ORGANISED BY

scottish renewables

IN ASSOCIATION WITH

CATAPULT Offshore Renewable Energy

OFFSHORE WIND CONFERENCE, EXHIBITION & DINNER

28 & 29 JANUARY 2020 **GLASGOW**

Crown Estate Scotland
Oighreachd a' Chrùin Alba

areg
Aberdeen Renewable Energy Group

sse Renewables

DEME

FORTH & TAY OFFSHORE

HIE
Highlands and Islands Enterprise
Iomairt na Gàidhealtachd 's nan Eilean

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SDIC
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Chief Executive
Scottish Renewables

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Paul Wheelhouse MSP

Minister for Energy, Connectivity & the Islands
Scottish Government

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Bringing the economic benefits home

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Jim Smith

Managing Director

SSE Renewables

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Benj Sykes

UK Country Manager – Offshore

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Offshore wind: reaping the economic benefits

Sector deal and 40GW target

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Benj Sykes

Tuesday 28 January 2020

UK and Scotland legally commit to reducing greenhouse gas emissions to net zero, with 40GW of offshore wind by 2030

Climate Change Act 2008

(2050 Target Amendment)

Scotland + Add to myFT

Sturgeon puts climate change top of Scotland agenda

SNP leader reiterates demand for second independence vote

© Andrew Cowan/Scottish Parliament

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Powering a competitive global economy

£120

2015
CfD Auction
Round 1

East Anglia
Neart NG

£57.50

2017
CfD Auction
Round 2

Hornsea 2
Moray East

£39.65

2019
CfD Auction
Round 3*

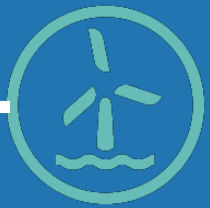
Dogger Bank /
Sofia

£51.51

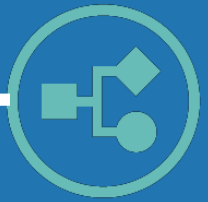
2024
Predicted
Wholesale
Price

CfD Auctions Every 2 years

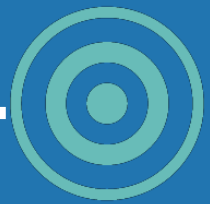
Which will deliver…



At least 30GW by 2030



Regional clusters



Addressing barriers to deployment

Supporting the UK Supply Chain

Solutions to integration

Transmission solutions

£2.6bn/year exports

27,000 jobs, greater diversity

Increased UK content

OffshoreWind IndustryCouncil

Ørsted

Four core strands of activity

Offshore Wind Growth Partnership

A Collaborating for Growth

Enhanced engagement between developers and supply chain.

Developer-led activity

B Business Competitiveness

An intensive structured business improvement programme.

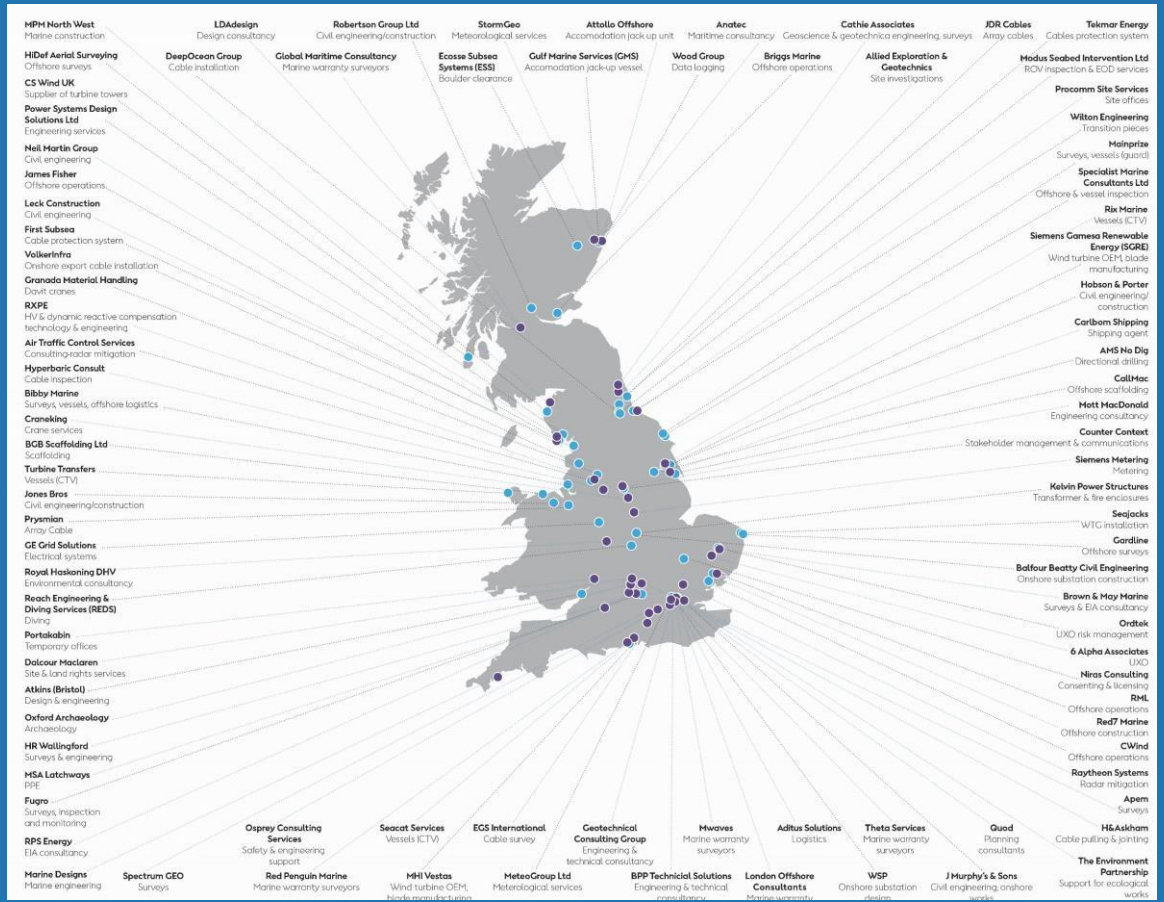
C Building New Capacity

Increasing the breadth of the UK supply chain by attracting cross-sector companies.

D Supply Chain Futures

Developing growth based on new UK intellectual property.

Ørsted has grown a significant domestic supply chain



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Developers are keen to work with innovative Scottish companies

For example, Ørsted has partnered with Pict Offshore to develop the Get Up Safe (GUS) system

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Offshore Wind Sector Deal

The development of UK clusters

The Offshore Wind Sector Deal committed industry to work alongside local government to help bolster the UK's regional offshore wind 'clusters'. Clusters are a collaboration between developers and the regional supply chain, public sector and education bodies. The ambition is to increase the industry's productivity, competitiveness and innovation, while helping to grow these coastal economies.

1. DeepWind (North Scotland)

With almost 1.7GW of projects operational or under construction, DeepWind already has the established ports infrastructure, fabrication and construction supply chain to support the new ScotWind leasing round. It also has recognised significant expertise in the areas of subsea engineering and floating offshore wind.

sse equinor VATTENFALL edp DeepWind KOWL

2. Forth and Tay Offshore

With 2.5GW of projects in development and led by a close collaboration of local authorities and developers, Forth and Tay seeks to build on well-established strengths to deliver a growing and internationally-recognised offshore energy supply chain.

sse SDIC Red Rock Power Limited EDF

3. North East England

Home to the UK's first offshore wind farm in Blyth in 2000, the region now has a world class offshore wind supply chain. The cluster, driven by NOF, is innovative and collaborative with key strengths in subsea technologies, heavy engineering and fabrication.

equinor sse innogy

4. Humber

A well-established cluster, the Humber is building on its powerful maritime history to harness the 1.4GW generated by wind farms offshore from Hull and Grimsby. Aura brings together the stakeholders in the region through a strong collaboration, led by the University of Hull, supported by regional government, industry, educational bodies and others.

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5. East Anglia

East Anglia aims to produce 8.4GW by 2032. It has world class physical infrastructure, suitable ports, an established supply chain and a skilled workforce. The All Energy Industry Council will oversee the regional cluster development.

VATTENFALL equinor SCOTTISHPOWER RENEWABLES innogy sse

6. Solent

The Solent is a leader in the field of composites and the region's companies have been successful in applying this expertise to the offshore wind industry; from MHI Vestas Offshore Wind producing 80-metre blades at their facility on the Isle of Wight, to Seacat Services and South Boats manufacturing vessels for the industry.

7. Celtic Sea Cluster

Founded on existing offshore renewable and marine businesses and their supply chains, the cluster draws on regional offshore renewables R&D excellence and technology transfer from the fixed offshore wind, wave and tidal, and oil and gas sectors.

VATTENFALL

8. North West and North Wales

With 12 offshore wind farms (approx. one third of UK offshore wind capacity), the North West North Wales region boasts physical infrastructure and ports, a growing industry base and local supply chain, a skilled workforce and established apprentice schemes at local colleges. Collaborative supply chain activity is facilitated via The Offshore Energy Alliance (OEA) and the region has been identified by The Crown Estate as a key area for further offshore wind development.

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Key specialisms

- Advanced Manufacturing
- Fabrication
- Innovation and business incubation
- Subsea Innovation
- Decommissioning
- Specialist Engineering
- Operations and Maintenance
- Testing and Demonstration
- Construction

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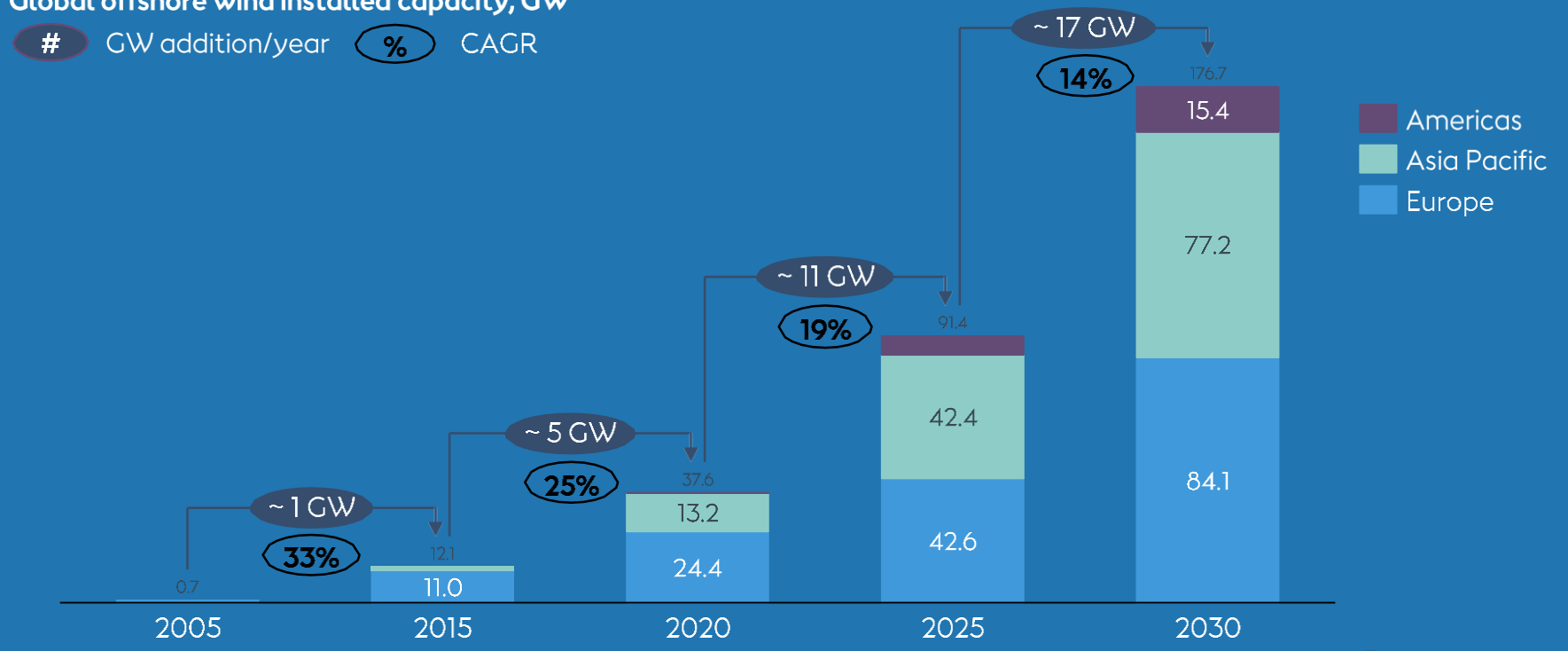
Let's build a world leading supply chain



Source: Bloomberg New Energy Finance (BNEF), 1H 2019 offshore wind market outlook Note 1: Defined by a country's public offshore wind target by 2025/2030

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Rainer Broering

Industrialization and Supply Chain Strategy Leader

GE Renewable Energy

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Chief Executive, Scottish Renewables

Jim Smith

Managing Director, SSE Renewables

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UK Country Manager - Offshore, Ørsted

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Market outlook: Scotland, UK and the world

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Fabrice Leveque

Senior Policy Manager

Scottish Renewables

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David Pratt

Head of Planning & Strategy

Marine Scotland

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Draft Sectoral Marine Plan for Offshore Wind Energy

Scottish Government
Riaghaltas na h-Alba
gov.scot

David Pratt
Head of Marine Planning and Strategy

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Marine Scotland and The Crown Estate

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Marine Planning and Licensing Authority

Crown Estate Scotland
Oighreachd a' Chrùin Alba

Seabed Leasing Agency

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Scottish Marine Planning System

MSA & MCAA

- Marine Scotland Act and Marine and Coastal Access Act provides legislative basis for a marine planning system in Scottish inshore (0 -12nm) and offshore waters (12 -200nm)

MPS

- Marine Policy Statement (MPS) is the UK framework for marine plans and taking decisions

National Marine Plan

- National Marine Plan translates the MPS into policy and spatial guidance for the Regional Marine Plans

Regional Marine Plan

- Regional Marine Plans will provide greater spatial policy and guidance at a local level for inshore area (0 – 12nm).

