Carbon Trust Offshore Wind Accelerator

A joint industry project to deliver cost savings for European Offshore Wind Projects

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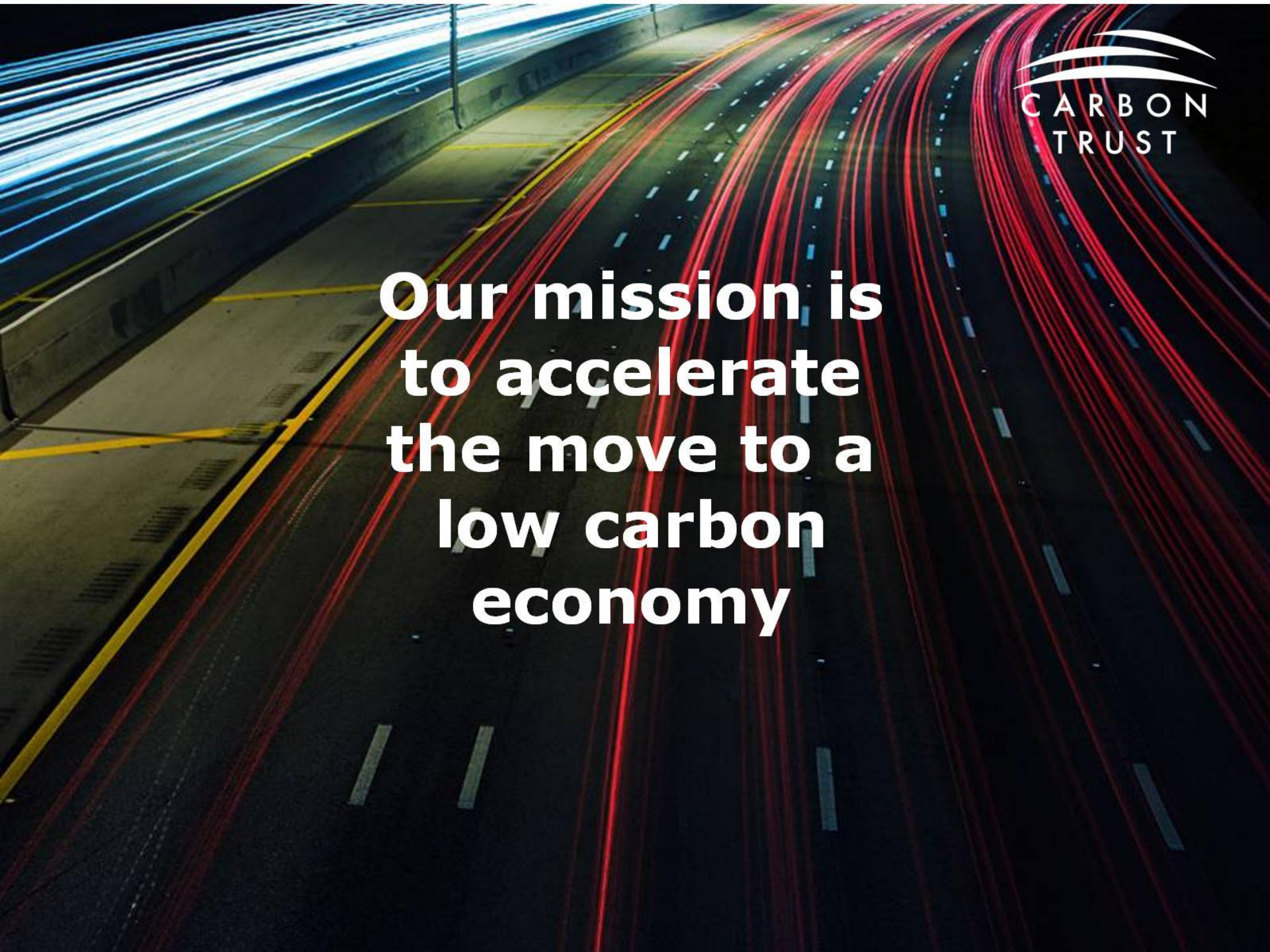
Director, Asia

World Energy Green Forum
18 October 2012, Gyeongju, Korea

CARBON TRUST
DONG energy
e·on
MAINSTREAM RENEWABLE POWER
RWE The energy to lead
SCOTTISHPOWER RENEWABLES
SSE Renewables
Statkraft
Statoil


CARBON
TRUST
Our mission is to accelerate the move to a low carbon economy

Climate Change Act 2008

- Unilateral, legally binding emissions reduction targets
- The world's first long-term national legal framework, in full compliance with the Kyoto Protocol
- Reducing by at least 34% by 2020 and at least 80% by 2050, from 1990 baseline

Our activities span 4 areas

- Standards and accreditation
- Policy & markets
- Specialist advice and finance
- Innovation & technology acceleration

Our innovation activities span the low carbon technology space

- **Creating commercial ventures** for early-stage technologies:
  - Pyrolysis
  - Polymer Fuel Cells
  - Advanced PV
- **Boosting cleantech start-ups**:
  - Our "Entrepreneurs Fast-Track" provides start-ups with business support, grants and networking
  - Our experience of over 3,000 start-ups means we can pick potential winners – and transform their chances of success
- **Demonstration programmes**:
  - Advanced Metering
  - Biomass heat
  - Micro combined heat and power
  - Low carbon buildings
- **Cost reduction acceleration**:
  - Marine energy
  - Industrial energy efficiency
  - Offshore wind

We work with customers to deliver their clean technology goals

CARBON TRUST™

Delivering different solutions for different customers along the innovation journey

Prioritising innovation areas → **Designing** innovation initiatives → **Delivering** innovative solutions

Example customers:

DEPARTMENT OF ENERGY & CLIMATE CHANGE

Technology Strategy Board
Driving Innovation

The Scottish Government

GE

Confidential: oil and gas major

DONG energy
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We work with customers to deliver their clean technology goals

CARBON TRUST™

We support our customers along the whole technology commercialisation journey

Prioritising innovation areas → **Designing** innovation initiatives → **Delivering** innovative solutions

