework

### MODELLING

- Costs of infrastructure
- Benefits from market integration  
=> reduction in *system costs*
- Comparing costs and benefits to a base case (ENTSO-E TYNDP)

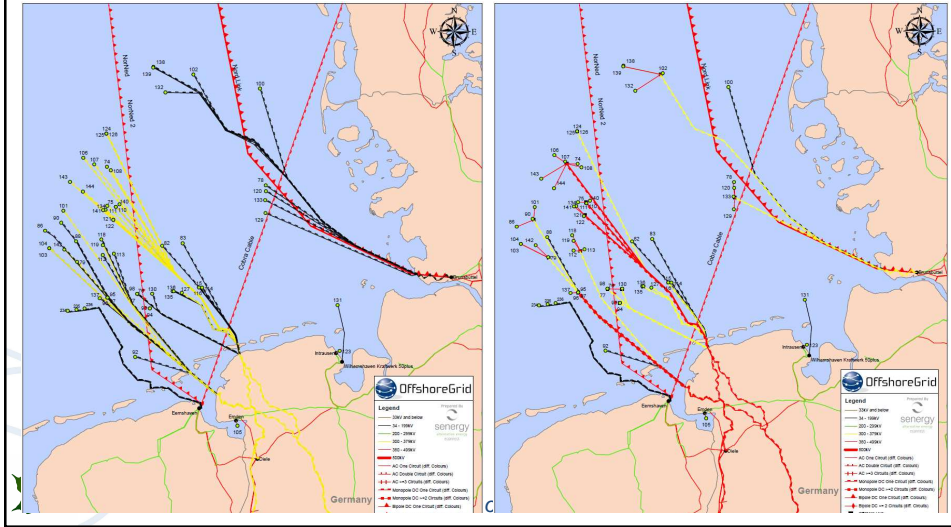


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# Hubs versus Radial Connections

RADIAL: BUSINESS AS USUAL

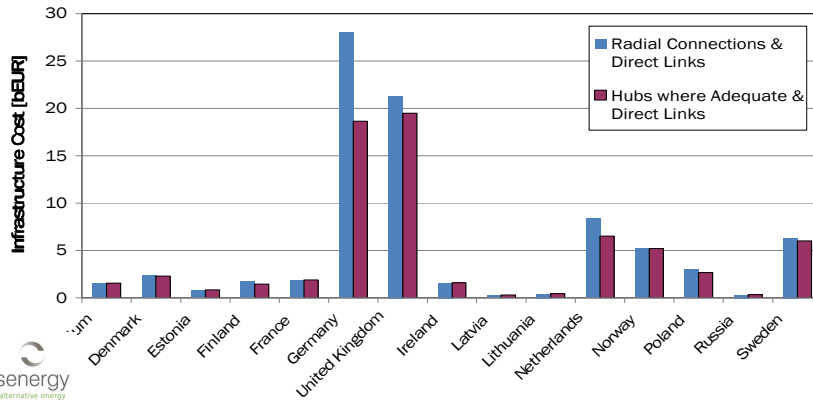
CLUSTERED WITH HUBS



# Results cost-benefit analysis: Hubs vs radial

## GENERAL

- Hubs defined via hub assessment tool
- Most important countries: DE, UK, NL  
(UK Round 3: potential is big but lot of hubs will be built implicitly)



## Results cost-benefit analysis: Hubs vs radial

### Results 2030

- <50km:  $Cost_{radial} < Cost_{hubs}$
- >50 km: hubs usually beneficial if  $P_{inst_{40kmRadius}} \sim P_{max_{HVDC-cable}}$
- Cost reduction up to 34% possible

### Results 2020

- Benefit of hub in 2020 depends on number of wind farms
- Example of DanTysk hub: Hub is still beneficial, even with only 2/4 WF

Risk of stranded investment ?

