North Sea
Wind Power Hub

PLANNING THE FUTURE TOGETHER

WindEurope Conference 2018
Side event North Sea Wind Power Hub

Hamburg | September 2018

VISION AND WORK IN PROGRESS

REINALT NIJBOER
PROJECTMANAGER

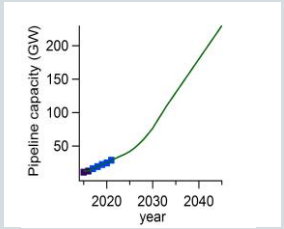
WINDEUROPE 2017: 3 CONCEPT PAPERS PRESENTED

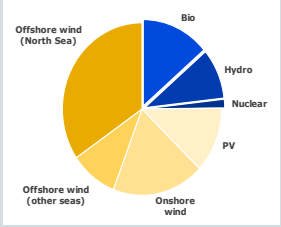
PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

Perspective - power system

Concept Paper 1 - The Vision

- *80-95% reduction (compared to 1990) in CO2 emissions before 2050*
- *full decarbonisation of the electricity supply well before 2045*





- *large scale, far offshore wind*
- *accelerated deployment*

- *cross-border spatial planning*
- *minimum impact / maximum benefit to environment*

- *sufficient interconnection capacity to maintain operational security*

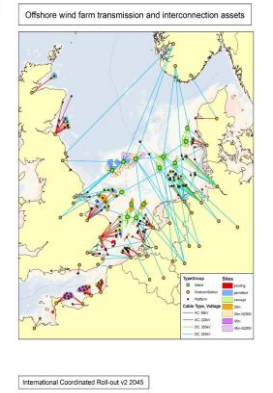
- *flexibility to support non-dispatchable generation*

WINDEUROPE 2017: 3 CONCEPT PAPERS PRESENTED (2)

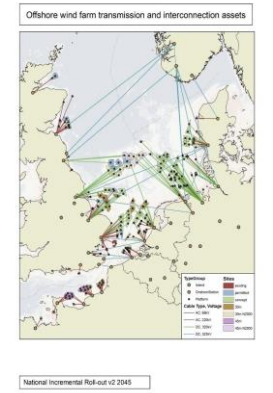
Perspective - power system

Concept Paper 2 - Modular Hub and Spoke

International Coordinated Roll-Out (ICRO)
Synergies between wind farm transmission assets and interconnectors are maximized within a total system internationally coordinated framework.



vs



National Incremental Roll-Out
OWF transmission assets and interconnectors are developed as individual projects and are connected to the closest national onshore connection point in a radial and uncoordinated manner.

Concept Paper 3 – Hub as an Island

- *cost reductions from optimised offshore connection concepts, economies of scale, synergies with interconnection functionality and coordinated approach to reinforcement of the onshore grid and system integration*
- *additional socio-economic benefits from energy market coupling*

DEVELOPMENTS 2018

Opportunity Statement NSWPH

“We see an opportunity for internationally coordinated, large scale far offshore wind energy from the North Sea: an opportunity which would deliver energy at competitive prices around 2030 and facilitate meeting the Paris agreement.

Therefore we are committed to explore and develop regional socio-economic beneficial and reliable offshore infrastructure, including possible conversion into P2G, that supports wind farm operations and interconnections between markets.”

NSWPH organisation in place: based on TECOP

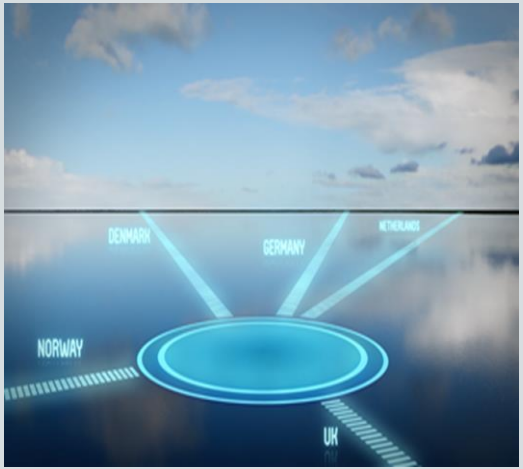
Assessment phase: Road map developed

TWO INTERRELATED TASKS DEFINED

2030 – 2050
International Coordinated Roll-Out (ICRO)