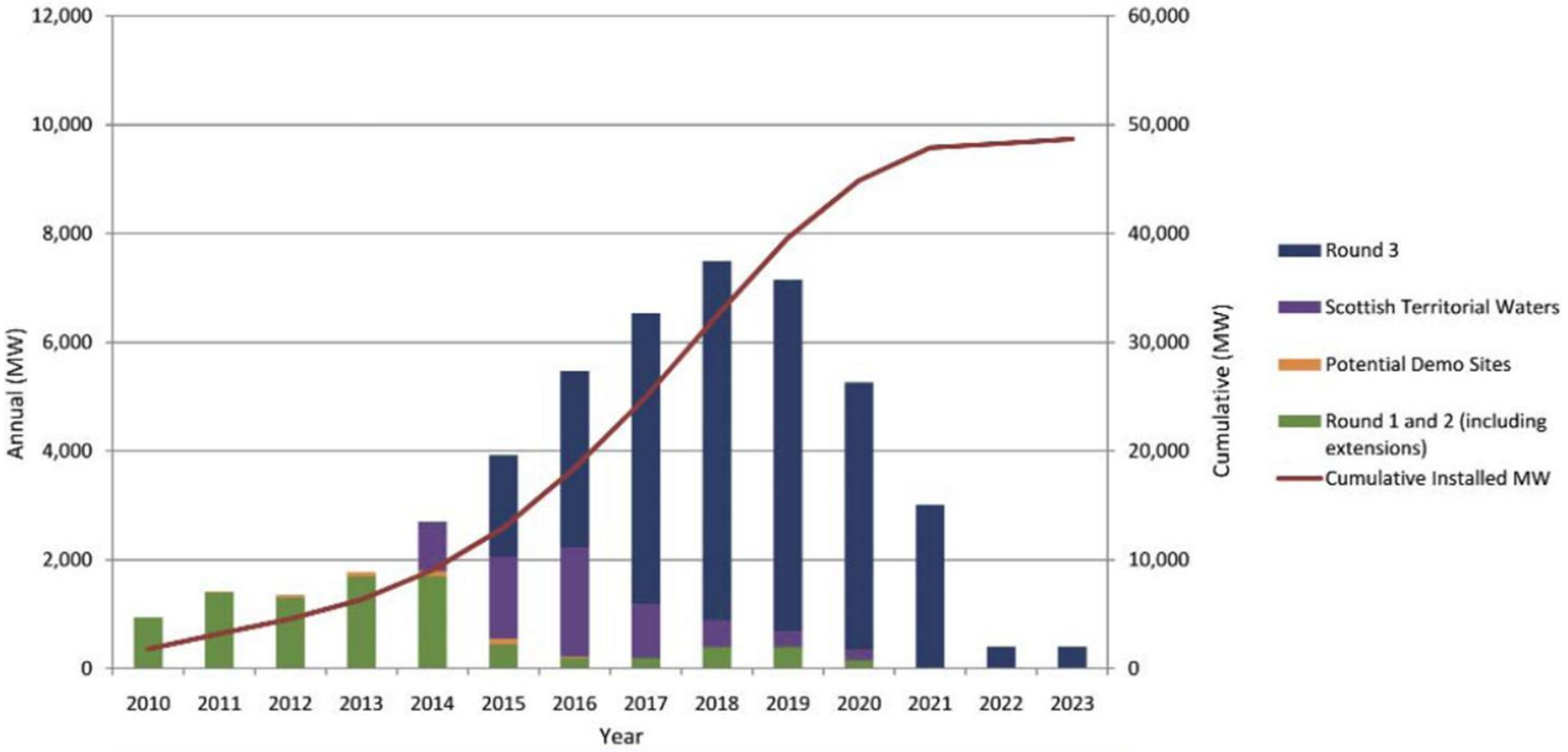
Examples of what we do

- **Synthesise** market dynamics and other external factors
- **Identify innovative start-ups** and other developments
- **Prioritise** which cleantech investment options constitute the best portfolio to create value
- **Inform potential roles in the value chain** based on available resources, economic drivers, market structures

- **Roadmap** potential activities in the sector and define specific objectives and timescales
- **Select suitable engagement models**, from consortia to competitions, investment to joint R&D
- **Structure tailored programmes** to overcome specific barriers, de-risk innovation and catalyse investment
- **Identify potential project** partners, funding sources

- **Negotiate**, contract and set up necessary structures then programme manage delivery
- **Run** targeted, global **competitions** to source best solutions
- **Convene consortia** of major industrial players to share R&D costs
- **Create commercial vehicles** to best incentivise teams
- Provide **incubation** support to de-risk potential start-up investments

UK has ambitious offshore wind deployment plans



- Investment of ~$160bn over 10 years
- Total of 6000 new turbines to be installed

