Wind Power

Technology Trends, Economic and Environmental Issues

David Woodhead

20th Nov 2023

experts | evolving | energy

ME – 10 years in offshore renewables

Development, design, construction, innovation, financing…

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CONTENTS

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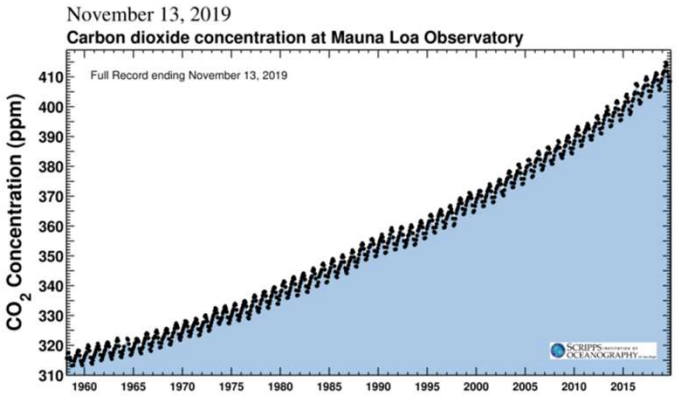
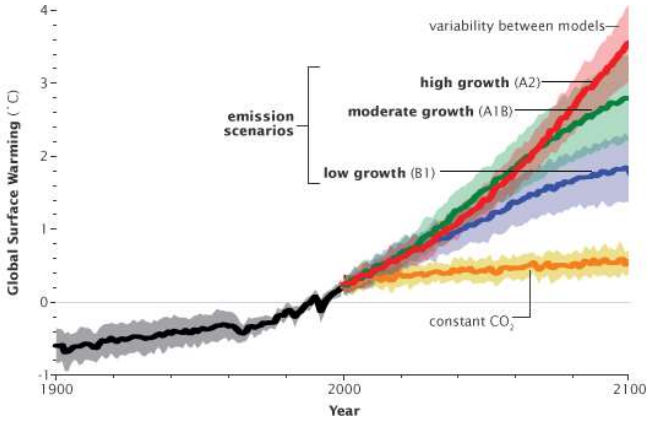
1 Lecture 1 - Wind Power Technology

- Global Wind Industry
- Turbine Technology Trends
- Constructing a Windfarm
- Consenting a Windfarm
- Environmental Impacts

CLIMATE CONTEXT





PARIS2015
UN CLIMATE CHANGE CONFERENCE
COP21·CMP11

MARRAKECH
COP22|2016|CMP12
UN CLIMATE CHANGE CONFERENCE

COP23 FIJI
UN CLIMATE CHANGE CONFERENCE
BONN 2017

COP24·KATOWICE 2018
KONFERENCJA NARODÓW ZJEDNOCZONYCH
W SPRAWIE ZMIAN KLIMATU

COP25
CHILE
MADRID 2019

COP 26 GLASGOW
UNITED NATIONS
CLIMATE CHANGE
CONFERENCE
NOVEMBER 2020

COP27
SHARM EL-SHEIKH
EGYPT2022

Climate Change Act 2008

Net Zero
The UK's contribution to stopping global warming
Committee on Climate Change

COP28
UAE

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WIND POWER

ZERO CARBON ?

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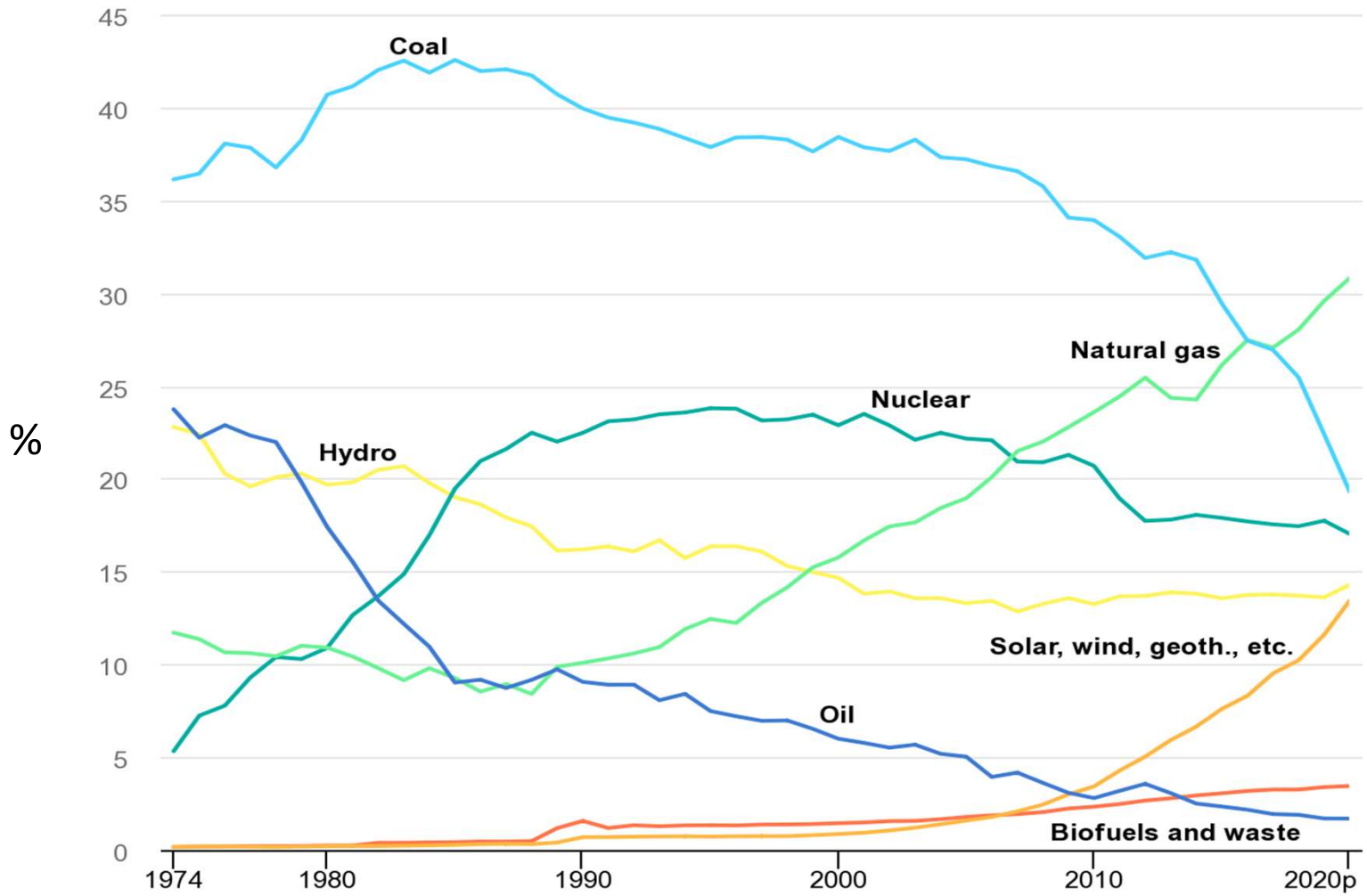
WIND POWER

Share of OECD gross electricity production by source, 1974-2020p



https://www.iea.org/reports/electricity-information-overview/electricity-production

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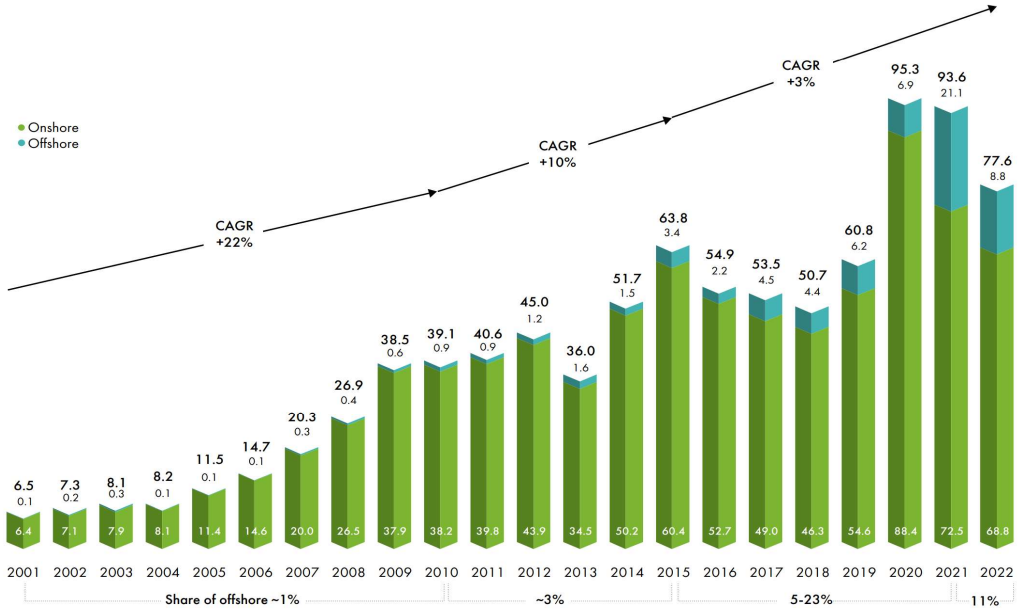
GLOBAL WIND CAPACITY



End 2022 Comparison:

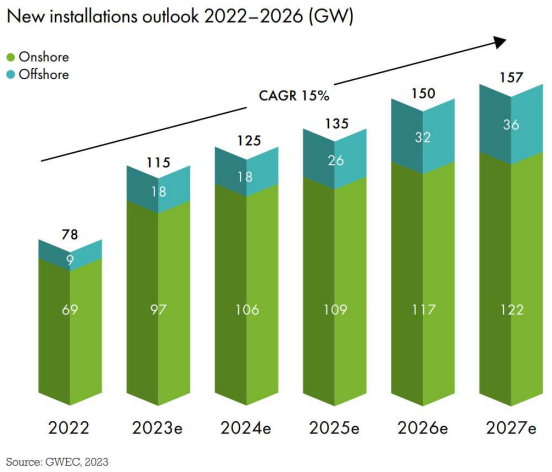
Wind - 906 GW

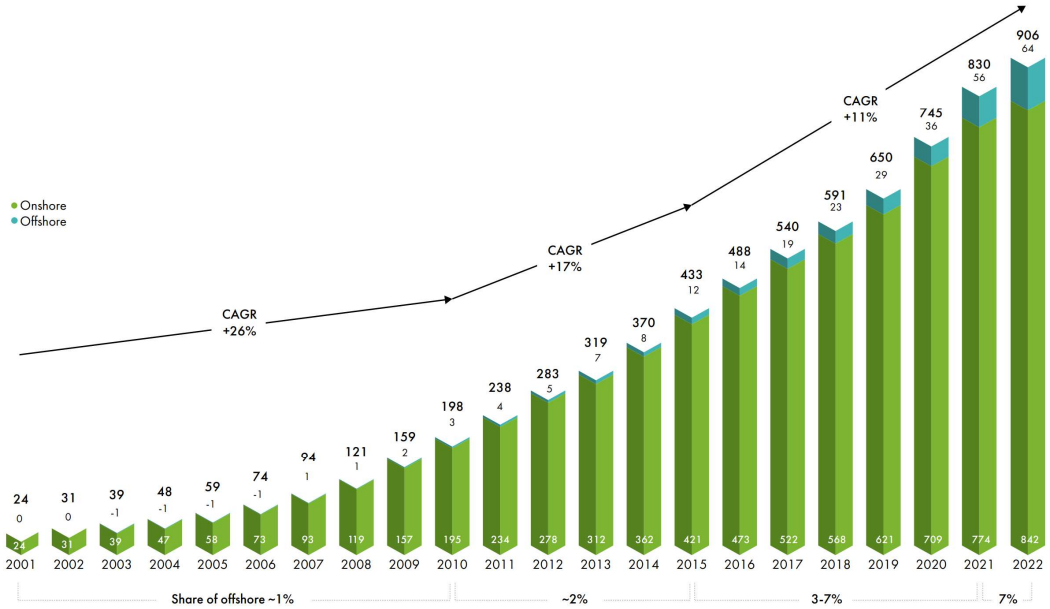
Solar PV – 1,177 GW

Nuclear - 394 GW

Hydro - 1,267 GW

Coal ~ 2,200 GW

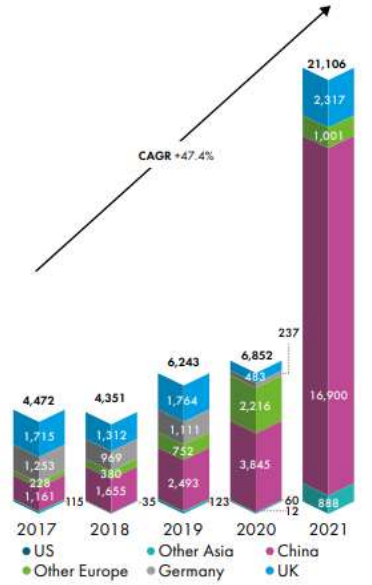




Wind power Investment

~€200bn/year

in 2021



Source – Global Wind Energy Council
https://gwec.net/

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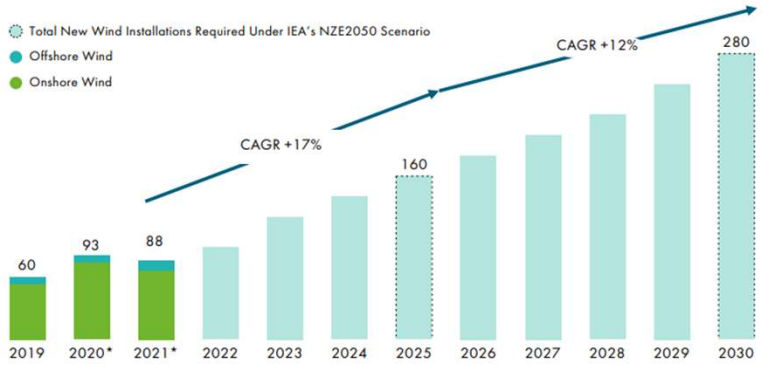
GLOBAL WIND CAPACITY

