Round 3 offshore wind farms
UK Future Energy Scenarios seminar 2012

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FOREWIND
DELIVERING YOUR ENERGY FUTURE

Contents

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Development to date

UK Offshore Wind development

	Award Date	Capacity	
Round 1	April 2001	15 projects	1.6 GW in total
Round 2	December 2003	15 projects	7.3 GW in total
Round 1 / 2 Extensions	May 2010	4 projects	1.6 GW in total
Scottish Territorial Waters	January 2009	5 projects	4.8 GW in total
Round 3	January 2010	9 Zones	>32 GW in total

- The Crown Estate owns the rights to the seabed out to 12 nautical miles
- It also has rights to exploit the seabed for renewable energy out to 200 mile international waters
- The Crown Estate has run 5 separate leasing rounds so far

UK Round 1

15 separate projects in total

3 projects not taken forward due to technical and consenting issues

11 projects in operation

1 project currently in construction – Teesside (EdF)

- Vast majority under ownership of a single utility
- “Big 6” UK utilities plus DONG Energy and Vattenfall

UK Round 2 and extensions

15 separate projects in total

5 projects in operation

6 projects currently in construction, capital investment of £7 – 8 billion

3 projects approved (pre-construction)

1 project refused consent (cumulative bird impacts in Greater Wash)

- Consortia of utilities at construction stage, with some post-construction refinancing

Key experiences to date

> **2.3 GW** in operation

> **2.5 GW** in construction (£7 – 8 billion capex)

> **1.8 GW** approved and in pre-construction

Further 4.8GW in development in Scottish waters

- Nearly all offshore wind farm developments in UK waters have achieved consent to date
- Consent phase is complex and time-consuming
- All consented offshore wind farms have achieved a successful investment decision

UK Ambitions

Department of Energy and Climate Change view

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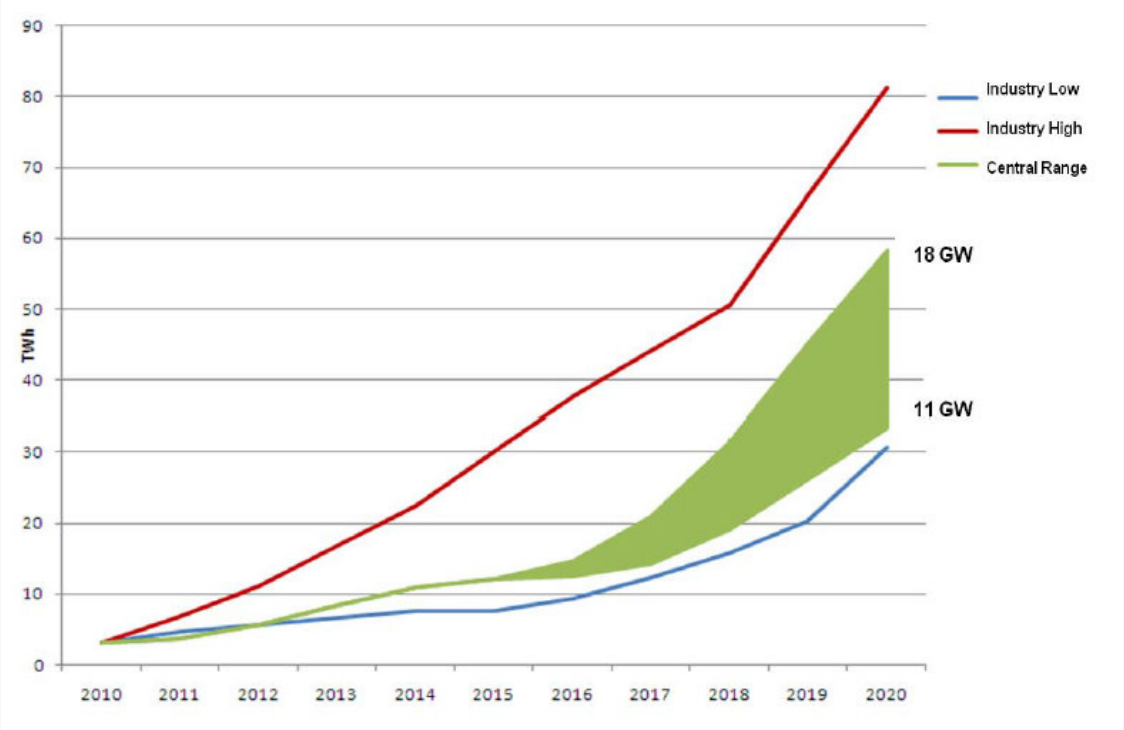
- UK Renewable Energy Roadmap published in July 2011
- Concluded that the UK "...can meet the target to deliver 15% of the UK's energy consumption from renewable sources by 2020"



Central range indicates that **up to 18 GW** could be deployed by 2020.

Beyond 2020 there is a very high potential for deployment

"Increasing the rate of deployment to realise this potential will require **substantial reduction in costs**"

"We are determined to drive down costs ... from development, construction and operations to £100/MWh by 2020"

Support Mechanisms for offshore wind

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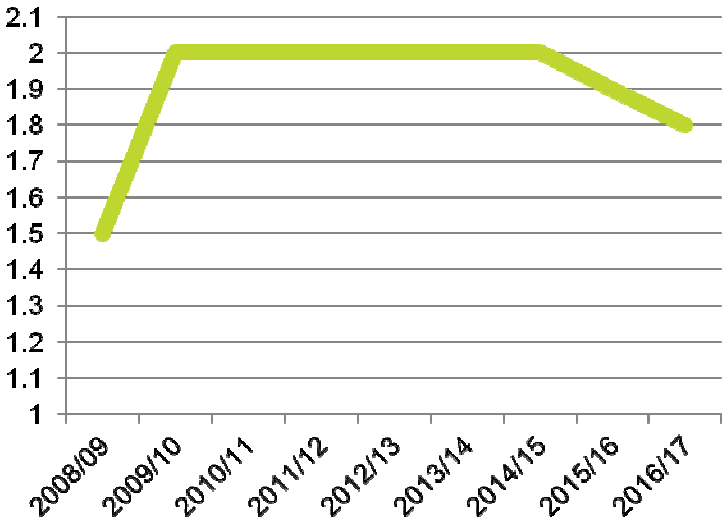
Renewables obligation to be replaced by CfD FIT mechanism from April 2017