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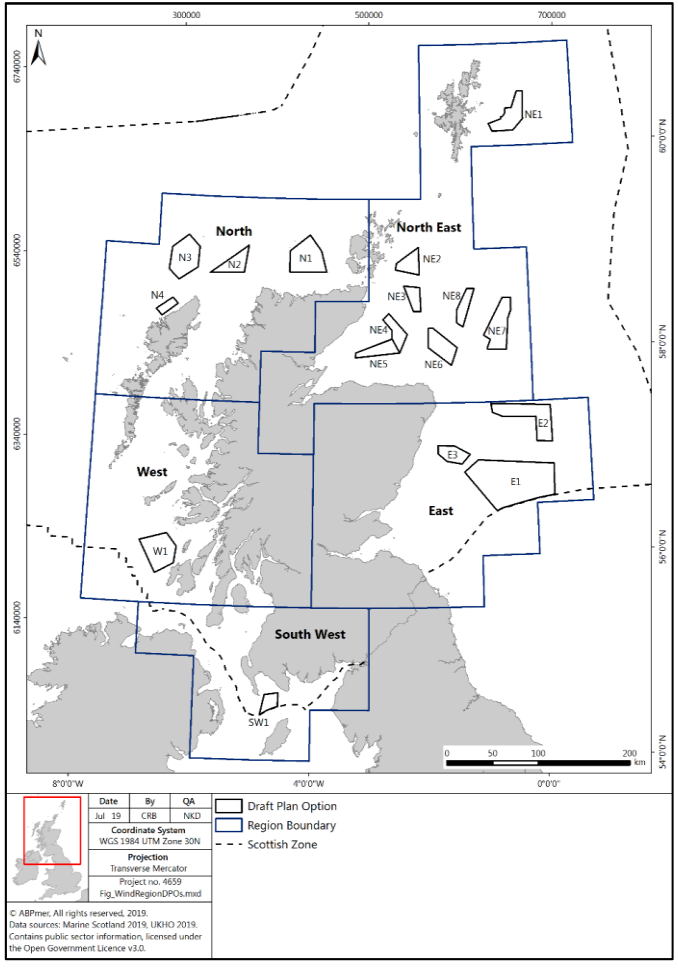
Draft Sectoral Marine Plan for Offshore Wind Energy 2019



- **Draft Sectoral Marine Plan for Offshore Wind Energy**
  - **https://bit.ly/36Gi5tX**
- **Offshore Wind Policy Statement**
  - **https://bit.ly/36CpURw**
- **Both will run from 18 December 2019 until 25 March 2020**

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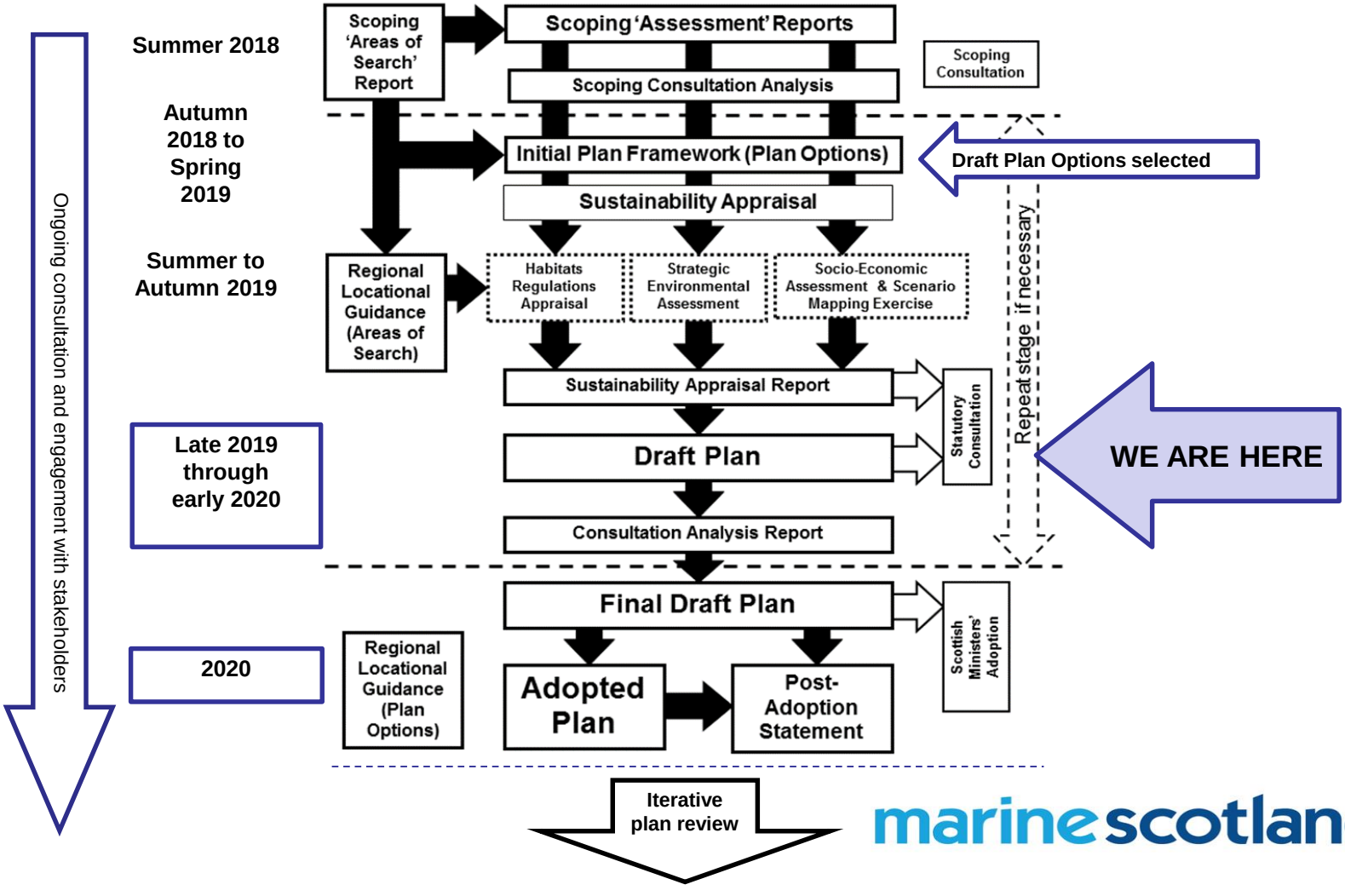
The planning process…..



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Consultation Details

- Draft Sectoral Marine Plan for Offshore Wind Energy
- Strategic Environmental Assessment
- Habitats Regulations Appraisal
- Social and Economic Impact Assessment
- Sustainability Appraisal
- Partial assessments
    - Equalities Impact Assessment
    - Islands communities Impact Assessment

Inviting comments on all of these and the individual DPOs

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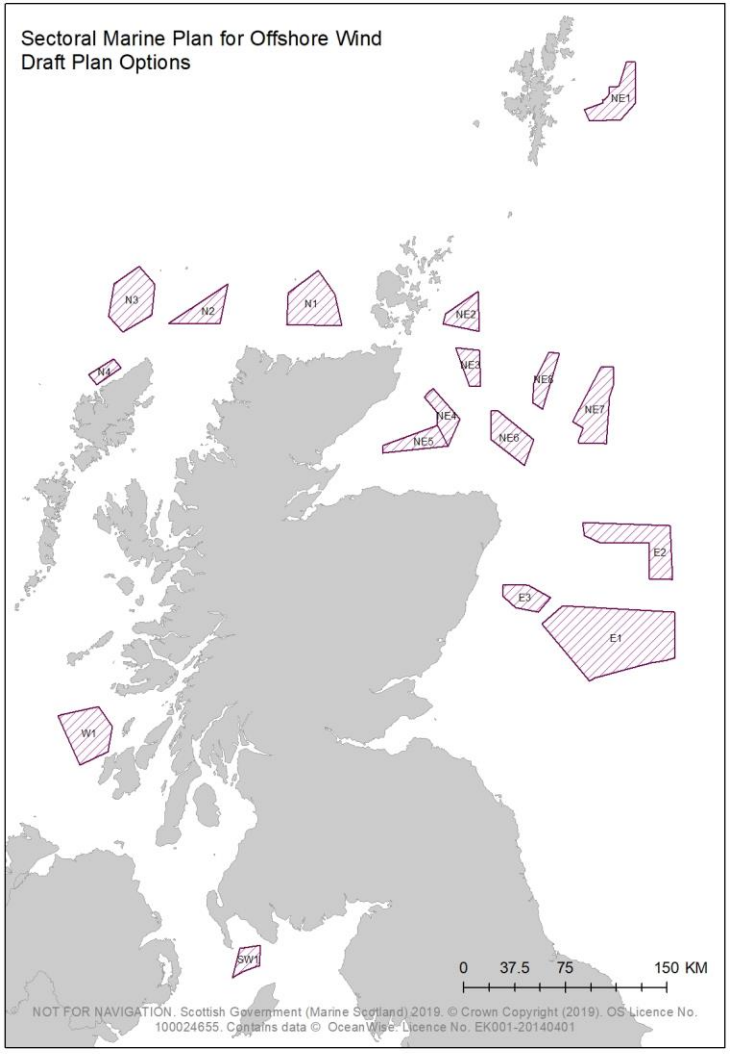


17 Draft Plan Options

Total option area = 14,657 KM² (73.27 GW)

SEA identifies a mitigation measure to limit the total scale of development under this plan to **10** GW

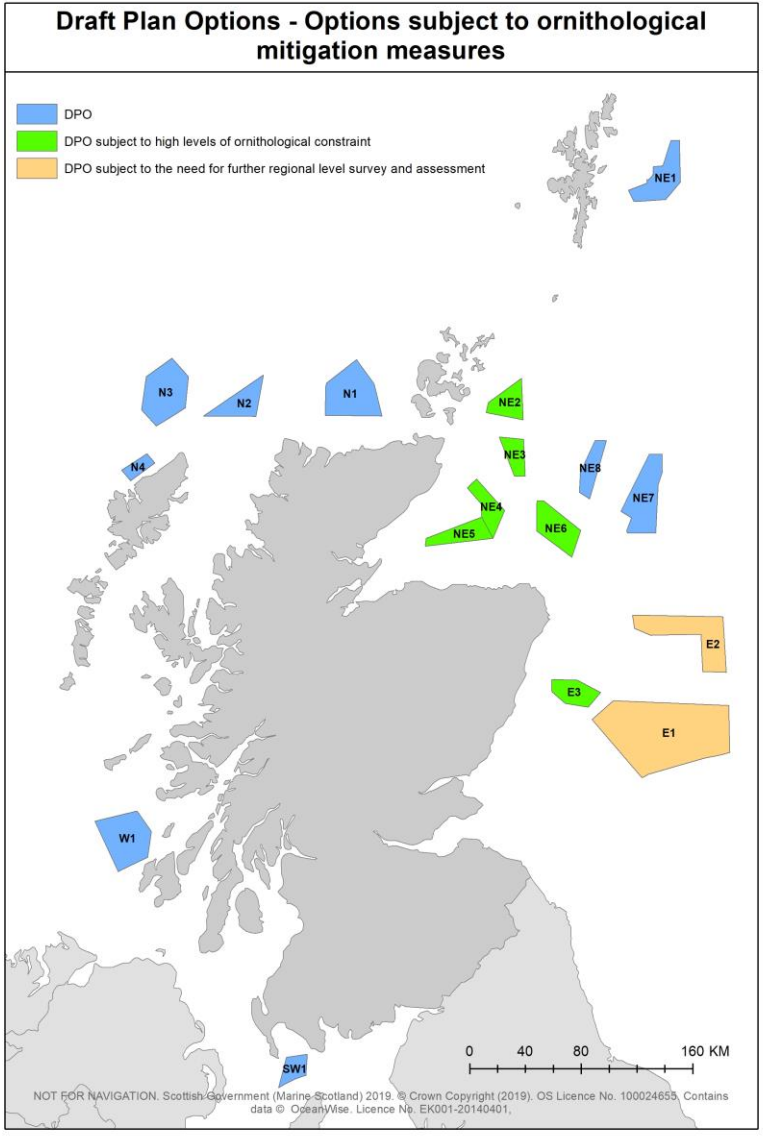
Development scenarios for assessments are set at **3**, **5** and **10** GW

The Plan seeks to minimise the potential adverse effects on other marine users, economic sectors and the environment resulting from further commercial-scale offshore wind development; and

The Plan seeks to maximise opportunities for economic development, investment and employment in Scotland, by identifying new opportunities for commercial-scale offshore wind development, including deeper water wind technologies.

Region	DPO	Area (km²)	Potential installed capacity (GW)	Realistic maximum development scenario for DPO (GW)	Realistic development as percentage of site area	Regional Low Scenario (GW)	Regional Central Scenario (GW)	Regional High Scenario (GW)
East	E1	3816	19.1	3	16%			
	E2	1287	6.4	2	31%			
	E3	474	2.4	1	42%			
	Sub-total	**5577**	**27.9**	**6**		**1**	**2**	**3**
North-east	NE1	776	3.9	2	52%			
	NE2	464	2.3	1	43%			
	NE3	339	1.7	1	59%			
	NE4	440	2.2	1	45%			
	NE5	496	2.5	1	40%			
	NE6	699	3.5	2	57%			
	NE7	1027	5.1	3	58%			
	NE8	401	2.0	1	50%			
	Sub-total	**4641**	**23.2**	**12**		**1.5**	**3**	**4.5**
North	N1	1163	5.8	2	34%			
	N2	560	2.8	2	71%			
	N3	1106	5.5	2	36%			
	N4	200	1.0	1	100%			
	Sub-total	**3030**	**15.1**	**7**		**1**	**2**	**3**
West	W1	1107	5.5	2	36%			
	Sub-total	**1107**	**5.5**	**2**		**0.5**	**1**	**2**
South-west	SW1	292	1.5	1	68%			
	Sub-total	**292**	**1.5**	**1**		**0.3**	**0.6**	**1**
Total		**14646**	**73.2**	**28**		**4.3**	**8.6**	**13.5**
Scaled back in national scenario to:						**3**	**5**	**10**

nd



Plan-level Mitigation

- **Blue** - Standard DPO
- **Green** - Subject to high levels of ornithological constraint (previously temporal mitigation)
- **Orange** - Subject to regional level survey and assessment

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Crown Estate Scotland - ScotWind leasing

- 10 GW = 2000 KM²
- Due to nature of leasing and development processes and likely attrition rates, CES will offer a larger area for Option Agreements to achieve 10 GW capacity
- This has been calculated to 8,600 KM² of seabed for Option Agreement.
- Total generating capacity arising from leases awarded in this cycle of ScotWind should not exceed 10GW nationally nor the realistic development scenario assessed for a given DPO.
- No more than 8,600 KM² or 10 GW

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Next Steps (Short term)

December 2019 to March 2020

- Consultation on the draft Plan, Sustainability Appraisal and draft Offshore Wind Policy Statement.

Spring to Summer 2020

- Consultation feedback analysed and updates to draft Plan made.
- Final Plan submitted for Ministerial approval and adoption.
- ScotWind leasing round application window closes at least 4 weeks after adoption.

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What will happen in the medium to long-term?

Autumn 2020 onwards

- Option Agreements awarded by Crown Estate Scotland
- Start of survey work by developers/pre-application engagement

Early to mid 2020s

- Consultation on consent and licence applications
- Sectoral Plan likely to be reviewed by Marine Scotland to support any further CES Leasing Round

Late 2020s onwards

- Deployment - construction and operation

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Thank you

Draft Sectoral Marine Plan for Offshore Wind Energy

- https://consult.gov.scot/marine-scotland/draft-sectoral-marine-plan-for-offshore-wind/
- 18 December 2019 – 25 March 2020
- https://bit.ly/36Gi5tX

Offshore Wind Policy Statement

- https://consult.gov.scot/energy-and-climate-change-directorate/draft-offshore-wind-policy-statement/
- 18 December 2019 – 25 March 2020
- https://bit.ly/36CpURw

For more information about sectoral marine planning please visit:
www2.gov.scot/Topics/marine/marineenergy/Planning

Or contact the team at:
SectoralMarinePlanning@gov.scot

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Head of Energy & Infrastructure

Crown Estate Scotland

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Mandy Gloyer

New UK Offshore Sites Manager

ScottishPower Renewables

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Offshore Wind Conference 2020