System

2035 NSWPH project
module #1



Project

INTERNATIONAL COOPERATION NEEDED

Assess phase

Stakeholder Interaction

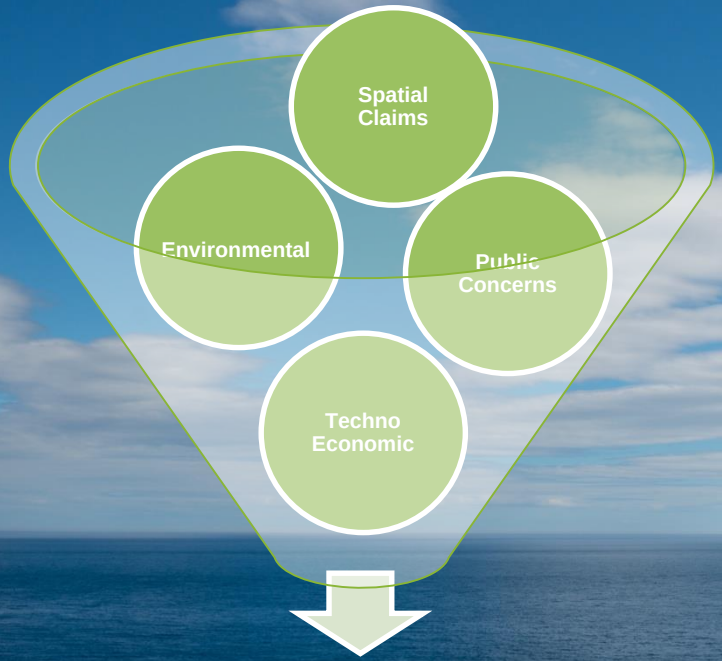
OWF SPATIAL PLANNING COST DRIVERS

STACY BARNES
TEAM LEAD ECONOMICS

CONTENTS

1. Introduction
2. Purpose
3. Approach
4. Point of departure: share & learn
5. North Sea user functions
6. First observations: share & learn
7. Next Steps

POLICY MAKING CHALLENGES



North Sea Spatial Planning

WHY IN RELATION TO NSWPH

Leg 1:
North Sea International Coordinated Roll Out

Long term spatial plan

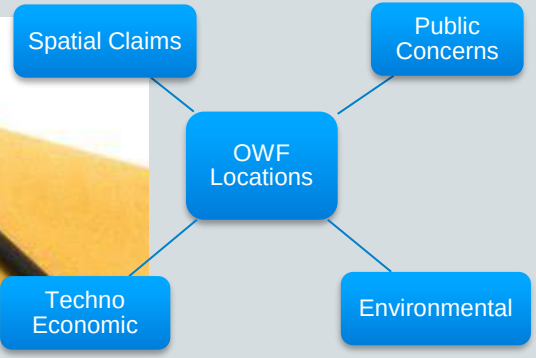
Source: NSWPH Concept Paper 'The Vision'

Leg 2:
First Concrete Concept

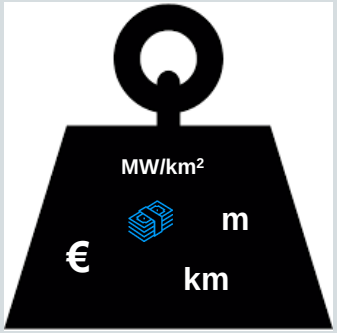
Where?

PURPOSE


Framework


Spatial Claims
Public Concerns
OWF Locations
Techno Economic
Environmental


Co-utilization


MW/km²
m
€
km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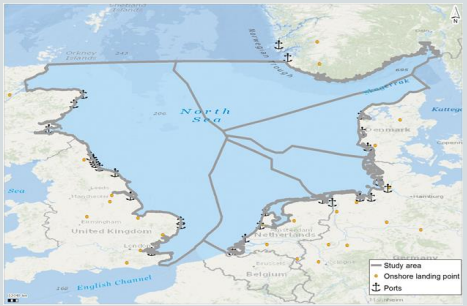
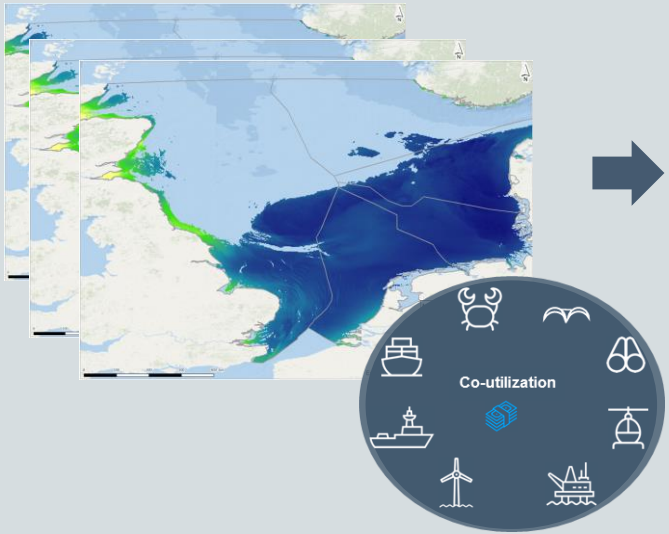
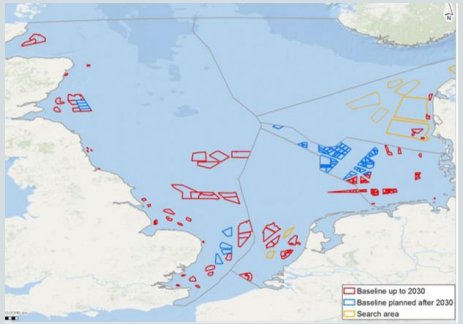
APPROACH







