

Material Opportunity

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Energy Materials



BVG Associates

Market analysis & business development

- **Supply chain development**
- **Economic impact assessment**
- **Support to industrialisation**

Technical innovation & engineering analysis

- **Support to investment in technology**
- **R&D programme management**
- **Design and engineering services**

Project implementation

- **FIT project development (UK only)**
- **SCADA & condition monitoring**
- **O&M technical support**

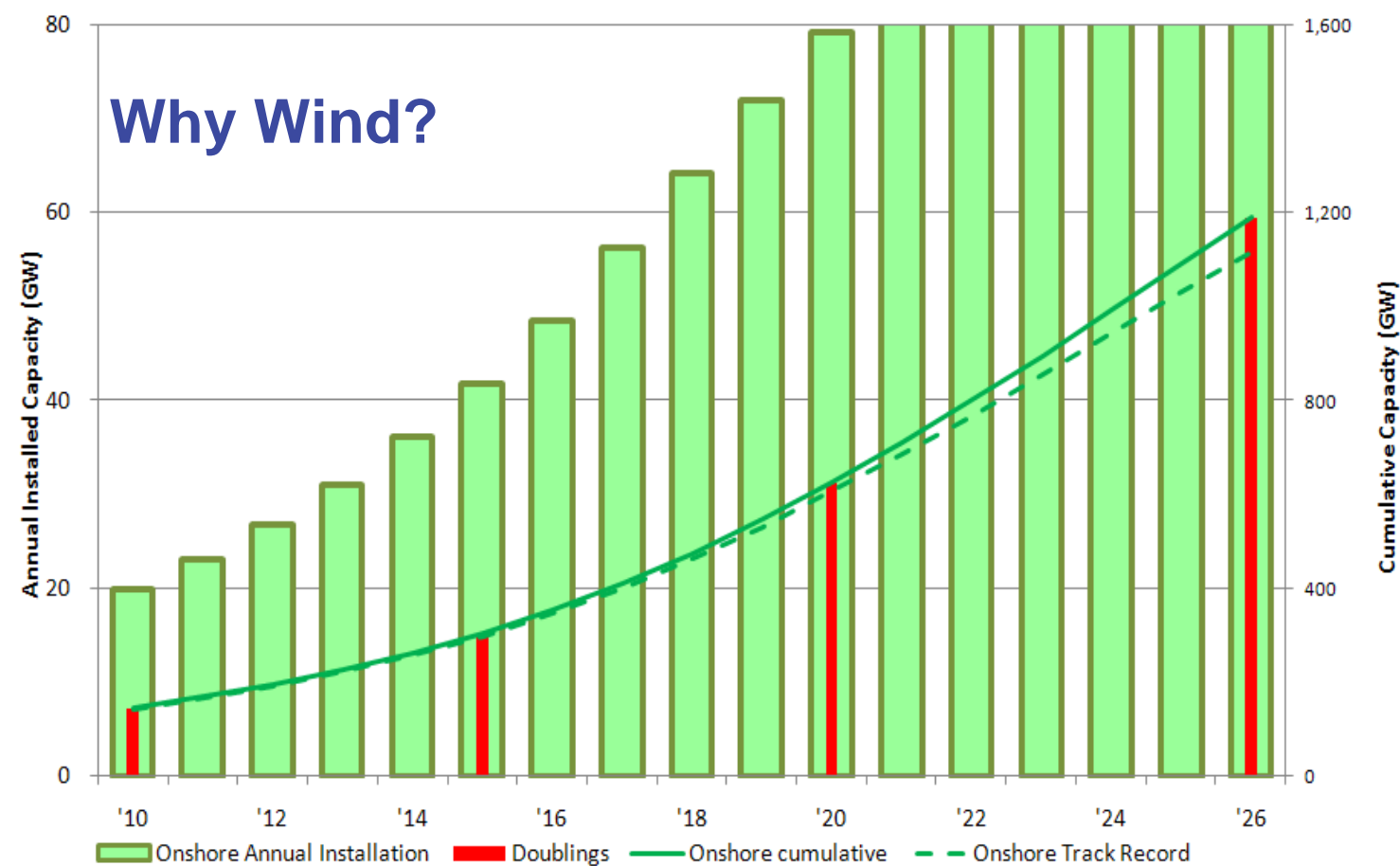
Technical education





Why Wind?

3VGassociates



- **Fastest** growing sector of the power generation industry ~ \$40bn/yr
- **Great** history of reducing prices
- **Big** technology challenges remain (10%+ learning rate)
- **Big** user of materials - ½ of world supply of large SG iron

Why UK Wind?