Source: The Crown Estate 2010

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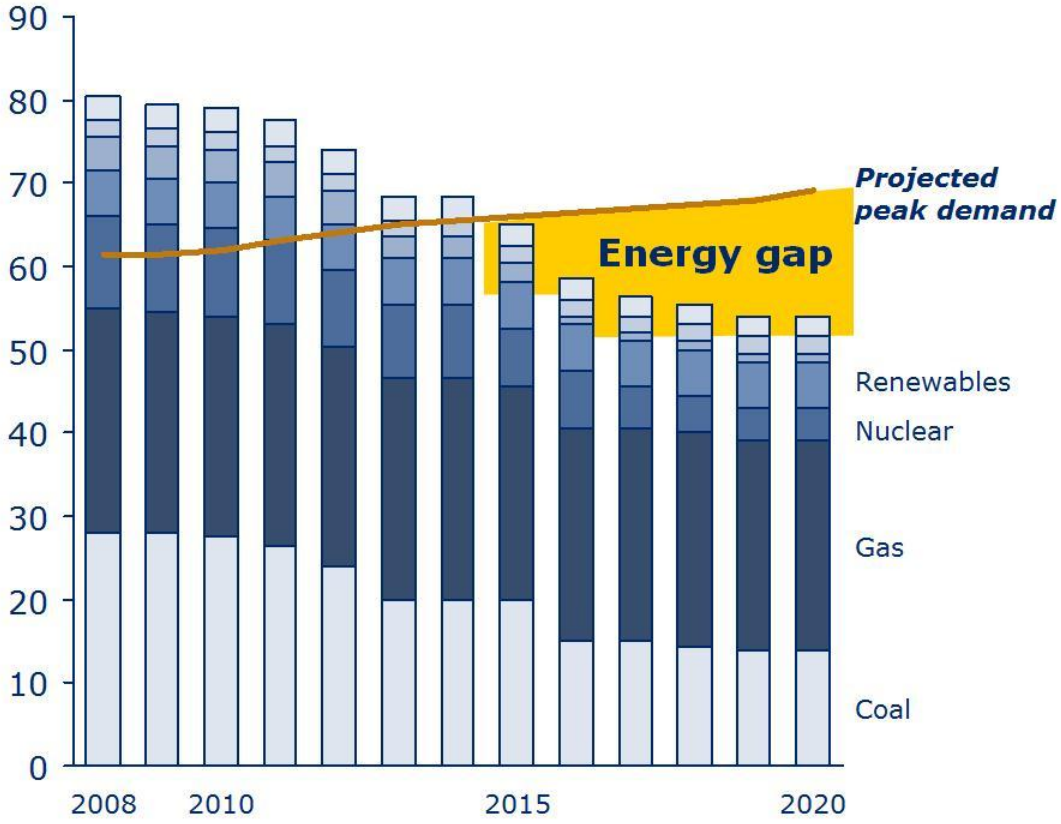
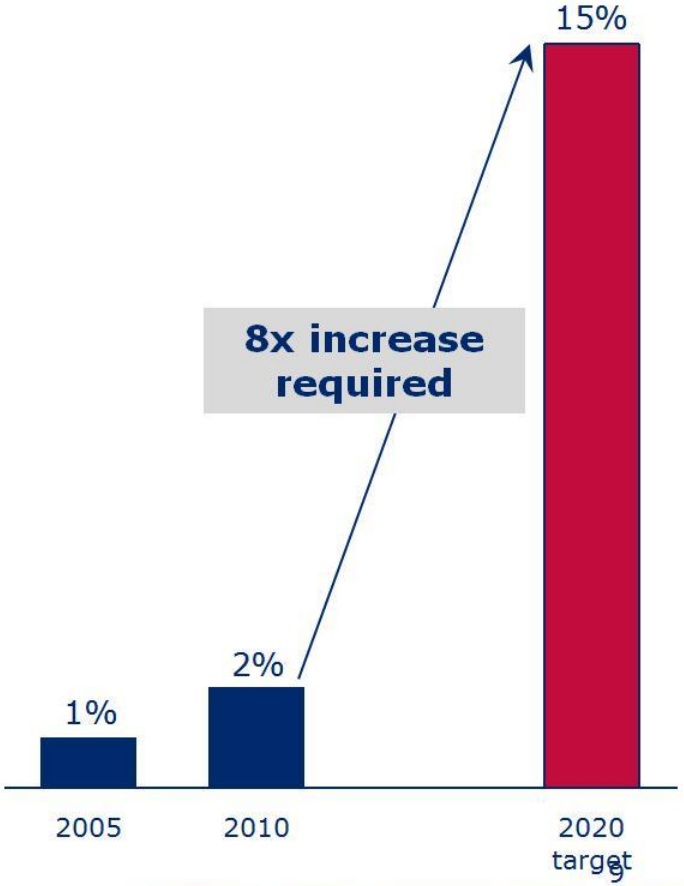
UK faces an energy gap and tough renewable energy target

There is a need for mass deployment of offshore wind

Installed capacity, projected demand (GW), 2008-2020



% of UK energy from renewables, 2005-2020



Source: Committee on Climate Change, 2008 (based on DECC Energy Model)

UK leads the offshore wind market

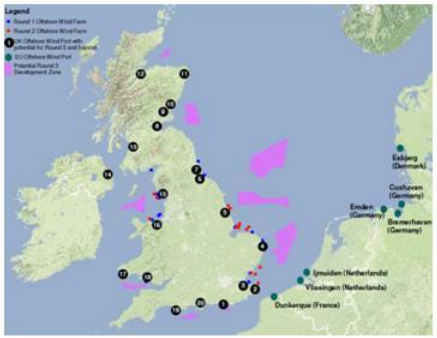
Inward investment

SIEMENS

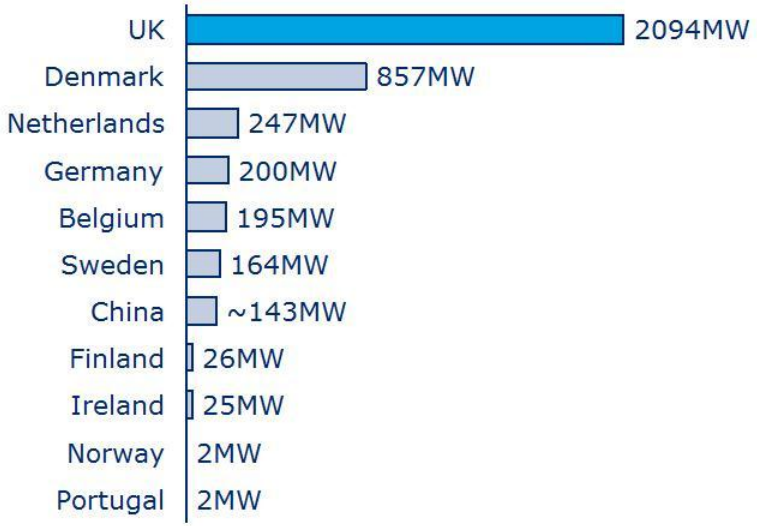
Gamesa

MITSUBISHI HEAVY INDUSTRIES, LTD.