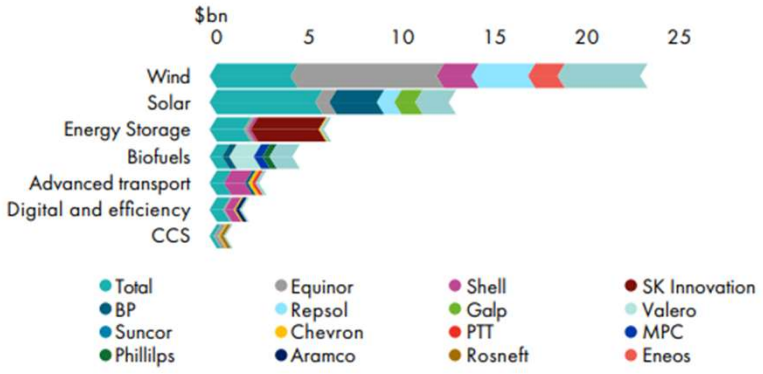
Annual wind installations must increase dramatically to reach net zero by 2050

New global wind installations (GW)



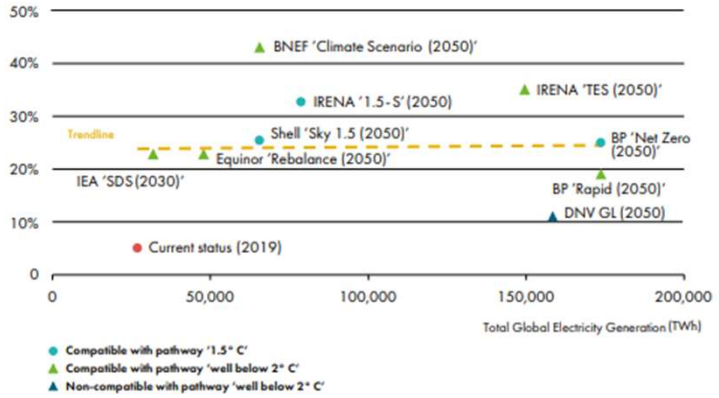
Source: GWEC Market Intelligence; IEA World Energy Outlook (2020), volume in 2022-2024 and 2026-2029 are estimates

Oil and gas sector investment in low-carbon technologies, 2015-2020



Source: BloombergNEF, company reports

Share of wind energy (%) in total global electricity mix versus total electricity generation



Source – Global Wind Energy Council: GWEC-Global-Wind-Report-2021.pdf

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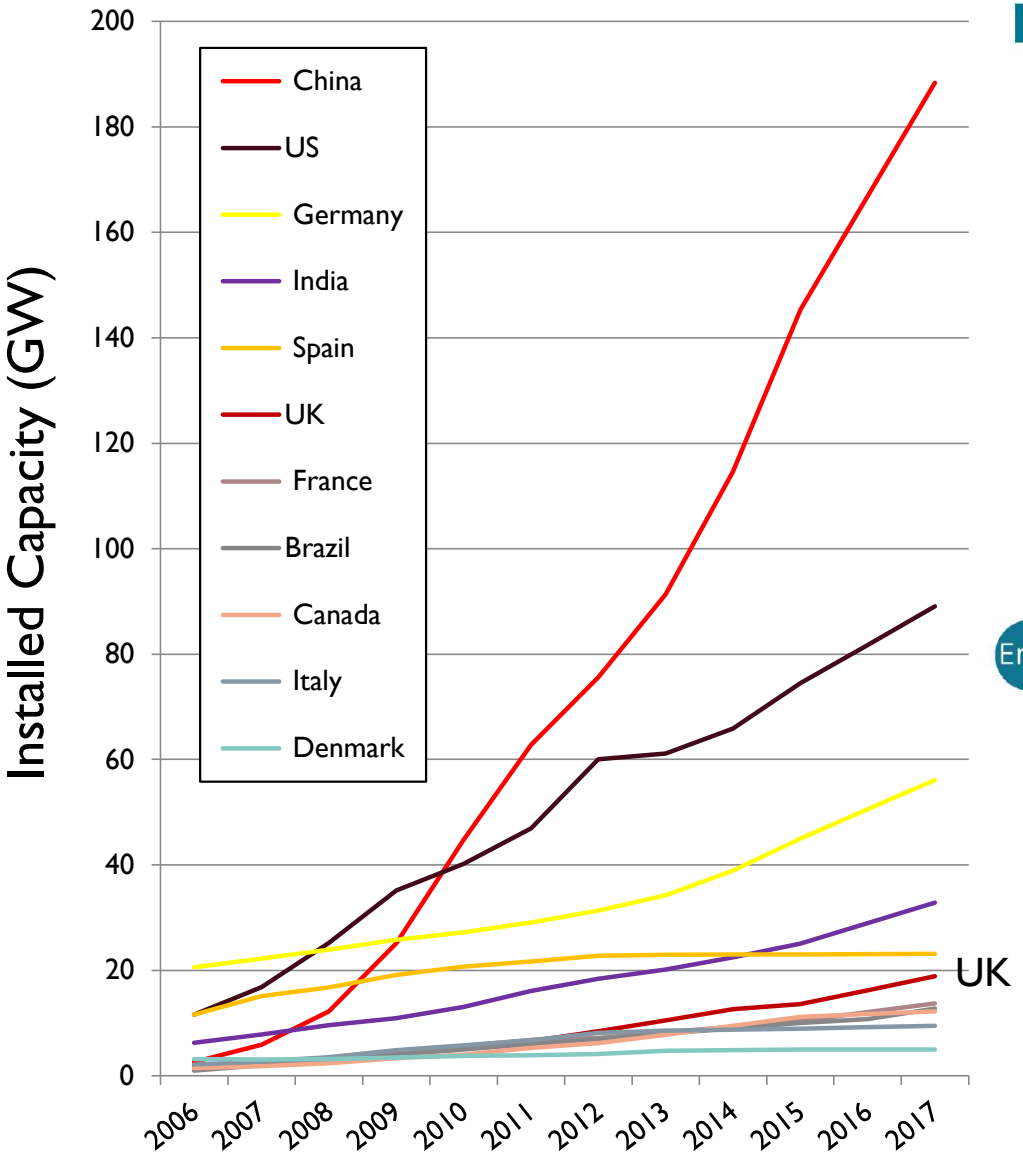
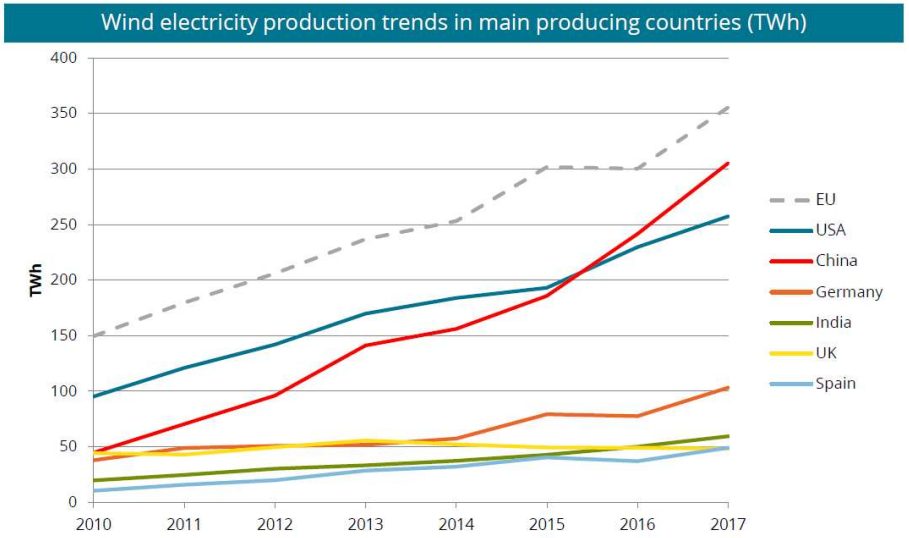
INSTALLED CAPACITY vs. ENERGY PRODUCTION





Enerdata

- 26% growth in wind power generation in **China** in 2017: 35 GW installed in 2015, 17 GW in 2016 and 15 GW in 2017
  Wind accounts for 12% of new capacity installations in China
- Strong growth (+18%) in the **EU** (32% of global generation) with additional capacities and improved wind conditions in most European countries in 2017
- New growth in the **US:** +12% (23% of global wind generation, 40% of new US capacity). Wind installations slowed down to 6.2GW, after a record +8.7 GW in 2016

Source : Enerdata

World Energy Trends - 2018 Edition - 25

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WIND POWER IN THE UK

Nov 2012 vs. Nov 2023:

7.3 → 29.6 GW

(Compound Annual Growth Rate +17%)

Offshore < Onshore

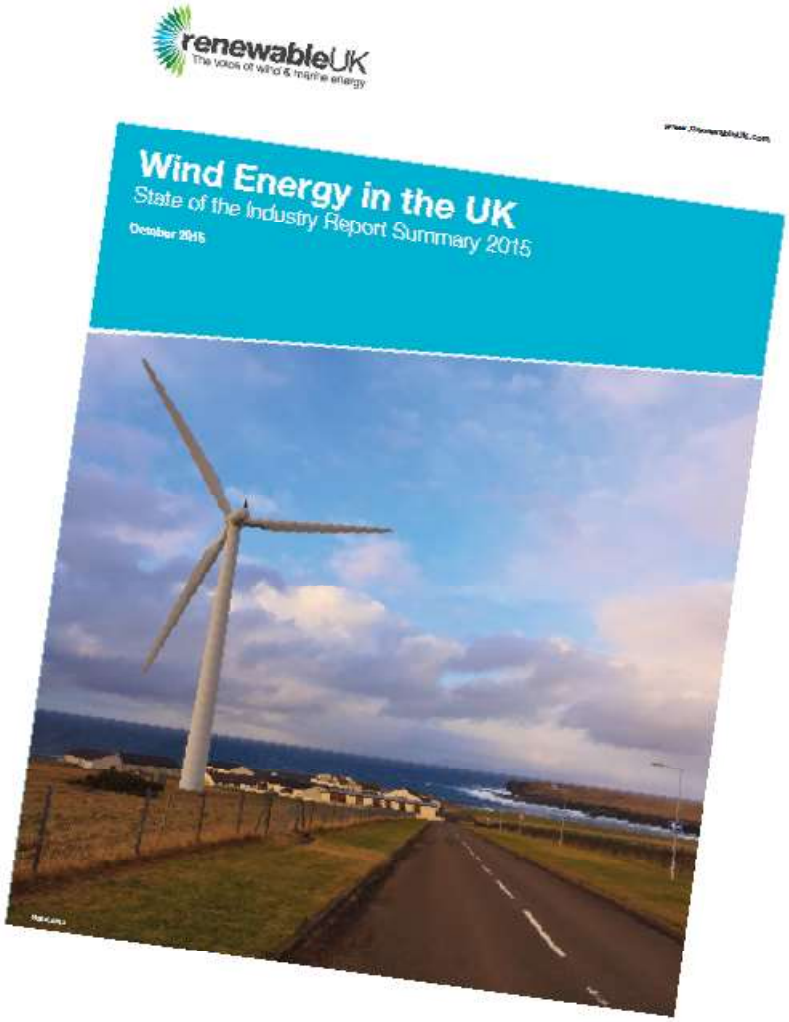
14.7 GW 14.9 GW

UK 2030 Targets:

Offshore **50GW**

Onshore ???

Offshore build rate > Onshore build rate



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WIND POWER IN THE UK

	Trail Blazers		Record Breakers	
	Onshore	**Offshore**	**Onshore**	**Offshore**
Name	Delabole	Blyth	Whitelee	Hornsea2
Completion	1991	2000	2009	2022
Size (No. x Turbine Size)	4 MW (10 x 0.4 MW)	4 MW (2 x 2.0 MW)	539 MW (215 x 2.5 MW)	1,386 MW (165 x 8.0 MW)

Ørsted

Re-powered 2011
9.2 MW
(4 x 2.3 MW)

good energy

Decommissioned
2018

e·on

Replaced by:
Blyth Offshore Demonstrator
42MW (5 x 8.4 MW)

SCOTTISHPOWER

EDF renewables

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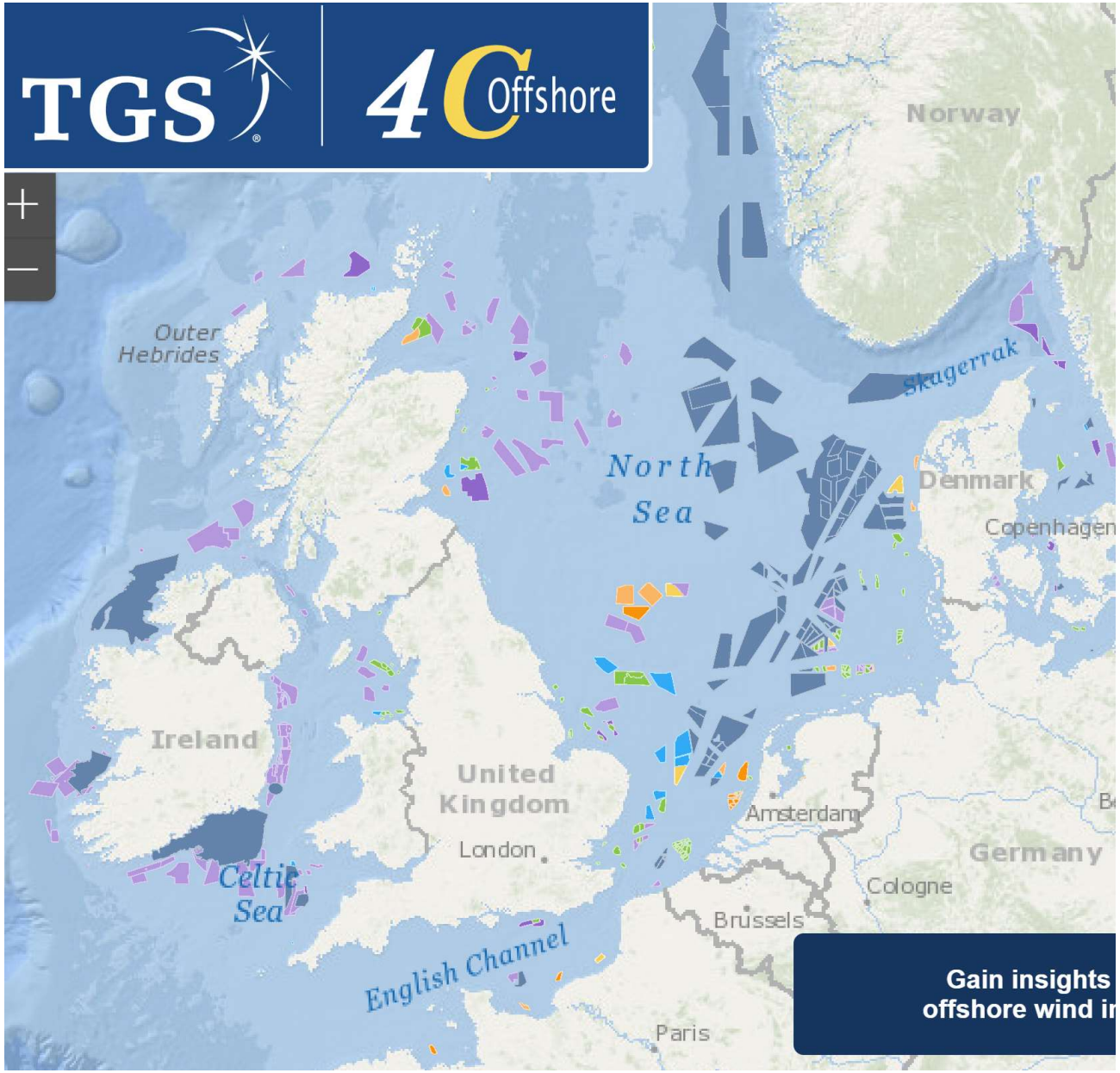
OFFSHORE WIND – PATH TO 50GW – LEASING



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OFFSHORE WIND – CROWN ESTATE

Playing our part in the growth of UK offshore wind

THE CROWN ESTATE

Our team of environmental and commercial experts, working in partnership with industry, stakeholders and Government, take an active, long-term approach to offshore wind development, helping unlock the extraordinary potential of the UK's seabed.