Period	ROC Banding
Up to 2009	**1.5**
Up to April 2015	**2.0**
Up to April 2016	**1.9**
Up to April 2017	**1.8**



Renewables Obligation

- Successful mechanism for stimulating growth in offshore wind to date
- Significant banding level increase in 2009 to match industry cost increases
- Recent banding review implemented support reductions from April 2015 onwards

Electricity Market Reform

- Currently undergoing development
- Will replace ROCs with Contract for Difference Feed-In Tariff (CfD FITs)
- “Strike price” will set support for projects

Offshore Wind cost reduction pathways study

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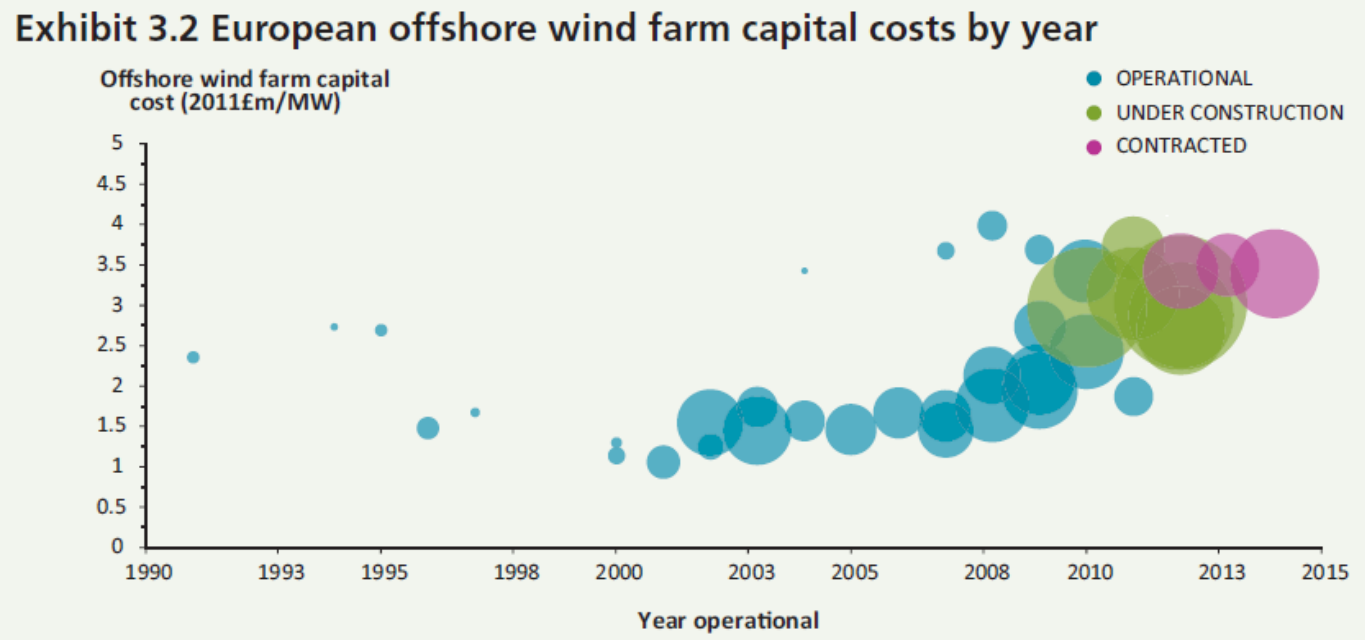
- Offshore wind industry study led by The Crown Estate, published in May 2012
- Identifies and quantifies cost reduction opportunities for the industry



- Costs have increased substantially since early 2000s
- Recent projects indicate costs have stabilised at ~ £140 per MWh (FID 2011)
- Future cost reduction critical in determining the future size of UK industry