Set point of departure

Preliminary grid connection system, locations, users & test LCOE

Short list based on cost, nature, visibility

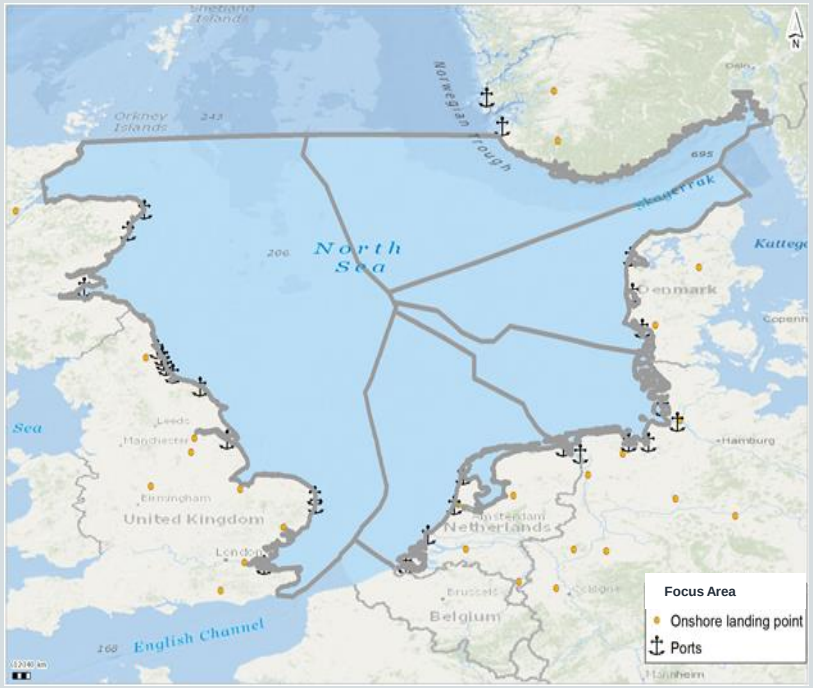
POINT OF DEPARTURE

Focused on:

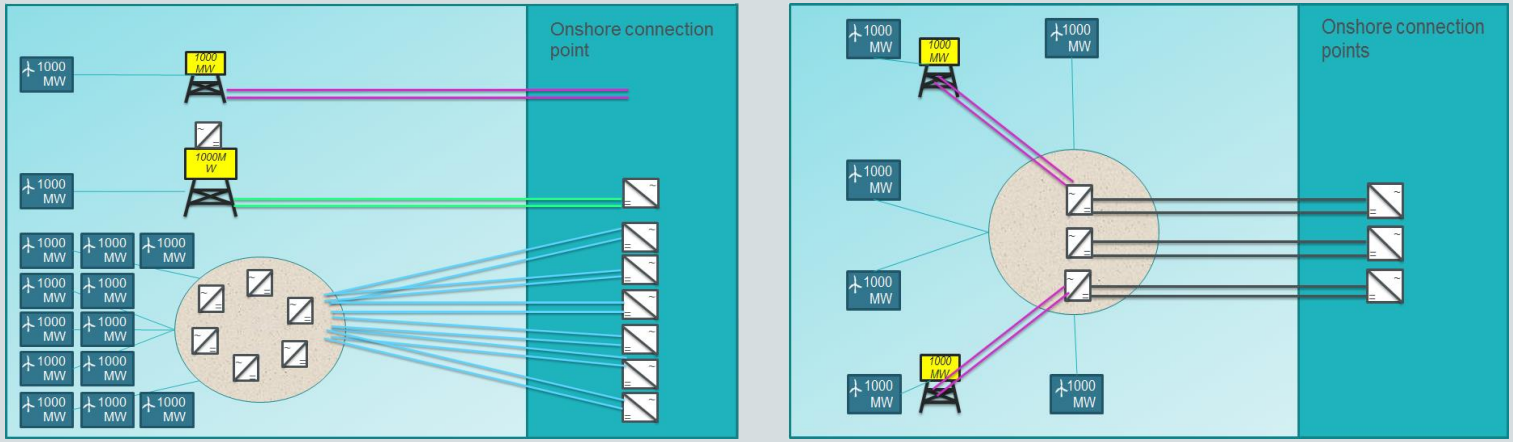
- Electrical infrastructure
- ‘End Game’
- Offshore OWF & TA