### Dan Tysk Hub

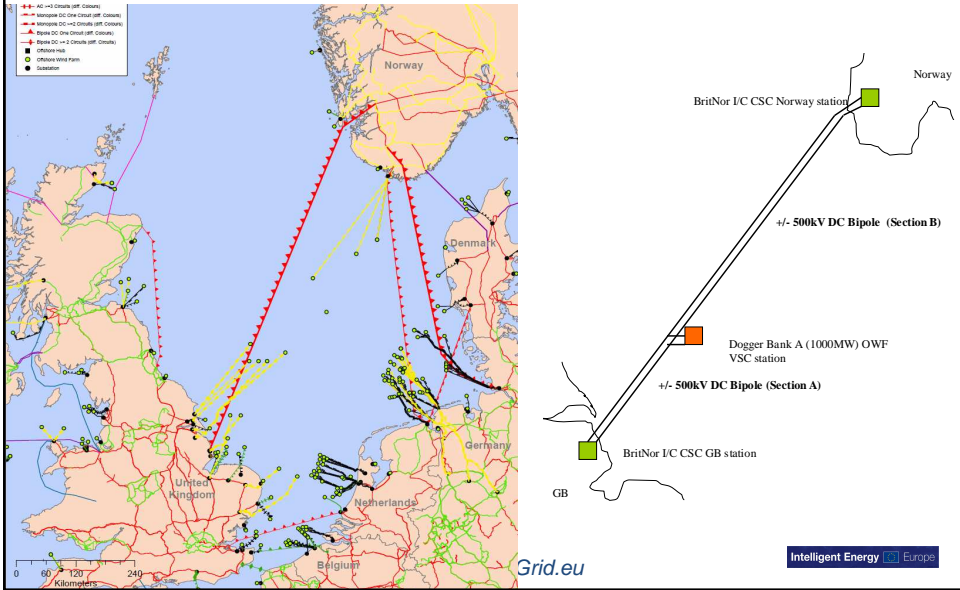
# WF in hub	Cost Radial [M€]	Cost hub [M€]	Relative cost
4	1 302	846	0.65
3	1 171	768	0.66
2	833	731	0.88
1	408	653	1.60

## Results cost-benefit analysis: Hubs vs radial

### RECOMMENDATIONS AND CONCLUSIONS

- When concession areas defined:
  - => Adapt regularly framework to favour hubs where beneficial
- When no concession areas defined:
  - => Aim for few areas with large wind farms or larger wind farm concentration
- Hubs can still be beneficial if not all wind farms are built right away
- Good coordination is needed to plan hubs and timing of installation
- Focus on a few hubs at a time, instead of building WF randomly

# Interconnector Tee

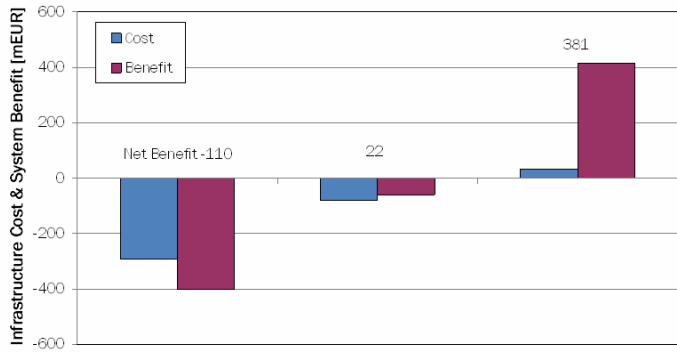


# Results cost-benefit analysis: Tee-in WF

General

- Cost-benefit analysis: evaluation of reduced costs vs reduced benefits (trade constraints)

1000 MW Dogger Bank wind farm T-connected to BritNor, for different interconnector ratings



## Results cost-benefit analysis: Tee-in WF

### General

- Cost-benefit analysis: evaluation of reduced costs vs reduced benefits (trade constraints)