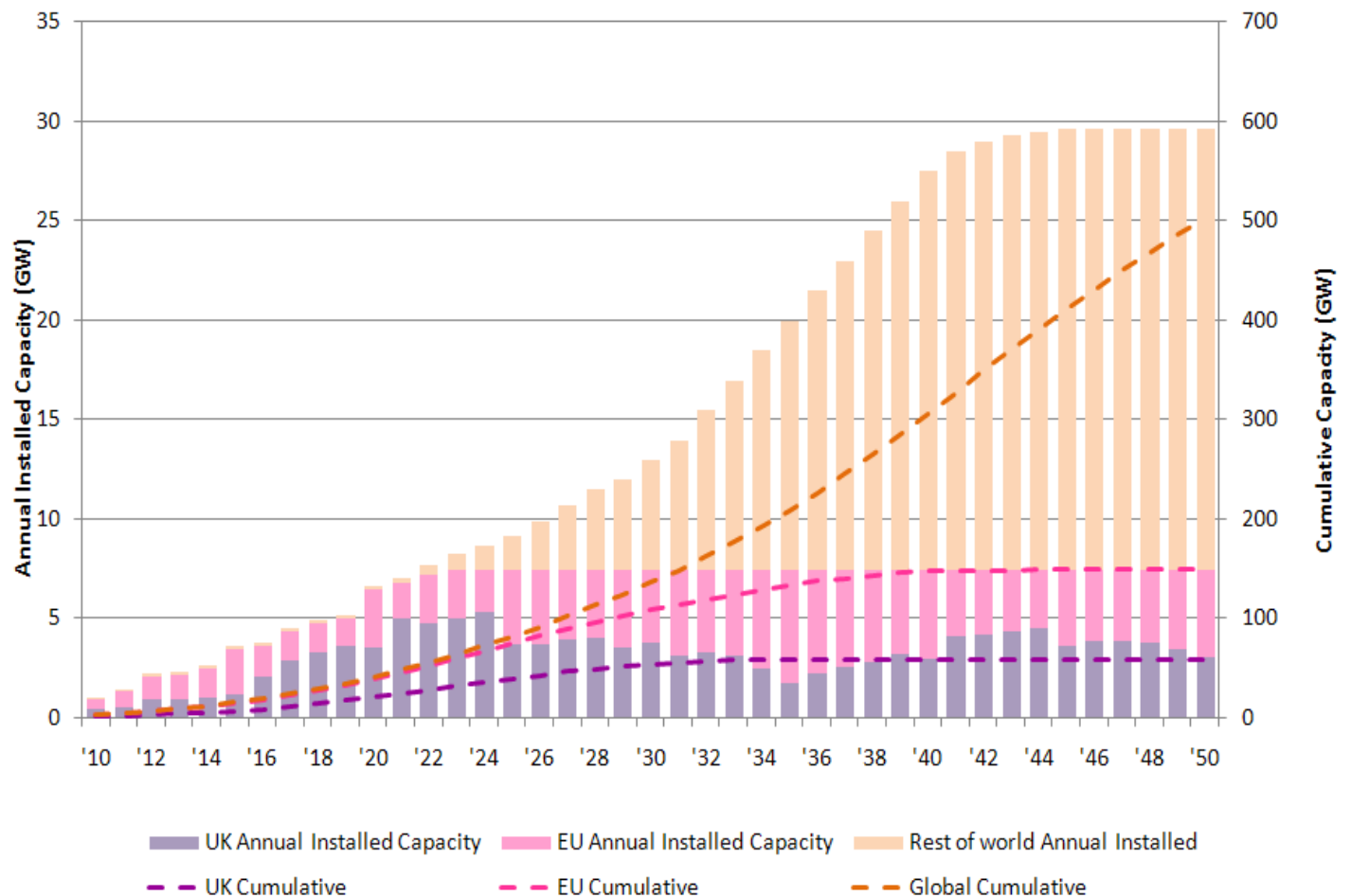
- UK 4th most **attractive wind market**
- **No.1** offshore wind market
- **Greatest wind** resource in EU
- Spend **£75bn+** by 2020
- Massive supply chain **growth** required
- UK has **opportunity** to industrialise



Quality In Everything We Do

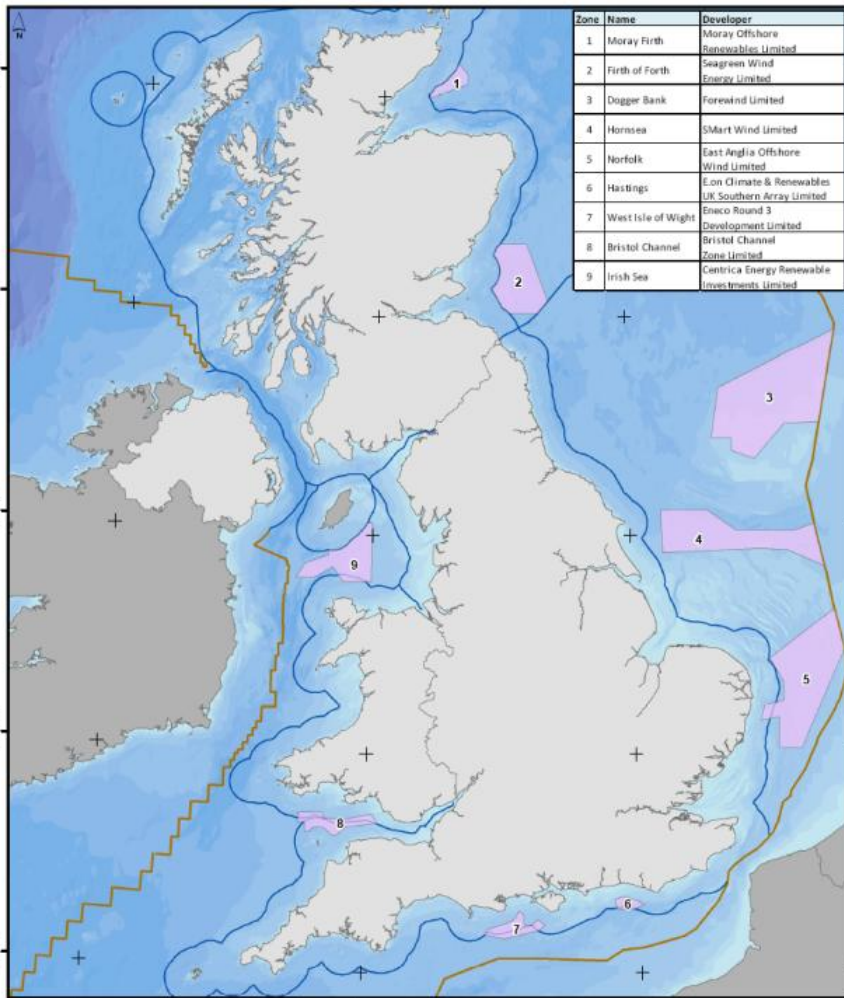
Offshore Wind Market

- Happening **here, now,**
- Rest of **EU and world will follow**



UK Round 3: A new approach

Offshore Wind - Round 3 Zones



Scale

- Flexibility in project location within zones
- Investment in supply chain and infrastructure
- Est. 70,000 jobs

The Crown Estate as a development partner

DECC decision on SEA "A Prevailing Wind"

The Crown Estate's Round 3 plan is considered to be consistent with that decision.