Mandy Gloyer

New UK Sites Manager (offshore)
ScottishPower Renewables

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Fotos
iPod

East Anglia Zone

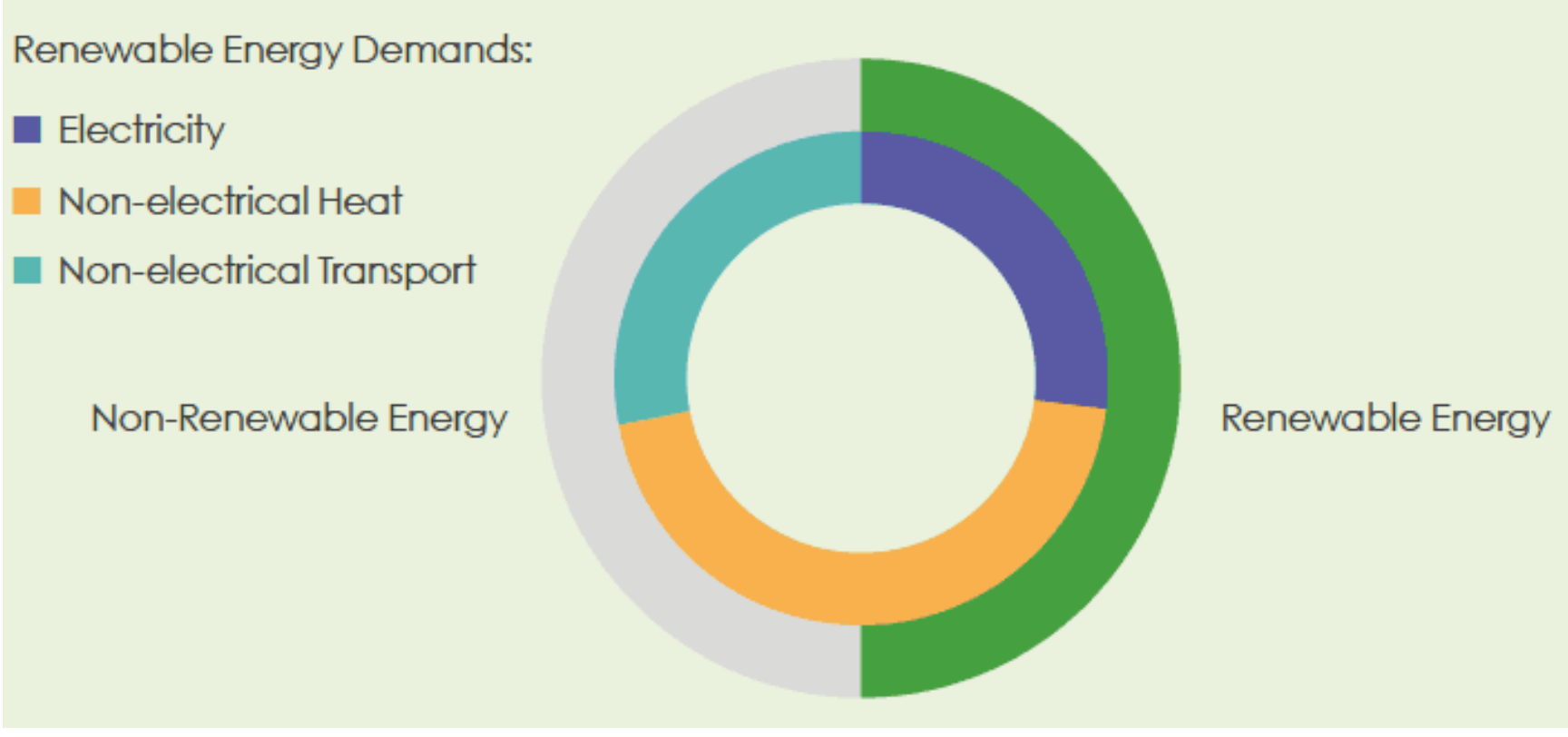
ScottishPower Renewables' Decade

ScotWind	Round 4
Up to 10GW	At least 7GW
Sectoral Marine Plan DPOs, maximum leasable areas in each	4 bidding areas, max 3.5 GW in each
No maximum award per organisation	Maximum 3 GW per bidding entity
Max 5 project bid submissions	Max 5 project 'groups' with primary and variants
Large areas over 60m water depth	All areas below 60m water depth
Max Applicant Valuation, focus on project value	Multi-cycle bidding, highest bid/km^2 wins
Supply Chain Development Statement	400MW-1.5 GW project size

Status	UK (GW)	Scotland (GW)
Operational	8.5	0.9
In construction	2.9	1.2
Consented	*11.1*	*3.1*
In Planning/on hold	*10.6*	*2.6*
Total pipeline	33.1	7.8

2020 UK Leasing Approximate Timelines

50% by 2030



https://www.gov.scot/publications/scottish-energy-strategy-future-energy-scotland-9781788515276/pages/5/

https://www.crownestatescotland.com/media-and-notices/

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Head of Energy & Infrastructure, Crown Estate Scotland

Mandy Gloyer
New UK Offshore Sites Manager, ScottishPower Renewables

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Supply chain: opportunities for growth

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Director of Communications & Strategy, Scottish Renewables

Andrew MacDonald
Programme Director, Offshore Wind Growth Partnership

Paul O'Brien
Senior Development Manager, DeepWind

Allan Taylor
Head of Renewables Supply Chain, Department for Business, Energy and Industrial Strategy

Isla Robb
SE Wind Lead, representing Forth & Tay Offshore

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Professor Keith Bell

Committee on Climate Change

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Committee on Climate Change

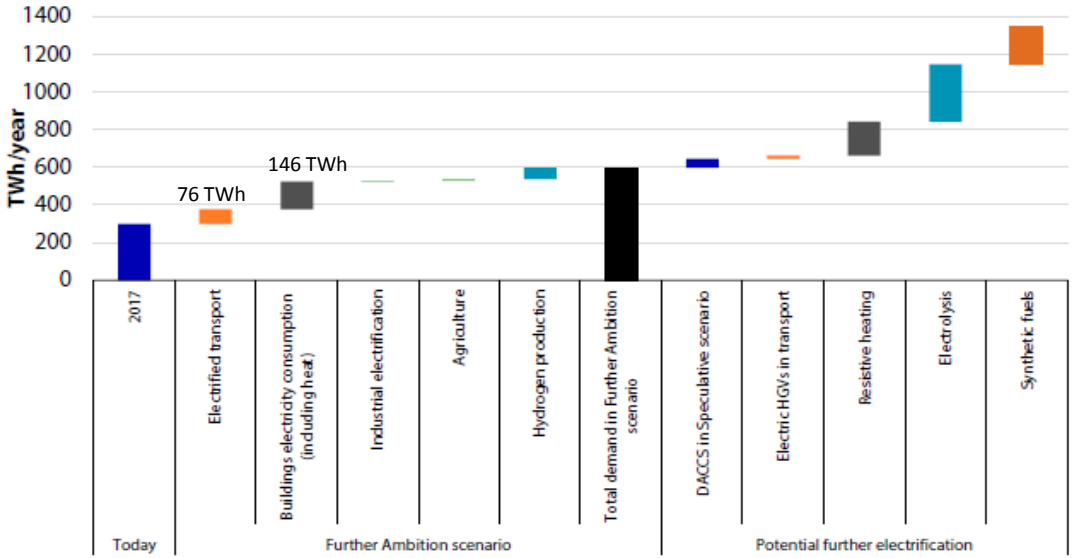
Scottish Renewables
Offshore Wind Conference

Power from the seas: offshore wind's place in Scotland

Keith Bell

Electrifying transport and heat in the UK

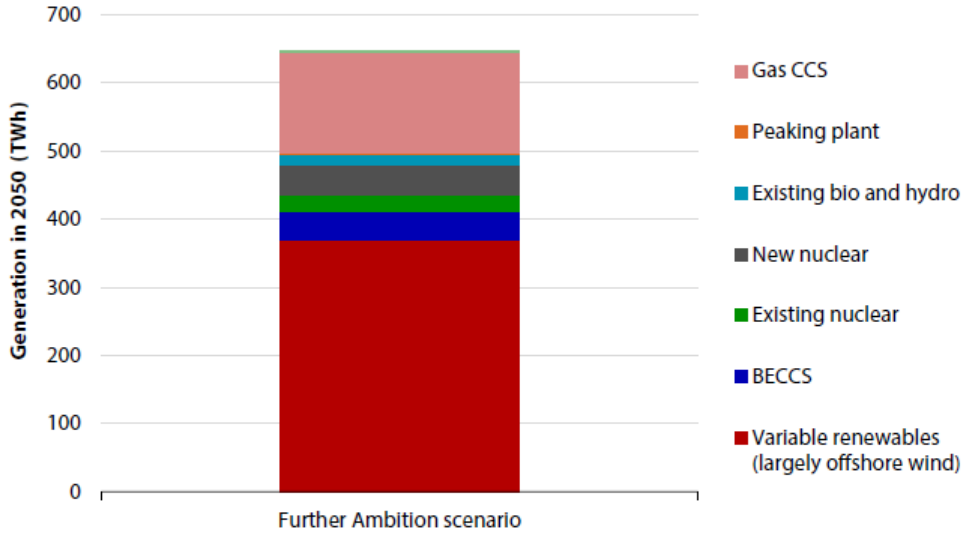
Figure 2.3. Potential new electricity demands from 2017 to 2050



Source: CCC analysis based on the capacity and generation mix in the "Hybrid 10 Mt" scenario of Imperial College (2018) *Analysis of alternative heat decarbonisation pathways.*
Notes: Electric HGVs in transport are hydrogen fuelled vehicles switching to electricity.

Sources of the UK's electricity in 2050?

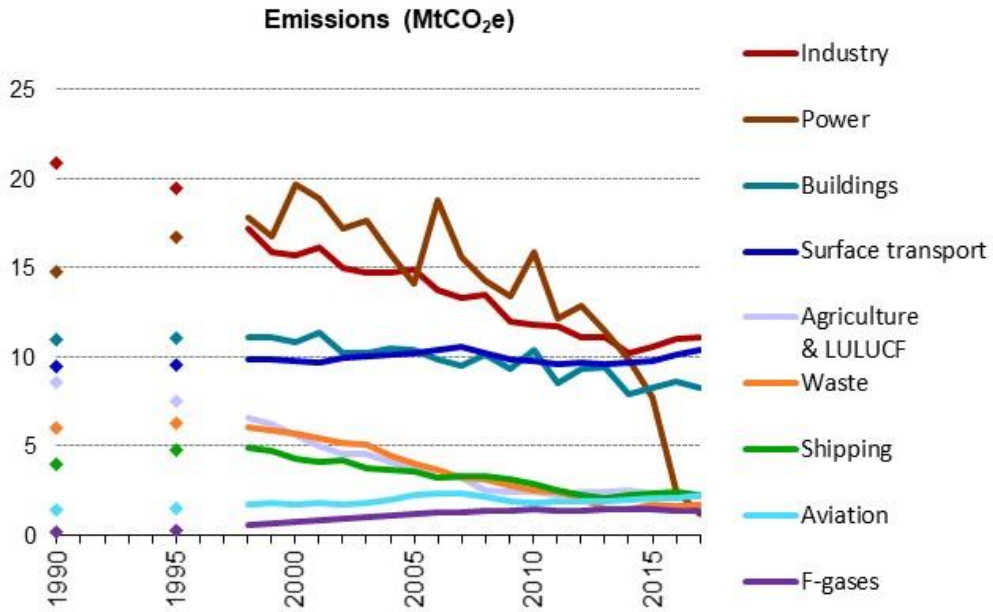
Figure 2.5. Illustrative generation mix for a low-carbon power system in 2050

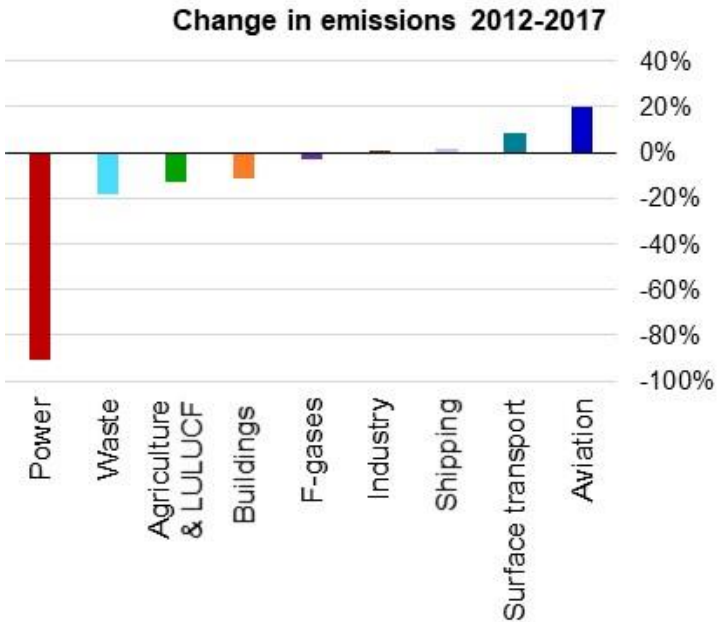


Source: CCC analysis based on the capacity and generation mix in the "Hybrid 10 Mt" scenario of Imperial College (2018) *Analysis of alternative heat decarbonisation pathways.*
Notes: The role of gas CCS in providing firm power is illustrative and could be replaced by nuclear power or alternative renewable technologies, reducing residual emissions.

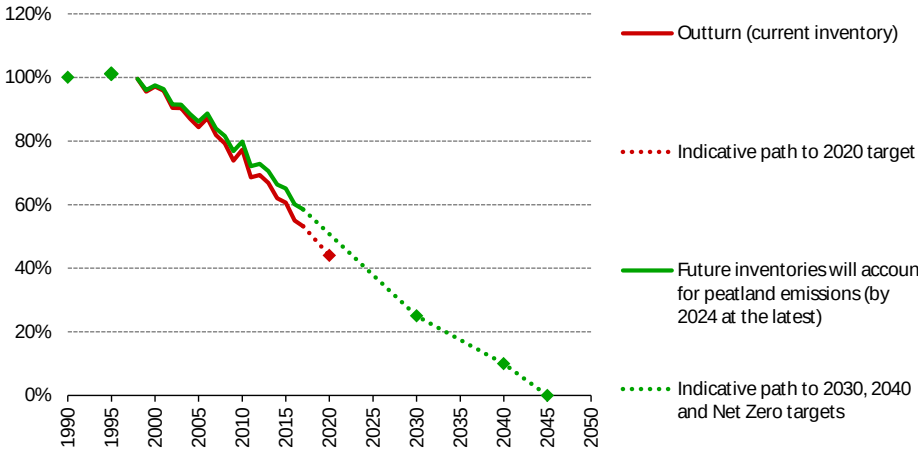
- The CCC's scenarios involve around a **doubling of electricity demand** with **all electricity produced from low-carbon** sources
  - (~50% low carbon electricity today)
- That could for example require **75 GW of offshore wind in 2050**
  - compare to 8 GW today and 40 GW by 2030 as in Conservative manifesto
- 75 GW of offshore wind would require up to 7,500 turbines
  - These could fit within 1-2% of the UK seabed, comparable to the area of sites already leased for wind projects by the Crown Estate

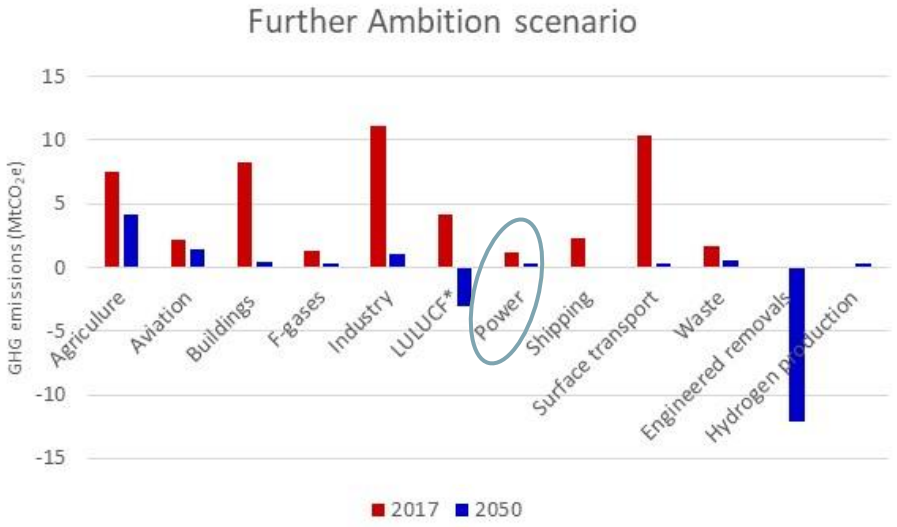
Reaching net-zero emissions in Scotland
Emissions in Scotland today





Reaching net-zero emissions in Scotland

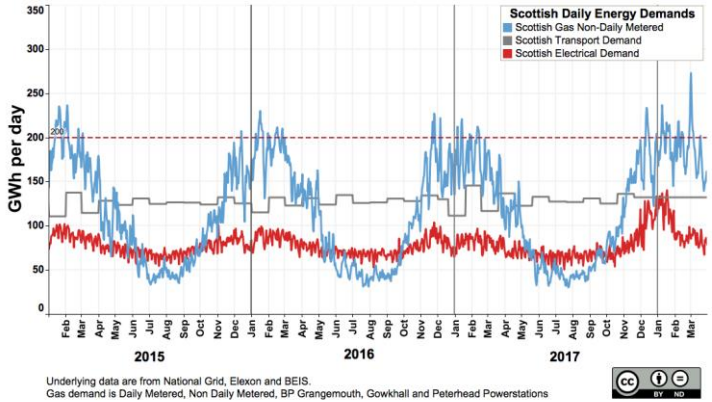


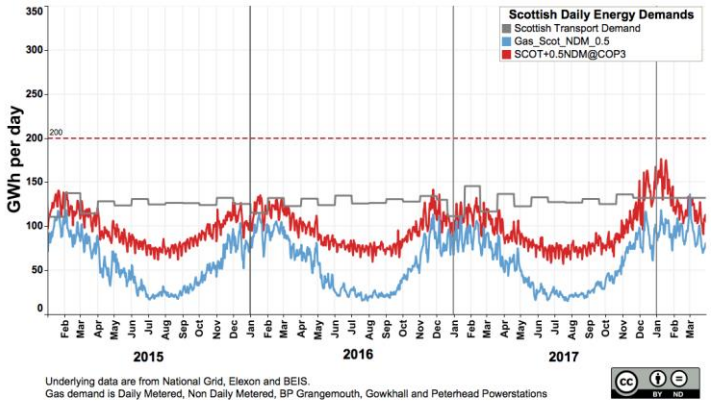


* Includes estimated peatland emissions

Scotland's demand for energy

What if half of gas demand for heat was converted to heat pumps with a (generous) Coefficient of Performance of 3?