Offshore Wind Farm:

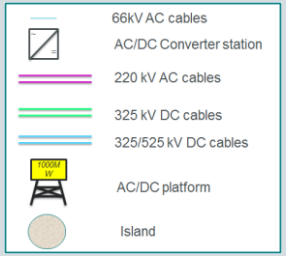
- Depth ≤ 55 m
- Size near ~ 1 GW
- Turbine: Fixed foundation 15 MW
- Capacity factor ~ 55%



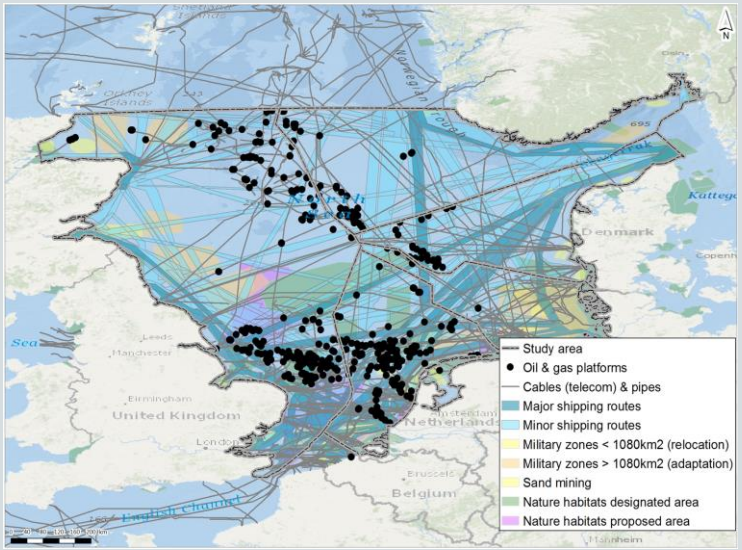
OFFSHORE GRID CONNECTION SYSTEM



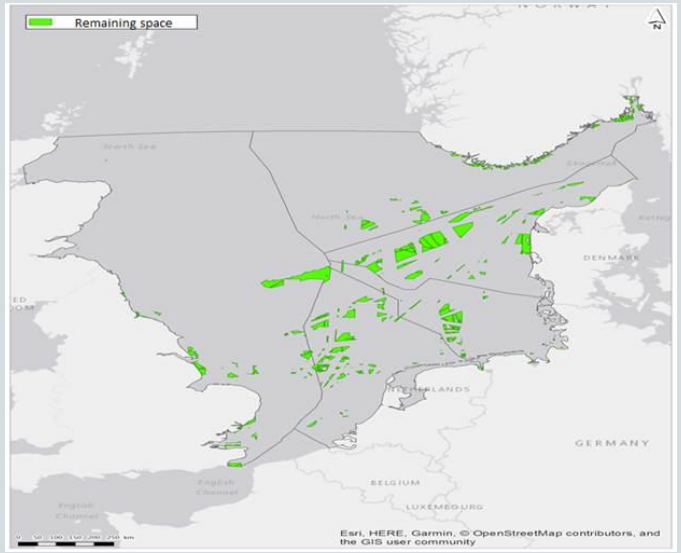
Schematic of offshore grid connection systems: AC-radial, DC-radial, Hub and Spoke



NORTH SEA CURRENT SPATIAL CLAIMS



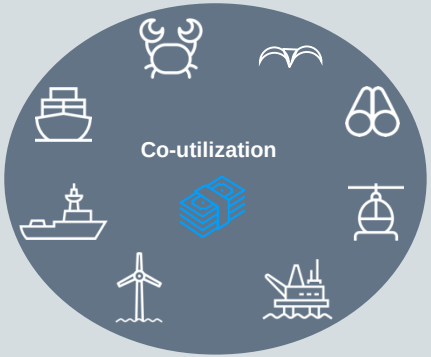
- North Sea multiple users and stakeholders
- Known appointed areas ~ 65 to 80 GW capacity