SAMSUNG



Installed capacity (2011)



- **Manufacturing is moving to UK to create a North Sea hub**
- **Expected to create 70,000 jobs by 2020**

International licenced capacity to be developed by 2020-30

- UK: 48GW
- Other Northern Europe: 40+GW
- China: 30GW
- Republic of Korea: 2.5GW

Source: Carbon Trust 'Big Challenge, Big Opportunity' 2009, EWEA 2012, Xinhua 2011, Carbon Trust analysis

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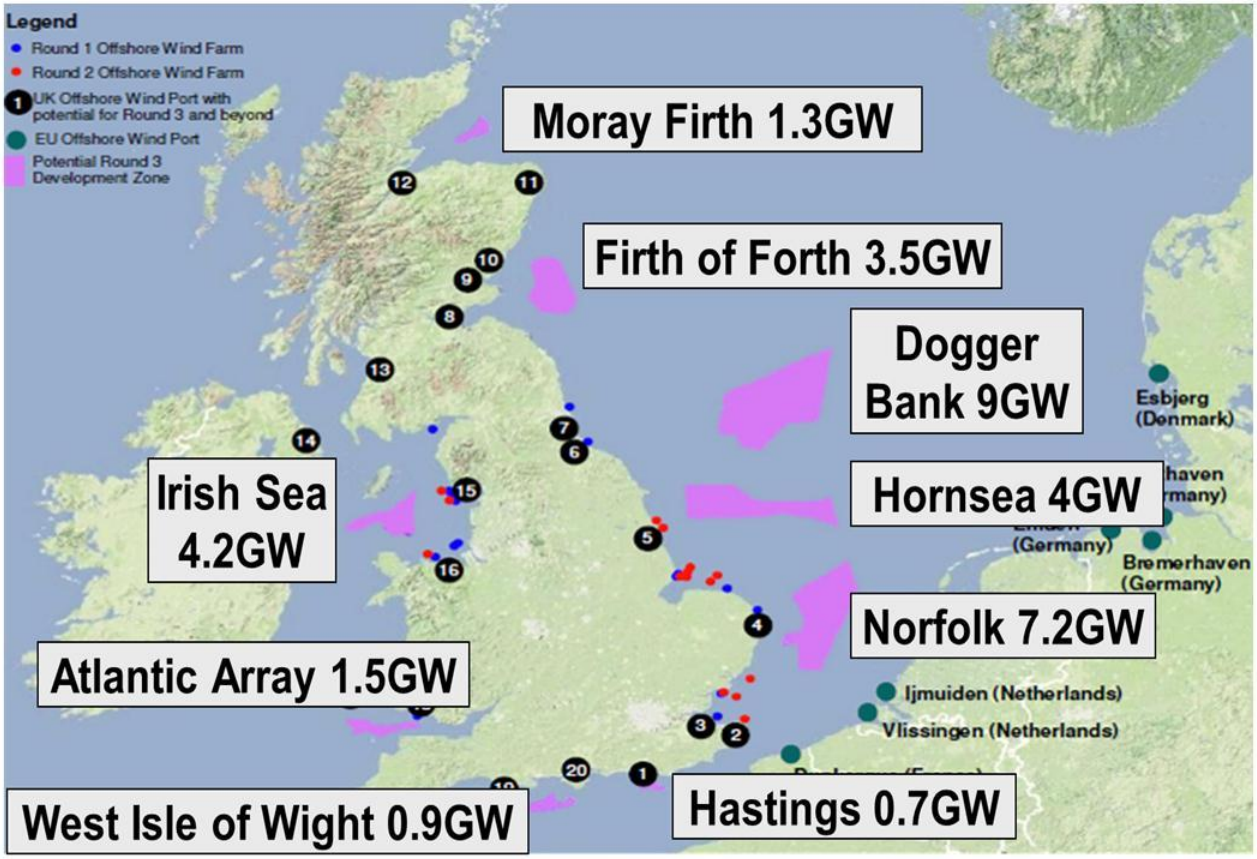
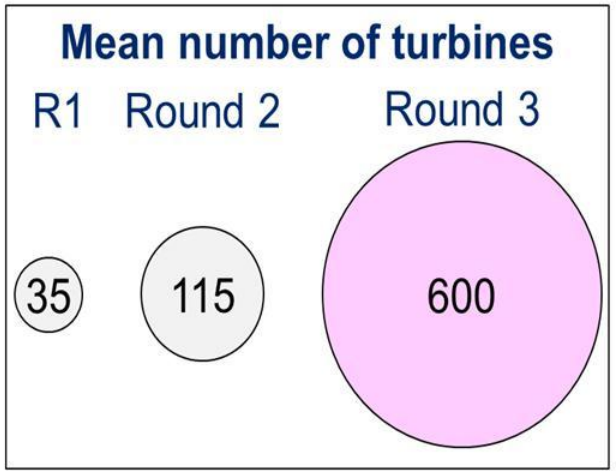
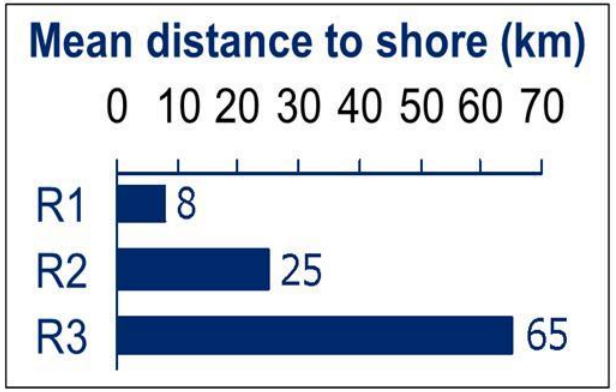
Round 3 wind farms will be larger and further offshore







Source: Map taken from UK Ports for the Offshore Wind Industry: Time to Act, DECC / BVG Associates, 5 February 2009, p.17; Carbon Trust analysis of The Crown Estate data 2011