THE CROWN ESTATE



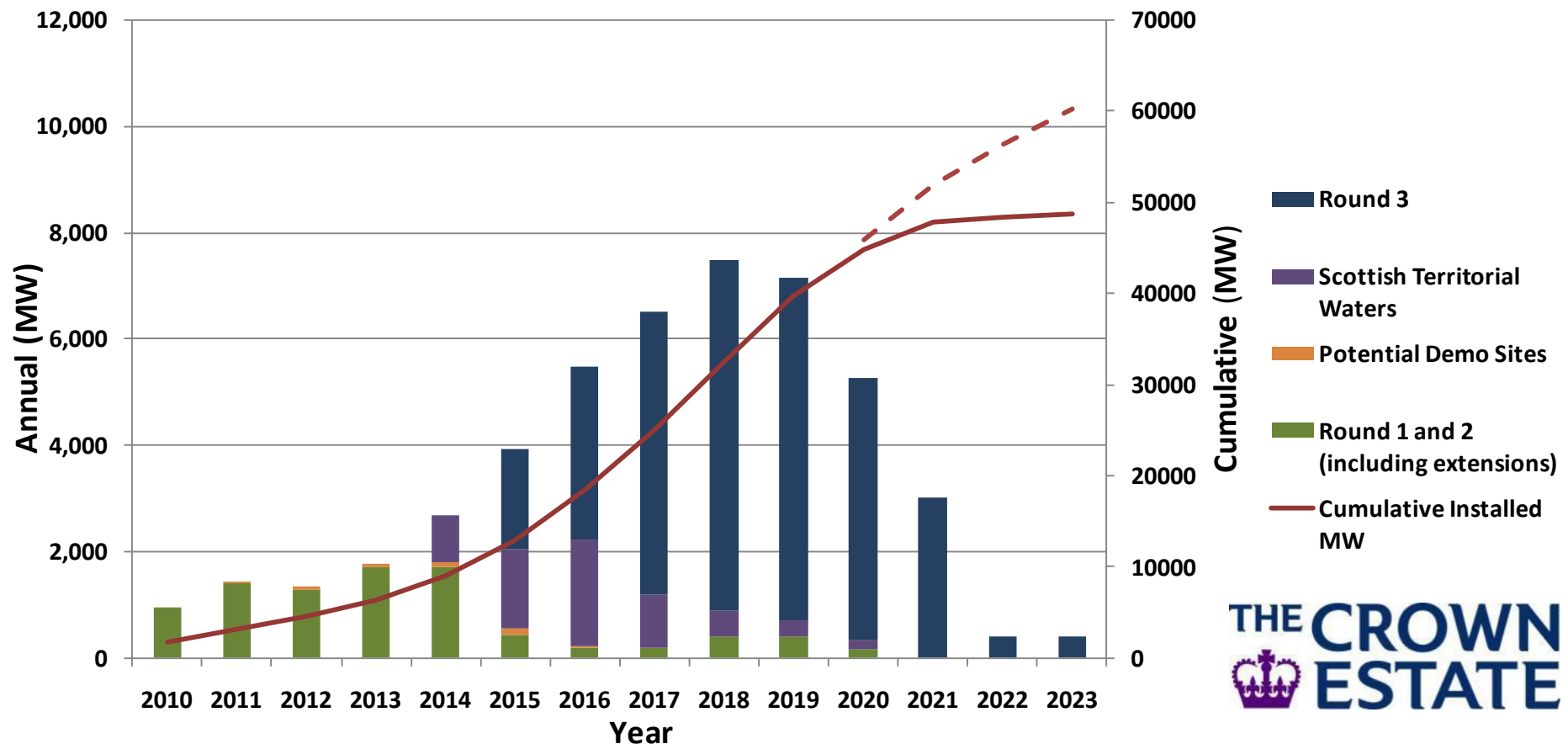
Round 3: Programme

DATE	PROGRAMME
Mar 09	Bids received
July 09	Shortlisted bidders interviewed
End 2009	Award of zones
2010 onwards	Site selection within Zones and submission of planning applications for sites
2014-16	Construction begins
2020	25GW installed