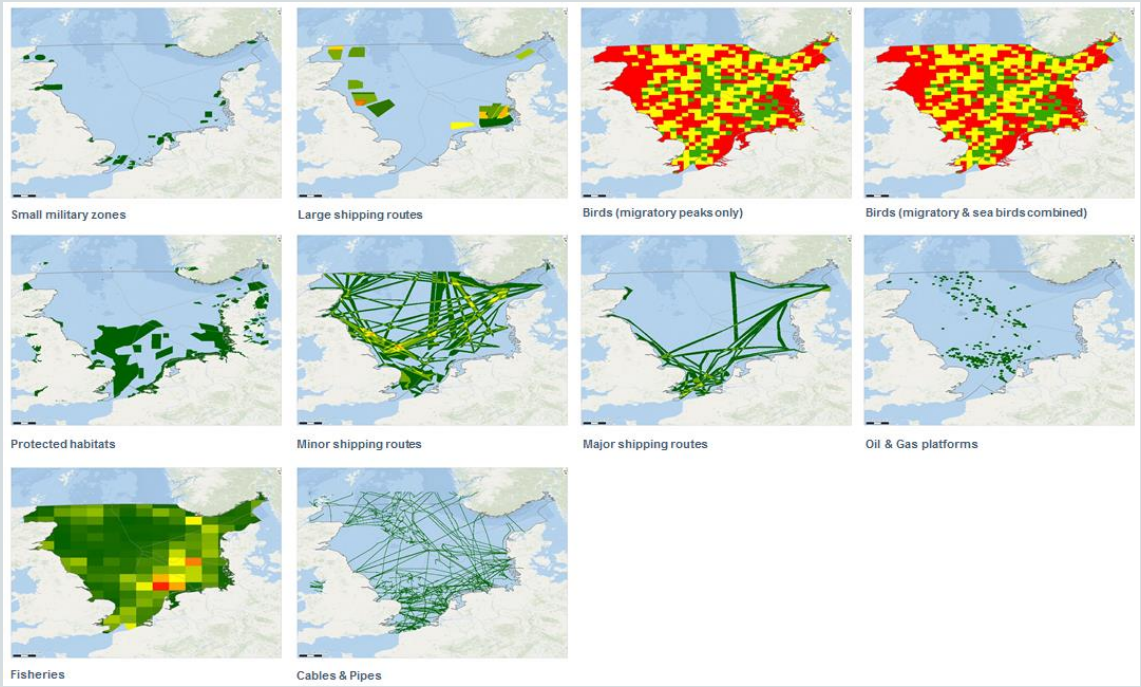
- Exclusionary approach leaves small, scattered OWFs
- Remaining space (≤ 55 m) ~ 13,190 km^2

NORTH SEA USER FUNCTIONS

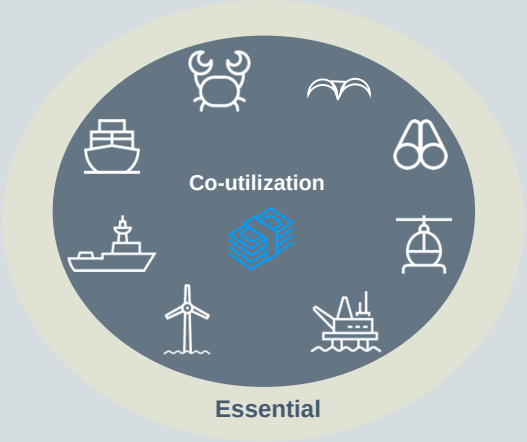
- Co-utilization & Adaption



- Excluded:
  - Cumulative impact costs of the total ‘roll out’
  - Broader perspective ‘shifted user’
  - ‘Procedural’ project delay