- Peak daily electricity demand roughly 50% bigger
- Bigger intra-annual variation of electricity
  - What extremes should the system be capable of meeting? How big and for how long?

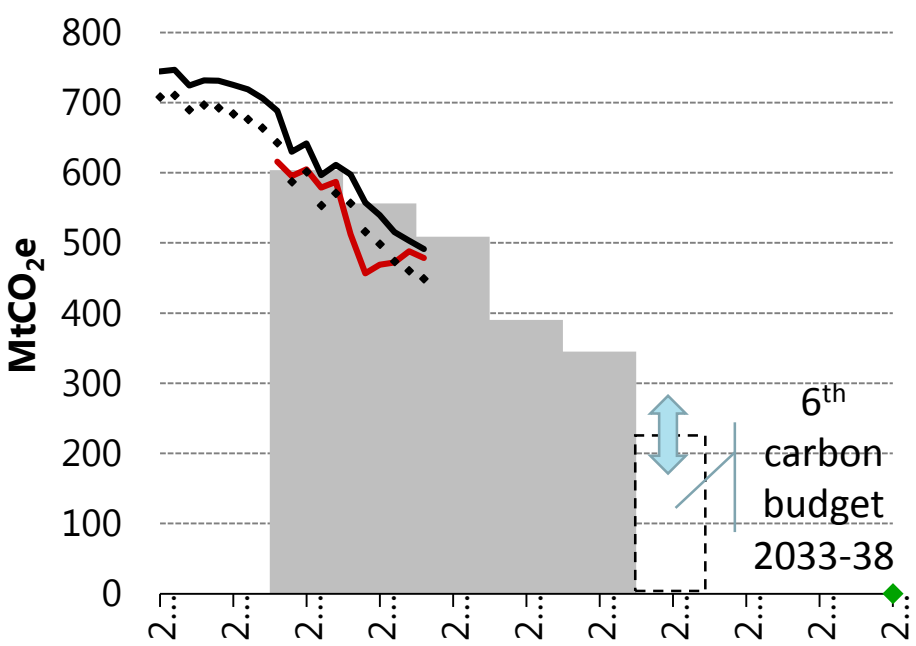
Charts courtesy of Grant Wilson, University of Birmingham

Next steps for Scotland

- **Setting a net-zero greenhouse gas emissions target for 2045 represents a step-change in ambition for Scotland.**
- **The Scottish Parliament's 2030 target to reduce emissions by 75% will be extremely challenging to meet.**
- Ensure that by 2032 (or even earlier if feasible) there is no need for anyone in Scotland to buy a petrol or diesel car or van.
- Ensure that all buildings are as energy efficient as can be practically achieved and that low-regret forms of low-carbon heating (i.e. heat pumps in off-gas areas, hybrid heat pumps, and low-carbon district heating) are being rolled out at scale in the 2020s
- Incentivise switches to low-carbon heat and improve energy and resource efficiency in industry.
- Work with the UK Government to ensure that policy mechanisms and infrastructure are developed in a way that allows Scotland to decarbonise industry, roll-out greenhouse gas removals, and **transform low-carbon electricity generation and distribution** to enable electrification of other sectors.
- **Tackle skills gaps** that would otherwise hinder progress and deliver the commitment to 'green' jobs that has been promised.

The CCC's approach to carbon budgets

Five legislated Carbon Budgets (so far)



Legislated carbon budgets

Outturn GHG emissions

Outturn GHG emissions (excluding IAS)

Net carbon account emissions

Net-zero target

Source: CCC (2019) Progress Report to Parliament

6th Carbon Budget due to be published in September 2020

6th carbon budget: call for evidence

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Home > News stories > CCC launches Call for Evidence to inform advice on UK's Sixth Carbon Budget

CCC launches Call for Evidence to inform advice on UK's Sixth Carbon Budget

5 December 2019

The Committee on Climate Change (CCC) has launched a new Call for Evidence to inform its advice to the UK Government on the Sixth Carbon Budget, due to be published in September 2020.

The Sixth Carbon Budget, required under the Climate Change Act, will provide ministers with the Committee's recommendation on the level of greenhouse gases the UK can emit during the period 2033-2037. It will set out a pathway to meeting the UK's new net-zero emissions target in 2050, and is the first carbon budget to be legislated following that commitment.

Responses to the Call for Evidence will help to inform the Committee's analysis over the next six months. It covers five key topics:

- Climate science and international circumstances
- The path to the 2050 target
- Delivering carbon budgets
- Wales, Scotland and Northern Ireland and
- Emissions reductions in key sectors of the UK economy

Topics:

Carbon budgets and targets

Related content

The Sixth Carbon Budget and Welsh emissions targets – Call for Evidence
5 December 2019

CCC to publish Sixth Carbon Budget in September 2020
17 October 2019

- What business models and/or policy instruments could be used to continue to decarbonise UK power emissions to close to zero by 2050,
  whilst minimising costs?
- Managing variability: interconnection, battery storage. flexible demand.
  - What other technologies could play a role here?
  - What evidence do you have for how much demand side flexibility might be realised?

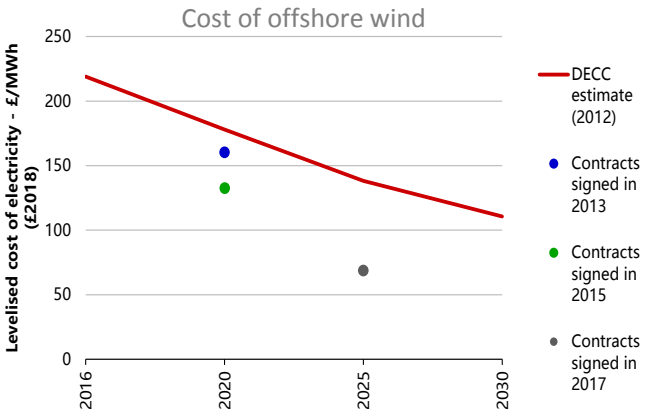
Deadline for responses: Wednesday 5 February, 2020

Net-zero and the reality of innovation: No more cost than already expected

More effort

2050 target (v 1990)	Estimated cost
2003: -60% CO_2	0.5-2.0% of GDP
2008: -80% GHG	1-2% of GDP
Now: -100% GHG	1-2% of GDP

Same cost

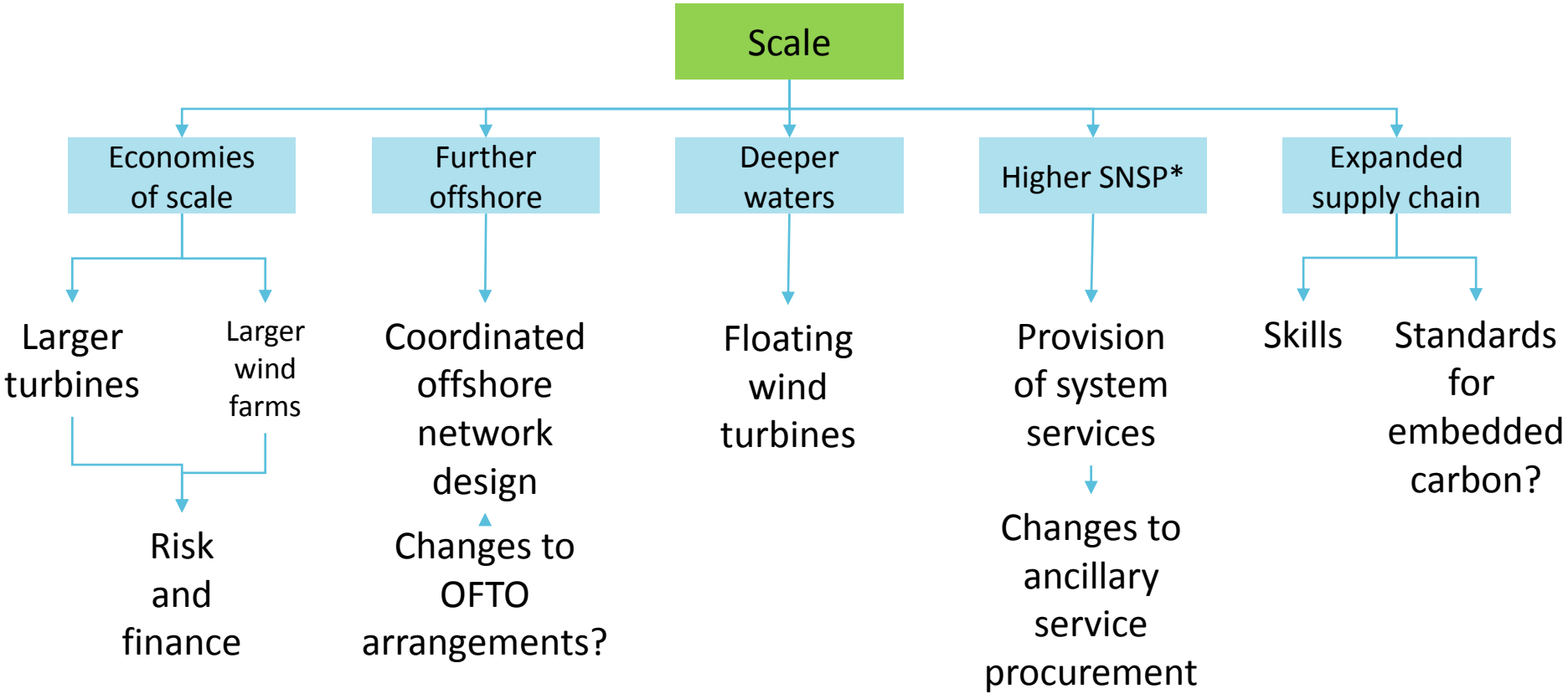


Innovation

Clean Growth

Co-benefits

Offshore wind sector challenges



* System Non-Synchronous Penetration

System challenges from more wind power

- What mix of 'schedulability', flexibility and 'persistence' of resources do we need?
- Reduced system inertia and short circuit current
  - New faster frequency containment reserve
  - A market for short circuit current capability?
- Closure of plant providing frequency, voltage and black start services
  - New value for storage and enhanced reactive power capability
- Network constraints
  - 'Flexibility' gets you only so far
- Uncertain interactions between power electronic converters
  - New sets of Grid Code requirements and enforcement responsibilities

Figure B1.1. Generation from wind and nuclear; electricity demand (first three weeks, Jan 2018)

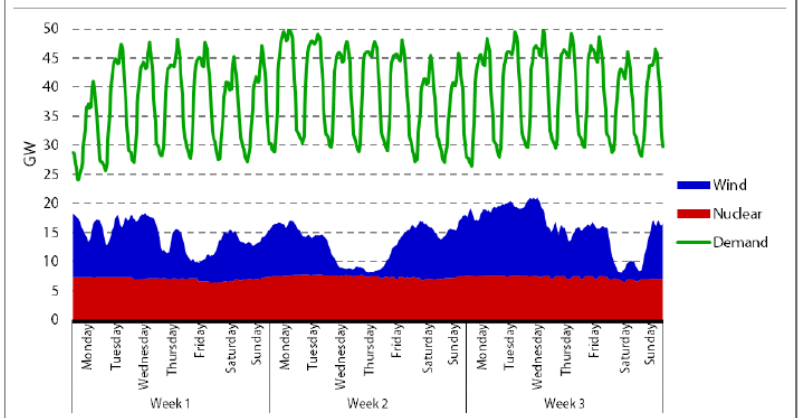


Figure: the CCC

Government and business both have key roles

- Clear that major action is needed by everyone – government, business leaders, investors and citizens – in the next decade not just in the 20 years after that
- A role for government (at all levels) in driving towards net-zero
  - Supporting R&D
  - Creating the environment for investment
  - Regulating and monitoring to drive change
  - Developing clear pathways to allow business investment and workforce planning
    - Consultation and clear signalling of policy direction
    - Risk of stranded assets as emissions reduction becomes ever more pressing
  - Supporting education and development of skills
  - Ensuring fair distribution of costs, risks and benefits, and a just transition
- Business can
  - Invest in skills and knowledge
    - It cannot be left to government alone
  - Help to shape consumer expectations and norms
  - Enable its own workforce to minimise personal emissions, e.g. in travel and diet
  - Invest knowing that emissions reduction must happen

Claire Mack

Chief Executive, Scottish Renewables

Professor Keith Bell

Committee on Climate Change

Zoë Keeton

Head of Regulation and Policy, innogy Renewables UK

Dan Finch

Managing Director, EDP Renewables

Colin Maciver

Development Manager, Crown Estate Scotland / Project Manager, SOWEC

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Planning for sustainable growth

Stephanie Conesa

Policy Manager
Scottish Renewables

Tweet @ScotRenew
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Brian McFarlane

Head of Projects - Offshore Development
SSE Renewables

Tweet @ScotRenew
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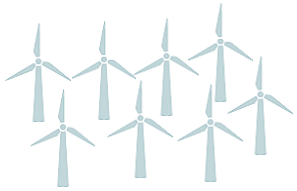
Offshore Wind Sector Deal
Barriers to Growth Workstream Overview

Brian McFarlane

OffshoreWind IndustryCouncil

What is the Offshore Wind Sector deal?

2019

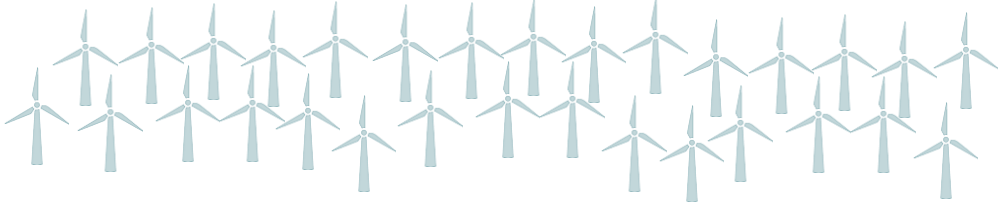


A partnership between the sector and the government which is an ambitious, long-term strategy, in which offshore wind will become the backbone of the UK's power system.

Policy framework to deliver

- 30GW by 2030 (30% of UK electricity, with £48billion infrastructure investment, £2.6billion a year export value, £2.4billion a year total electricity system costs reduction, jobs from 11K to 27K).
- And step up to net zero by 2050.