On time

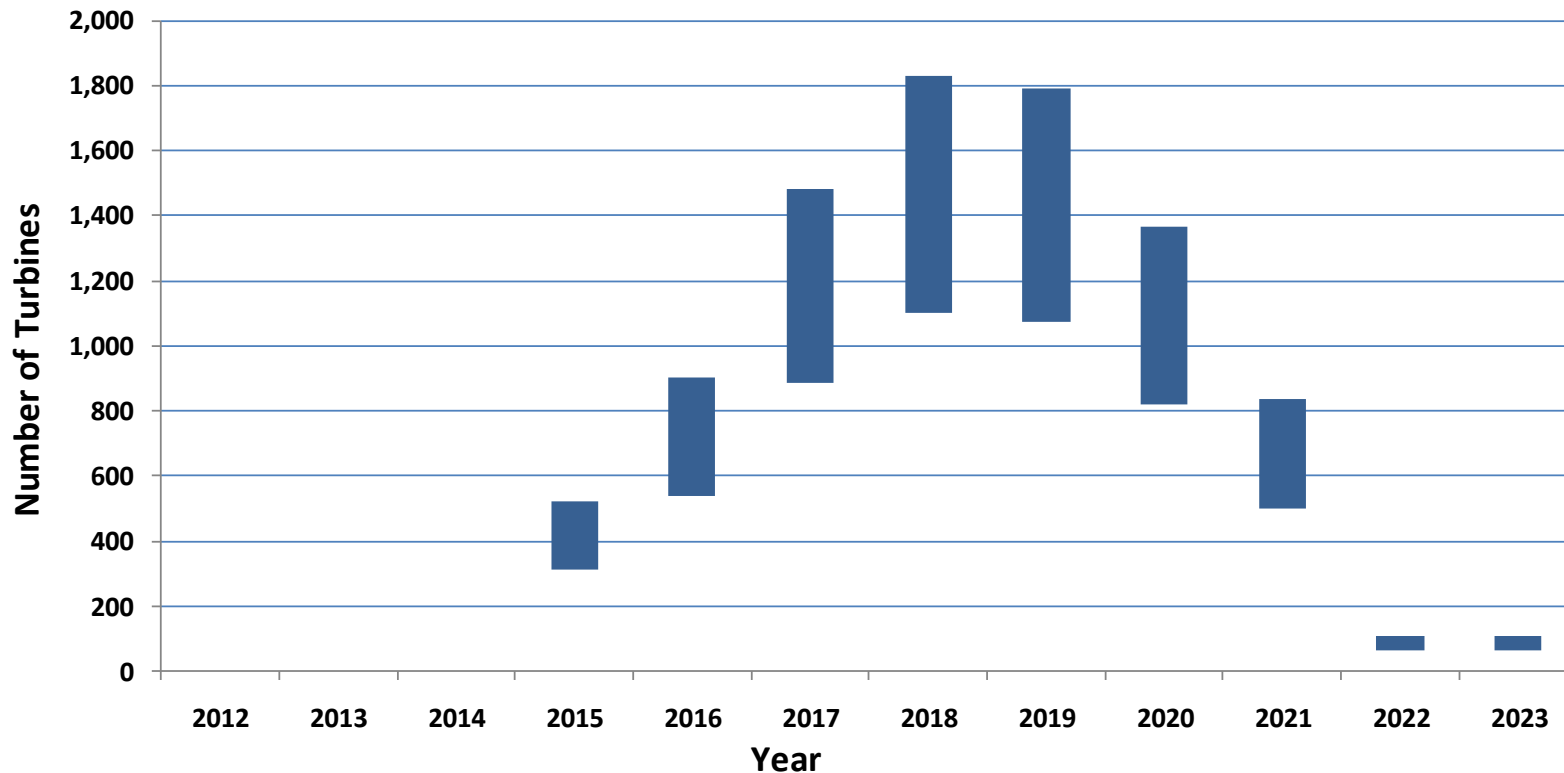
The Green Energy Decade -

Opportunity for generating capacity from all current leasing rounds



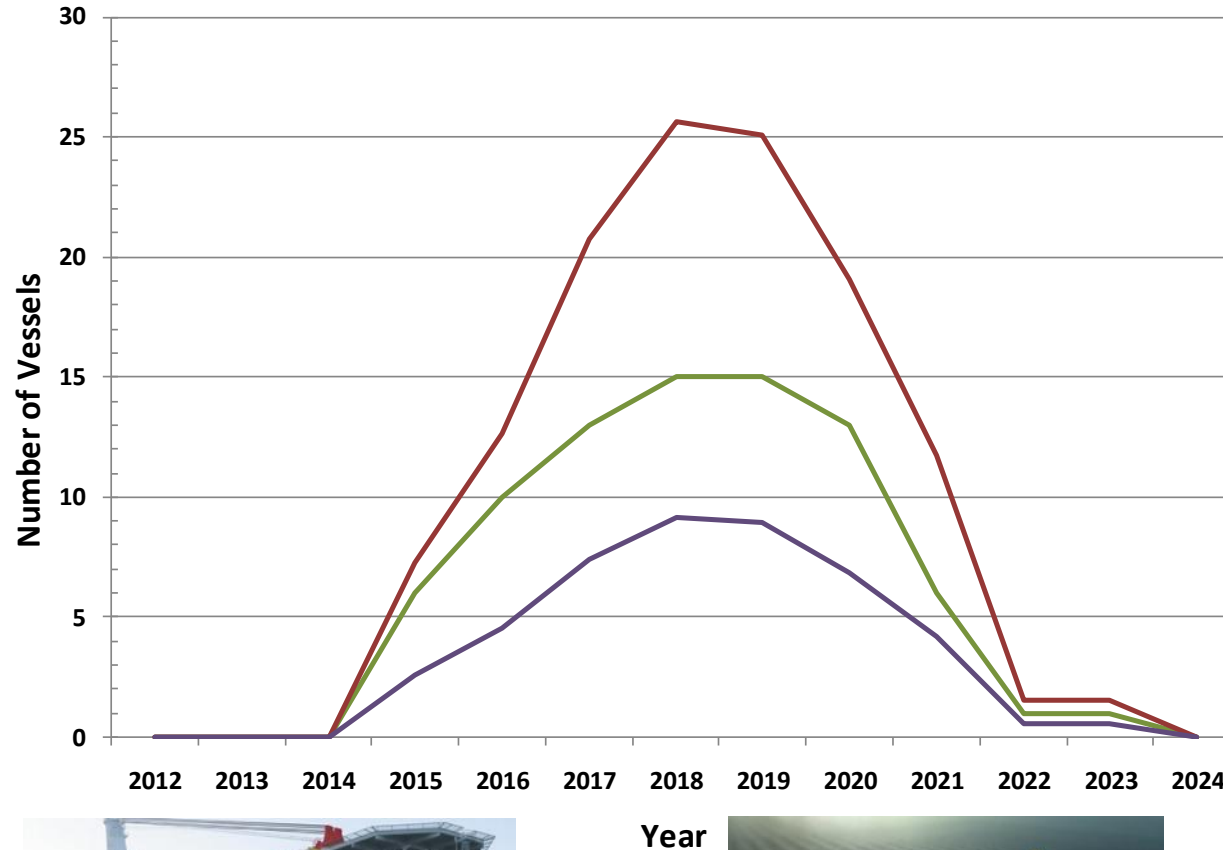
Turbines FOR ROUND 3 ONLY

Potential Number of turbines required annually (3.6MW vs 6MW)