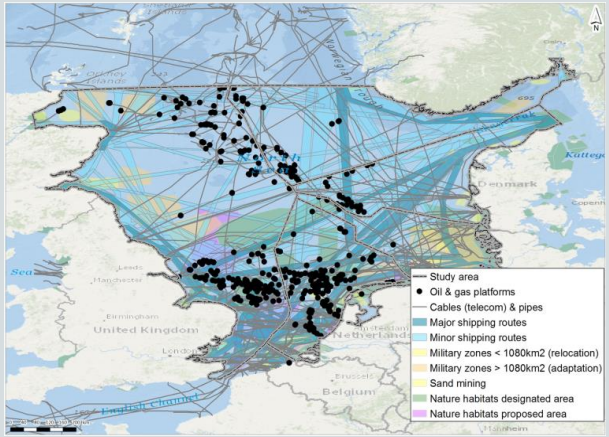
FIRST OBSERVATIONS

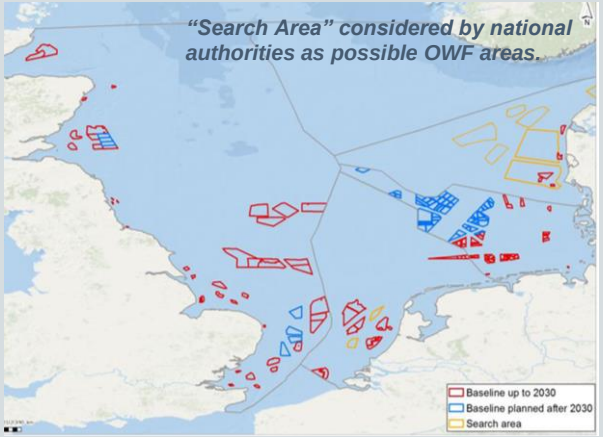


Cost Drivers

Hub Size
Power Density

AC Infra
Wake Losses





FIRST OBSERVATIONS HUB ISLAND BENEFITS

ALEXANDER VINK
TEAM LEAD COMMERCIAL

INITIAL THINKING AROUND NSWPH AS AN ISLAND

Key questions WindEurope 2017 Amsterdam:

- What benefits would an artificial island have for wind farm installation and O&M at locations >250 km from shore/port?
- What requirements are important to wind farm developers for co-development of such an island to realise these benefits? >> which business models support realising the identified benefits?
- Could the design of an artificial island contribute to a 10-15% cost reduction for wind turbine O&M far from shore (>250 km)?

CONTINUED ASSESSMENT OF POTENTIAL BENEFITS

Offshore Windfarm benefit study with TNO/ECN (2018)

- Starting point study:
  - What benefits would an artificial island have for wind farm installation and O&M at locations >250 km from shore/port?

- Market consultation Schiphol 3 July
  - 18 industry participants (OWF, SC, Dredgers)
  - Open and interactive discussion on initial assumptions
  - Feedback from participants led to valuable new insights
  - Based on these insight consortium and TNO/ECN decided to investigate 6 options

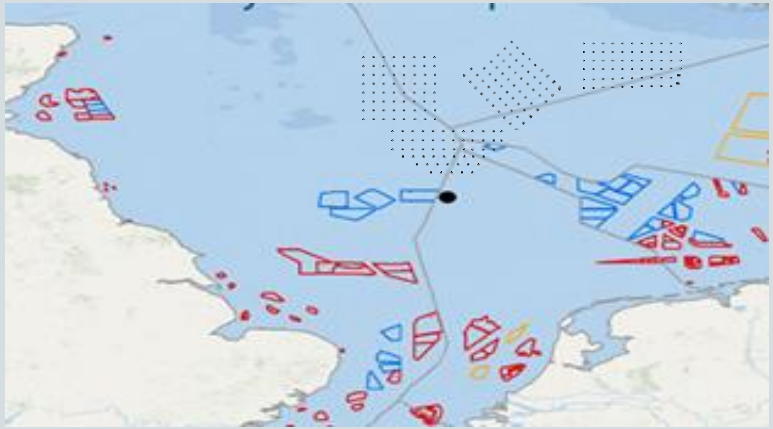
FIRST OPTIONS IDENTIFIED

Based on industry feedback first focus on:

- Installation & Commissioning (I&C)
  - Marshalling Harbour
  - Crew stationed on island for commissioning
  - Sheltering base in lee of island/ in island port

- Operation & Maintenance (O&M)
  - Accommodation of O&M personnel
  - Large warehouse to store spare parts
  - Shared jack-up barge

2035 ONWARD PLAN – KEY ASSUMPTIONS – I&C



SES (left) and an SOV (right)