2030



OffshoreWind IndustryCouncil

Sector Deal- Barriers to Growth

Project	OWIC Sponsor	W/S Lead
People & Skills	Hugh McNeal	Celia Andersen
Solving the Integration Challenge	Matthew Wright	Jane Cooper
Supply Chain	Clark MacFarlane/Jonathan Cole	Ray Thompson
OWGP	Halfdan Brustad	Sophie Banham
Clusters	Julian Brown	Mary Thorogood
OFTO & Future Transmission Model	Danielle Lane	Zoe Keeton
Aviation / Radar	Zoe Keeton	Dujon Goncalves-Collins
Barriers to Growth	Benj Sykes	Brian McFarlane
Innovation (Cross-cutting)	Andrew Jamieson	Chris Hill

OffshoreWind IndustryCouncil

What is the B2G workstream?

- The B2G workstream aims to **understand and navigate the challenges** faced by consents and cumulative environment impacts to meet the Sector Deal commitments and report these to Government via OWIC and the Sector Delivery Team, which B2G forms part.
- B2G will provide **leadership and oversight** to the offshore wind industry to identify, resolve and overcome strategic deployment issues in relation to consents and cumulative environmental impacts both in the marine and onshore areas.
- B2G will coordinate and collaborate with the numerous existing programmes of work (e.g. SCOT MER, TCE's SEAP, ORJIP, OSMWRF etc), SNCB's and key decision makers.
- The B2G workstream will have to **demonstrate to Government** that these challenges are being managed to overcome to allow 30GW to be consented by 2030.

Barriers to Growth- structure

The Barriers to Growth Coordination Group will have an overview of all of the work in consents, licencing and the environment relating to Barriers to Growth. They will be responsible for ensuring that there is a clear road map with commitments to meet the 2030 and net-zero targets

OffshoreWind IndustryCouncil

Barriers to Growth- Tackling Barriers in collaboration

OffshoreWind IndustryCouncil

Barriers to Growth – Key barriers to address

1. Approach to derogations (alternatives, IROPI, compensation)
2. Cumulative ornithology issues
3. Under water noise and marine mammals
4. Stretched resourcing
5. Co-existence and priorities with other sea bed users
6. Biodiversity net gain
7. Alleviate delay and uncertainty arising from Review of Consents process

Dr Janelle Braithwaite

Senior Policy Officer - Marine Planning and Policy

Marine Scotland

Tweet @ScotRenew

#SROFFSHORE20

Scottish Marine Energy Research (ScotMER)

A coordinated approach to marine renewable energy research in Scotland

Janelle Braithwaite
Senior Policy Officer
Janelle.Braithwaite@gov.scot

Scottish Government
Riaghaltas na h-Alba
gov.scot

Scottish Government Policy

Scotland's National Marine Plan (2015):

Decision making in the marine environment will be based on sound scientific and socio-economic evidence

Where evidence is inconclusive and impacts of development or use on marine resources are uncertain, reasonable efforts should be made to fill evidence gaps and decision makers should apply precaution within an overall risk-based approach.

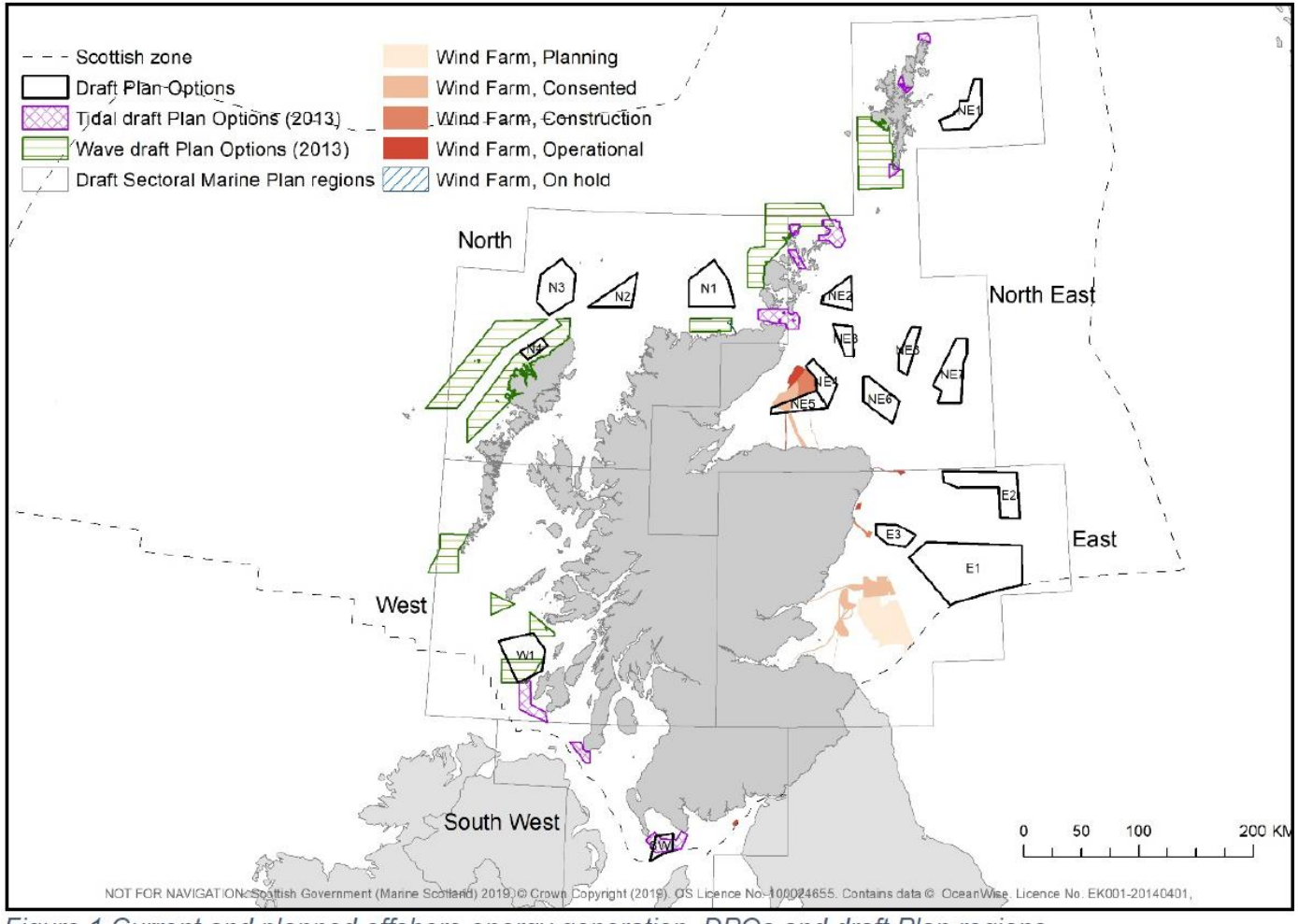
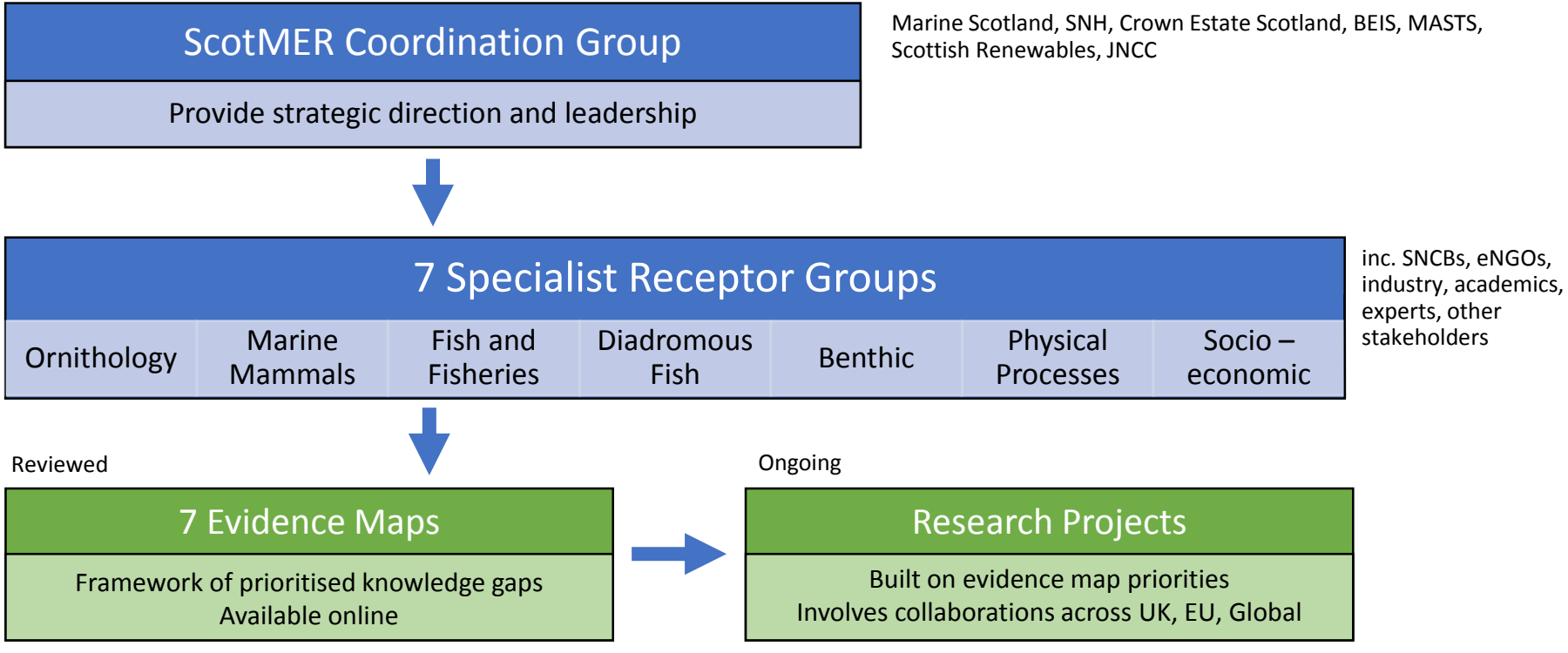


Figure 1 Current and planned offshore energy generation, DPOs and draft Plan regions

ScotMER Programme

- To deliver coordinated and collaborative research to facilitate the sustainable development of the offshore renewables sector in Scotland.
- Three parts to ScotMER:

Coordinated and collaborative approach



marinescotland

Scottish Government
Riaghaltas na h-Alba
gov.scot

ORNITHOLOGY	Last Updated: March 2017

Information					Themes				Reasoning	Prioritisation						
ID	Knowledge Gap	Target Species/Group	Seasons	Target Regions	Collision	Displacement	Barrier	Interactions	Relevance	Renewables Sector	Current or Very Likely Future Constraint?	Relevant to >1 Sector?	Relevant to >1Project or Region	Score	Currently feasible	Potential activity
OR.26	Forecasting population level consequences of predicted effects.	Gannet	All Year	UK	High	High	High	High	Population level consequences often critical question for assessments. Population Viability Analyses often used, but range of approaches available. The predictive ability of the PVAs produced has not been tested/ validated.	All	2	0	1	2	1	Compare performance of availa population forecast approache and produce guidance on most appropriate method. Consider quality/ quantity available.
		Kittiwake		UK						All	2	1	1	4	1	
		Auks		UK						All	2	1	1	4	1	
OR.27	Sensitivities of metrics of change produced by PVAs.	Seabirds	All Year	UK/ Europe	High	High	High	High	Assessment ultimately based on population consequence of predicted effect, which rely upon appropriate use of metrics of change.	All	2	1	1	4	1	Sensitivity analysis
OR.28	Influence of large scale change on population forecasts e.g. climate change.	Gannet	All Year	UK	High	High	High	High	Assessments are often based on no impact population forecasts, but these forecasts currently ignore large scale drivers of change. Effects of climate change on kittiwake have been predicted to be particularly relevant.	All	1	0	1	1	1	Produce a predictive populatio model that accounts for climate change scenarios
		Kittiwake		UK						All	2	1	1	4	1	
		Auks		UK						All	2	1	1	4	1	
OR.29	Gathering data at sites that are small, in shallow waters, experience very strong tidal flows.	Seabirds	All Year	Europe	High	High	Low	High	Standard survey techniques are poorly suited to these sites, resulting in data that has poor spatial/ temporal resolution, detectability issues, or expensive.	All	1	1	1	2	1	Develop and validate appropria cost effective methodologies. U of drones, VP methods, etc.
OR.30	Technologies to allow tracking species/ during seasons of interest.	Seabirds	All Year	UK/ Europe	High	High	High	High	Limited data available to inform assessments for some species due to technological constraints.	All	1	1	1	2	1	Develop and demonstrate taggi technologies.
OR.31	Information and methods for CIA at large spatial/ temporal scale.	Seabirds	All Year	UK/ Europe	High	High	High	High	Predicted effects may occur throughout the year, seabirds travel large distances and may encounter effects from range of projects over large spatial scale e.g. North Sea, and it may be appropriate to include this in an assessment.	All	2	1	1	4	1	Produce and populate a centralised framework (at UK level)?
									Seabird populations may be impacted by multiple							Assessment of relative importance of other managed

Examples of research activity

- Seabirds:
  - Bird sensitivity mapping tool
  - Seabird behaviour at sea, flight heights, body-mass survival rates
  - Framework for regional Strategic Environmental Assessment
  - Bird and cetacean monitoring in Scottish waters

- Marine mammals:
  - Reviewing noise modelling approaches to guide assessments
  - Improving modelling population consequences of disturbance (iPCoD)
- Cumulative effects assessment framework
  - Consistent approach to assessing cumulative impacts on priority species
- Socio-economic: how best to define the ‘local area’ for impact assessments

Link up with other groups

- North Sea Energy Cooperation: Marine Spatial Planning (EU)
  - CEAF - Common Environmental Assessment Framework
  - CREW - Cooperation on research on ecological effects of offshore wind
- Offshore Renewables Joint Industry Programme (ORJIP)
  - ORJIP Offshore Wind
  - ORJIP Ocean Energy
- Crown Estate Scotland, Crown Estate (rest of UK)
- BEIS Offshore Energy SEA Research Projects
- International e.g. WREN

  Working Together to Resolve Environmental Effects of Wind Energy

Coming up

- ScotMER Symposium in Edinburgh
  - 3-4 March 2019
  - Focussed on monitoring
- Report from MASTS Workshop
  - Ecological impact and research priorities
- EIMR Conference
  - Environmental Interactions of Marine Renewables
  - 21-23 April 2020

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ScotMER

Scottish Marine Energy Research Programme

Collaborative research to support the sustainable development of offshore renewable energy in Scotland's seas

marinescotland

Scottish Government
Riaghaltas na h-Alba
gov.scot

Liam Leahy

Offshore Wind Manager

The Carbon Trust

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Offshore Renewables Joint Industry Project (ORJIP) for Offshore Wind

A collaborative approach to reducing consenting risk in support of achieving 2030 targets

