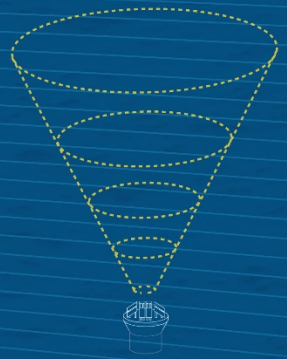
Carbon Trust Offshore Wind Accelerator

Collaborative R&D: An effective way of pulling innovation to market

DeepWind 2015

12th Deep Sea Offshore Wind Conference



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Offshore Wind Accelerator is a Joint Industry Programme to drive down costs

Objective: Reduce cost of energy by 10% in time for Round 3

- **Joint industry programme involving 9 developers + Carbon Trust**
- **International outlook for best ideas**
  - OWA programme is tailored around internal R&D priorities of 9 large developers
- **£45-60m programme**
  - 2/3 industry, 1/3 public (UK Government – DECC and Scottish Government)
- **Value to government and industry**
  - New lower-cost technologies, ready to use
  - Insights into best technologies for Round 3
  - Simple governance model
- **Set up 2009 and commitment to 2016**

OWA is unique in commercialising innovations

The Industry decides what is required

Technology push versus Market Pull

- Technology tries to find application
- May not meet customer needs

OWA approach

- Research is close to market and commercially-focused
- Industry involved in the innovation process.
- Technology will meet market needs
- Aligned objectives

Flexible to utilise opportunities

- Funding available when needed
- Annual funding allocated by Government.
- No requirement to apply for funding
- This makes it possible to utilise opportunities for testing and demonstration when they arise.

Good leverage

- 2/3 industry funding
- 1/3 public funding
- For Common R&D we have a leverage of 13.5:1
- For every £1 a partner invests he will get £13.5 of research

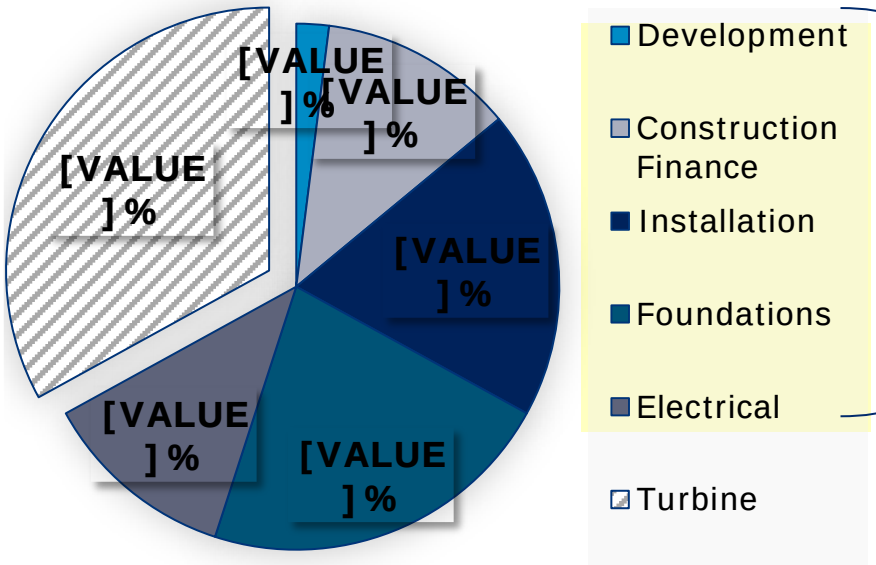
Effective way of learning from each other

- Five working groups for different disciplines e.g. foundation, electrical
- Steering Committee providing strategic direction.
- Over 60 experts involved
- Open discussions and exchange of information

Six research areas

Focusing on everything but the turbine, representing roughly 70% of offshore wind costs

LCOE Breakdown



Source: Navigant (offshore)