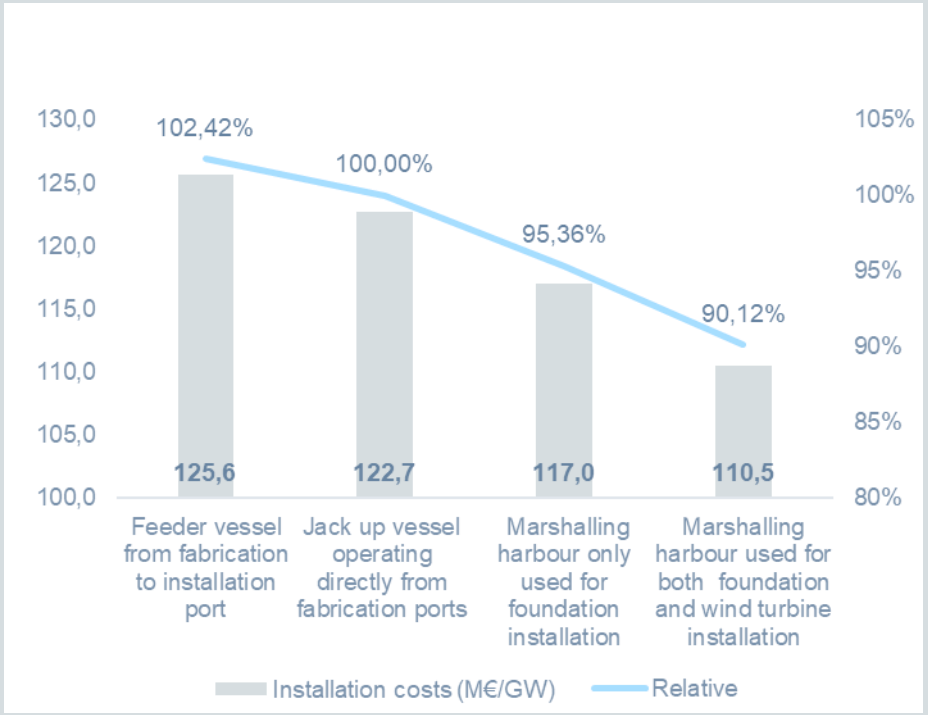
- 4 WF x 65 WT x 15 MW = 3.9 GW/year (260 WT)
- Ports:
  - Installation ports Seaton and Sunderland
  - Foundation: Rotterdam (380 km), Ijmuiden (320 km)
  - WT: Esjberg (380 km), Eemshaven (340 km)
- Max distance WF to island: 30 km
- OHVS (Offshore High Voltage Substation) & export cables excluded
- SOV: 2 weeks on/ 2 weeks off; crew change: island or “onshore” port
- SES: 2 weeks on/ 2 weeks off; after every 12hr shift: return to island

I&C : ISLAND AS MARSHALLING HARBOUR

Insight benefit of marshalling harbour at island:

- Less JUV (Jack Up Vessel) vessels needed (6 instead of 8), leading to a decrease in mob/demob costs
- Significant less travelling time causing also less weather delays, components are supplied by feeder vessel in advance (summer)
- Increase costs of un/load at island is compensated by significant travel time
- Most benefit in marshalling harbour for both foundation and wind turbine installation

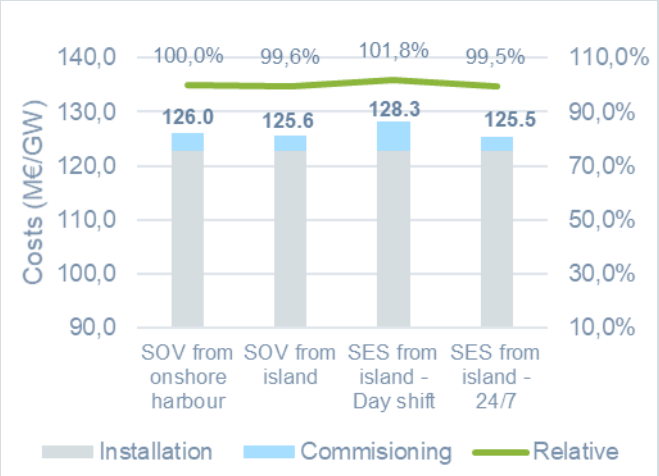
Benefit: ±12 M€/GW or ± 10% reduction



ISLAND FOR COMMISSIONING & SHELTERING BASE

Insight for commissioning

- Constructed 4 WF/year to be commissioned during last quarter on each year
- SES has significant lower day rate than SOV, SES has significant lower workability than SOV
- Benefit in SES, island based, is limited at **569 k€/GW installed**



Insight for sheltering around island/in island port:

- Sheltering JUV needed when Hs > 6 m
- Hs> 6m happens 7 times in 10yr period at Dogger Bank, conform Metocean data

	SOV	SES
k€/day	50	10
Hs (m)	3	2
Accessibility	~91%	~72%

2035 ONWARD PLAN – KEY ASSUMPTIONS – O&M

- 3.9 GW WF: 18700 GWh/year ~4800 Full Load Hrs/yr
- O&M Ports in case not from island: O&M: Seaton UK, Sunderland UK (220 km)
- Max distance WF to island: 30 km: 12 – 36 GW
- SOV: 2 weeks on/ 2 weeks off; crew change: island or “onshore” port
- SES: 2 weeks on/ 2 weeks off; after every 12hr shift: return to island
- Spare parts < 2 ton handled by SOV; heavier spare parts are handled by JUV
- JUV in island port: 10% of traveltime vs “onshore” port
- JUV permanent under contract of WF operators: day rate -/- 33% vs spotmarket