Four models for industry development

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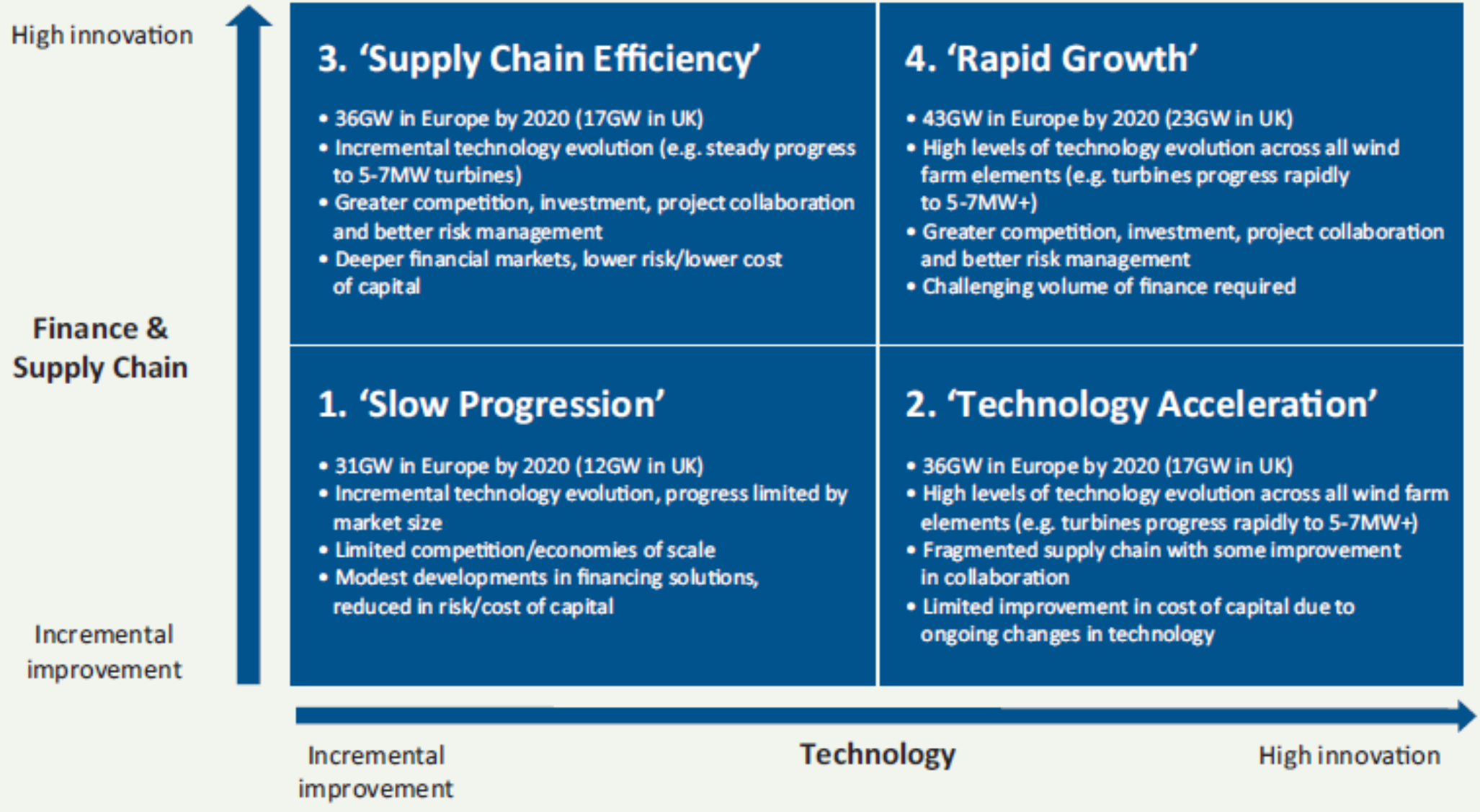
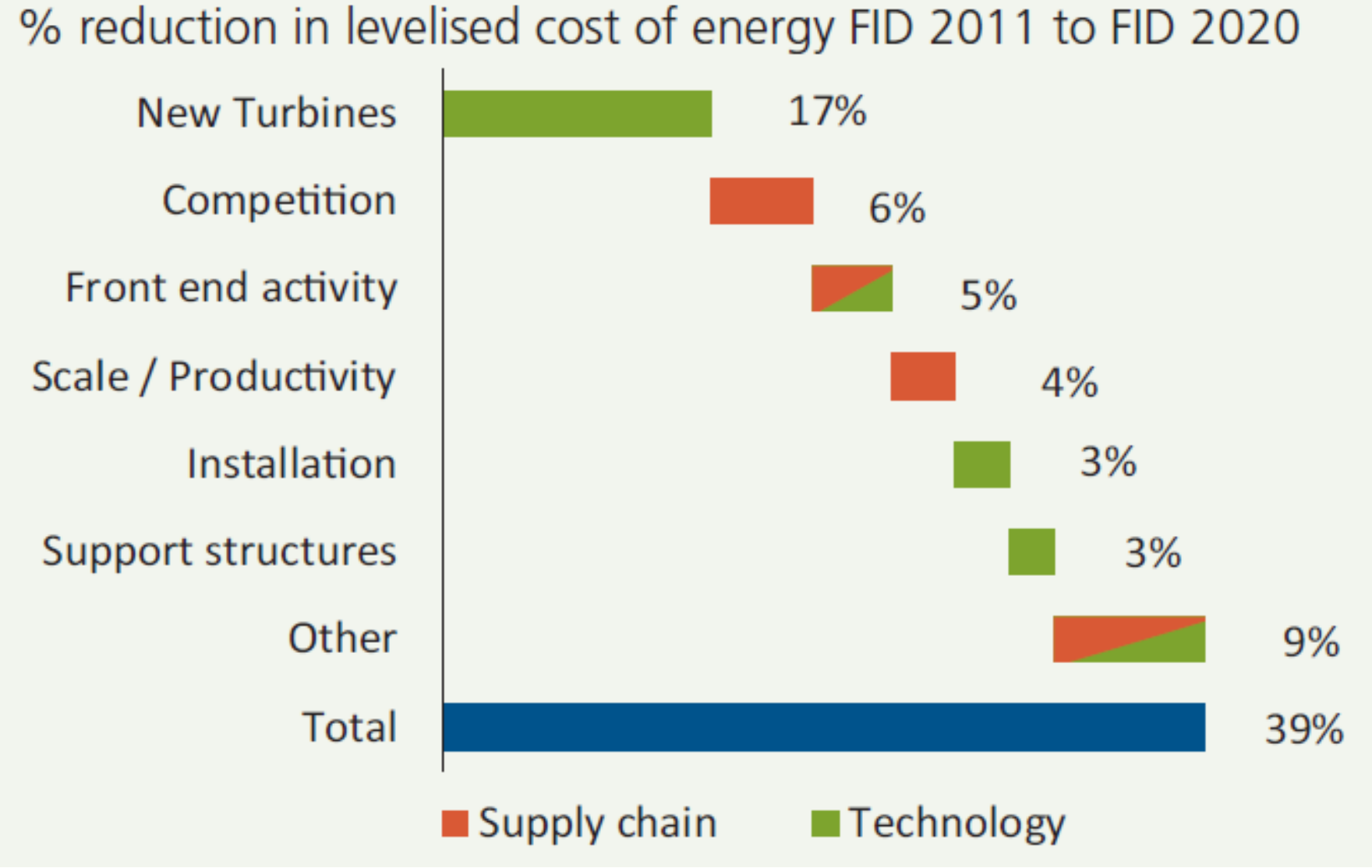
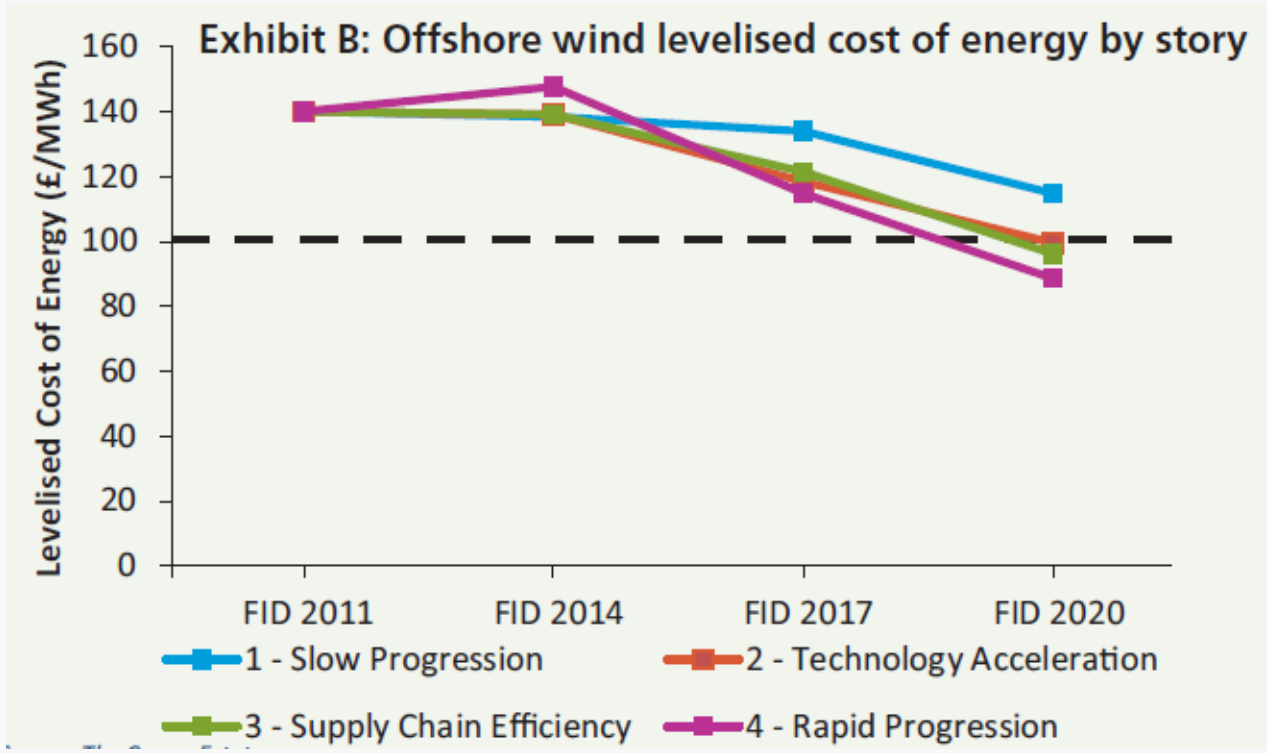
Exhibit A: Industry Stories