OWA has made real impact so far

Demonstrating innovations is critical to achieve cost reduction

Reducing O&M cost
New vessels concepts

Fjellstrand

Prototype: 2013

NautiCraft

Prototype: 2014

WaveCraft

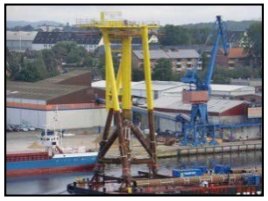
Prototype: 2015

Extreme Ocean

Prototype: 2015

Reducing Foundation cost
New foundation concepts

Keystone

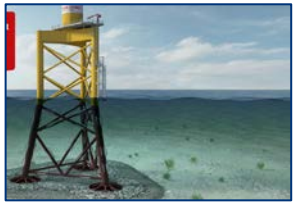


Installed: 2011

Universal

Installed: 2013

Suction Bucket Jacket



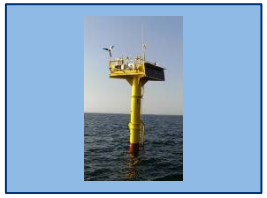
Installed: 2014

Reducing Financing cost
New wake models & LIDAR

FLIDAR

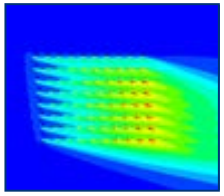
Installed: 2012

Babcock



Installed: 2013

Fuga



Prototype: 2011

Wake Campaign

Installed: 2012

Reducing Elec. System cost
Higher voltage arrays

66kV

Commercial: 2015

Cable qualification

Commercial: 2015

Suction Bucket Jacket demonstration with turbine

Objective
Full scale demonstration of a new foundation concept

Benefits
Structure is easier to fabricate – standardisation and simpler welds
Suction buckets allow fast and quite installation

Status
Fabrication completed
Installed at Borkum Riffgrund

Participants: Dong Energy (lead), E.ON, SPR, Statoil, Statkraft, MRP

Suction Bucket Jacket - Installation

Suction Bucket Trial Installation

Objective: To better understand the sensitivity of suction buckets to challenging soil conditions.

UF suction bucket and a reference bucket installed and withdrawn at a 12 locations

Installation started in September 2014

4 participants (Statoil – lead partner, DONG Energy, E.ON, Statkraft)

Proving feasibility in different soil types

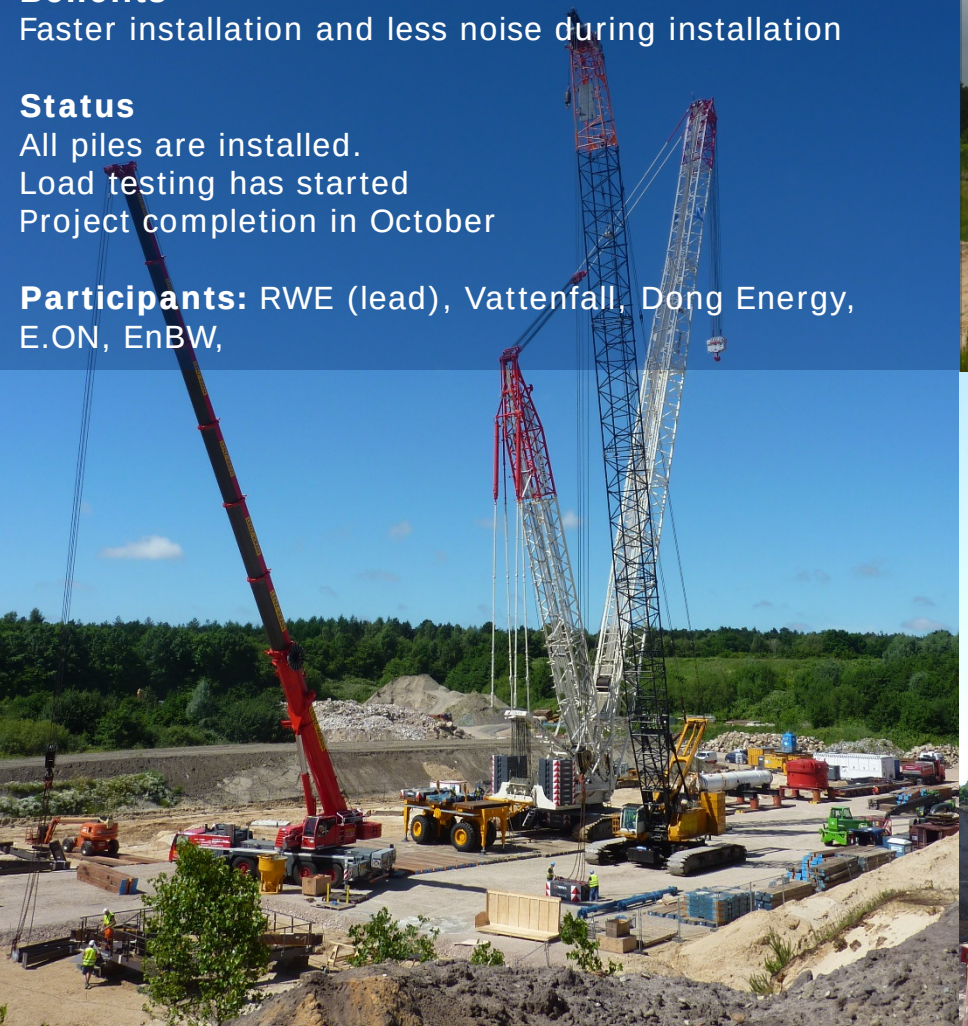
VIBRO driving foundation installation method