BENEFITS ISLAND FOR O&M PURPOSES

- Accommodation of O&M personnel on island
  - Although SOV travel time ↓, no significant benefit
  - Costs of SES from island 24/7 < SOV from island, but SES workability < SOV leads to increased repair time and reduced production
  - Benefit max: SOV 24/7 from island → **0.143 €/MWh**
- Warehousing for large WTG spare parts on island
  - Spare parts between 2-100mT are stored at island
  - Costs of warehouse at island is not included
  - Downtime decrease is very limited (0.1%)
  - Small cost increase: **0,005 €/MWh**

- Shared jack-up vessel at the island combined with large warehouse
  - mobilisation time is significantly lower
  - travel time is significantly lower causing lower weather delays
  - Result: fast response resulting in lower standstill times and greatly reduced lost production
  - Benefit: **0.6 €/MWh produced**

NEXT STEPS

Internal Consortium

- Finalise report with TNO/ECN
- Conduct internal cost/benefit analysis
- First preliminary observations

External

- Follow up of the 3 July MC session (international airport):
  - aim to refine assumption sheet and discuss more in depth the findings.
- Discuss and review together the assumptions investigated and discuss which other options could prove beneficial?
- Open for bilateral meetings to discuss!

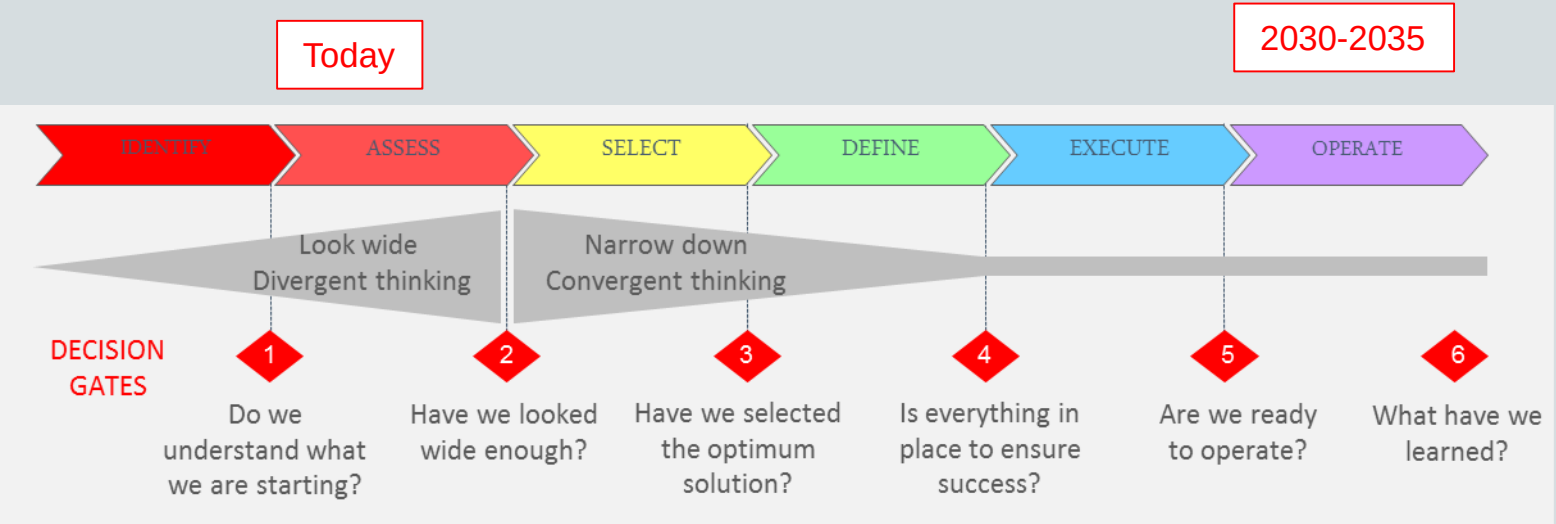
NSWPH IN THE CONTEXT OF THE NORT SEAS OFFSHORE ENERGYCLUSTERS STUDY

UWE WEICHENHAIN
ROLAND BERGER

ROLAND BERGER SLIDES IN SEPARATE FILE

PLANNING AND PROCES GOING FORWARD

PROCESS OUTLINE



Thank you for your attention

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