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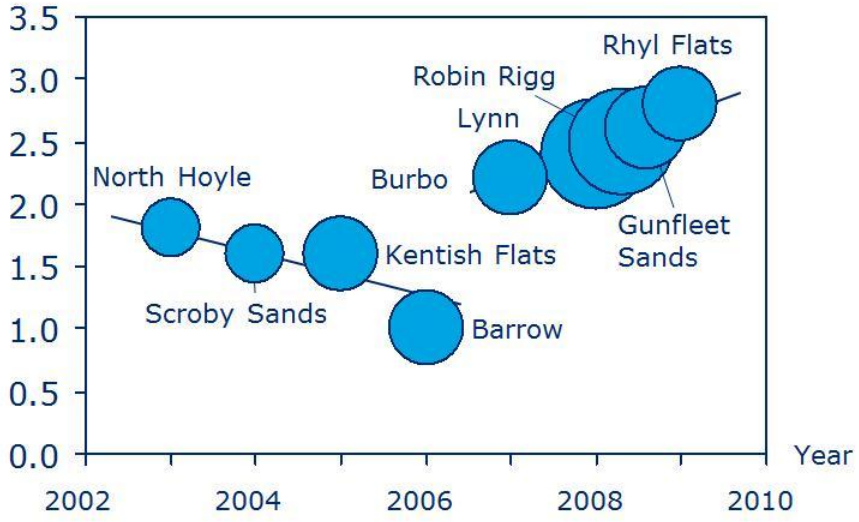
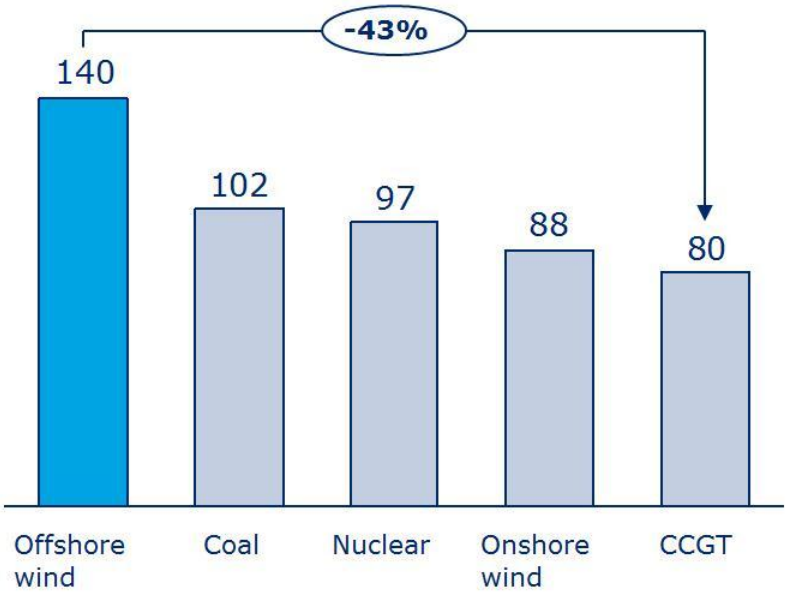
Resulting in a cost challenge

Capital cost
(€m/MW – UK)



Drivers
- Rising commodity prices
- Bottlenecks in supply chain
- Complexity of sites, distance, depth
- FX rate volatility

Cost of energy
(£/MWh - UK)



Industry is targeting 30% cost reduction by 2020

Source: Emerging Energy Research 2009, UKERC 2010, Carbon Trust analysis

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Offshore Wind Accelerator

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

- **Joint industry project involving 8 developers + Carbon Trust**
  - Learn from each other
  - Do more RD&D than would be possible individually
- **£45m programme**
  - £10m for collaborative R&D
  - Up to £35m for demonstrations
  - Carbon Trust funds 1/3

R&D model is unique

- **Only offshore wind developers are members**
  - Aligned interests, very collaborative
- **Research is close to market and commercially-focused**
- **Innovation contracted to 3rd party designers who keep their IP**
  - Attracts the best innovators from around the world
- **In return, OWA members can negotiate preferential terms to procure designs funded by the OWA**
  - eg, royalty-free licences when deploying OWA foundations
- **Value for money**
  - For every £1 invested by an OWA member results in £12 of Common R&D
  - Each member contributes equally: £920k in total over 2009-2014

OWA will be continuing for at least another 2 years

Stage I model

Approach: Feasibility phase, then demonstration phase

5 developers

Airtricity, DONG energy, RWE The energy to lead, SCOTTISHPOWER RENEWABLES, Statoil

18 month commitment

£1.5m for Common R&D

60+ people involved

160+ companies engaged

Stage II model

Approach: Multi-year common R&D with demonstration spin-offs

8 developers

DONG energy, e.on, MAINSTREAM RENEWABLE POWER, RWE The energy to lead, SCOTTISHPOWER RENEWABLES, SSE Renewables, Statkraft, Statoil