Objective
Demonstrate the loading capacity when using vibratory pile driving

Benefits
Faster installation and less noise during installation

Status
All piles are installed.
Load testing has started
Project completion in October

Participants: RWE (lead), Vattenfall, Dong Energy, E.ON, EnBW,



Vibro - Vibrodriving of Foundation Piles

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Electrical Systems and cable installation work

Cable installation projects:

- Free hanging cables
- Revised BPI
- Tendering of
  - Reduced weather downtime
  - Condition monitoring

Electrical System projects:

- We aim to increase intra-array voltage from 33kV to 66kV
- Grid connection technologies:
  - Optimise HVDC and AC transmission
  - Tendering of:
    - LFAC
    - Condition monitoring

First of Fjellstrand WindServers is now in the water

Advantage

- Fast and efficient
- Stability in station-keeping

Participants:

- All OWA partners

Source: Fjellstrand 2013

Umoe Mandal's Wave Craft

Prototype to be completed next year

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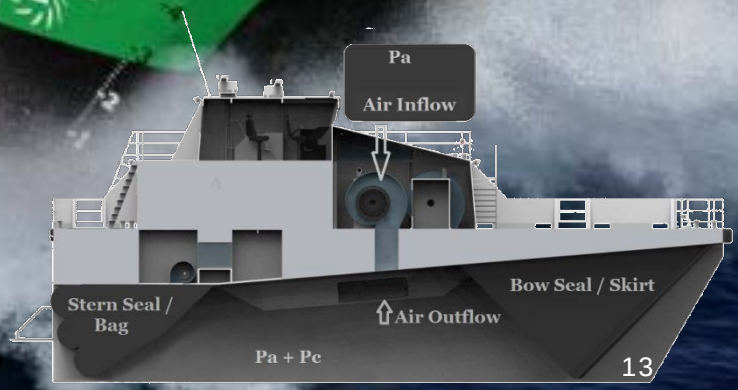
Advantage

- Speed
- Air cushion compensates motions

Participants:

- All OWA partners



Source: Umoe Mandal 2013

Floating Lidars Validation

OWA Validation Campaign

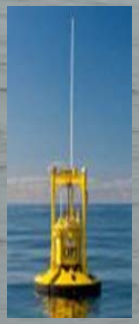
Objective
–To make Floating LIDAR a bankable alternative to conventional met masts

Approach
–Validation designed according to Roadmap KPI
–Gwynt Y Môr hosted provided IEC compliant met mast data