Sources of cost reduction



Cost of energy reduction potential to 2020



Slow progression model

12GW by 2020, does not lead to required cost reduction

Supply Chain Efficiency model
or
Technology Acceleration model

17GW by 2020, can achieve cost reduction targets

Circa 17 GW by 2020 required for supply chain efficiency and technology dvpt

Needed to meet cost reduction targets and hit higher end of DECC ambitions

Equates to 10 – 11 GW from Scottish waters and Round 3 by 2020

Round 3

The Round 3 concept

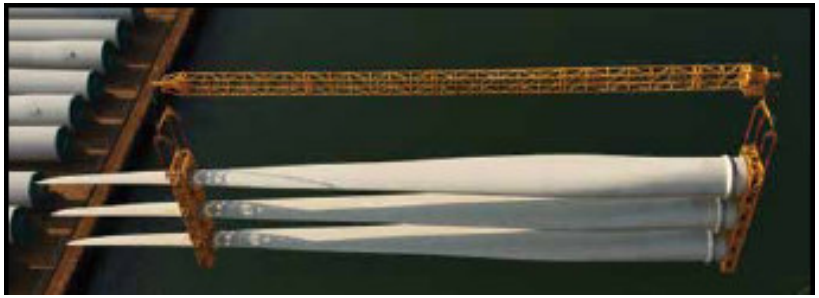
For the third round of offshore wind leasing, The Crown Estate awarded exclusive development rights to a number of multi-project “zones”