5.5 year commitment

£9.2m for Common R&D

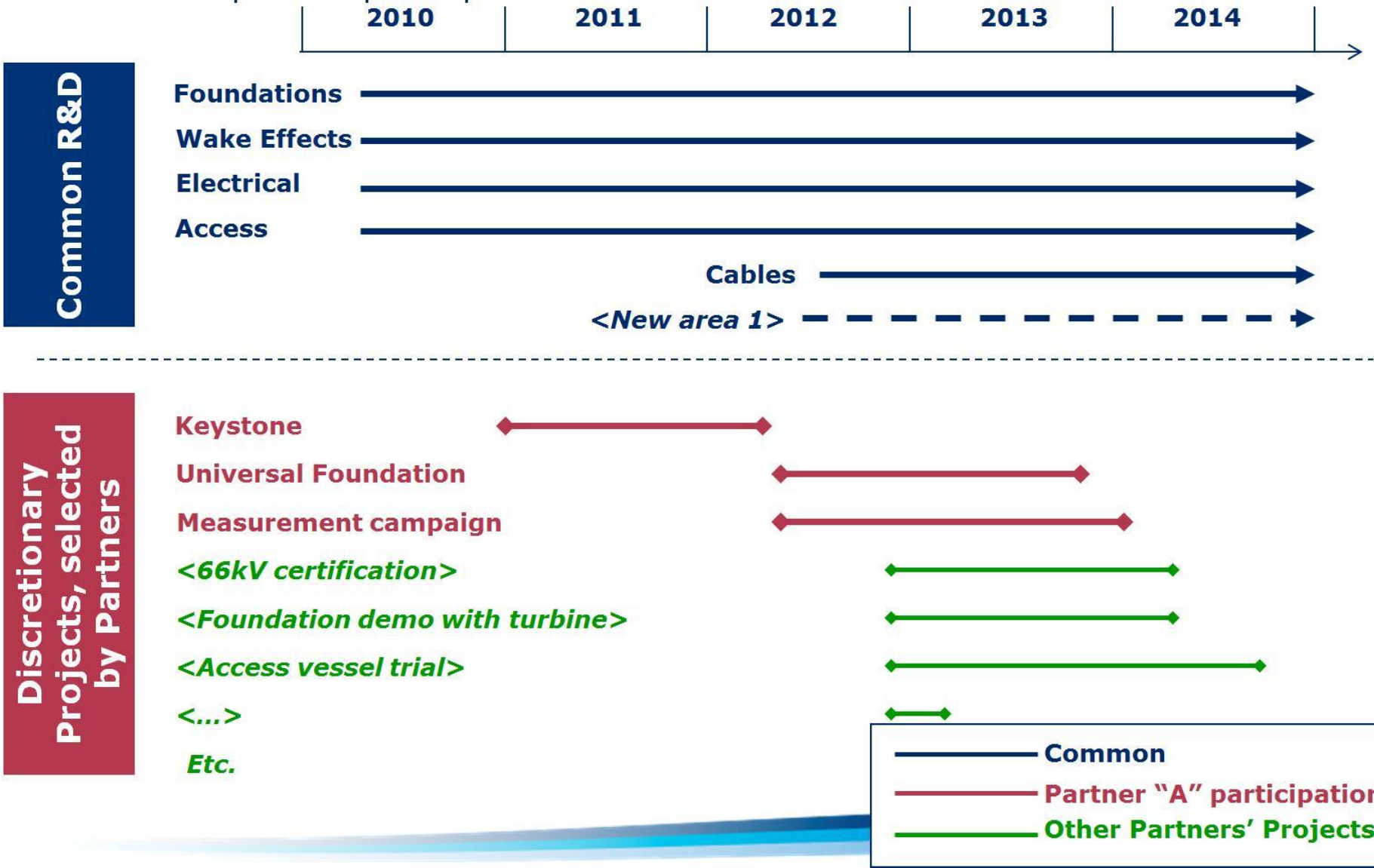
3 discretionary projects

200+ people involved

550+ companies engaged

Two types of project: Common R&D and Discretionary Projects

Partners opt-in to participate in demonstration DPs



OWA focuses on five research areas to drive down costs

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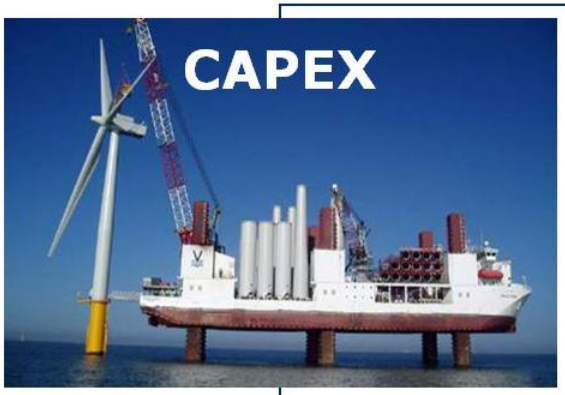
Cost of energy



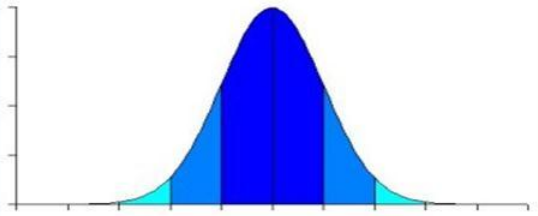
Foundations

Access systems

Electrical systems

Cables

Cost of finance

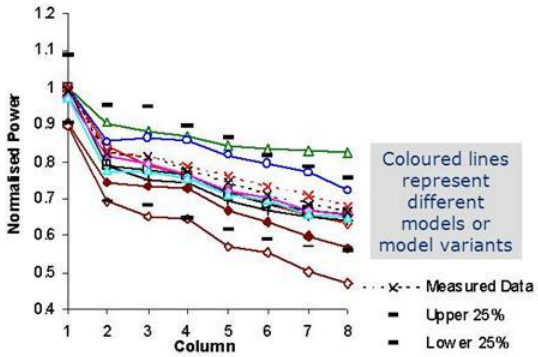


Wake effects

Understanding wake effects is key to higher yields

OWA has focused on improving yields, reducing financing costs

Faster and more accurate models

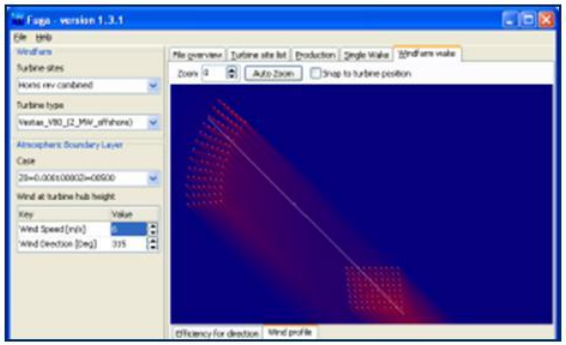


AEP prediction for 225 turbines

–Traditional models: 20-weeks (mainframe)