Key enabling actions

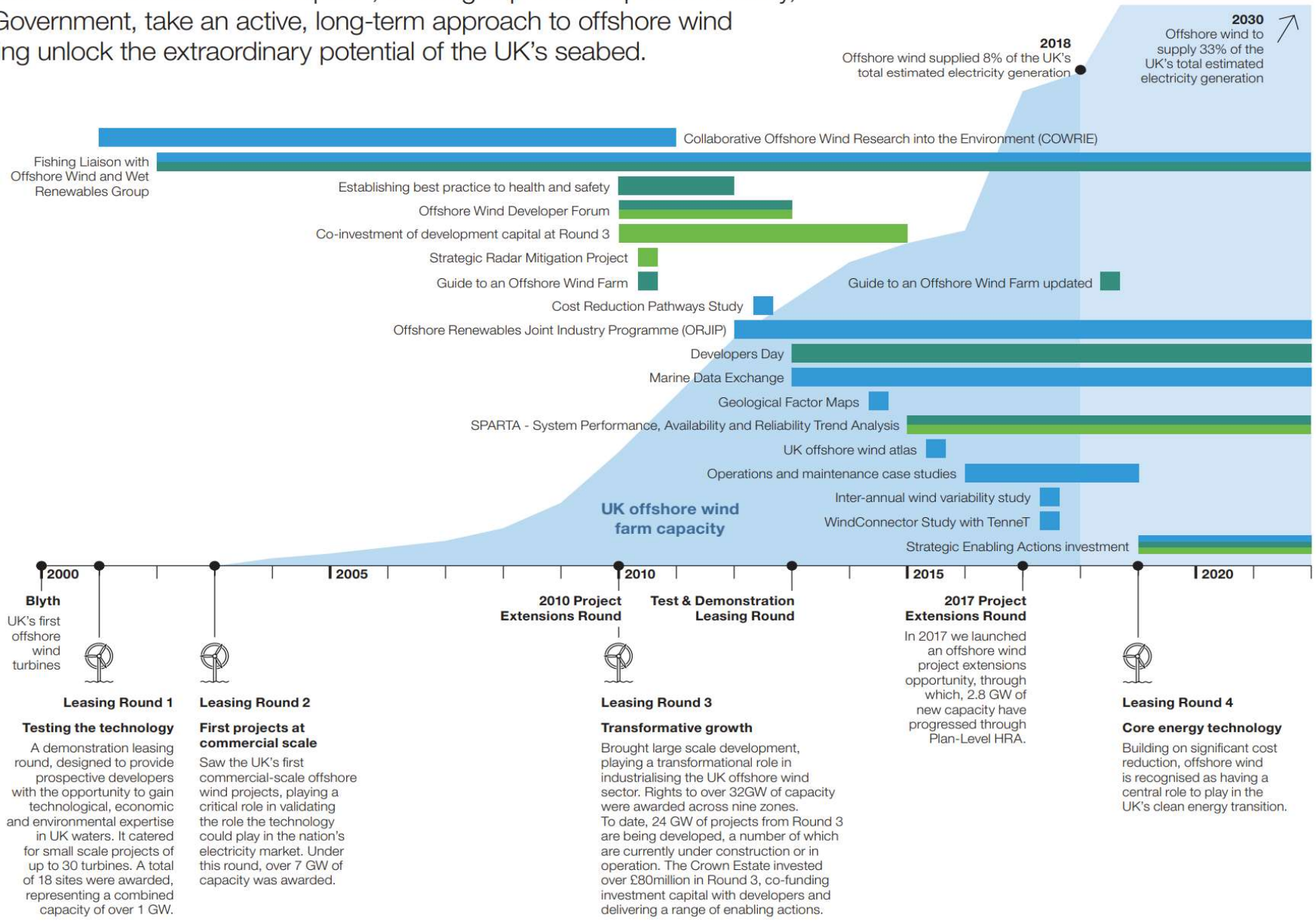
The chart on the right represents the timeline of our key enabling actions and the launch of leasing activities.

In addition to leasing seabed sites, we have undertaken a number of important enabling actions, together with the industry and stakeholders, to support the development and continued growth of the UK offshore wind sector.

These include:

- **Growing the evidence base**
- **Establishing best practice**
- **Investing alongside developers**

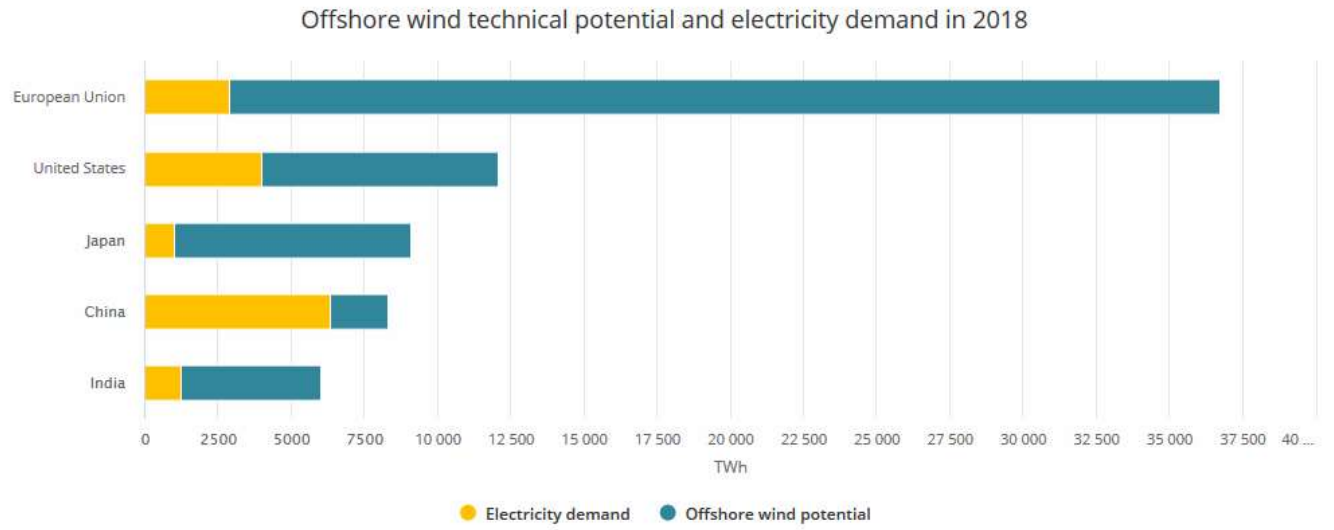
All of this has helped to bring down cost, de-risk developments and unlock value, making our nation's seabed a brilliant place to invest.



GLOBAL OFFSHORE WIND POTENTIAL

Offshore wind is gathering speed

Cost reductions and experience gained in Europe's North Sea are opening up a huge renewable resource. Offshore wind has the technical potential to meet today's electricity demand many times over. It is a variable source of generation, but offshore wind offers considerably higher capacity factors than solar PV and onshore wind thanks to ever-larger turbines that tap higher and more reliable wind speeds farther away from shore. There are further innovations on the horizon, including floating turbines that can open up new resources and markets.



Increasingly cost-competitive offshore wind projects are on course to attract a trillion dollars of investment to 2040. Europe's success with the technology has sparked interest in China, the United States and elsewhere. In the Sustainable Development Scenario, offshore wind rivals its onshore counterpart as the leading source of electricity generation in the European Union, paving the way to full decarbonisation of Europe's power sector. Even higher deployment is possible if offshore wind becomes the foundation for the production of low-carbon hydrogen.

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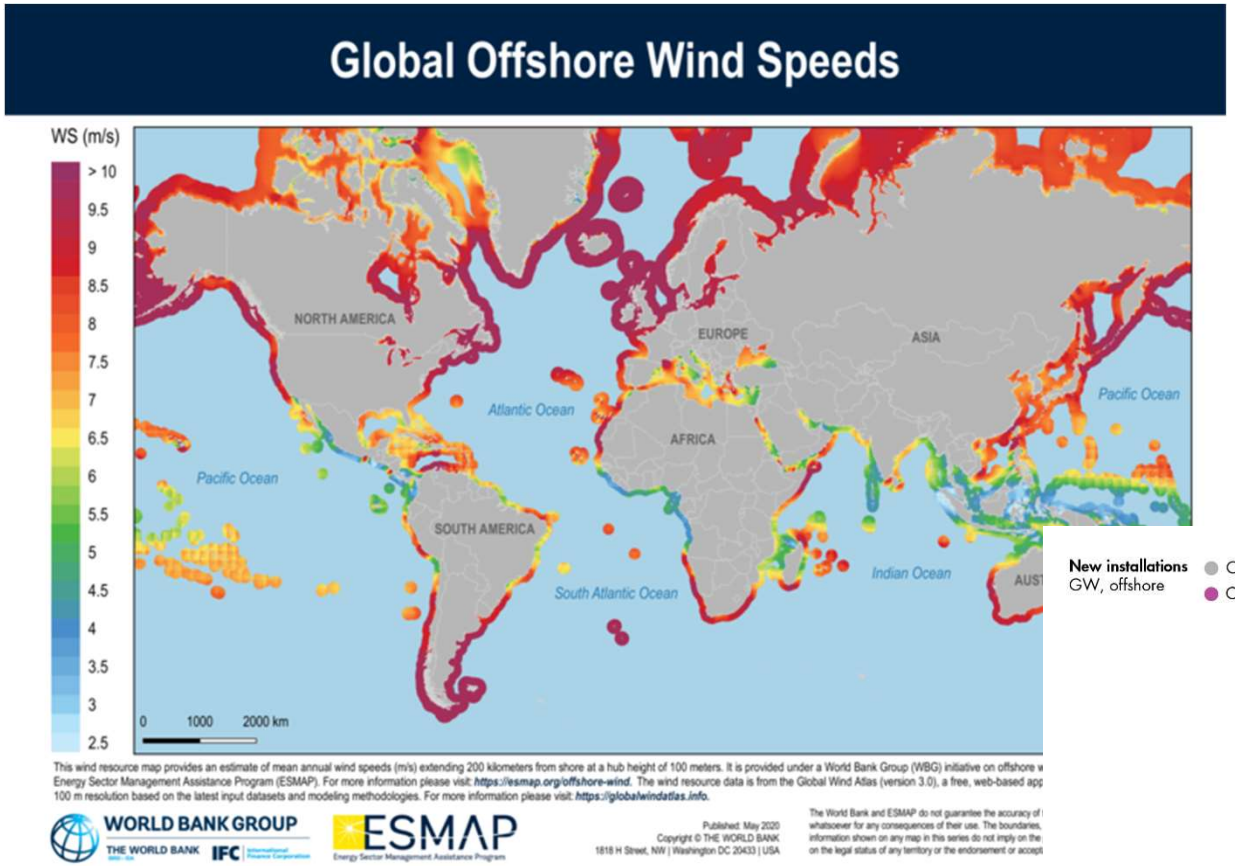
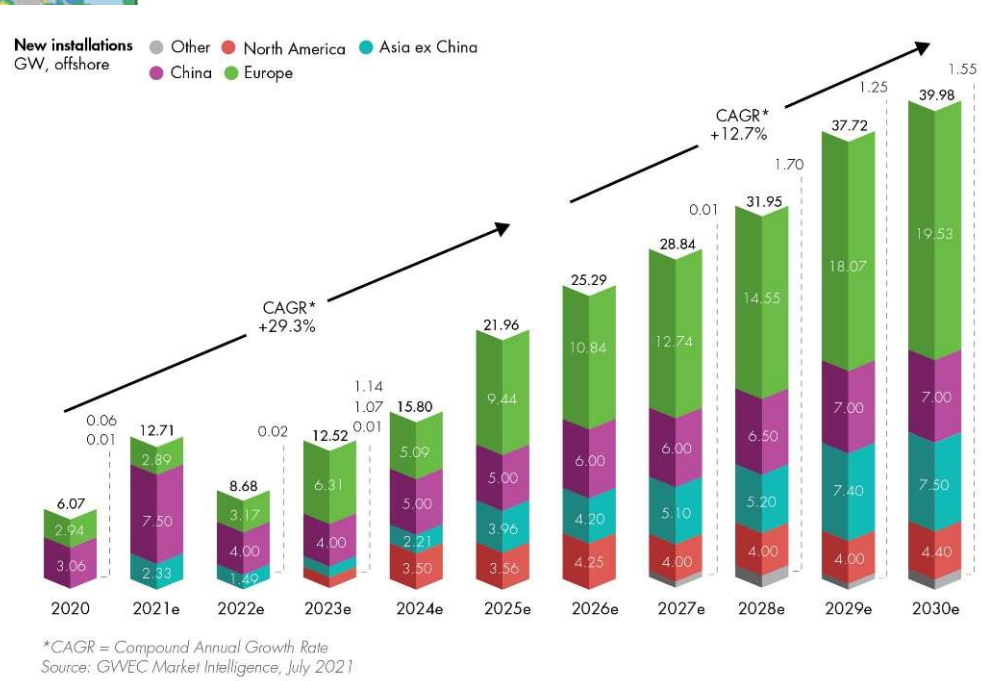
GLOBAL OFFSHORE WIND POTENTIAL