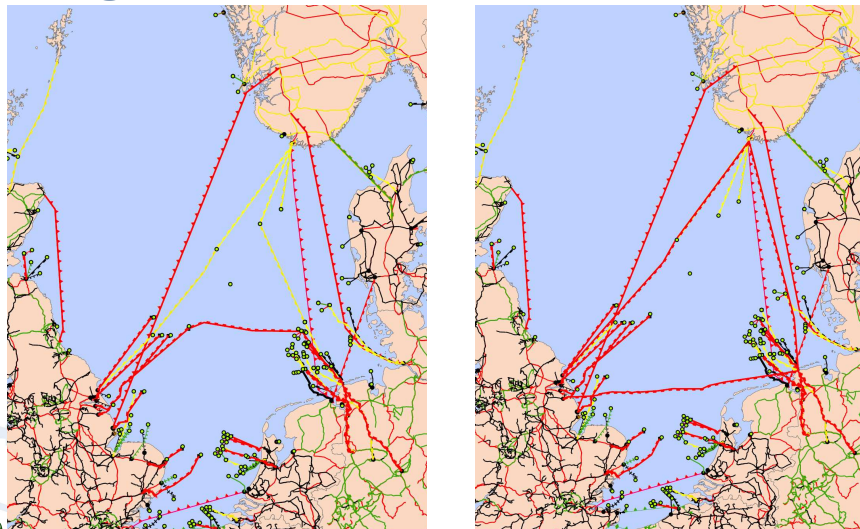
### Results

- Possible with both technologies (HVDC classic & HVDC VSC)
- $P_{\text{Windfarm}} < 1/2 P_{\text{cable}}$  to limit constraints
- More beneficial if distance to shore is high

### Recommendations and conclusions

- Don't delay interconnectors for trade or security of supply
- When wind farms could be connected to interconnector → make technology decision based on analysis of all costs & benefits
- If investment in wind farm along route is firm → go for fully integrated solution

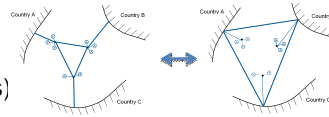
## Integrated WF vs Direct Lines



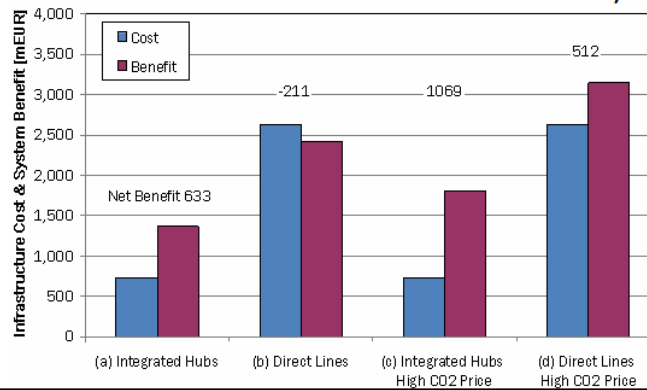
## Results cost-benefit analysis: Integrated WF

### General

- Cost-benefit analysis: evaluation of reduced costs vs reduced benefits (trade constraints)



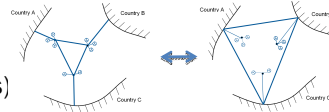
### Triangular NO - UK - DE (1000 MW direct lines vs 1000 MW connections via hubs)



## Results cost-benefit analysis: Integrated WF

### General

- Cost-benefit analysis: evaluation of reduced costs vs reduced benefits (trade constraints)



### Results

- $P_{\text{CableBetweenHubs}} \sim < 1/2 P_{\text{ConnectionHubsToShore}}$  to limit constraints
- More beneficial if  $D_{\text{WFToShore}} \gg D_{\text{BetweenHubs}}$

### Recommendations and conclusions

- Integrated solution requires detailed economic analysis (task for TSOs)
- Good dimensioning could bring large benefits
- Good coordination is crucial! (TSO's, wind farm & hub developers)
- Regulatory frameworks should foster coordinated approach! (NSC'OGI)



## Importance of Compatible Support Schemes



### COMPATIBLE SUPPORT SCHEMES ARE ESSENTIAL

- International exchange via the wind farm hub
- Power is not necessarily injected into the grid of the host country
- Today, almost all MS's support systems require
  - siting in the national EEZ and
  - connection/injection to the national grid

### SOLUTION: RELAX THE CONNECTION REQUIREMENT

- Easy for premium and quota systems
- Feed in tariffs: touching the essence of the feed-in concept



## Summary



### HUBS

- Beneficial with large distance to shore
- Strategic siting and scheduling increase opportunities

### T-CONNECTIONS

- Considerable option in trade driven case
- Do not slow down interconnector development

### INTEGRATED OFFSHORE GRID HUBS

- Often beneficial, oversize the connection to shore
- Requires coordination between TSO & hub developer

### COMPATIBLE SUPPORT SCHEMES

- Essential for integrated development





**Thank you for your attention!**  
**[www.offshoregrid.eu](http://www.offshoregrid.eu)**

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**Achim Woyte  
3E sa, Brussels  
[Achim.Woyte@3E.eu](mailto:Achim.Woyte@3E.eu)  
[www.3E.eu](http://www.3E.eu)**

**Intelligent Energy  Europe**