29th January 2020

Scottish Renewables' Offshore Wind Conference 2020
Plenary 4A: Planning for sustainable growth

working to accelerate offshore consenting

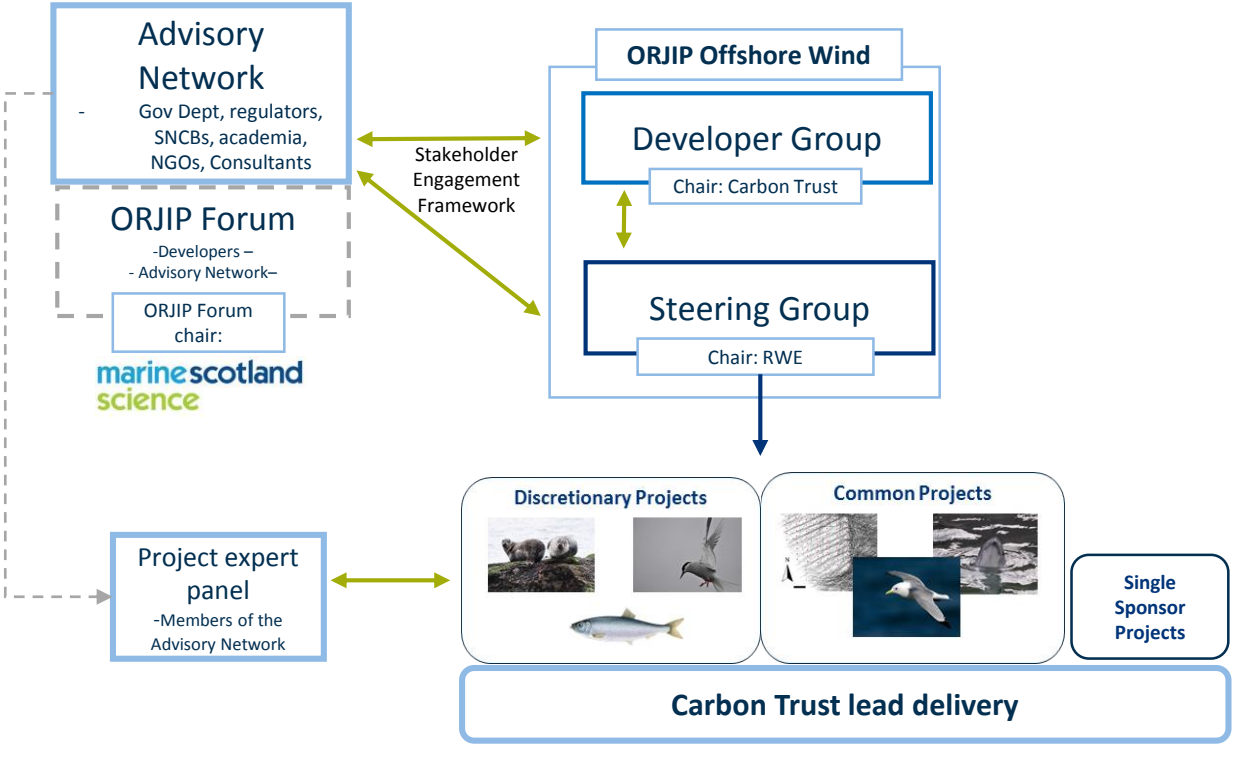
Offshore Renewables Joint Industry Project (ORJIP) for Offshore Wind

Programme set up to conduct research into the environmental impact of offshore wind to help reduce the consenting risk to support achieving industry capacity targets

Key insights:

- 8 Offshore Wind Developer Partners/4 Non Developer Partners (Membership always open to new partners)
- Stage 2 launched July 2019, minimum 4 year programme with possible 2 year extension
- Minimum of £940k investment with significantly more expected towards Strategic Discretionary Projects
- No constraint in terms of geographical context or consenting risk definition, priorities defined each year based on consenting risk at the time

ORJIP Offshore Wind - Stage 2: Programme structure



ORJIP Offshore Wind Project Types

Common Projects

Projects solely funded by the ORJIP Offshore Wind core budget which address common issues for all ORJIP Offshore Wind partners and the offshore wind industry. These will be contracted out to subject experts and managed by Carbon Trust with the aim of commencing at least 2 a year.

Project types- Guidance notes, tools, strategic plans, technology scans, literature studies, desk-based studies

Discretionary Projects

Projects which are either, too large to be delivered through the ORJIP Offshore Wind common budget or, cover more specific topic areas which are priority for a proportion of the ORJIP Offshore Wind partners. The projects will be set up using core ORJIP Offshore Wind budget, but the projects will be funded by ORJIP Offshore Wind partners that 'opt in' to participate with the aim of commencing at least 2 a year. Non-ORJIP partners will also be invited to fund these projects if interested.

Project types- Large strategic projects like the Stage 1 BCA study or species specific projects like herring spawning sites

Single Sponsor Projects

A Project relevant to ORJIP Offshore Wind's objectives that is driven and funded by a single ORJIP Offshore Wind partner. SSPs can be suggested by any ORJIP Partner, under the understanding that project set up and management will entirely be financed by that single partner and not receive any contribution from the ORJIP core budget. The ORJIP Offshore Wind Steering Group will be consulted and will decide whether a SSP can be brought forward under the ORJIP Offshore Wind name.

Project types- Strategic projects for a single party such as Marine Scotland's *Bird Sensitivity Mapping* project completing under ORJIP Offshore Wind Stage 1.

Project Identification, Prioritisation & Selection

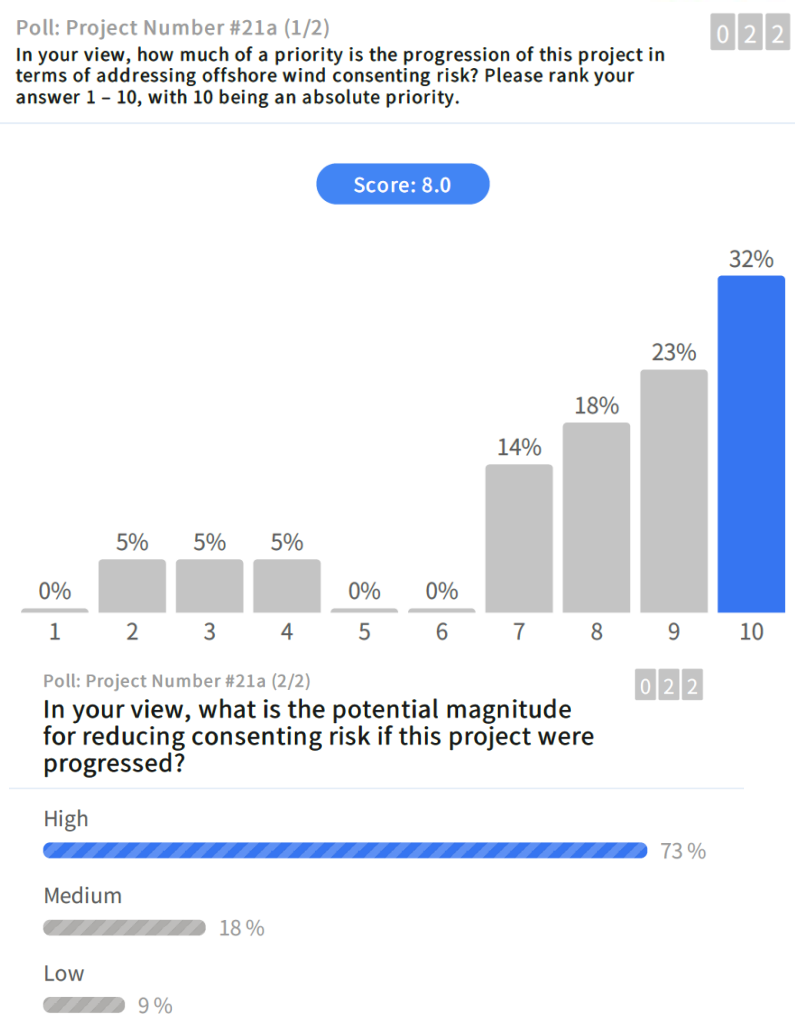
- Annual repetitive process

1 – 3 months	Evidence Gathering	• ORJIP OSW Partners agree priority focus areas the programme will focus on depending on current consenting risk, • Depending on priority focus areas, ORJIP OSW Partners will nominate stakeholders to the Advisory Network, • Carbon Trust engage with the ORJIP OSW Advisory Network to understand current work and identify project ideas through a 'call for project ideas', • ORJIP Forum Chair with the Steering Group define the aims and objectives for the ORJIP Forum and topics or specific project ideas that should be discussed.
1 month	ORJIP Forum	• ORJIP Forum Chair, with the support of Carbon Trust, organise the ORJIP Forum • The ORJIP OSW Steering Group and Advisory Network, as appropriate, participate in the ORJIP Forum, a workshop chaired by the ORJIP Forum Chair to support the development of common projects, discretionary projects and collaboration opportunities based on the ideas brought forward, • ORJIP Forum participants are informed of the way ORJIP OSW is proceeding, and how future projects will be scoped and how they can expect to be involved.
3 months	Preliminary Project Scoping	• The outcomes of the ORJIP Forum informs a list of ORJIP OSW project ideas • The ORJIP OSW Steering Group confirm the highest priority projects through a prioritisation exercise and decide on project to be taken forward • Project Expert Panels are nominated for each project • High level scopes for the highest priority projects are developed by the Project Expert Panel, coordinated by Carbon Trust
2 months	Project Selection	• The ORJIP OSW Steering Group evaluate available budgets and approve the final scope of the ORJIP OSW Projects that are to be taken forward • The projects will be tendered as ORJIP OSW Common Projects or taken forward as Discretionary Projects

ORJIP Forum – Stage 2 Year 1

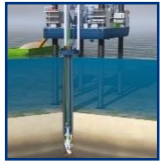
- 74 project ideas reviewed in 1 day
- Fantastic engagement from Advisory Network
- Use of SLIDO as interactive polling tool
- Two questions asked:

1. Project Idea progression in terms of priority
2. Impact on consenting risk if project idea progressed



Project Prioritisation and Selection Process – Year 1

Uncertainty around the risk to the environment of OSW



Research which aims to reduce uncertainty

Research outputs shared

Improved understanding and consenting process

Reduced risk to developers and the environment

General Selection Principles

- Screen out projects relating to IROPI
- Screen out projects where duplication with other industry groups has been identified
- Screen out projects not within focus areas unless strategic reason to keep in
- Account for ORJIP Forum results by applying a priority threshold based on forum results
- ORJIP OSW partner evaluation exercise

Robin Cox

Environmental Specialist

Vattenfall

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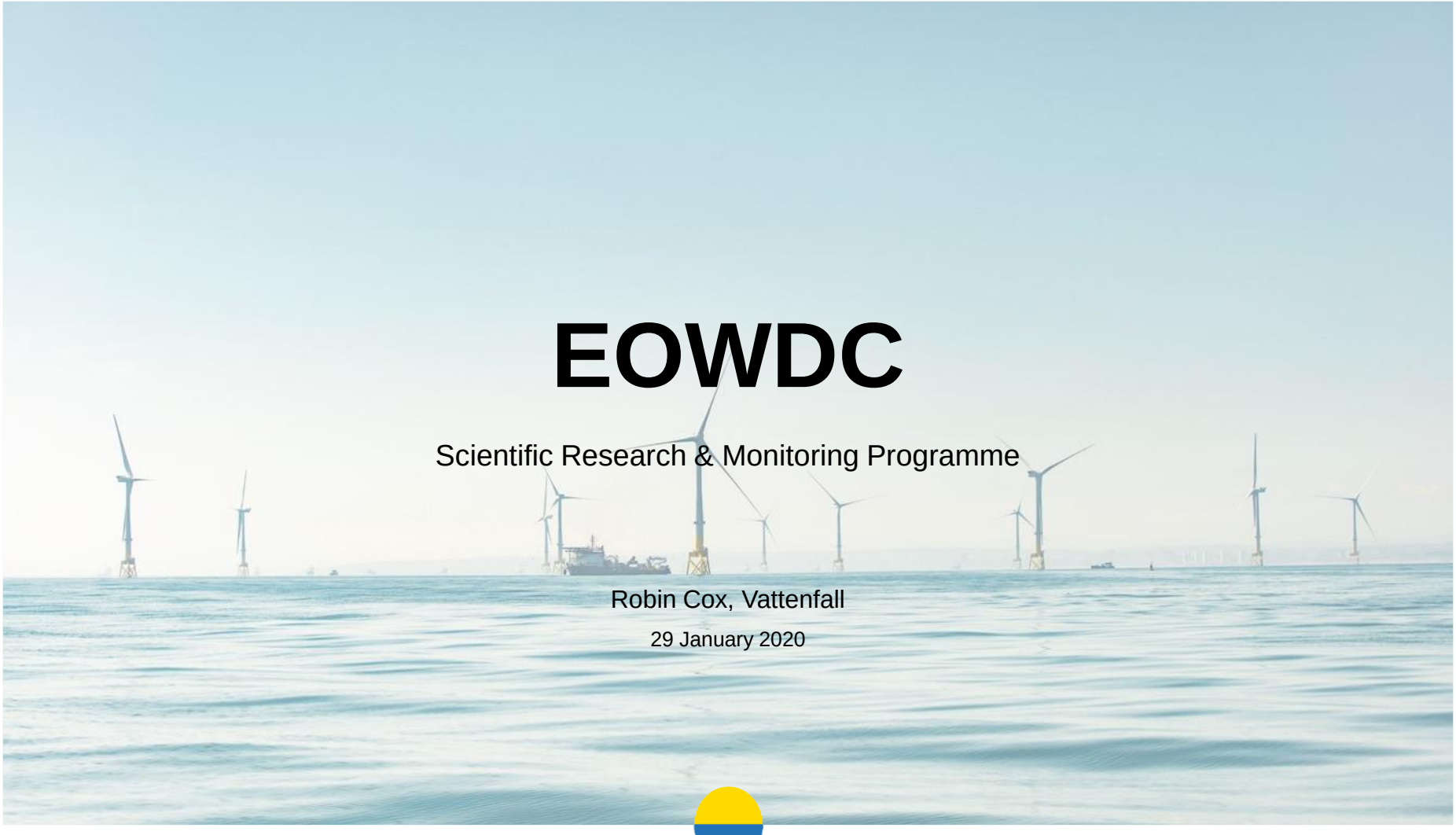


EOWDC

Scientific Research & Monitoring Programme

Robin Cox, Vattenfall

29 January 2020

VATTENFALL

Introduction

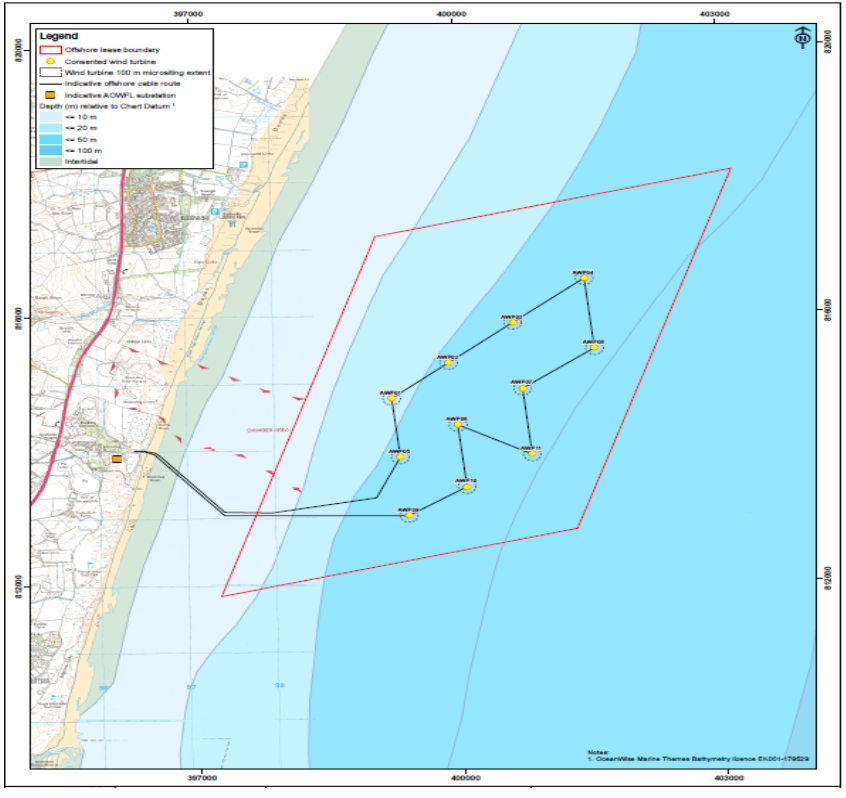
- Background to EOWDC
- Five Research Programmes
- Outputs and timescales