*CAGR = Compound Annual Growth Rate
Source: GWEC Market Intelligence, July 2021

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WIND POWER IN THE UK - FUTURE

Floating Offshore Wind

Green Hydrogen

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BREAKING RECORDS - 2015

Renewables overtake coal in UK power mix

Latest government figures show major growth in wind and solar generation, as ills

han | 24 Sep 2015 | 2 Comments

Comment

UK wind industry sets new generation record as it nears 25 per cent power share

As nuclear and gas power plants remain off line, wind industry celebrates its role in helping to address supply fears

Print Send Save

By James Murray 20 Oct 2014

More from this author 5 Comments

LATEST STORIES ABOUT WIND

MIT: Wind farms do not make you sick

Wind power generates 140% of Denmark's electricity demand

Unusually high winds allowed Denmark to meet all of its electricity needs – with plenty to spare for Germany, Norway and Sweden too

Renewables briefly covered 78 percent of German electricity

28 Jul 2015 by Craig Morris Comments (8)

On July 25, Germany surpassed the old record of 74 percent renewable electricity. But perhaps the most interesting aspect is power trading between France and Germany on that day. Craig Morris explains.

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BREAKING RECORDS - 2016

BUSINESS GUIDE

Borssele 1&2 World's Cheapest Offshore Wind Farm

Image: TenneT

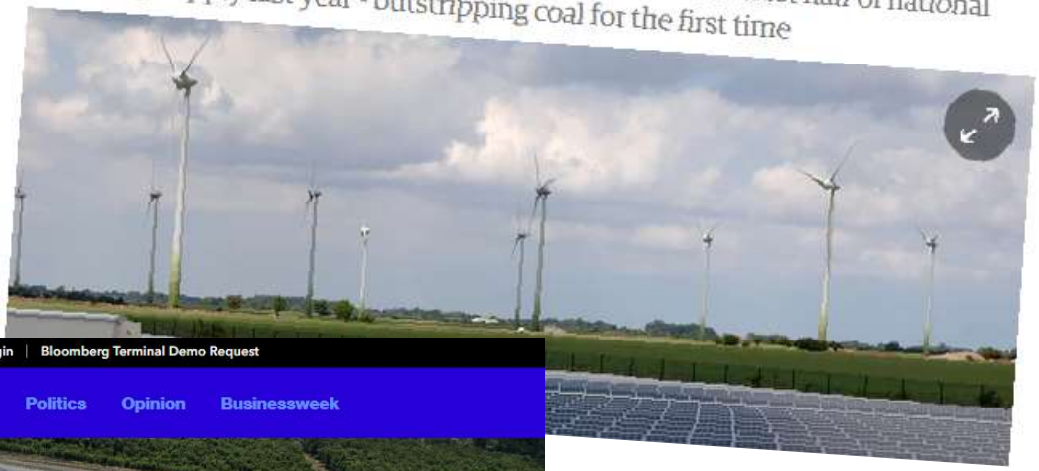
The cost of building and operating the 700MW Borssele 1 and 2 offshore wind farm is expected to be EUR 2.7 billion cheaper than previously estimated. Moreover, the wind farm will generate 22.5% more electricity than anticipated

Fierce competition between companies in the public tender to secure the permit and associ subsidy to build and operate the wind farm resulted in achieving the lower than anticipat price, thus making the project cheapest

government following the annou

Record 46% of UK's electricity generated by clean energy sources in 2015

Official figures show low-carbon sources accounted for almost half of national electricity supply last year - outstripping coal for the first time



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Record Green Power Installations Beat Fossil Fuel for First Time

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MORE GOOD NEWS - 2017

UK renewables displaces coal for 2nd time in 2017

10/06/2017
By Diarmaid Williams
International Digital Editor

On 21st April this year, the UK saw the first day of no coal-fired power generation since the industrial revolution, as coal was displaced by renewable energy generation, in particular 1.7 GW of solar output. This notable occasion was repeated on Sunday 1st October, as the country again went coal-free.

WIND MARKETS & POLICY

New Study Finds Offshore Wind May Be Haven for Sea Life

But more research is needed to understand the long-term impacts.

JASON DEIGN | OCTOBER 23, 2017

Alpha Ventus offshore wind farm under construction in the North Sea in 2009.

Photo Credit: DOTI/Matthias Ibeler

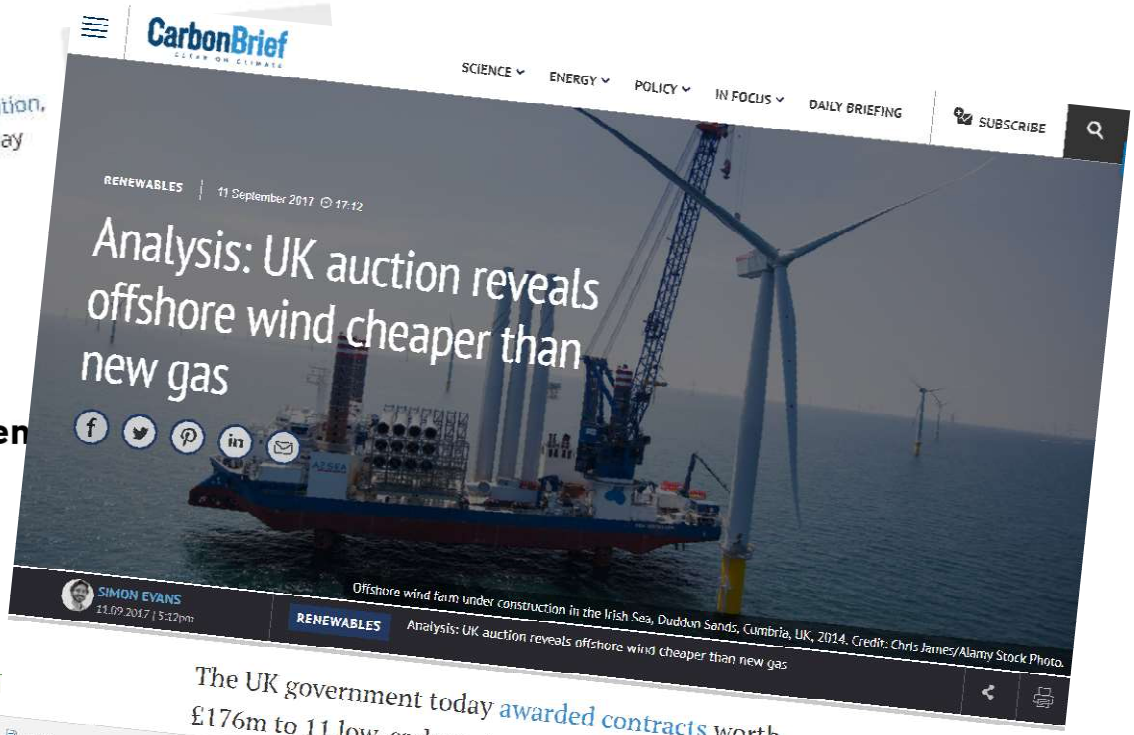
94

CarbonBrief

SCIENCE ENERGY POLICY IN FOCUS DAILY BRIEFING SUBSCRIBE

RENEWABLES | 11 September 2017 17:12

Analysis: UK auction reveals offshore wind cheaper than new gas



SIMON EVANS
11.09.2017 | 5:12pm

Offshore wind farm under construction in the Irish Sea, Duddon Sands, Cumbria, UK, 2014. Credit: Chris James/Alamy Stock Photo.

RENEWABLES Analysis: UK auction reveals offshore wind cheaper than new gas

The UK government today awarded contracts worth £176m to 11 low-carbon electricity schemes, with offshore

IMG_8108.PNG IMG_8107.PNG Show all

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OFFSHORE EXPANSION - 2018

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Wind

Triple good news for US offshore wind sector

Published Oct 18, 2018 18:01 CEST

Author Ivan Shumkov

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Topics Business Capacity

Country USA

Industry Electricity Generation Energy/Utilities Renewable Energy Power Offshore Wind

October 18 (Renewables Now) - The Trump Administration made three announcements on Wednesday that bring positive signals to the US offshore wind industry, both on the East and West Coasts.

First, US Secretary of the Interior Ryan Zinke unveiled that the Bureau of Ocean Energy Management (BOEM) will hold an auction for nearly 390,000 acres (157,800 hectares) offshore Massachusetts on December 13, 2018. According to the Secretary, the particular area can accommodate about 4.1 GW of capacity if fully developed. A total of 19 companies have qualified to take part in the process. Details will be published [illegible] tober 19, 2018.

A picture from Cathie Associates visit to the US first commercial offshore wind farm: Block Island.

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News & insights > Is the sun finally rising...

Is the sun finally rising on the Japanese offshore wind market?

Posted by **Jan Matthiesen** | 27 March 2018 | **Viewpoint**

The Japanese Government has drafted a new bill which will set nationwide rules for offshore wind developments in national waters, which could be a much-needed boost for the offshore wind industry.

FRENCH OFFSHORE WIND: LET THE GRAND REBOOT BEGIN!

Published November 2016

Rewind only two years and offshore wind in France looked quite rosy. A pipeline of 6 projects totalling 3 GW awarded in the space of two years, two French-owned turbine OEMs and significant supply chain commitments. Two years on, permits have been appealed, national turbine OEMs have changed hands, the 2016 energy sector plan has brought vague targets, and the third offshore tender round is ever-postponed, and looks very meagre.

French Energy and Environment Minister Ségolène Royal appears set to formally kick-off the third tender round with a site off Dunkirk and another off Oléron in the upcoming weeks. A shift in approach – a "grand reboot" – is on the way. And it's coming not a moment too soon!

The cost reboot:

Offshore wind in France has been tipped as too expensive with a 20-year FiT for round #1 projects north of 170 € / MWh, excluding grid connection. Policy-makers are now benchmarking this with projects to be constructed in approximately the same period with FiTs at or below 70 € / MWh. A crying gap!

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ACCELERATION - 2019

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NEWS

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UK England N. Ireland Scotland Alba Wales Cymru Local News

Climate change: Offshore wind expands at record low price

By Roger Harrabin
BBC environment analyst

Share

20 September 2019

Climate change

A record amount of new offshore wind power has been announced in the UK.

The new projects will power more than seven million homes at a lower-than-expected cost.

The government says the wind farms represent a breakthrough, typically generating electricity without subsidy.

Renewable electricity overtakes fossil fuels in UK for first time

New offshore windfarms opening in third quarter mark milestone towards zero carbon

Ten years ago fossil fuels made four fifths of the UK's electricity supply. Photograph: Islandstock/Alamy

Renewable energy sources provided more electricity to UK homes and businesses than fossil fuels for the first time over the last quarter, according to new research.

The renewables record was set in the third quarter of this year after its share of the electricity mix rose to 40%.

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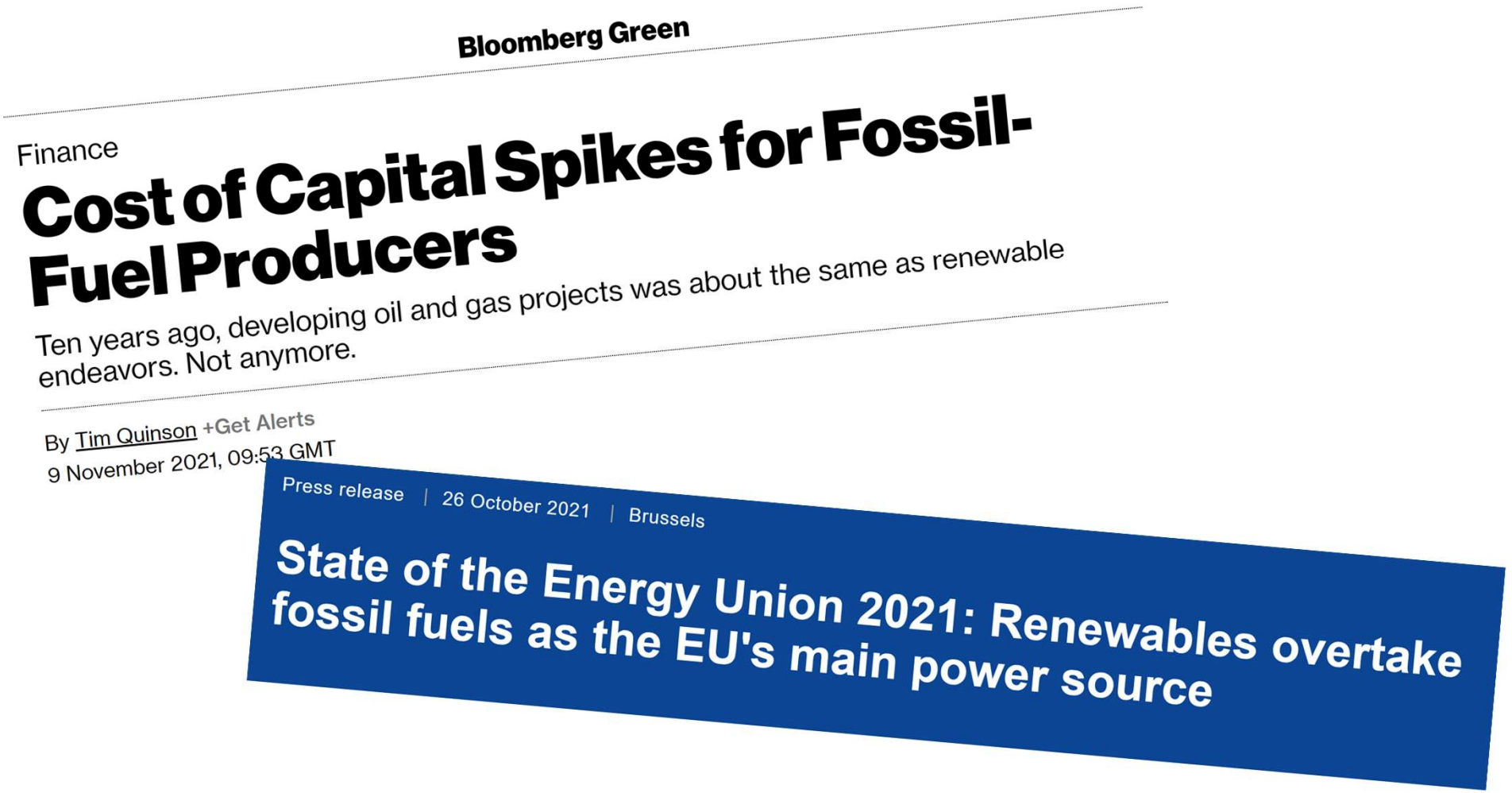
ACCELERATION – 2021



Bloomberg Green

Finance

Cost of Capital Spikes for Fossil-Fuel Producers

Ten years ago, developing oil and gas projects was about the same as renewable endeavors. Not anymore.