Zones identified through consultation with key national stakeholders

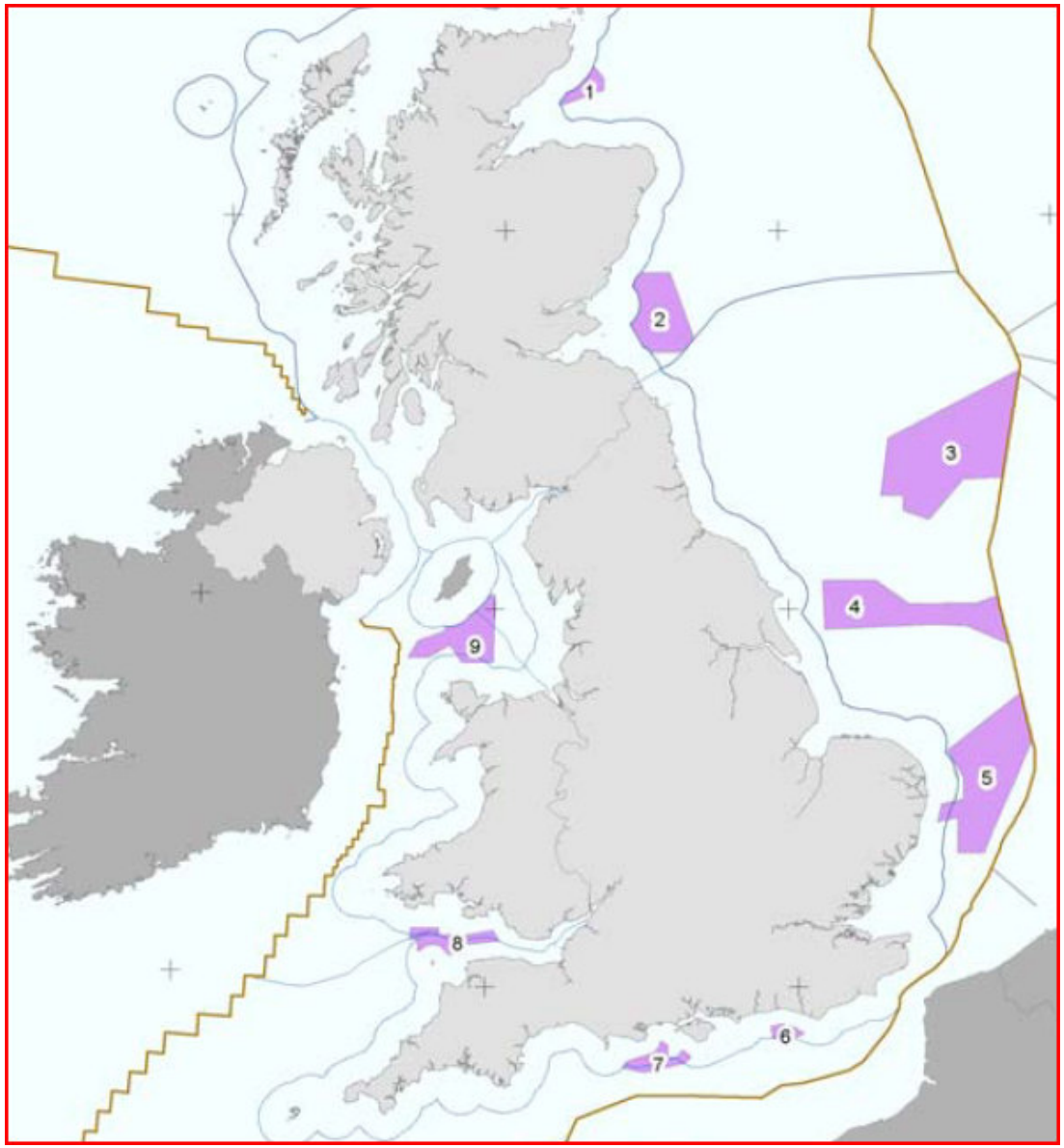
Successful bidders agreed Zone Development Agreements (ZDA) with The Crown Estate

The Crown Estate are co-investing with developers up to the point of consent

In addition they have placed a contract manager in each zone developer's office



The Round 3 development zones (32.2 GW)



Zone	Owner	MW
1. Moray Firth	EDP Renovavais Repsol	1500
2. Firth of Forth	SSE Renewables Fluor	3465
3. Dogger Bank	SSE Renewables RWE Npower Statkraft Statoil	9000
4. Hornsea	Mainstream Siemens DONG Energy	4000
5. East Anglia	Iberdrola Vattenfall	7200
6. Rampion	E.ON UK	665
7. Navitas Bay	Eneco EdF	1200
8. Bristol Channel	RWE Npower	1500
9. Celtic Array	Centrica DONG Energy	4185

Transmission Entry Capacity secured

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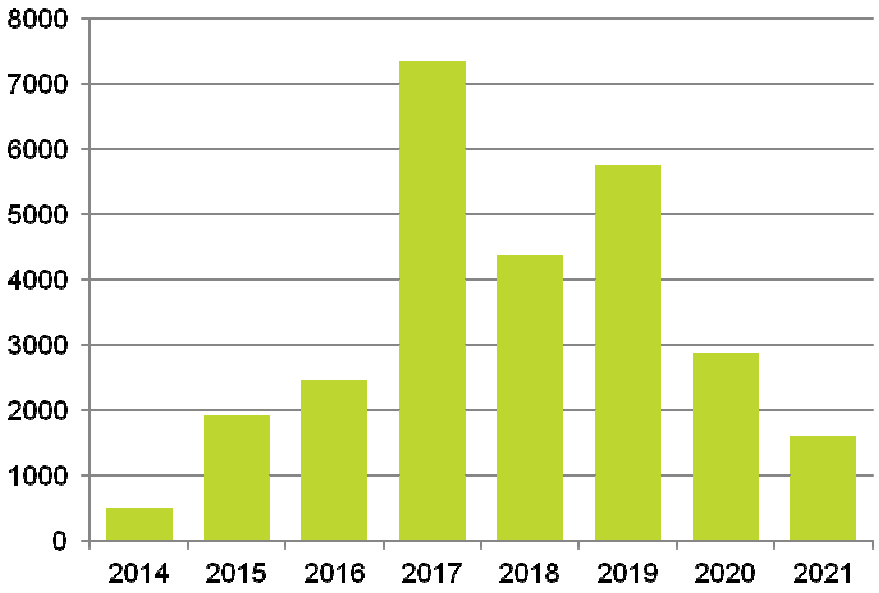
Moray Firth	1500 MW	100% of target
Firth of Forth	3690 MW	100% of target
Dogger Bank	6000 MW	75% of target*
Hornsea	2000 MW	50% of target*
East Anglia	7200 MW	100% of target
Rampion	664 MW	100% of target
Navitus Bay	1200 MW	100% of target
Atlantic Array	1515 MW	100% of target
Celtic Array	3000 MW	72% of target