Installation Vessels

Number of turbine installation vessels required annually



Scenarios

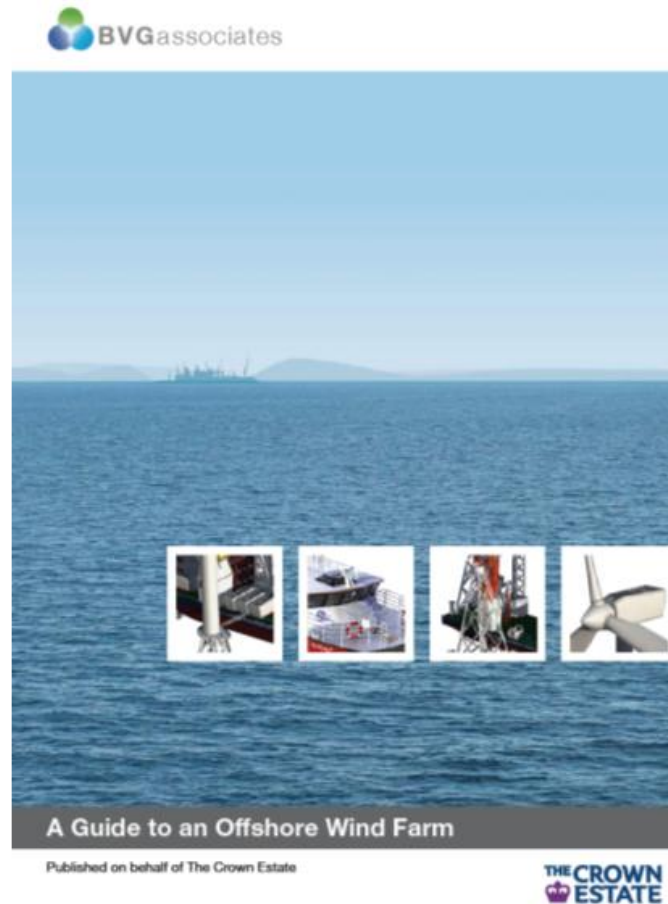
- Projected number of projects installing (adjusted to account for vessel use across projects within a zone)
- Projected number of vessels required assuming 150 days pa for 6mw @3.5 days per turbine
- Projected number of vessels required assuming 200 days pa for 6mw @2.5 days per turbine