The alternative to Met Masts



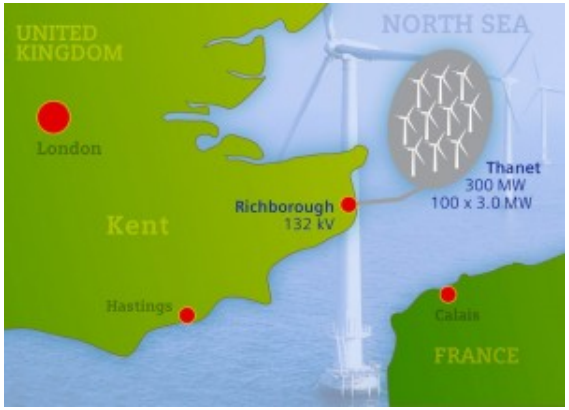


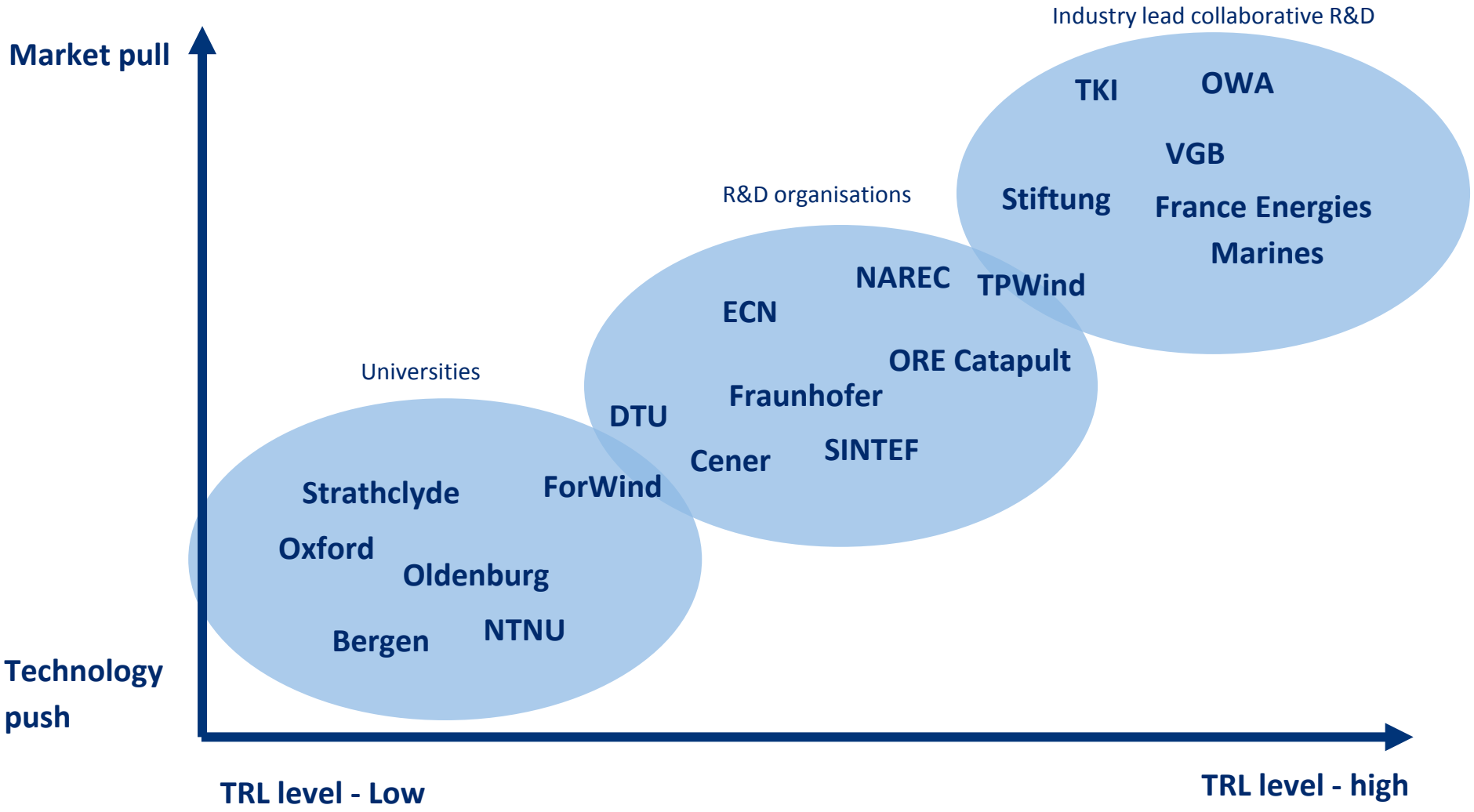
ORJIP - Bird collision avoidance study

Project to monitor bird behaviour for ~2 years at Thanet

- Objective: Understand behaviour of bird in and around a wind park
- DONG Energy, EDF, Eneco, Fluor, MRP, RWE, Siemens, SPR, SSE, Statkraft, Statoil and Vattenfall have signed funding agreements
- Status: Monitoring equipment installed and observations taking place.