26.77 GW of TEC secured by R3 wind-farms

Connection dates 2014 to 2021

Over 7GW to connect in 2017



Dogger Bank

The Dogger Bank Zone

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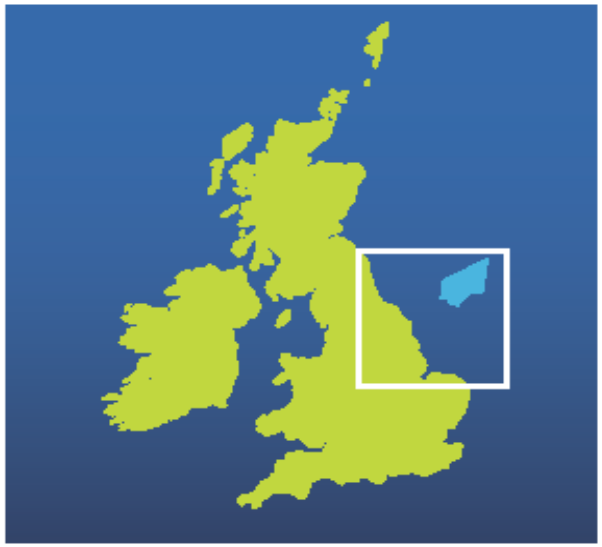
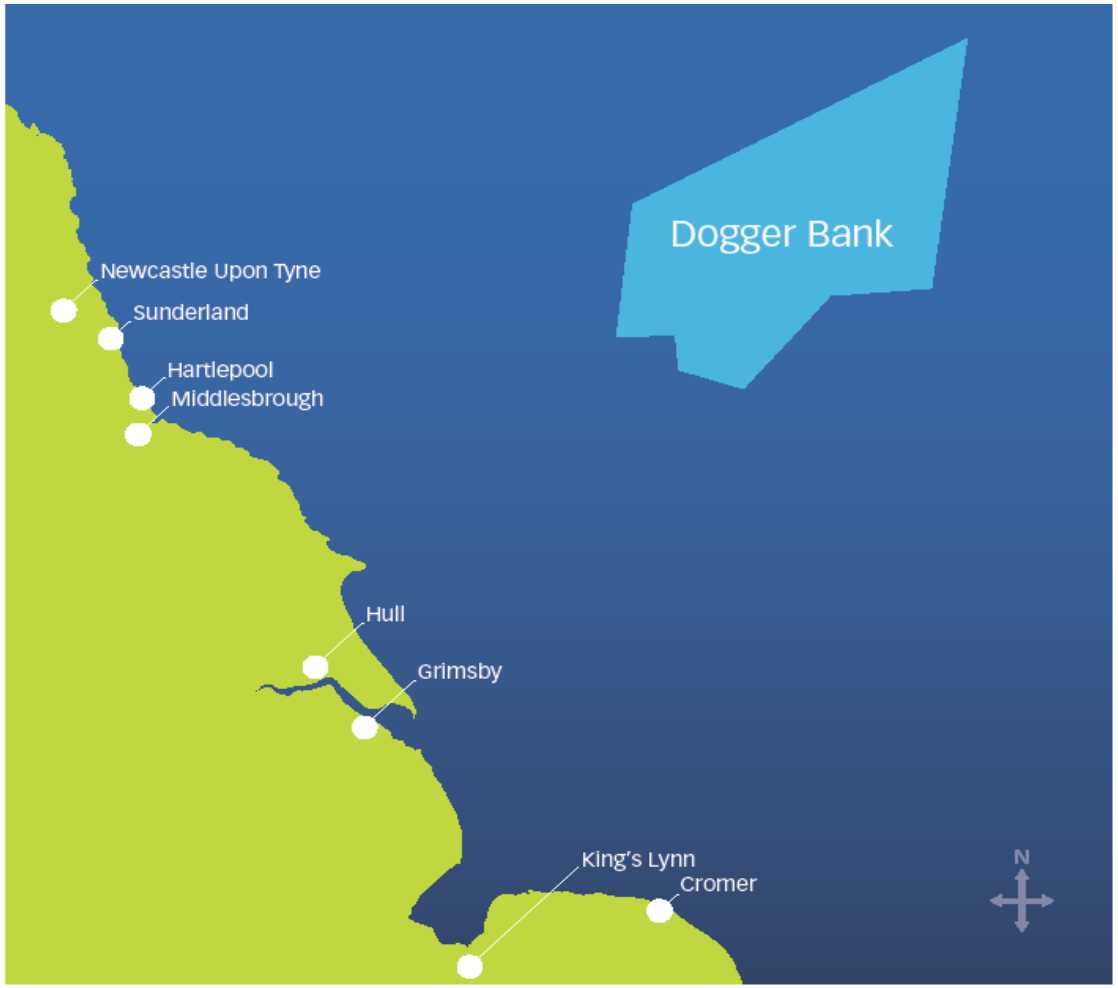
Dogger Bank offers shallow water, high wind speeds, and economies of scale
It's challenges are distance from shore and the truly marine environment





DOGGER BANK KEY FACTS

- Area: 8660km^2 (3343 square miles)
- Distance from shore: 125-290km
- Water depth: 18-63 m (59 to 206 ft)
- High wind speeds >10 m/s average