 **THE CROWN ESTATE**



Supporting Information



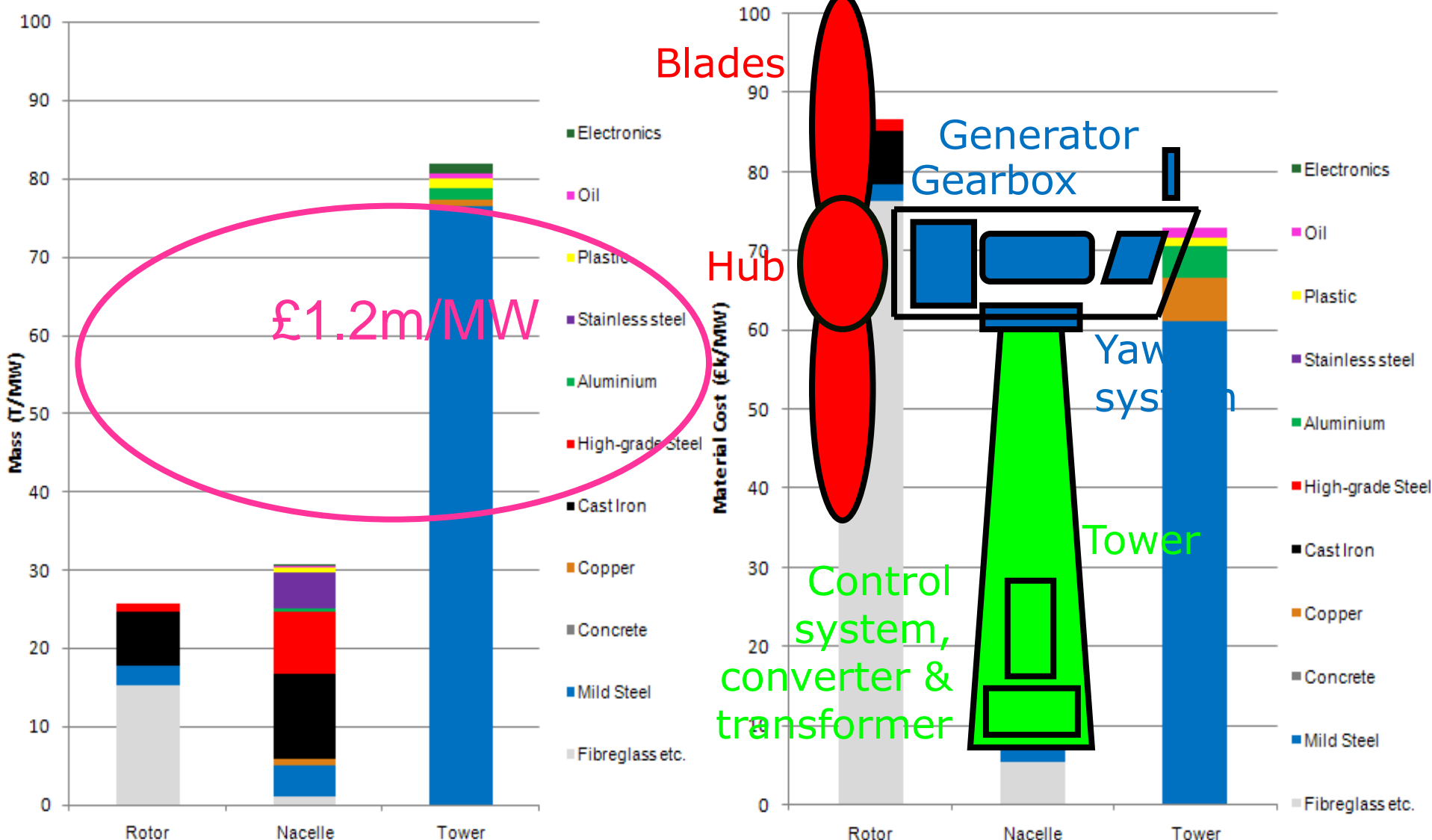
UK Market - Summary

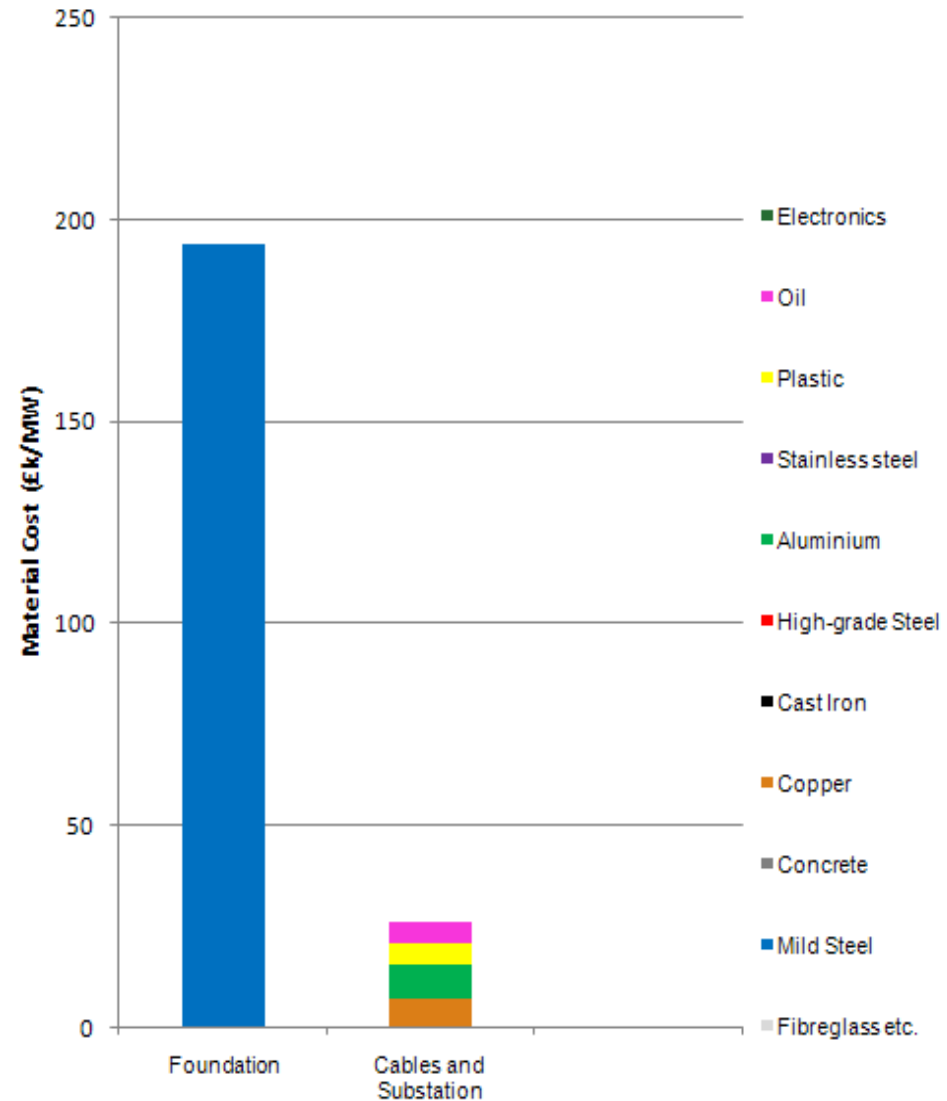
1. Strong framework for development (DECC, Crown Estate, Ofgem, marine planning etc.)
2. Good history of consenting
3. Good history of delivering on time
4. Good history of Government commitment
5. Crown Estate showing strong leadership
6. UK learnt from Round 1 and Round 2
 - Strategic Environmental Assessment done by DECC in advance
 - Crown Estate co-developing Round 3
 - Competition focussed on those that can deliver