Background

European Offshore Wind Deployment Centre

EOWDC

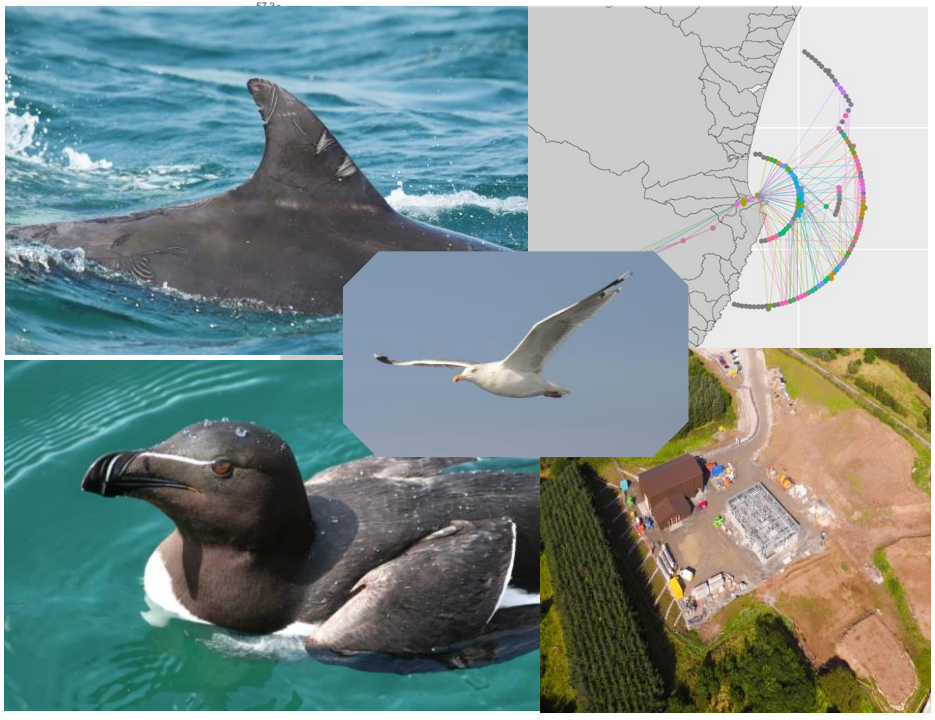
- Part of demonstration leasing round
- 11 turbine site consented 2013
- Construction 2016 – 2018
- First power 2018
- Planning condition for Scientific Research and Monitoring Programme
- Scientific panel comprised of University of Highlands and Islands, Scottish Government, SNH, RSPB, JNCC, Crown Estate Scotland, SEPA, Aberdeen City and Aberdeenshire Councils



Research Projects

Five projects

- Bottlenose Dolphin Movements
- Tracking winter movements of Auks
- Salmon and Sea Trout Tracking Array
- Socio-economic impact of offshore wind
- Bird collision avoidance study

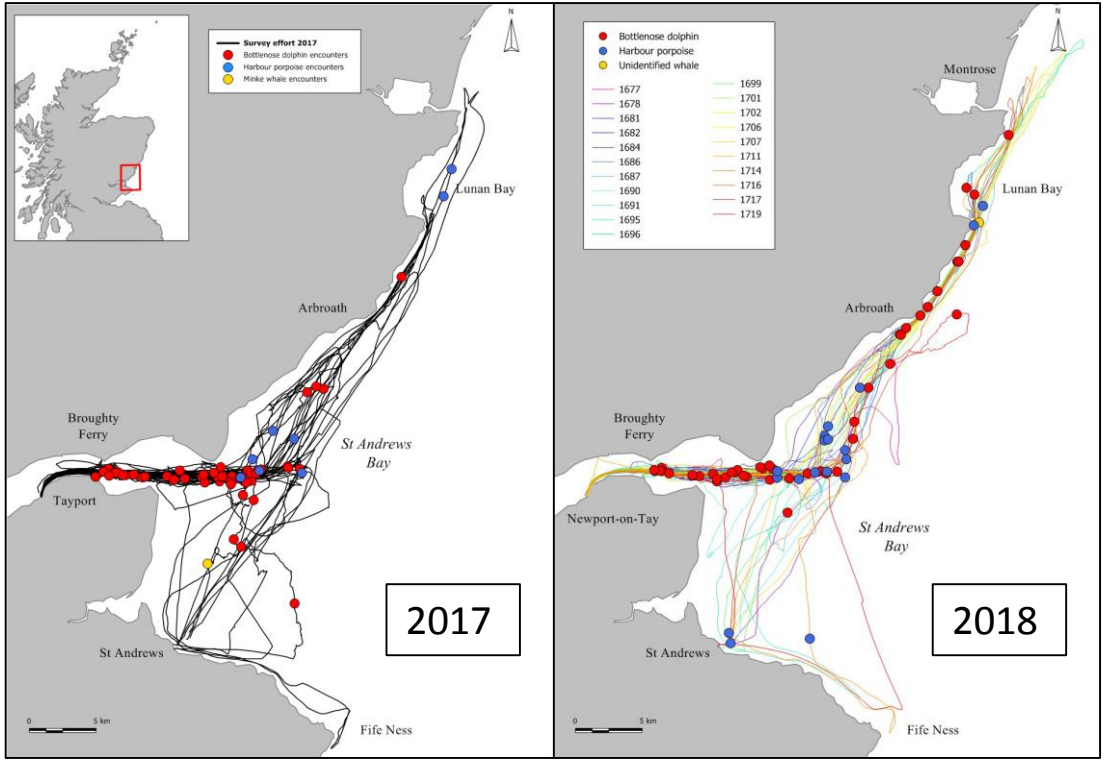


Dolphins

Improving understanding of bottlenose dolphin movements along the east coast of Scotland

SMRU Consulting and University of St Andrew's

- Project running 2017-2020
- Plugging gaps in long-running study
- Boat surveys and photo ID
- Update population estimates and demographic parameters
- Estimate movement probabilities

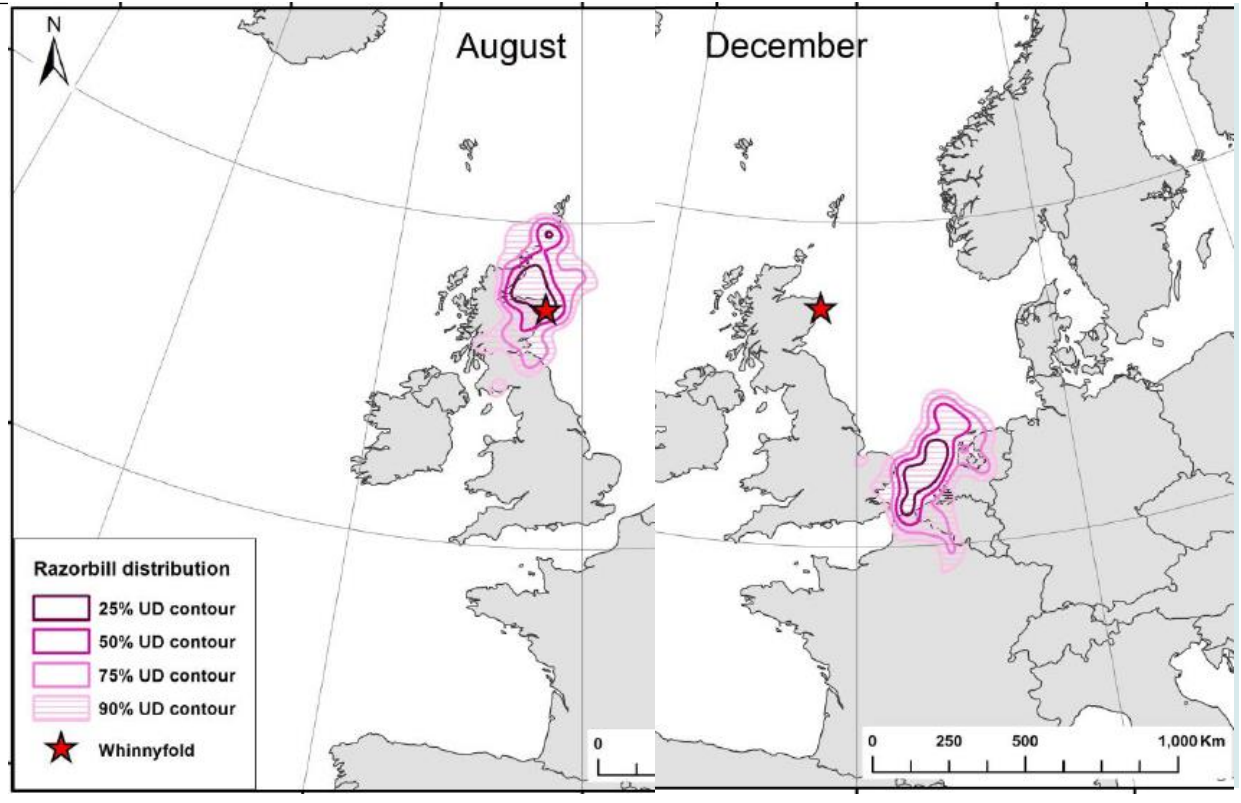


Auks

Tracking non-breeding season movements of adult auks

MacArthur Green and CEH

- Project Running 2017-2021
- Improving understanding of winter distribution of guillemots and razorbills
- Geolocators and Time Depth Recorders
- Identify which populations are at risk and when
- Reduce uncertainty in assessment of impacts

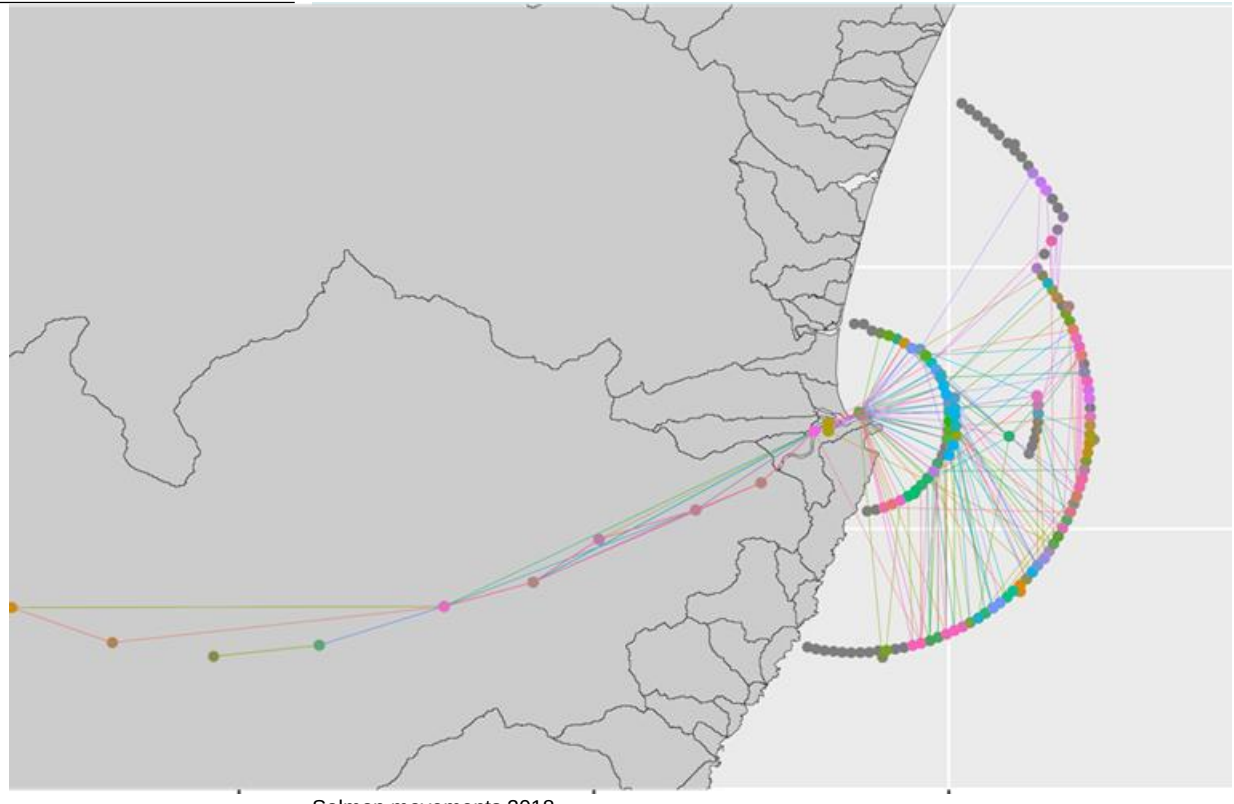


Salmon and Sea Trout

North East Scotland Salmon and Sea Trout Tracking Array

River Dee Trust and MSS

- Project running 2017-2020
- Increasing understanding of salmon and sea trout river mouth and coastal distribution and movements
- Tagging of smolts in Dee, Don and Ythan
- Receivers in rivers, harbour and offshore arrays (4km and 10km)
- Combine data with Scottish Shelf Model to understand smolt distribution
- Hope to develop predictive tool transferable to other rivers



Salmon movements 2018

Socio-economic study

Socio-economic impact of offshore wind on the human environment

Oxford Brookes University

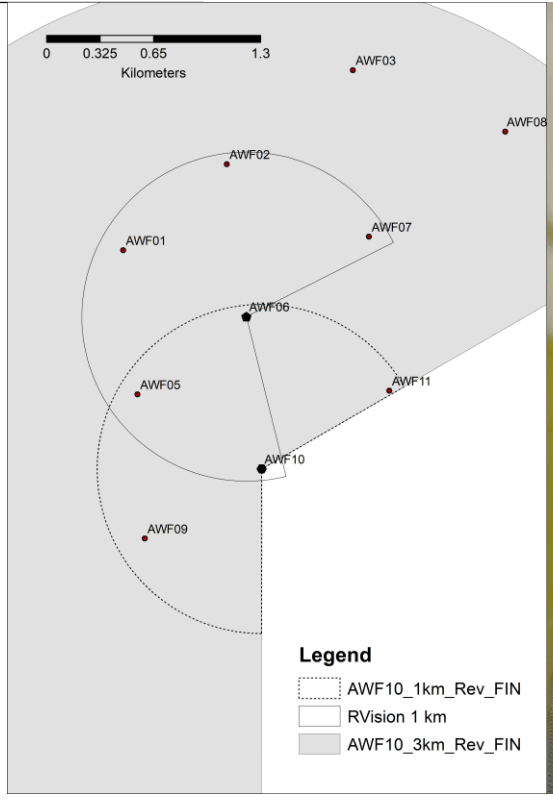
- Project running 2017 - 2020
- Review of existing methods
- Literature review
- Comparison of predictions with actual impacts
- Enhance understanding of offshore wind farm socio-economic impacts
- Production of good practice guide to socio-economic assessment of offshore wind in the UK

Bird Collision Avoidance

Seabird Flight Behaviour at Offshore Wind Farms

RPS group and DHI

- Project running 2019 – 2022
- Integrated radar and camera technology
- 3D flight tracks from combined radar and video footage
- Analysis to provide evidence of:
  - Flight behaviour within wind farm and vicinity of turbines
  - Meso- and micro-avoidance
  - Flight height and flight speed
- Improve certainty in collision impact predictions



Outputs

- Final reports in 2020 for Dolphin, Salmon and Socio-Economic projects
- Final report in 2021 for Auk project
- Final report in 2022 for Bird Collision Avoidance project
- Reports will available on Vattenfall EOWDC website (interim reports currently available)
- PhD theses
- Peer reviewed papers

- Vattenfall contact details:

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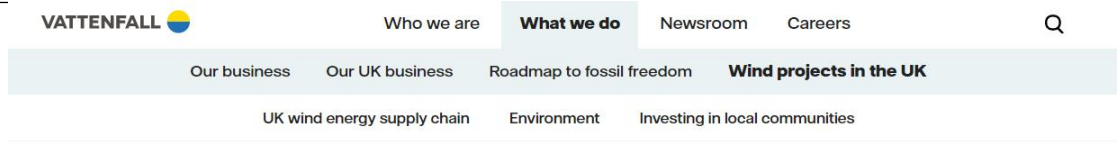

Research programmes

Please click on the links below to read each project's interim research report or latest update.