By Tim Quinson +Get Alerts
9 November 2021, 09:53 GMT

Press release | 26 October 2021 | Brussels

State of the Energy Union 2021: Renewables overtake fossil fuels as the EU's main power source

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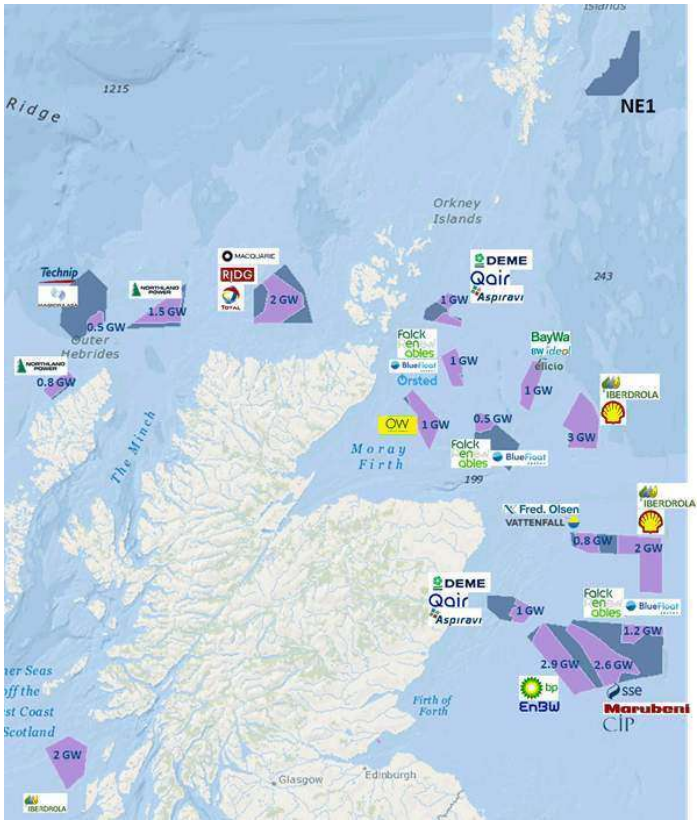
SYSTEM INTEGRATION – 2022



ScotWind

25 GW !!

£700m option fees

(half of projects considering green hydrogen)

Lead applicant	Option Fees	Technology	Total capacity (MW)
BP Alternative Energy Investments	£85,900,000	Fixed	2,907
SSE Renewables	£85,900,000	Floating	2,610
Falck Renewables	£28,000,000	Floating	1,200
Shell New Energies	£86,000,000	Floating	2,000
Vattenfall	£20,000,000	Floating	798
DEME	£18,700,000	Fixed	1,008
DEME	£20,000,000	Floating	1,008
Falck Renewables	£25,600,000	Floating	1,000
Ocean Winds	£42,900,000	Fixed	1,000
Falck Renewables	£13,400,000	Floating	500
Scottish Power Renewables	£68,400,000	Floating	3,000
BayWa	£33,000,000	Floating	960
Offshore Wind Power	£65,700,000	Fixed	2,000
Northland Power	£3,900,000	Floating	1,500
Magnora	£10,300,000	Mixed	495
Northland Power	£16,100,000	Fixed	840
Scottish Power Renewables	£75,400,000	Fixed	2,000
	£699,200,000		**24,826**

Hollandse Kust West

760 MW offshore wind

with..

600 MW electrolyser

Floating Solar

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DECELERATION – 2023

Wind is main source of UK electricity for first time

11 May · Comments

No bids for offshore wind in government auction

8 September · Comments

Vattenfall halts project, warns UK offshore wind targets in doubt

By **Susanna Twidale**

July 20, 2023 1:54 PM GMT+1 · Updated 4 months ago

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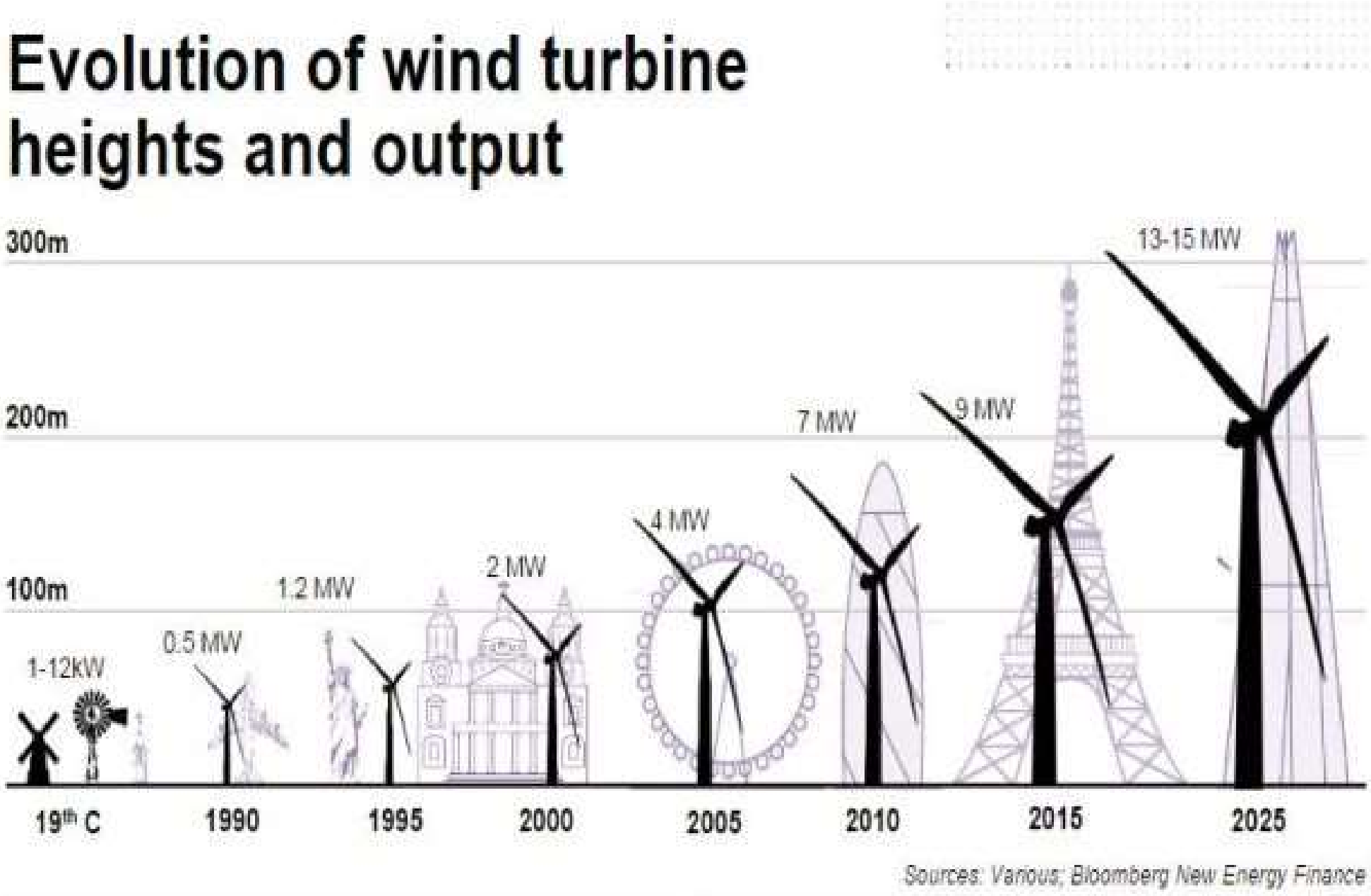
TURBINE TRENDS

TURBINE TRENDS



BIGGEST TURBINES - 2018

1. MHI Vestas V164-8.3MW (Burbo bank/Blyth/Aberdeen)
2. Enercon E126 7.5MW (onshore)
3. Samsung S7.0 171 7MW (sold to ORE Catapult)
4. MHI SeaAngel 7MW (mothballed)
5. Senvion 6M Series (10MW announced)
6. Siemens SWT-7.0 154 (Hull)
7. Alstom Haliade 150-6MW (bought by GE)
8. Sinovel SL6000
9. Areva M5000
10. Gamesa G5MW

7.


4.


8.


2.


5.


9.


1.


3.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Source http://www.windpowermonthly.com/10-biggest-turbines

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TURBINE TRENDS

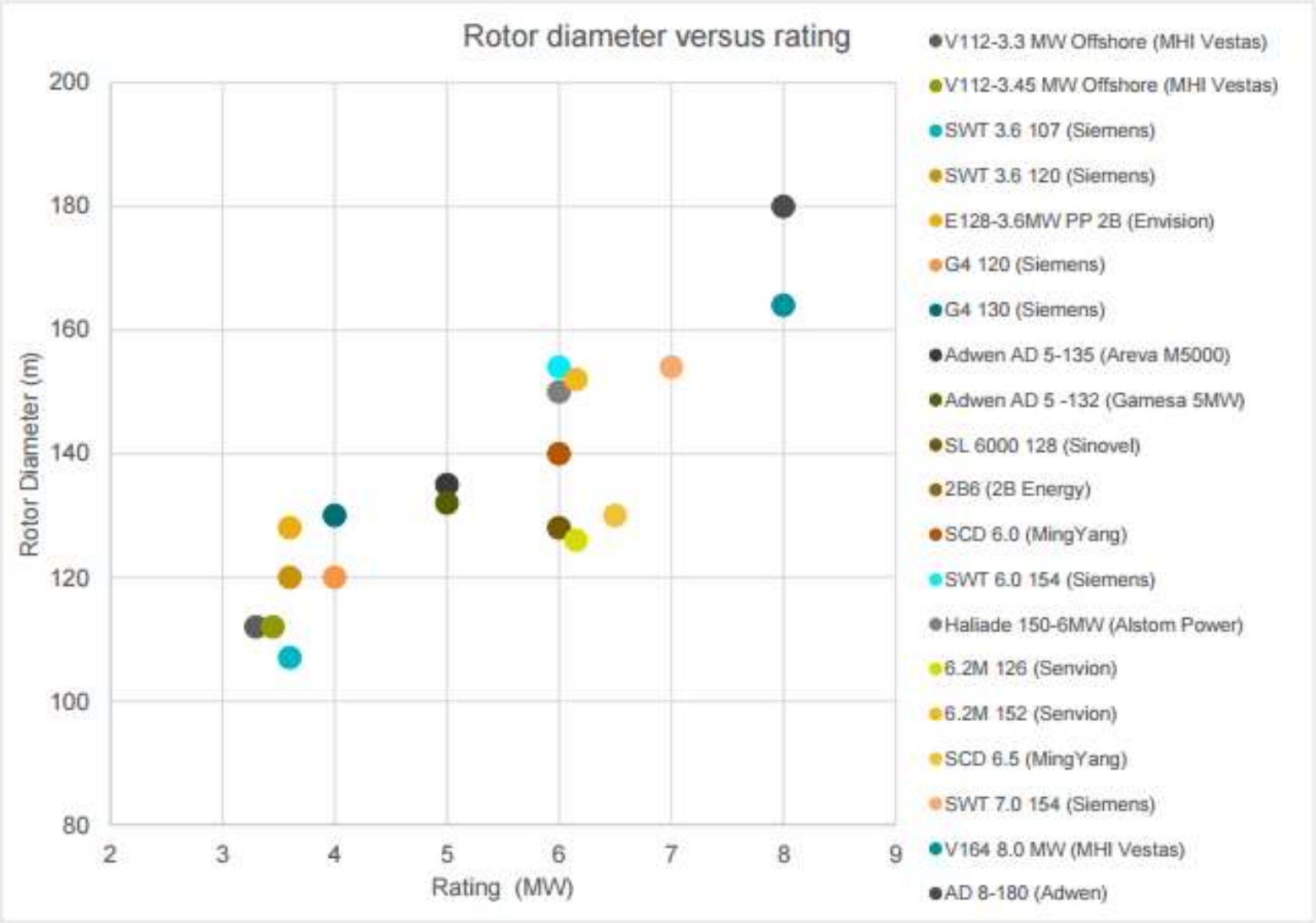

Figure 3 - Rotor diameter versus rating

https://ore.catapult.org.uk/wp-content/uploads/2016/05/Cost-Reduction-Monitoring-Framework-2015.-Qualitative-report.pdf