***“UK is Siemens’ no. 1 market offshore,
and is growing tremendously.”
SIEMENS WIND POWER***

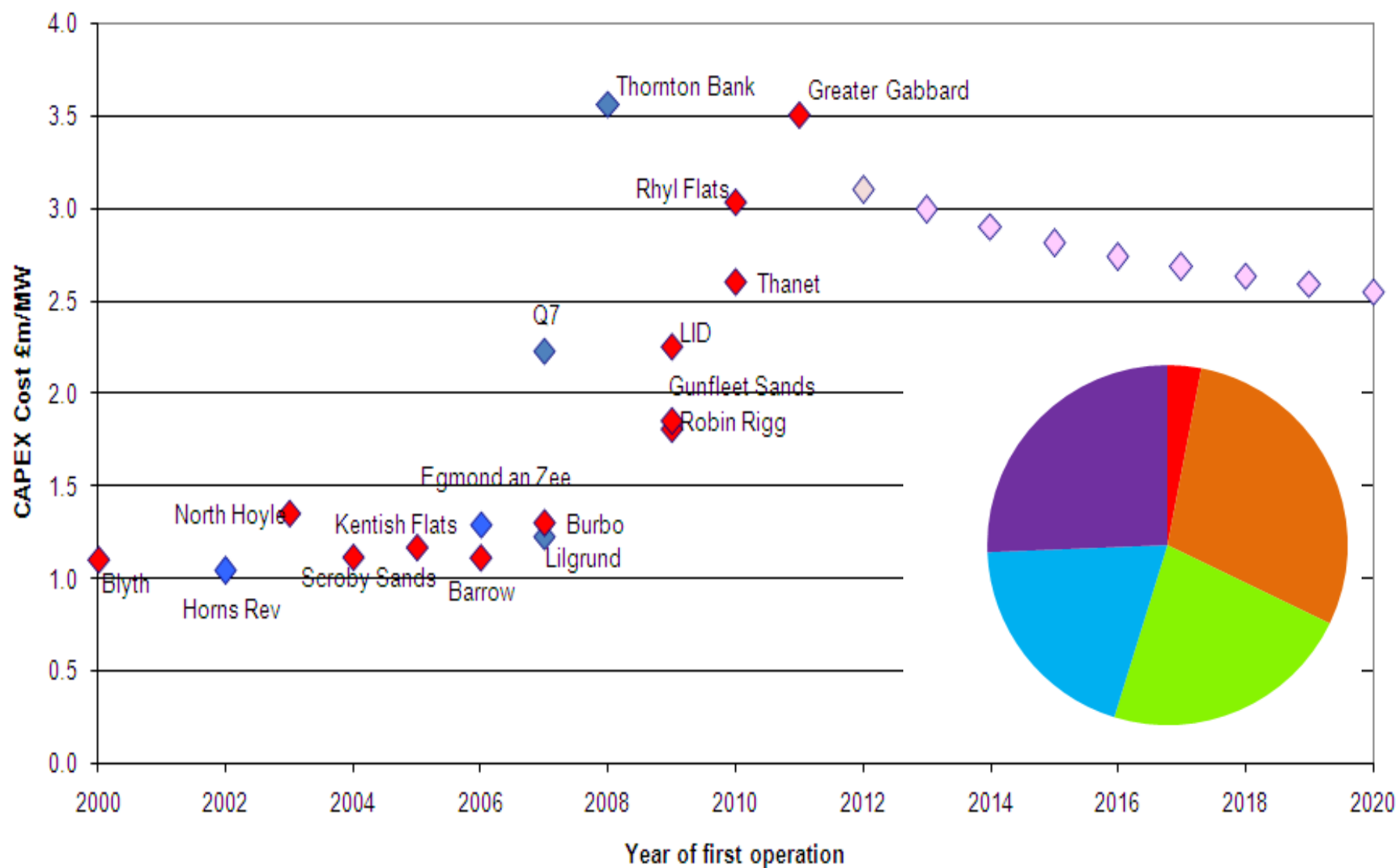
“UK is still THE market.” VESTAS

What's in a (1.5 MW) wind turbine?





Cost of Energy Challenge



COST OF ENERGY CHALLENGE

- Geotechnical

- M

- D

- C

- Tu

- Sup

- Net

- Well

- On-la

- Better

- Optimi

- Design

75

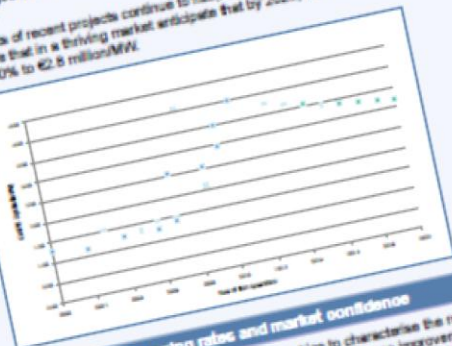
Improving the Cost of Offshore Wind Technology: There is Hope

Dr. Alan Roberts
BVG Associates

Abstract

The cost of offshore wind makes the economics of projects marginal in the eyes of many developers. Offshore projects will always be more expensive but currently they are 2.5 times as much as onshore developments. There are good reasons, however, for believing that the differential can be minimized.

While costs of recent projects continue to rise, as the graph below demonstrates, we believe that in a thriving market anticipate that by 2020, 2010 costs will fall by around 30% to €2.6 million/MW.

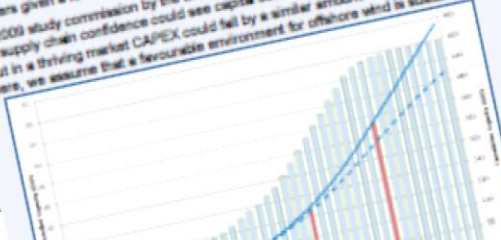


Learning rates and market confidence

Learning rates have been used in many industries to characterise the reduction in costs over time, due to technology development and process improvement. They are expressed as the percentage cost reduction per doubling of installed capacity.

The projection below, based on the ambitious plans of The Crown Estate, suggests almost four doublings between now and 2020. A study we undertook for The Crown Estate earlier this year concluded that 53 GW could be installed in UK waters given a favourable environment and confidence in the market.¹

A 2009 study commissioned by the British Wind Energy Association found that a lack of supply chain confidence could see capital costs increase by up to 20% by 2020 but in a thriving market CAPEX could fall by a similar amount. For our purposes here, we assume that a favourable environment for offshore wind is sustained.



The chart below shows the relative contributions to learning rates for different areas of the supply chain.



Turbine and balance of plant

The average turbine size is likely to double over the next 10 years. Larger turbines have implications for foundation and component design and decreases in cost/MW have not been observed to date.

There is potential for developments in blade production technologies (reductions in time and labour), improvements in structural and aerodynamic design, and aerodynamic control technologies.

Benefits would arise through the standardisation of gearboxes, and development of hydraulic drive/continuously variable transmission, mid- and low-speed generators, and next generation converters.

All offshore turbines to date (except Beatrice and Alpha Venus) have been installed on steel monopiles or concrete gravity bases. The practical limits for monopile foundations may well be around 4MW turbines and 30m of water. As support structures contribute a significant fraction of CAPEX cost and the technology is at an early stage of development, there remains plenty of room for cost improvement.

As the distances from shore increase, the switch from HVAC to HVDC transmission will stimulate innovation in the production of HVDC equipment.

Installation

Installation involves the logistics of large, heavy and delicate components. Specialist jacking vessels have been used but supply is limited and the cost is high. Innovations that enable the transfer of turbines from barges at sea and/or the construction of complete turbines on land could reduce costs.

Wind farm development

The largest CAPEX benefits relate to seabed surveys, and in particular geotechnical surveys which are currently expensive which could see cost reductions of 30-40% through the use of equipment deployed from floating vessels. This technology has been used in the oil and gas industry, but not so far for offshore wind.