Forewind's role

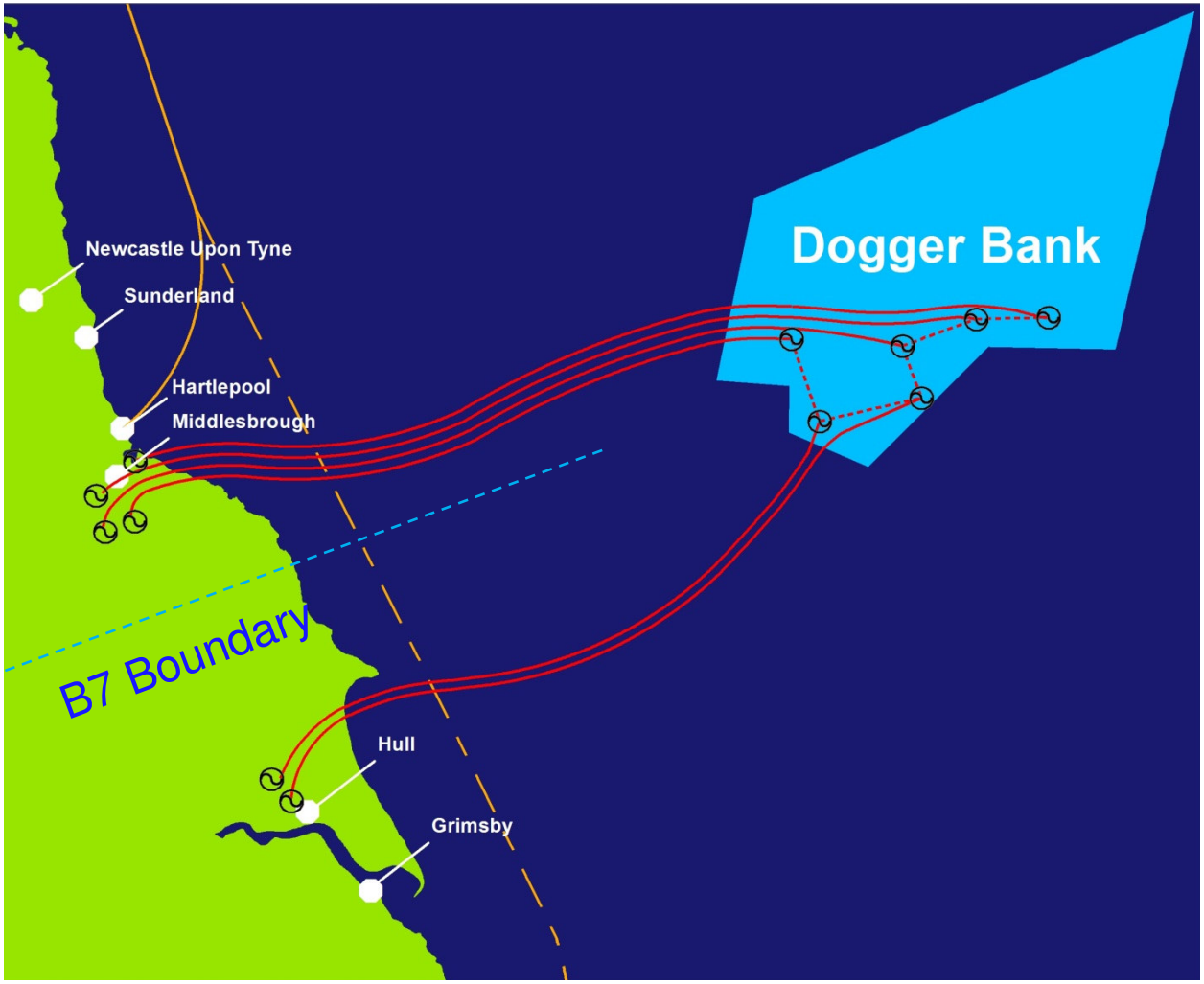
Four-way equal joint venture

Achieve development consent for a minimum of 9GW of safe, technically deliverable and economically viable offshore wind capacity on the Dogger Bank that will provide an attractive opportunity for investors.

- The Crown Estate is development partner in the consenting phase
- Zone Development Agreement with The Crown Estate for Dogger Bank zone
- Target zone capacity 9,000 MW
- Integrated project team based in Reading

Our priority is to deliver value in the first six projects, building momentum and confidence in the Dogger Bank development.

Transmission capacity secured



Connection point		Connection date
P1 – Creyke Beck	Yorkshire	Apr 2016
P2 – Lackenby	Teesside	Apr 2017
P3 – Lackenby	Teesside	Apr 2018
P4 – Creyke Beck	Yorkshire	Apr 2019
P5 – nr. Tod Point	Teesside	Apr 2019
P6 – nr. Tod Point	Teesside	Apr 2020

- 6000 MW of co-ordinated offers accepted
- Connection points in Teesside and Yorkshire
- Potential to link project offshore by HVAC links
- Projects will create a bootstrap over B7 boundary increasing N-S transfer

Cost reduction opportunities

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- Dogger Bank zone is relatively unconstrained from a consent perspective
- 18 months of cost optimisation performed to maximise value from the projects
- Full lifetime cost of energy model covering all aspects
- Dominant spatial effect is wake effects for large wind-farm arrays
- Optimum project size far larger than for projects in Round 1 and 2 to date