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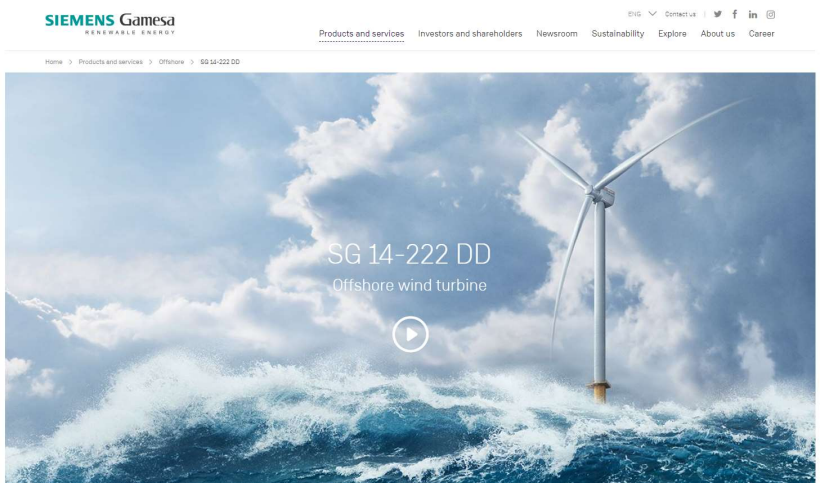
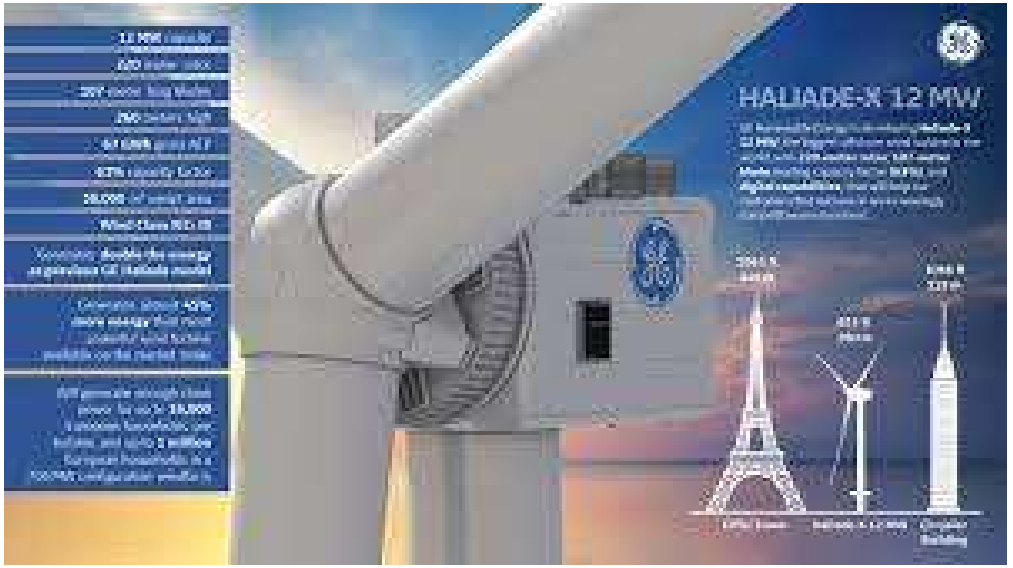
OFFSHORE TURBINE TRENDS - 10MW+



Siemens Gamesa

SG14-222 – 14MW



General Electric

Haliade X – 12MW

Mitsubishi Vestas

V164 10MW

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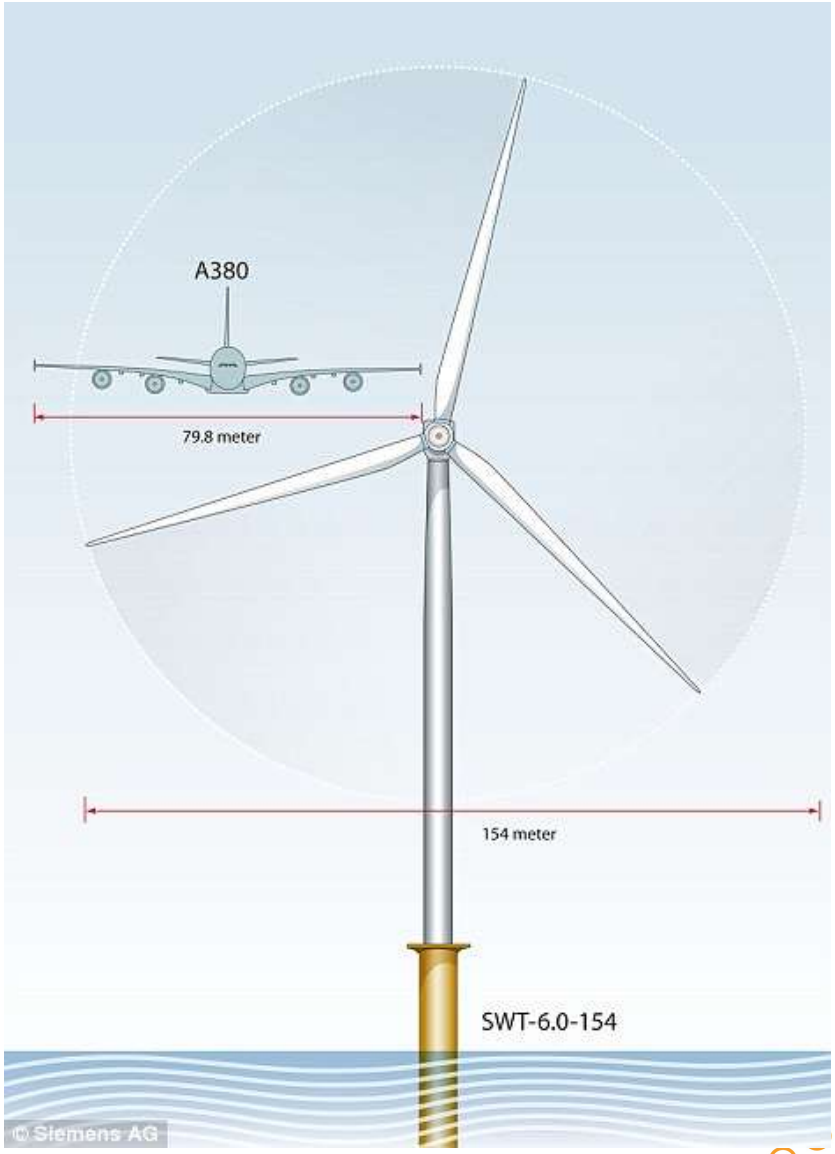
OFFSHORE SCALE



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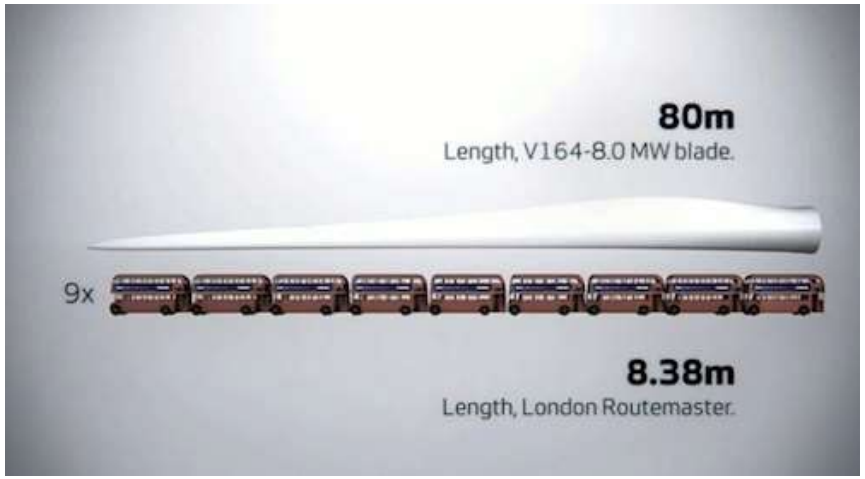
LONGEST BLADES



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LONGEST BLADES

Adwen/LM 88m

LZ Blades 123m

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BLADE TESTING

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CONSTRUCTION

ONSHORE CONSTRUCTION

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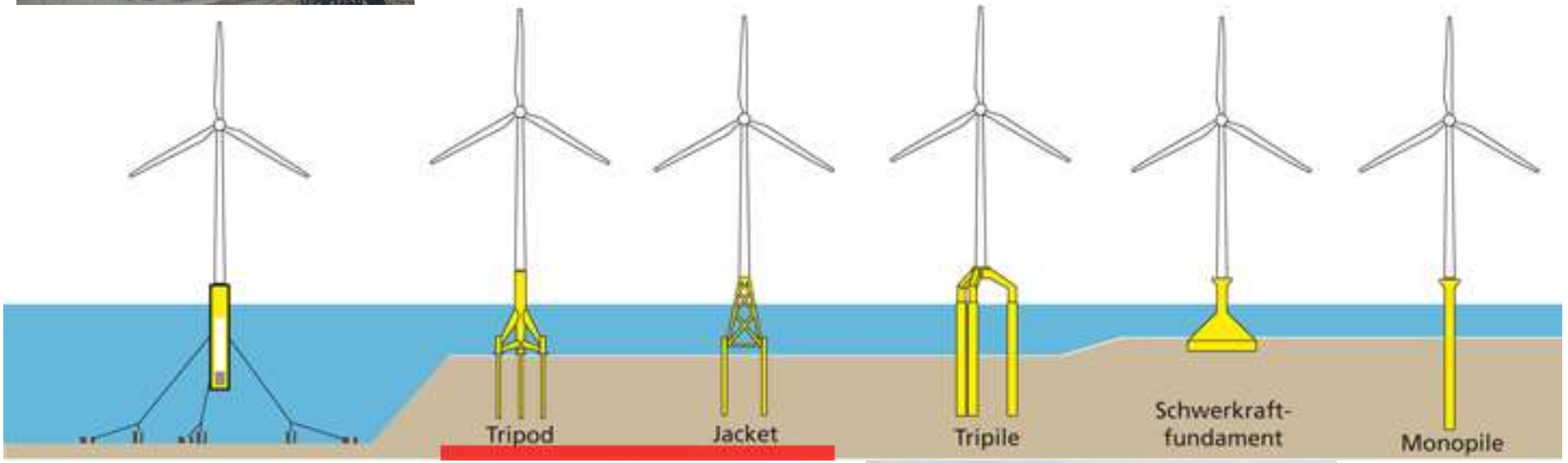
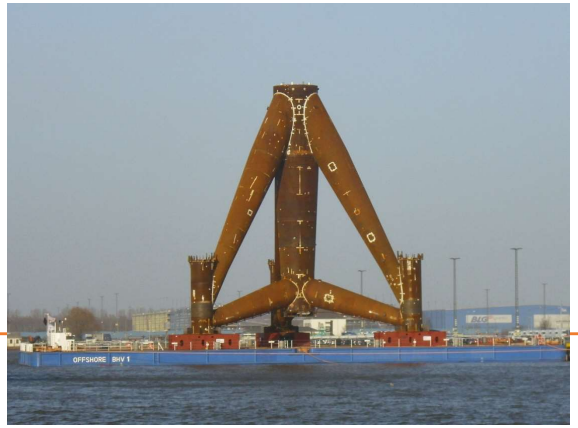
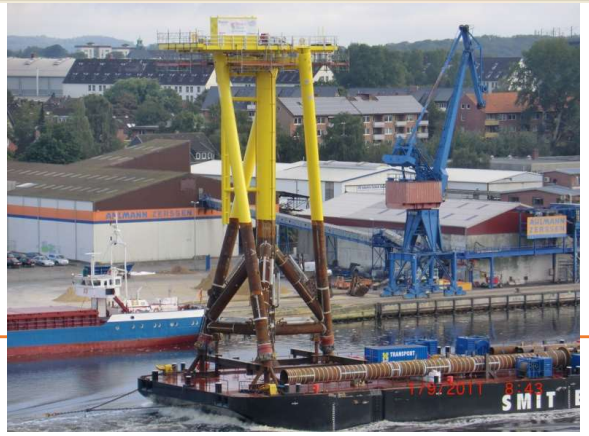
OFFSHORE CONSTRUCTION







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VOLE AU VENT

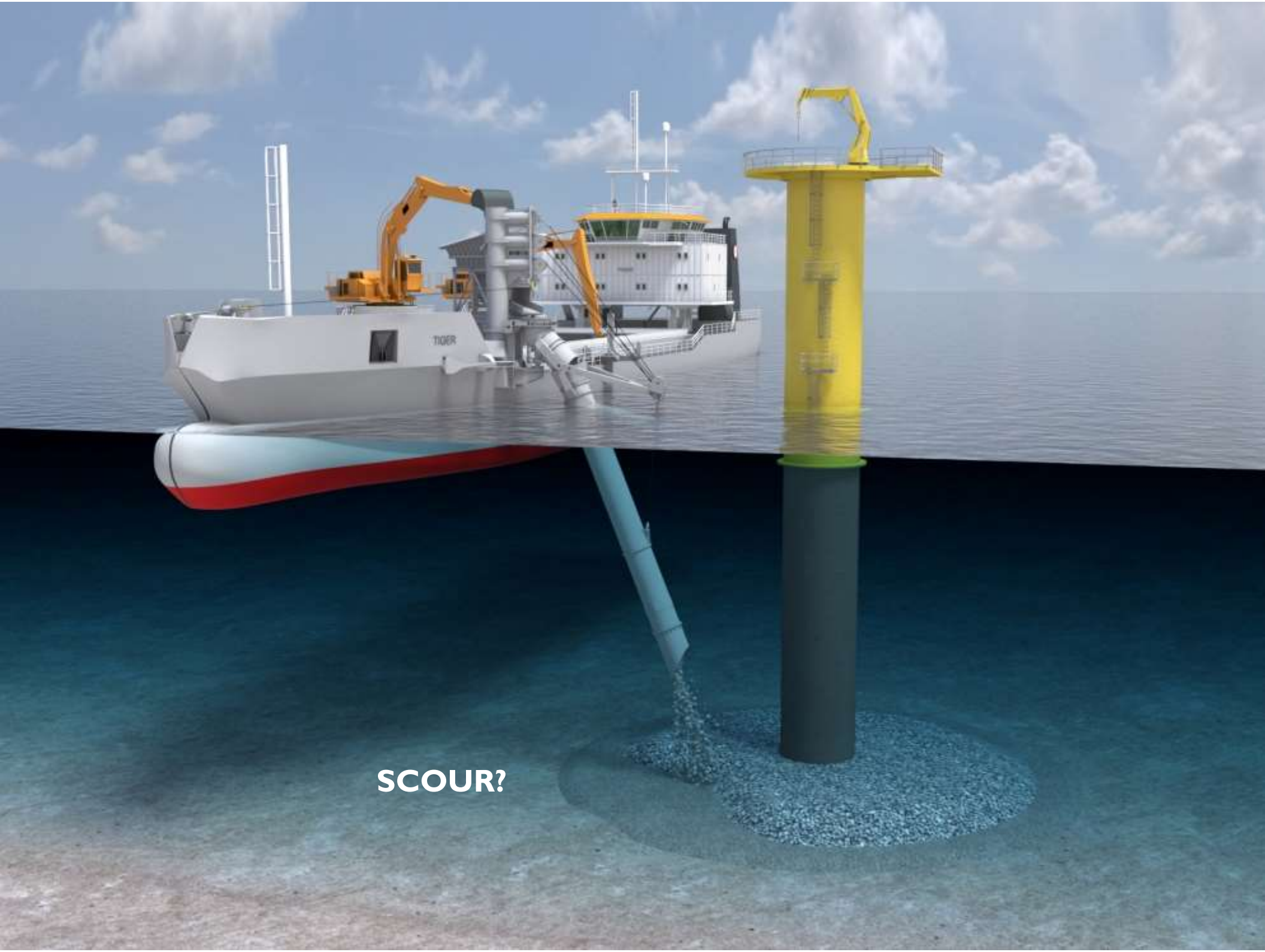

WEIGHT LIMITS?