Offshore systems

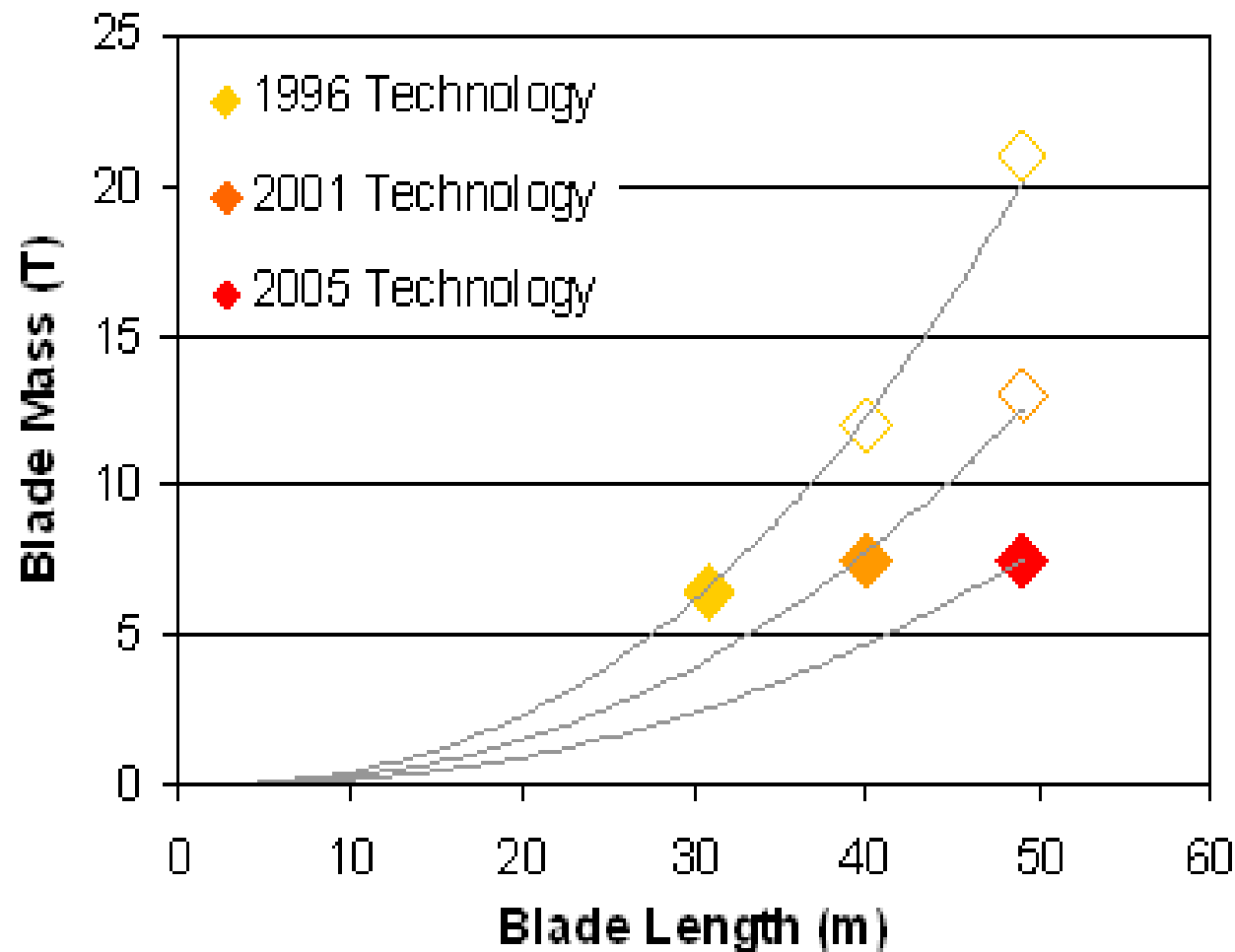
The standard model for revenue generation from wind is to sell electricity as it is produced. As energy storage methods come to market and new energy transport media are developed, opportunities to increase revenue will be available. Examples include compressed air energy storage, to maximise revenue by selling electricity when most needed, and large-scale hydraulic storage.

References

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Materials development: Composites



Steel and Concrete

1. **Fatigue / extreme allowables**
2. **Welding techniques**
3. **Sandwich and 'composite' materials**



1. Ceramic hybrid 4-pt contact ball bearings
2. Ceramic sealing solutions
3. Sensing materials – control and condition feedback
4. Heat treatments
5. Steel grade with less strength but greater fatigue life
6. Castings technology – e.g. SG iron
7. Permanent Magnet technology
8. Sustainable materials – bamboo, hemp, flax
9. Recyclable materials - reusing / recycling composites
10. High fatigue life materials suitable for automated manufacture

Prospects

1. Existing UK RD&D expertise
2. Big UK players involved; wind industry keen to engage
3. Route to (home) market
4. Global export potential
5. Good synergies exist between wind and the needs of other sectors – not purely “wind research”



Carbon Trust's Offshore Wind Accelerator

Program objective: Catalyse a 10% reduction in the cost of offshore wind power through a targeted set of RD&D activities.

Consortium structure:

- Collaboration between Carbon Trust and major offshore wind farm developers



Four technology RD&D areas

- Offshore foundations
- Wake effects
- Electrical systems
- O&M Access

Budget and timescale:

- Budget of £30m to which Carbon Trust will contribute up to £10m
- Launched October 2008, 4-6 years
- Already working with over 160 companies in the supply chain

This Environmental Transformation Fund (ETF) call is to support, stimulate and encourage the development and demonstration of offshore wind technologies/components that will create efficiencies across the supply chain, reduce the cost of deploying offshore wind and enable faster deployment of offshore wind technology.

Launched 19 February 2010

Any grants awarded under this scheme must be claimed in full by 31 March 2011.

£8 million budget

Deadline for Applications 19 March 2010

For more info please see

[http://www.decc.gov.uk/en/content/cms/what we do/lc uk/lc business/env trans fund/wind demo/wind demo.aspx](http://www.decc.gov.uk/en/content/cms/what_we_do/lc_uk/lc_business/env_trans_fund/wind_demo/wind_demo.aspx)

How we can help?

- We can connect materials players to right people in wind industry
- We can organise workshops on specific challenges
- We can act as a first wind industry ‘customer’ to help sharpen ideas before engagement with the industry
- We can answer a wide range of questions
- We can listen to your thoughts on way forward

ACT NOW?



Thank you for listening



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