Key results of cost optimisation

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8 projects in total

Up to **1200 MW** capacity per project

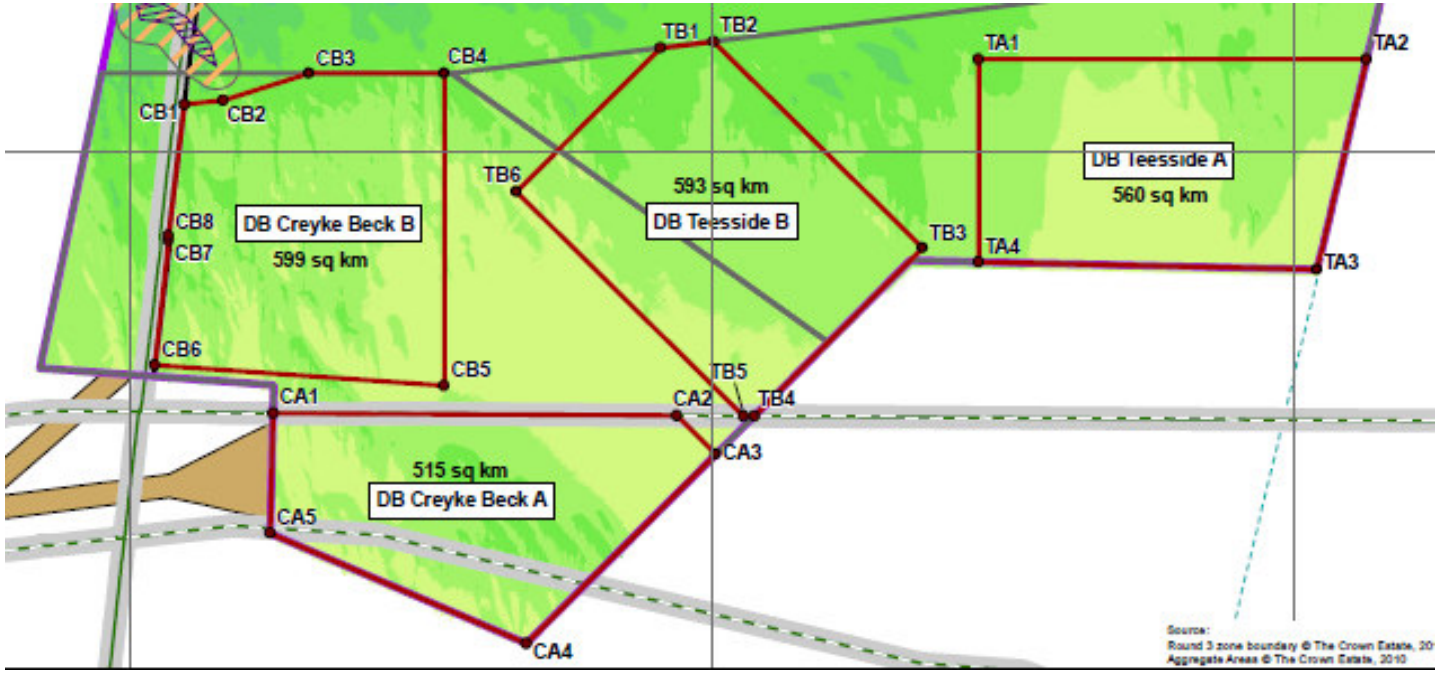
Revised zone capacity up to **9.6 GW**

First four projects identified for consent process

Each has an area of **at least 515 sq km**

Overplanting concept: up to 1200 MW for 1000 MW grid connection

Load factors **53 – 54%** (onshore interface)



Next steps in development

- First six projects in active development
- Projects being taken forward in pairs
- Further grid capacity for P7 / P8 depends on development of integrated offshore grid

<u>Consent Application Timeline</u>

Dogger Bank Creyke Beck A and B
2 x up to 1200 MW projects
Connecting in East Riding of Yorkshire

Consent Application	Q2 2013
Determination	**Q3 2014**

Dogger Bank Teesside A and B
2 x up to 1200 MW projects
Connecting at Lackenby in Teesside

Consent Application	Q1 2014
Determination	**Q2 2015**

Further Challenges

Key challenges for offshore wind and Round 3

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Cost reduction towards £100 / MWh by 2020

- Technology development (larger turbines)
- Supply chain efficiency and removal of bottlenecks

Timely and streamlined consent process for Round 3 projects

- "Front-loaded" consenting process

Certainty on mechanism and level of support after 2017

- EMR and transition to CfD FITs

Regulatory certainty around offshore co-ordinated grid connection

- Charging/securities for co-ordinated designs (National Grid)
- Co-ordinated offshore network delivery model (Ofgem)
- Integrated Network and Planning Regime (ITPR, Ofgem)

Thank you

Additional Slides

UK Round 1

	Owner	MW Capacity	Status
Barrow	DONG Energy / Centrica	90	Operational
Beatrice Demo	SSE Renewables	10	Operational
Blyth	E.ON UK Renewables	4	Operational
Burbo Bank	DONG Energy	90	Operational
Gunfleet Sands I & II	DONG Energy	173	Operational
Lynn & Inner Dowsing	Centrica Renewable Energy	194	Operational
Kentish Flats	Vattenfall	90	Operational
North Hoyle	RWE Npower Renewables	60	Operational
Rhyl Flats	RWE Npower Renewables	90	Operational
Robin Rigg	E.ON UK Renewables	180	Operational
Scroby Sands	E.ON UK Renewables	60	Operational
Teesside	EdF	62	Under Construction
Cirrus Array (Shell Flats)		270	Withdrawn
Cromer		108	Withdrawn
Scarweather Sands		108	Withdrawn

Operational Total (MW)	1041
Under Construction Total (MW)	62

UK Round 2 and extensions

	Owner	MW Capacity	Status
Thanet	Vattenfall	300	Operational
Walney I	DONG Energy / SSE Renewables/ Ampere Equity / PGGM	183.6	Operational
Greater Gabbard	SSE Renewables / RWE Npower Renewables	504	Operational
Ormonde	Vattenfall	150	Operational
Walney 2	DONG Energy / SSE Renewables/ Ampere Equity / PGGM	183.6	Operational
Gwynt Y Mor	RWE Innogy / SWM / Siemens	576	Under Construction
Lincs	Centrica / DONG Energy/ Siemens Project Ventures	270	Under Construction
London Array I	DONG Energy / E.On Renewables / Masdar	630	Under Construction
Sheringham Shoal	Statoil / Statkraft	317	Under Construction
West of Duddon Sands	Scottish Power/DONG Energy	389	Under Construction
Humber Gateway	E.ON UK Renewables	300	Under Construction
London Array II	DONG Energy / E.On Renewables / Masdar	370	Approved (2007)*
Westermost Rough	DONG Energy	240	Approved (July 2011)
Dudgeon	Warwick Energy	580	Approved (July 2012)**
Race Bank	Centrica Renewable Energy Ltd	620	Approved (July 2012)
Triton Knoll	RWE Npower Renewables	900-1200	Submitted to PINS
Galloper Wind Farm	SSE Renewables / RWE Npower Renewables	504	Submitted to PINS
Kentish Flats 2 Extension	Vattenfall	51	Submitted to PINS
Burbo Bank Extension	DONG Energy	234	In Development
Walney Extension	DONG Energy	750	In Development
Docking Shoal	Centrica Renewable Energy Ltd	540	Refused (July 2012)

Operational Total (MW)	1321.2
Under Construction Total (MW)	2482
Approved Total (MW)	1810