VERTICALITY?
MENCK


M74
M46
M66
M25
CORROSION?


FABRICATION COMPLEXITY?

INSTALLATION VESSEL COST?

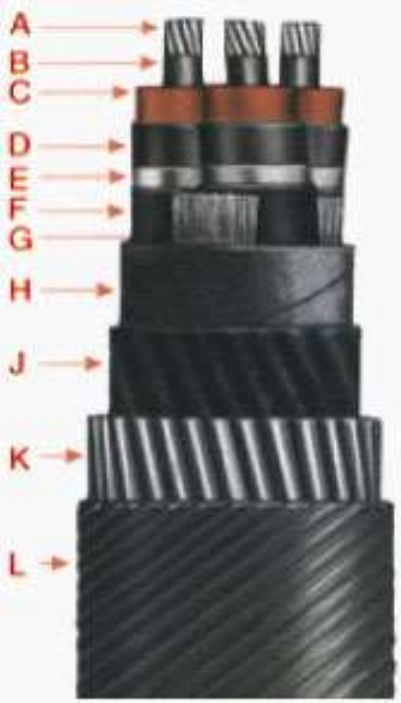

TIGER
SCOUR?


DURATION?


PACIFIC ORCA


WEATHER?

CABLES



A: Conductor-Copper
B: Strand Screen-Extruded Semi-conducting EPR
C: Insulation-Okoguard
D: Insulation Screen-Extruded Semiconducting EPR
E: Shield-Copper Tape
F: Fillers-Polypropylene
G: Binder Tape
H: Jacket-Okolene
J: Bedding-Polypropylene
K: Armor-Galvanized Steel Wires
L: Covering-Nylon Serving Slushed with Tar

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ISAAC NEWTON


HVAC / HVDC ?

TRAINING

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CREW TRANSFER

CONSENTING

CONSENTING

ENVIRONMENTAL IMPACT ASSESSMENT

Environmental Statement Chapters:

- Noise
- Landscape and Visual Assessment
- Ecology
- Archaeology and Cultural Heritage
- Traffic and Transport
- Socio-Economics
- Hydrology and Hydrogeology
- Shadow Flicker
- Infrastructure
- Telecommunication
- Television
- Aviation
- Public Safety

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ONSHORE CHALLENGES

RECHARGE

News | Insight | Wind | Solar | Thought Leaders | Brasil | 4040 | Newsr

all | in depth | analysis | opinion | europe + africa | americas | asia + australia | offshore | tech

Pickles extends grip on UK wind

Eric Pickles — Big Society Network/Flickr

By Andrew Lee in London Thursday, April 10 2014

Updated: Thursday, April 10 2014

The onshore wind industry has again cried foul after the UK's government announced it would keep a tight grip on planning decisions for another year.

SHARE STORY

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Renewable Energy + Add to myFT

UK wind operators hit at plans to end subsidies early

Thousands of jobs at risk and investment scrapped, industry warns

A wind farm forms the backdrop i

CLIMATE ACTION

Fracking vs onshore wind: the system isn't fair.

November 16, 2017

Head to a proposed wind turbine site, and all is still and empty. Nobody has been given permission to build wind turbines in England since 2015. Meanwhile in Lancashire, fracking company Cuadrilla are sharpening their drills - even though the local council and community has said no.

Public support for wind turbines has just reached an all-time high at 74%, while support for fracking - now at 13% - is at an all-time low. But the government's totally out of step. . They've rigged the system in favour of fracking and against onshore wind. This means communities who want onshore wind cannot have it, while communities who don't want fracking

New onshore wind planning hurdles concern developers

Industry says local councils having say over wind farm developments but not other energy sources creates uneven playing field

By Will Nichols | 19 Jun 2015 | 0 Comments

Send Print Comment

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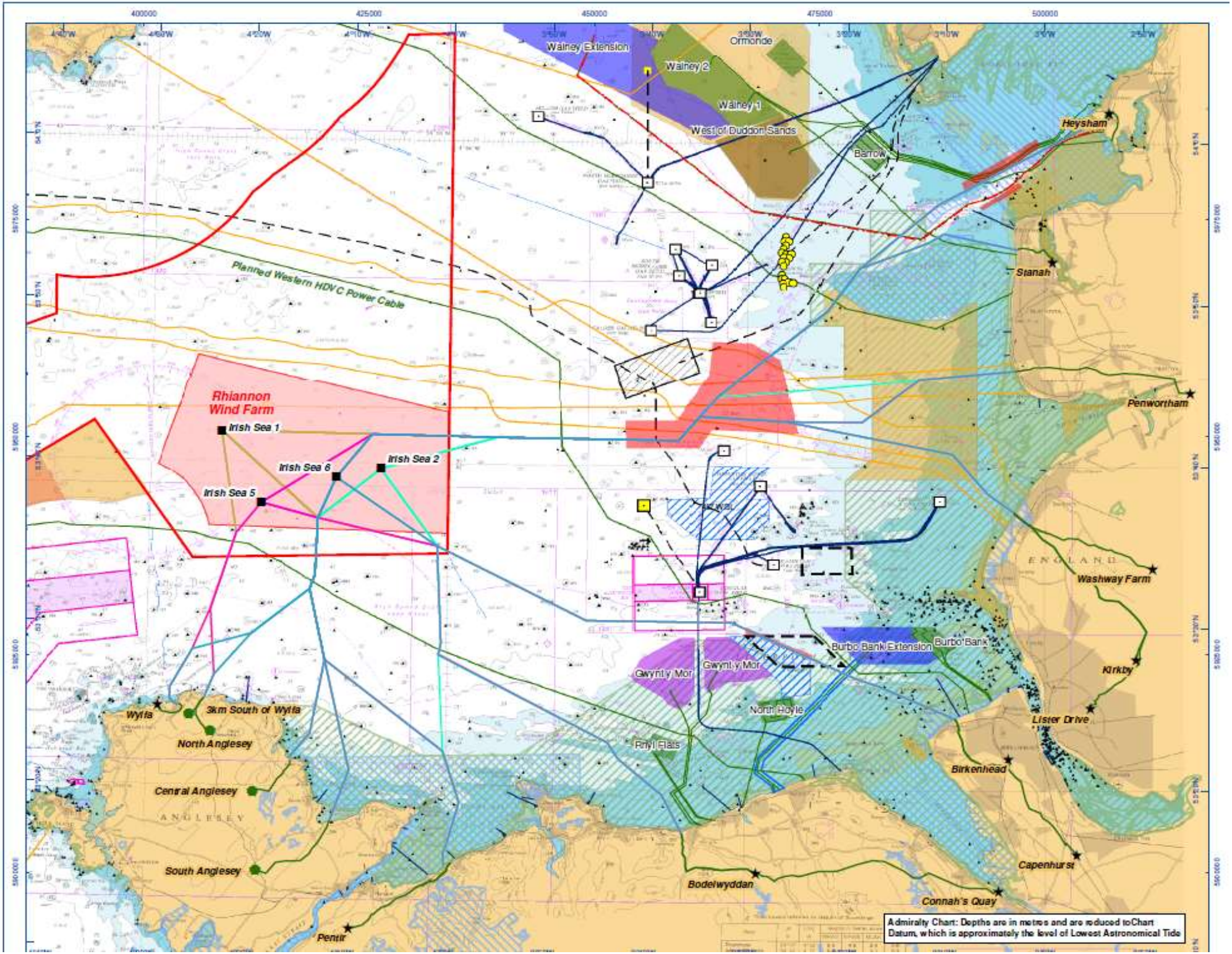
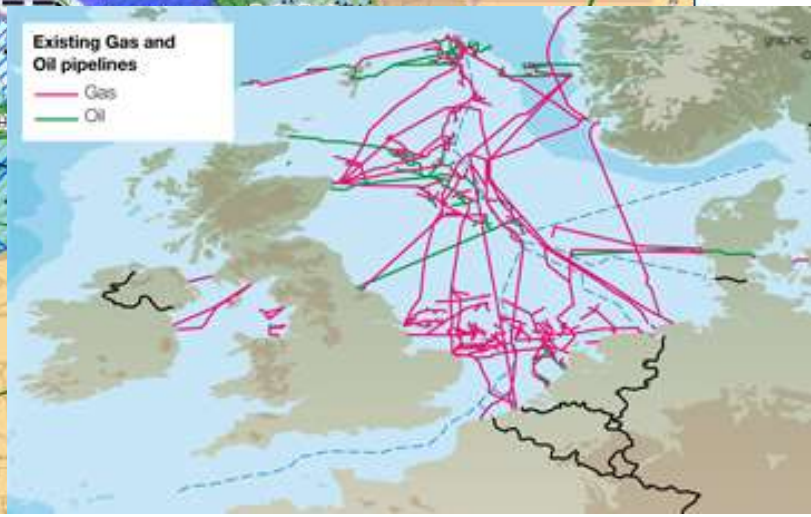
OFFSHORE DEVELOPMENT


Walney Extension
Walney 2
Walney 1
Ormonde
West of Duddon Sands
Barrow
Heysham
Planned Western HDVC Power Cable
Stanah
Rhiannon
Wind Farm
Irish Sea 1
Irish Sea 6
Irish Sea 2
Irish Sea 5
Penwortham
Washway Farm
Burbo Bank Extension
Burbo Bank
Gwynt y Mor
Kirkby
Lister Drive
North Hoyle
Rhyl Flats
Wylfa
3km South of Wylfa
North Anglesey
Central Anglesey
ANGLESEY
Birkenhead
South Anglesey
Capenhurst
Bodelwyddan
Connah's Quay
Pentir
Admiralty Chart: Depths are in metres and are reduced to Chart Datum, which is approximately the level of Lowest Astronomical Tide


STEAM-PACKET.COM


Existing Gas and
Oil pipelines
Gas
Oil

400000
425000
450000
475000
500000
Walney Extension
Walney 2
Walney 1
Ormonde
Planned Western HDVC
Penwortham
Washway Farm
ENGLAND
Gwynt y Mor
Rhyl Flats
Wylfa
North Anglesey
Central Anglesey
South Anglesey
Bodelwyddan
Pentir

OFFSHORE IMPACT ASSESSMENT

Onshore:

- Noise
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- Hydrology and Hydrogeology
- Shadow Flicker
- Infrastructure
- Telecommunication
- Television
- Aviation
- Public Safety

Offshore Environmental Statement Chapters:

Coastal Processes

Sediment and Water Quality

Marine Ecology

Nature Conservation

Marine Mammals

Fish Resources

Shipping and Navigation

Other Marine Users

Commercial Fisheries

Sub-Sea Noise and Electromagnetic Fields

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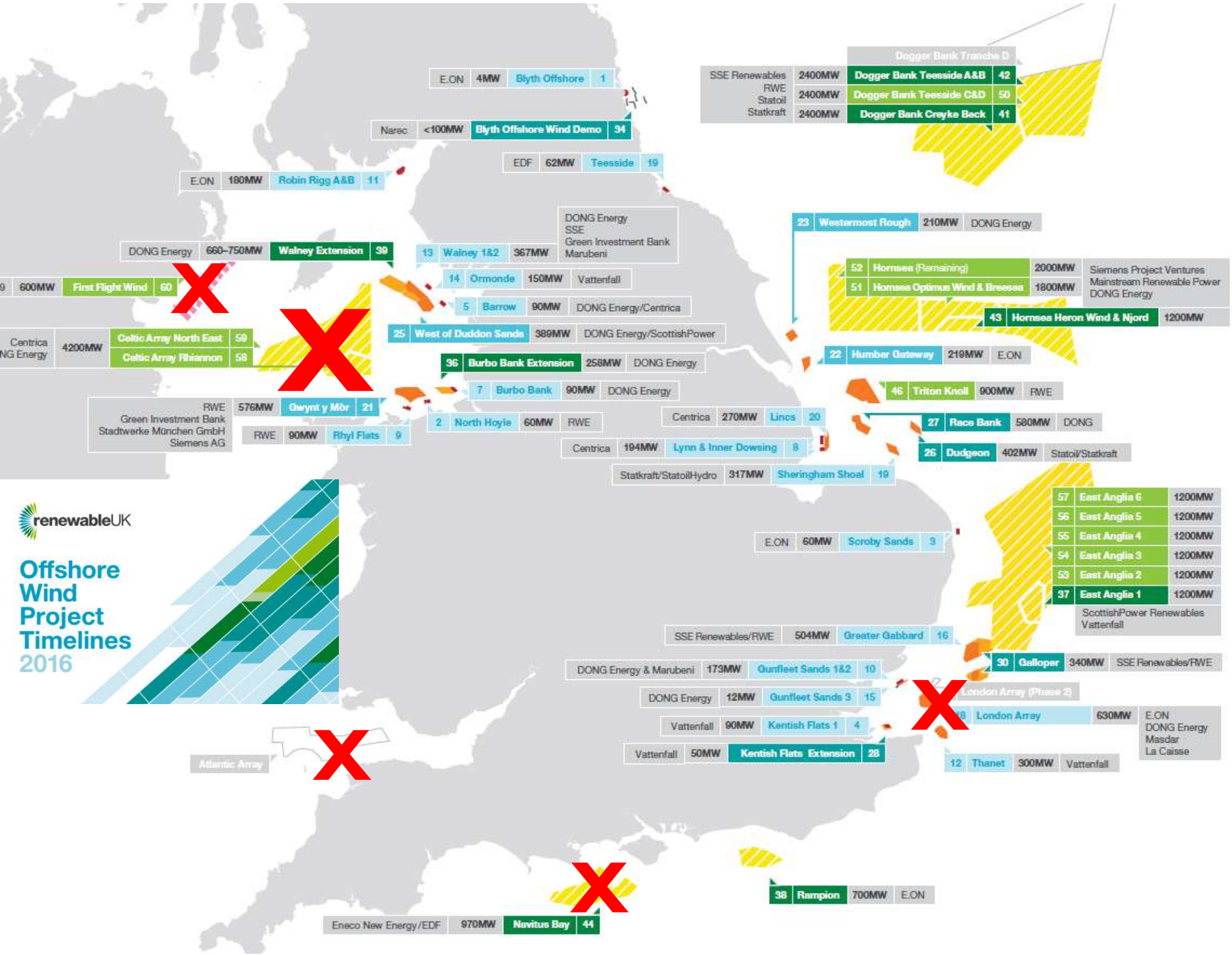
renewableUK
Offshore Wind Project Timelines 2016
E.ON 4MW Blyth Offshore 1
Narec <100MW Blyth Offshore Wind Demo 34
EDF 62MW Teesside 19
E.ON 180MW Robin Rigg A&B 11
DONG Energy 660–750MW Walney Extension 39
13 Walney 1&2 367MW
DONG Energy SSE Green Investment Bank Marubeni
14 Ormonde 150MW Vattenfall
5 Barrow 90MW DONG Energy/Centrica
25 West of Duddon Sands 389MW DONG Energy/ScottishPower
36 Burbo Bank Extension 258MW DONG Energy
7 Burbo Bank 90MW DONG Energy
2 North Hoyle 60MW RWE
RWE 576MW Gwynt y Môr 21
RWE Green Investment Bank Stadtwerke München GmbH Siemens AG
RWE 90MW Rhyl Flats 9
600MW First Flight Wind 60
Centrica NG Energy 4200MW
Celtic Array North East 59
Celtic Array Rhiannon 58
Atlantic Array
Eneco New Energy/EDF 970MW Navitus Bay 44
SSE Renewables 2400MW Dogger Bank Teesside A&B 42
RWE 2400MW Dogger Bank Teesside C&D 50
Statoil Statkraft 2400MW Dogger Bank Creyke Beck 41
Dogger Bank Tranche D
23 Westermost Rough 210MW DONG Energy
52 Hornsea (Remaining) 2000MW
51 Hornsea Optimus Wind & Breesea 1800MW
Siemens Project Ventures Mainstream Renewable Power DONG Energy
43 Hornsea Heron Wind & Njord 1200MW
22 Humber Gateway 219MW E.ON
46 Triton Knoll 900MW RWE
27 Race Bank 580MW DONG
26 Dudgeon 402MW Statoil/Statkraft
Centrica 270MW Lincs 20
Centrica 194MW Lynn & Inner Dowsing 8
Statkraft/StatoilHydro 317MW Sheringham Shoal 19
E.ON 60MW Scroby Sands 3
57 East Anglia 6 1200MW
56 East Anglia 5 1200MW
55 East Anglia 4 1200MW
54 East Anglia 3 1200MW
53 East Anglia 2 1200MW
37 East Anglia 1 1200MW
ScottishPower Renewables Vattenfall
SSE Renewables/RWE 504MW Greater Gabbard 16
DONG Energy & Marubeni 173MW Gunfleet Sands 1&2 10
DONG Energy 12MW Gunfleet Sands 3 15
Vattenfall 90MW Kentish Flats 1 4
Vattenfall 50MW Kentish Flats Extension 28
30 Galloper 340MW SSE Renewables/RWE
London Array (Phase 2)
London Array 630MW
E.ON DONG Energy Masdar La Caisse
12 Thanet 300MW Vattenfall
38 Rampion 700MW E.ON


ENVIRONMENTAL

MACRO SCALE

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MACRO SCALE

RECHARGEWIND

Orsted's Hornsea 1 in the UK. Photo: Orsted

Orsted shares plunge on offshore wind production warning

Danish giant warns of job cuts as it says production modelling may underestimate negatives from blockage and wake effects

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MACRO SCALE

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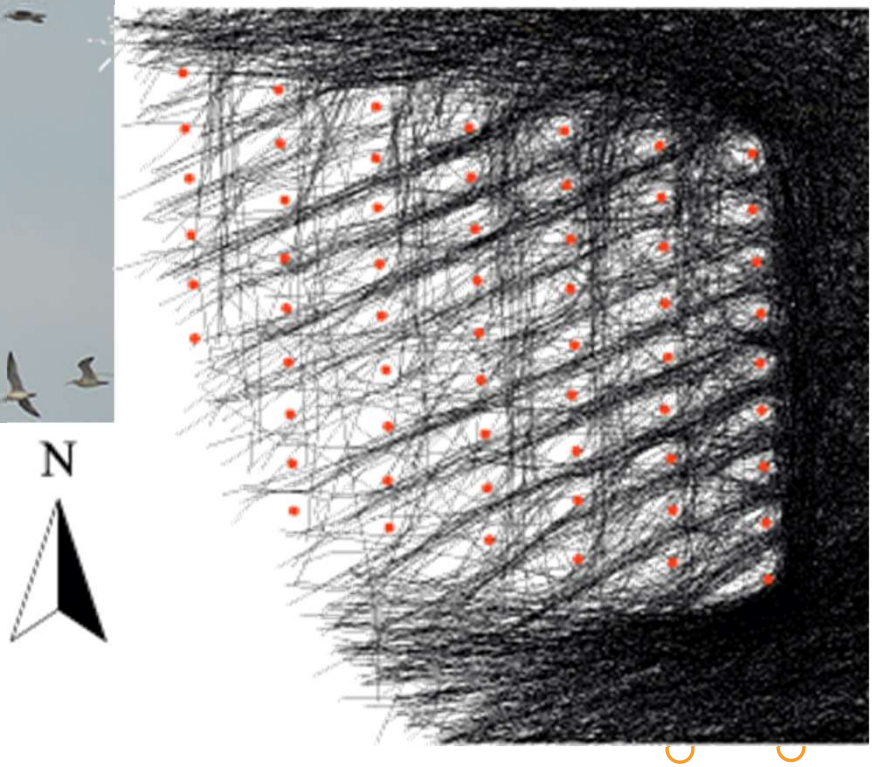
ECOLOGY



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MARINE MAMMALS

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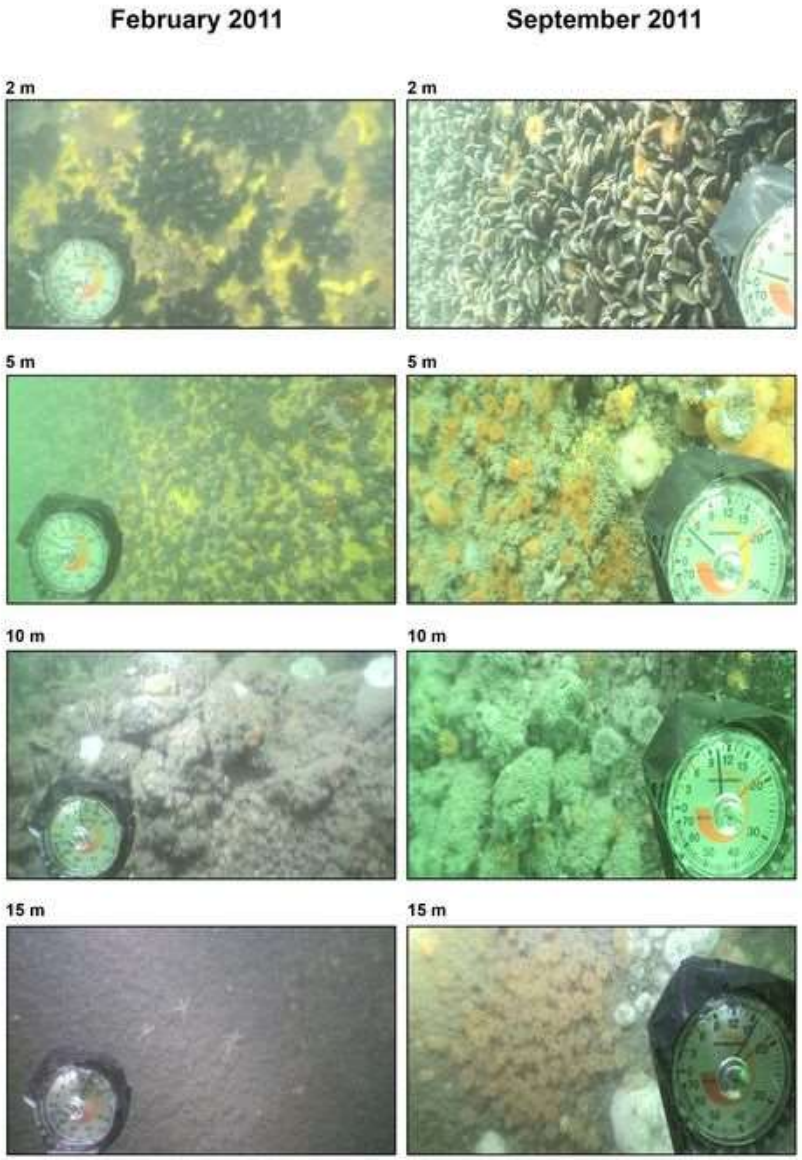
THE REEF EFFECT



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2 TUTORIAL

- Blyth Offshore Demonstrator
- Innovation for Cost Reduction
- Competitive Auction

TUTORIAL

THE CROWN ESTATE

Department for Energy Security & Net Zero

---- Press Release ---

To support innovation in the floating offshore wind sector, the Crown Estate and the Department for Energy Security & Net Zero (DESNZ) have today announced several new offshore wind zones, to be auctioned to eligible developers via a special CfD allocation round auction, to be held **tomorrow** in Electrical Engineering Room 116.

Developers are invited to submit bids to the auction but must include 2 (or more) innovative technologies in their floating offshore windfarm which will help the developer, and the wider industry, to **accelerate the deployment** of floating offshore wind, reduce the **environmental impact** or promote **system integration**. Developers must:

- Research the anticipated **levelized cost** of floating offshore wind in preparation for the auction
- Identify **two** promising **innovations** to demonstrate (for the first time) in your windfarm

Details of **auction 'pot size'** to be announced tomorrow

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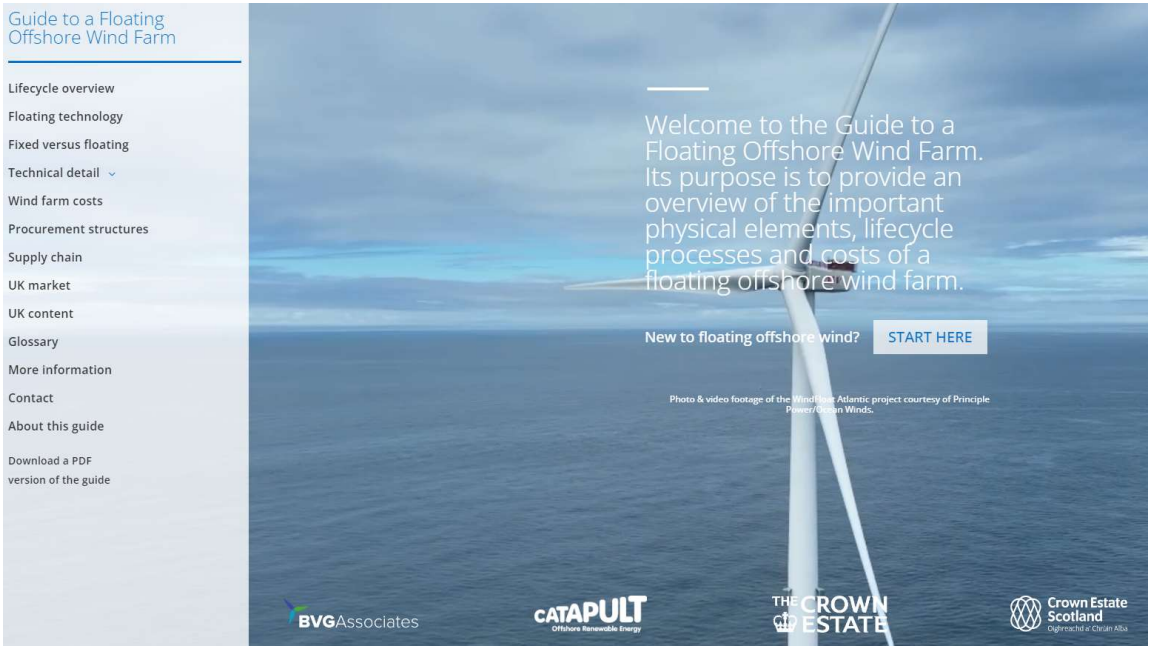
TUTORIAL RESOURCES

Some Innovation Inspiration:

- Offshore Wind Innovation Hub: http://offshorewindinnovationhub.com/
- Guide to a Floating Offshore Wind Farm: https://guidetofloatingoffshorewind.com
- IRENA – Innovation Outlook Offshore Wind: http://www.irena.org/publications/2016/Oct/Innovation-Outlook-Offshore-Wind
- Google!



Thanks for listening

Talk to us

contact@everoze.com

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experts | evolving | energy