–New model: 30s on desktop PC

Revolutionary new layout designs



New layout optimisation design tool has identified higher yield designs

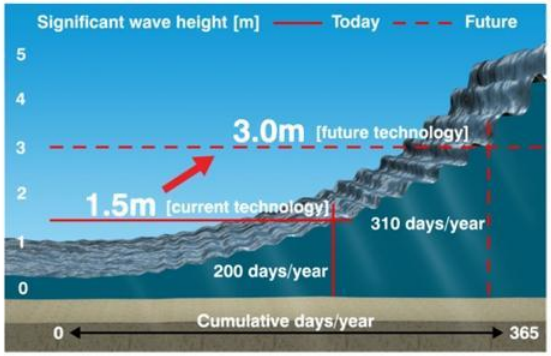
Wind resource measurement

Validating 3 floating LIDARs vs met mast in Irish Sea in Spring 2012

Next step: comprehensive measurement campaign to improve models further

Thirteen concepts from Access Competition are receiving financial and technical support

Next step is vessel trials and prototype testing



Transfer systems

Auto Brow – Ad Hoc Marine, South Boats

In-field crew transfer vessels

SolidSea Transfer

University of Strathclyde Glasgow

Launch & recovery

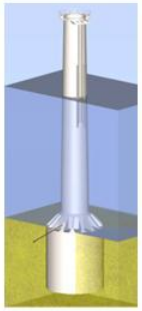
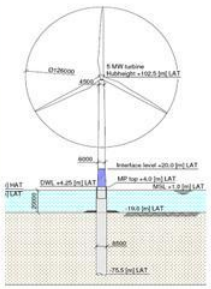
Source: Carbon Trust Offshore Wind Accelerator 2011

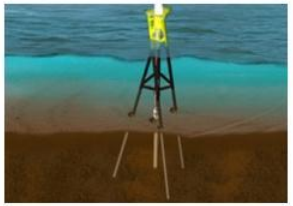
Four foundation designs prioritised for Round 3

Objective: Reduce lifecycle cost of foundations by up to 30% in depths 30-60m

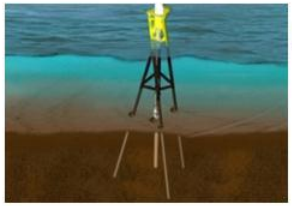
Shortlist






Finalists


Keystone


Gifford / BMT / Freyssinet


SPT Offshore


Universal Foundation

Stage II focus

Fabrication

Installation

Demonstration

Source: Carbon Trust Offshore Wind Accelerator 2010, IHC

GBF and SPT Offshore floated out with turbine pre-installed

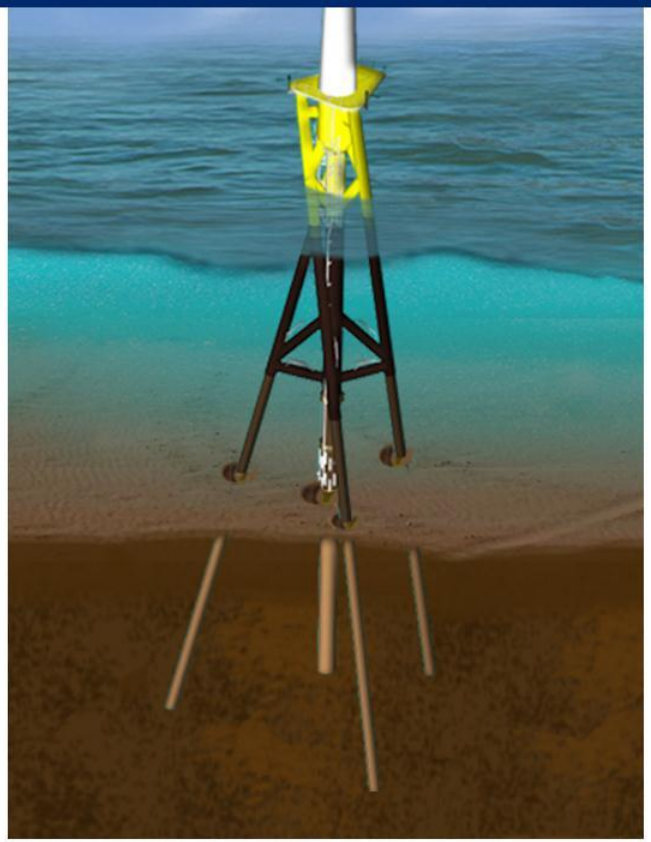
Gifford / BMT / Freyssinet Gravity Base Foundation

SPT Offshore & Wood Group self installing tribucket

Source: GBF, SPT Offshore 2012

Keystone and UF installed separately from turbine

Keystone's Inward Battered Guide System 'twisted jacket'



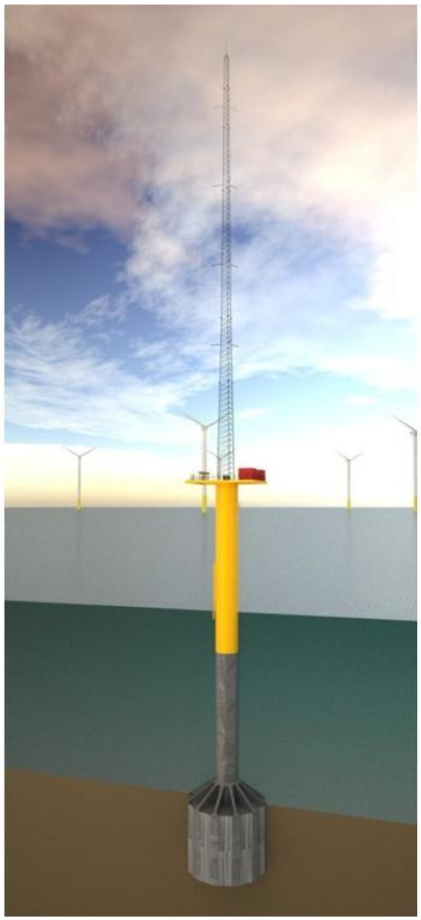
Universal Foundation bucket foundation

Source: Keystone, Universal Foundation 2012

Keystone and UF have been installed with a met mast

Next step is to demonstrate with turbine: we need test sites

Demonstration with Met Mast



Next step is Demonstration with Turbine

Source: Keystone 2009; Heiko Lindenthal, REpower 2011; Mainstream 2011; SeaEnergy 2011; Universal Foundation 2012