EU R&D landscape



Current coordination activities

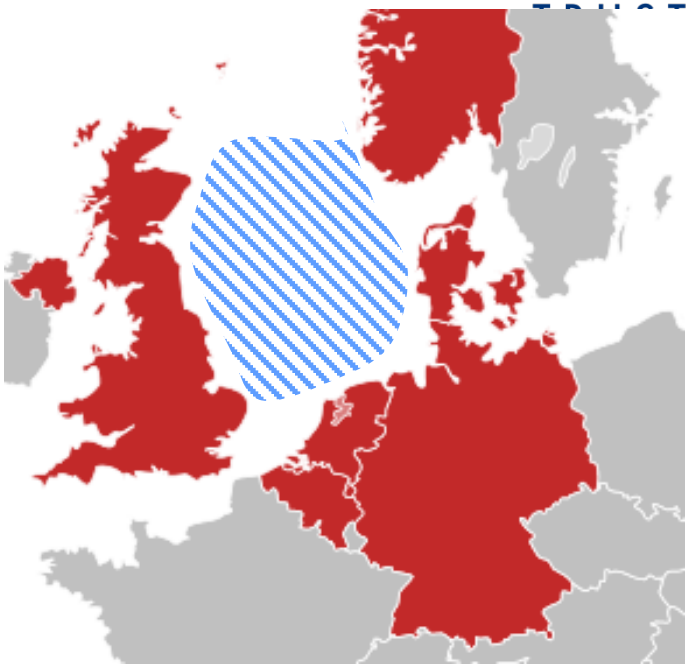
- **ForWind** - Joint Centre for Wind Energy Research of Universities
- **Energy Technology Partnership** - alliance of twelve independent Scottish Universities
- **EPSRC** - Research council supporting university collaborative research
- **SUPERGEN** - The SUPERGEN Wind Energy Technologies Consortium (SUPERGEN Wind) is a UK wind energy research consortium of Universities
- **EERA** - The European Energy Research Alliance (EERA) is a collaborative network to accelerate the development of new energy technologies.
- **TPWind** - The European Technology Platform for Wind Energy (TPWind) is the indispensable forum for the crystallisation of policy and technology research and development pathways for the wind energy sector

There is currently no collaboration of Industry lead R&D initiatives at EU level

We have started considering to expand the programme

Why establish a larger R&D collaboration across Europe?

- European developers have **common challenges** for cost reduction
- Centralised risk and **cost sharing is more efficient** and better use of scare industry resource
- A wider reaching OWA programme will ensure **closer coordination with other R&D initiatives** and less duplication



Why should we build on the Offshore Wind Accelerator model?

- Over the past 6 years of **OWA programme outputs have proven that industry-led, market-pull R&D is effective** and a high value means of accelerating commercialisation of innovations, especially those requiring large-scale demonstrations
- **Governance model has been refined over past 6 years to minimise administration** and ensure projects can be started quickly while ensuring state aid compliance
- OWA developers/operators have been involved in over ¾ of European projects and they believe the **OWA is an effective means of achieving cost reductions through RD&D**

Conclusions

- Cost reduction for Offshore Wind is a common challenge across the North Sea
- Innovation has the potential to deliver three-quarters of this cost reduction but commercialisation and demonstration of technology is critical to achieve this.
- The industry is international, and we need to work together to get the best ideas – we won't find the answers alone
- OWA is an example of collaborative R&D in offshore wind – an efficient framework for delivering joint industry projects
- A northern European, industry lead R&D initiative based on the OWA model will accelerate cost reduction.

Questions?

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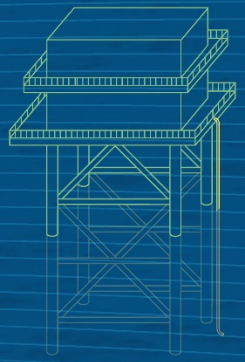

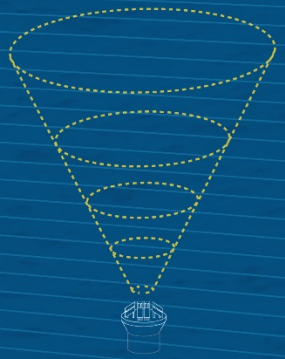

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