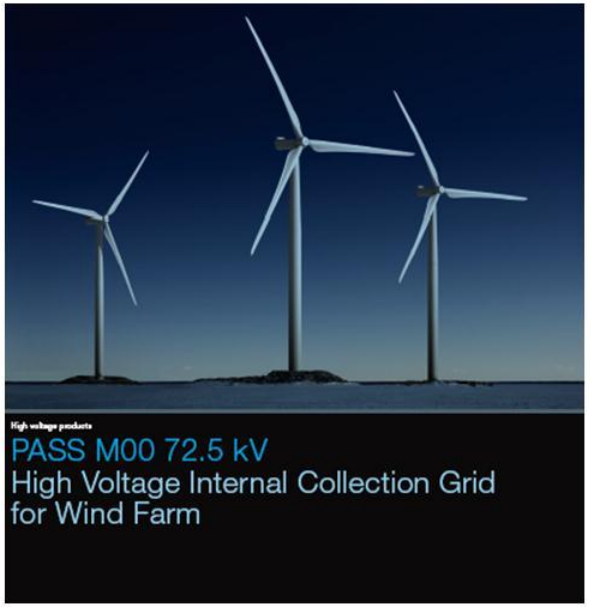
HVDC links

- **Currently engaging with HVDC suppliers**

Source: Siemens, ABB

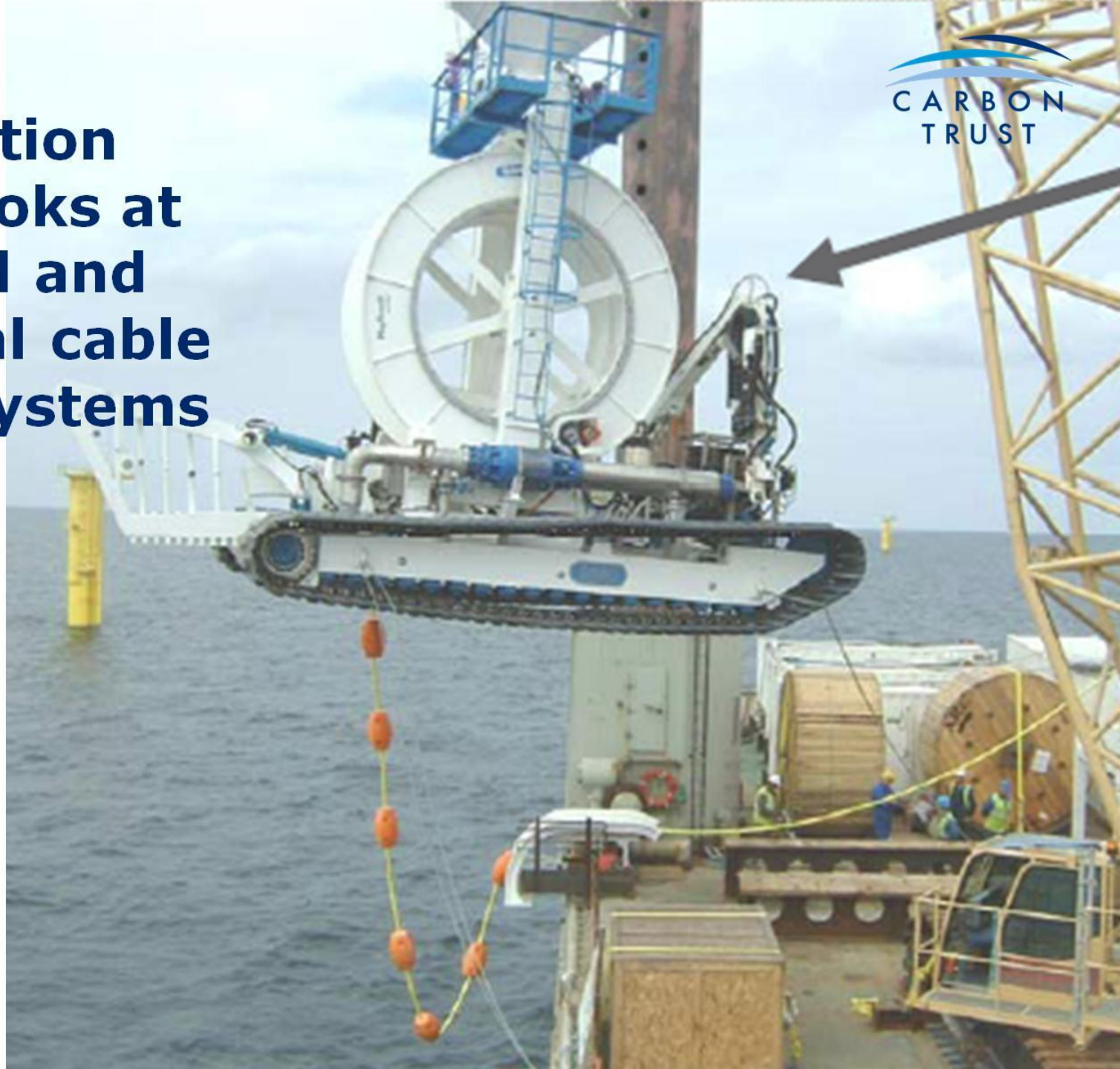
66kV

- **Developers, turbine OEMs both want it; switchgear and transformer suppliers offer it**



- **Benefits: improved reliability, lower losses, fewer substations, less cable**

Cable installation TWG looks at internal and external cable entry systems



Our new Turbine Advisory Board will help optimise turbine / BOP interfaces

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SIEMENS

ALSTOM

Vestas

AREVA

REpower Systems

MITSUBISHI POWER SYSTEMS

Gamesa

SAMSUNG

Conclusions

OWA is delivering cost reduction for European offshore wind projects

- Introducing new technologies
- Strengthening the supply chain
- Reducing cost

With the right mix of industry and government working together, Carbon Trust could help deliver a similar programme in Asia

- Transferring technology knowledge relevant to an Asian market
- Creating a collaboration model that meets the needs of industry and government

Carbon Trust could advise South-Korean companies seeking to enter western markets

Questions

www.carbontrust.com/offshorewind

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