- Auk and Guillemot Tagging Study by MacArthur Green
- Salmon sea trout and smolt tracking study by River Dee Trust
- Socio-Economic Study by Oxford Brookes
- Dolphin tracking study by SMRU
- Bird avoidance study by RPS

https://group.vattenfall.com/uk/what-we-do/our-projects/european-offshore-wind-deployment-centre

Gary McGovern

Partner

Pinsent Masons LLP

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THE LAWYER
AWARDS 2018
LAW FIRM OF THE YEAR

Offshore Wind Conference

Overcoming precaution, to deliver proportionality

28 January 2020

Pinsent Masons

The Context: A "Climate Emergency"

"There is a **global climate emergency**.

The evidence is irrefutable. The science is clear. **And people have been clear: they expect action.** The Intergovernmental Panel on Climate Change issued a stark warning last year: **the world must act now. By 2030 it will be too late** to limit warming to 1.5 degrees

(**Rosanna Cunningham, 14 May 2019**)

What Are We Doing About It?

We have a framework and emerging plan…

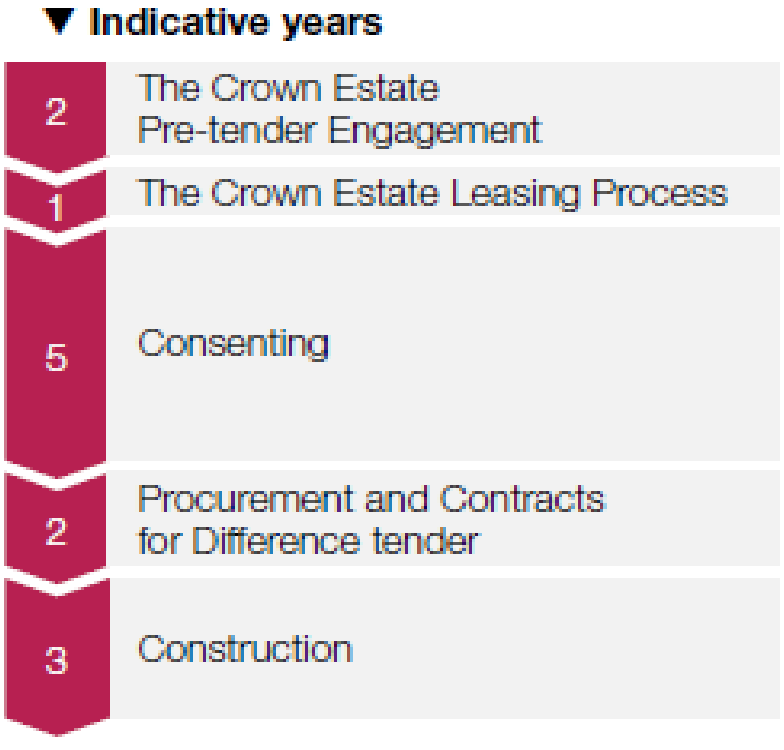
- "Net Zero" by 2045 (100% lower than baseline)
- Interim Targets, e.g. 2030 / 75% lower
- Low carbon electricity generation must "*quadruple*" (UK CCC)
- Sectoral Marine Plan (SMP) to be adopted in 2020
- Target of 10 GW by 2030 (draft SMP, "high scenario")
- OWF leasing rounds c. every 2 years from 2020 (CES)

Can the Plan be Delivered in Time?

- Yes - but perhaps not with "business as usual" approach

- Historic timescales:
  - 1st OWF in c. 2006
  - 915 MW operational (6 x OWF)
  - 4.1 GW consented (8 x OWF)

FIGURE 28: Time to deliver new projects



Diagnosis

- Planning and consenting needs streamlined
- That requires:
  - targeted approach to data collection
  - proportionate approach to assessment & risk
- Precaution must not stand in the way of proportionality

The Precautionary Principle

Competing definitions and interpretations…

Non-Preclusion	**Scientific uncertainty should not automatically preclude activities that pose a risk of significant harm**
Margin of Safety	Regulatory controls should include a safety margin; with activities limited below the level at which no adverse effect has been observed or predicted
Best Available Techniques	Activities that present an uncertain potential for significant harm should be subject to BAT to minimise the risk of harm (unless the proponent shows that they present no appreciable risk of harm)
Prohibitory	Activities that present an uncertain potential for significant harm should be prohibited unless the proponent shows that it presents no risk of harm

The High Water Mark – HRA

Waddenzee

- *"A risk… that cannot be excluded beyond reasonable scientific doubt….using objective information*".
- But….
  - absolute certainty not required.
  - Having exhausted scientific means, you can work with probabilities and estimates.
  - Not a licence for inaction based on mere "doubt".

The Right Precautionary Principle

- "…to protect the environment, the precautionary approach shall be widely applied… **Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation"**

(RIO Declaration, 1992)

- "The precautionary principle should not be used to impede development without justification"

(**SPP, 2014**).

A Reset: a Precautionary Approach

Two elements:

1. a need for decision-makers to anticipate harm: activity-proponent still responsible to establish that the proposed activity is unlikely to result in significant harm.
2. the concept of proportionality: consideration of risk and cost- benefit analysis.

A Reset : a Precautionary Approach

- The precautionary principle can enable decision-making
- Data can always be refined - ask: is it necessary?
- Regardless: data collection does not render existing data inadequate to the task in hand
- Interim uncertainty can be accounted for (e.g. margin of error)
- “Uncertainty” should not be a reason to not give advice at all
- Data gathering should inform but not delay advice or decisions

The Road Back to Proportionality

- Define and adopt a precautionary approach:
  - absolute certainty not required
- Cost v Benefit - cost of inaction should be a factor in decision-making
- Implement proper screening and scoping
- Culture shift required
- Reverse ECJ *People Over Wind* ruling (use of mitigation at screening stage)

Mantra for the 2020s…

Stephanie Conesa
Policy Manager, Scottish Renewables

Brian McFarlane
Head of Projects - Offshore Development, SSE Renewables

Dr Janelle Braithwaite
Senior Policy Officer - Marine Planning and Policy, Marine Scotland

Liam Leahy
Offshore Wind Manager, The Carbon Trust

Robin Cox
Environmental Specialist, Vattenfall

Gary McGovern
Partner, Pinsent Masons LLP

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areg
Aberdeen Renewable Energy Group

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Iomairt na Gàidhealtachd 's nan Eilean

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Solving the integration challenge

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Andy Hogg

Head of Energy Industries Division
Scottish Government

Tweet @ScotRenew @ORECatapult

#SROFFSHORE20

Dr Zeynep Kurban

Strategy Manager –
System Integration of Renewables
ORE Catapult

Tweet @ScotRenew @ORECatapult
#SROFFSHORE20

Pathways for offshore wind integration into energy systems

Dr. Zeynep Kurban

29 January 2020

CATAPULT
Offshore Renewable Energy

The OSW Integration Opportunity

Future Energy System will be more decentralised, multi-vector and reliable on renewables

Current Energy System

- 7 GW of offshore wind
- Majority of properties heated by natural gas
- Fuel engine vehicles are the most popular
- 50% of electricity generation comes from fossil fuels
- Meter reading send once every half a year

Future Energy System

- At least 30 GW of offshore wind by 2030
- Properties use electric heating or gas network converted to hydrogen
- All new vehicles are electric, hybrid or hydrogen-powered
- Only 20% of electricity generation comes from fossil fuels in 2030
- Smart meter reading send every half an hour

Outcomes

① **Offshore wind deployment can be bigger than we anticipate now**

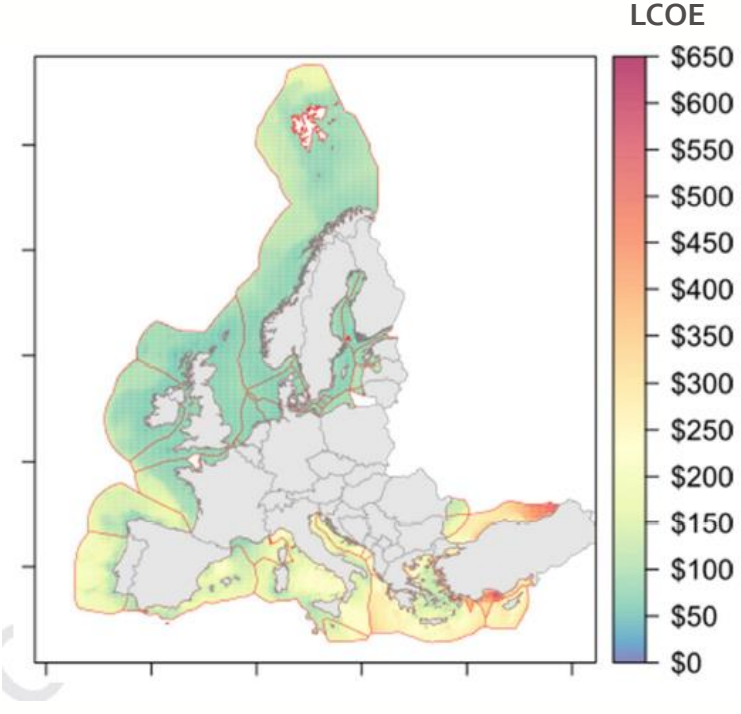
② **Intermittency issue of renewables will be largely overcome**

Impact of higher availability of OSW (ICL, Energy Systems Modelling)

Global LCoE from offshore wind [J. Bosch, 2019]

- **Potential capacity ~ 1000 GW**

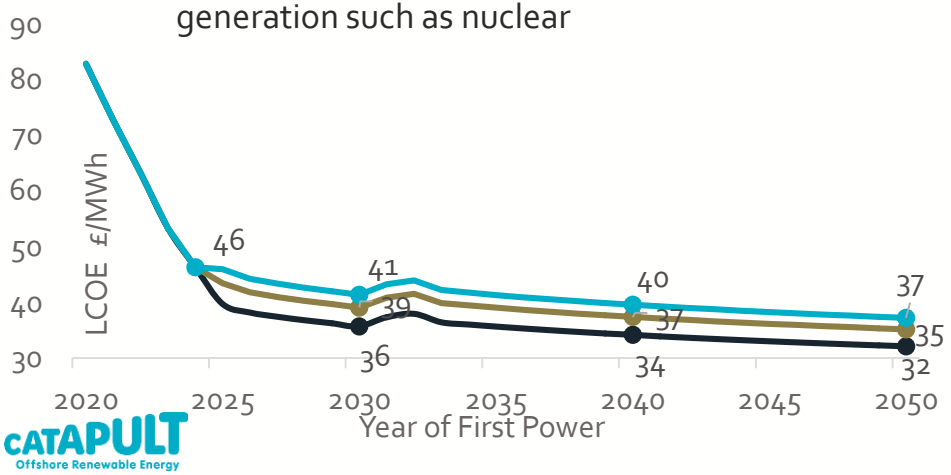
(with 890 GW > 55m depth).



LCoE ORE Catapult, 2019

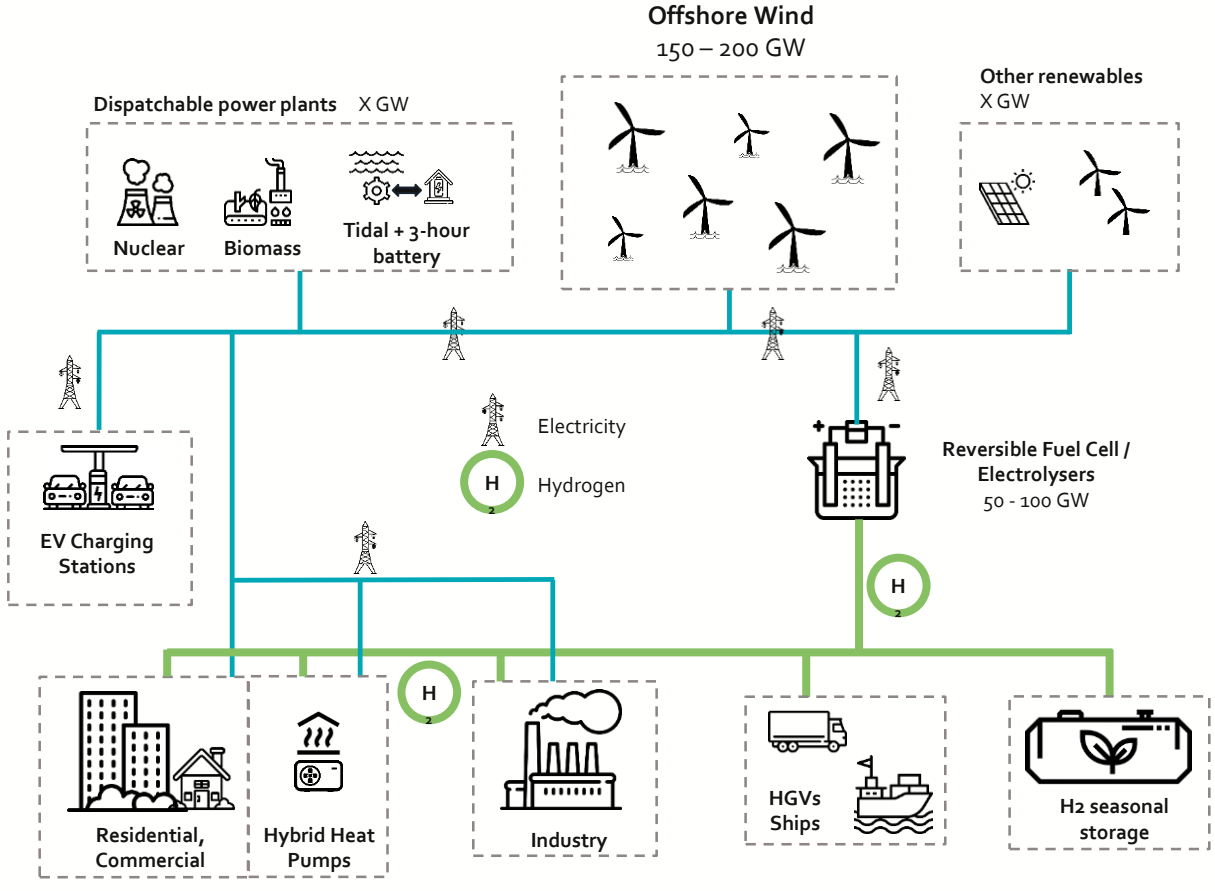
- By 2050 LCOE could be **£32/MWh [low] - £37/MWh [high]**
  - **CF: ~46-54%**

- **ICL IWES model:** Unlocking the potential wind resources (e.g. deep waters) is needed
  - **Up to 280 GW wind could be integrated to GB and interconnected EU grids and/or used to make H2**
  - Displace PV and more expensive low-carbon generation such as nuclear



Opportunity for offshore wind-dominated energy system by 2050

Potential offshore wind-dominated energy system in 2050



Key integration Challenges

- **Offshore wind farm development**
- **Demand sectors and their coupling**
- **Grid Design/Flexibility:**
  - balance between electricity and gas / hydrogen system
  - balancing for short and long timeframes

Policy mandates and frameworks

- level of interconnection,
- role of hydrogen in energy trading,
- Standards & regulation

Opportunity to Transition the oil and gas sector

- Floating Offshore Wind Centre of Excellence
  - Established in October 2019, based in Glasgow, working across the UK
  - Vision to **accelerate the commercial deployment** of **Floating Offshore Wind in the UK**
- Powering Oil and Gas Platforms Using FOW – Feasibility Study
  - Focused on North Sea assets
  - Techno-economic modelling

Industrial partners – major offshore wind developers, oil and gas owner / operators

Strategic partners – OGTC, Scottish Government, OGA

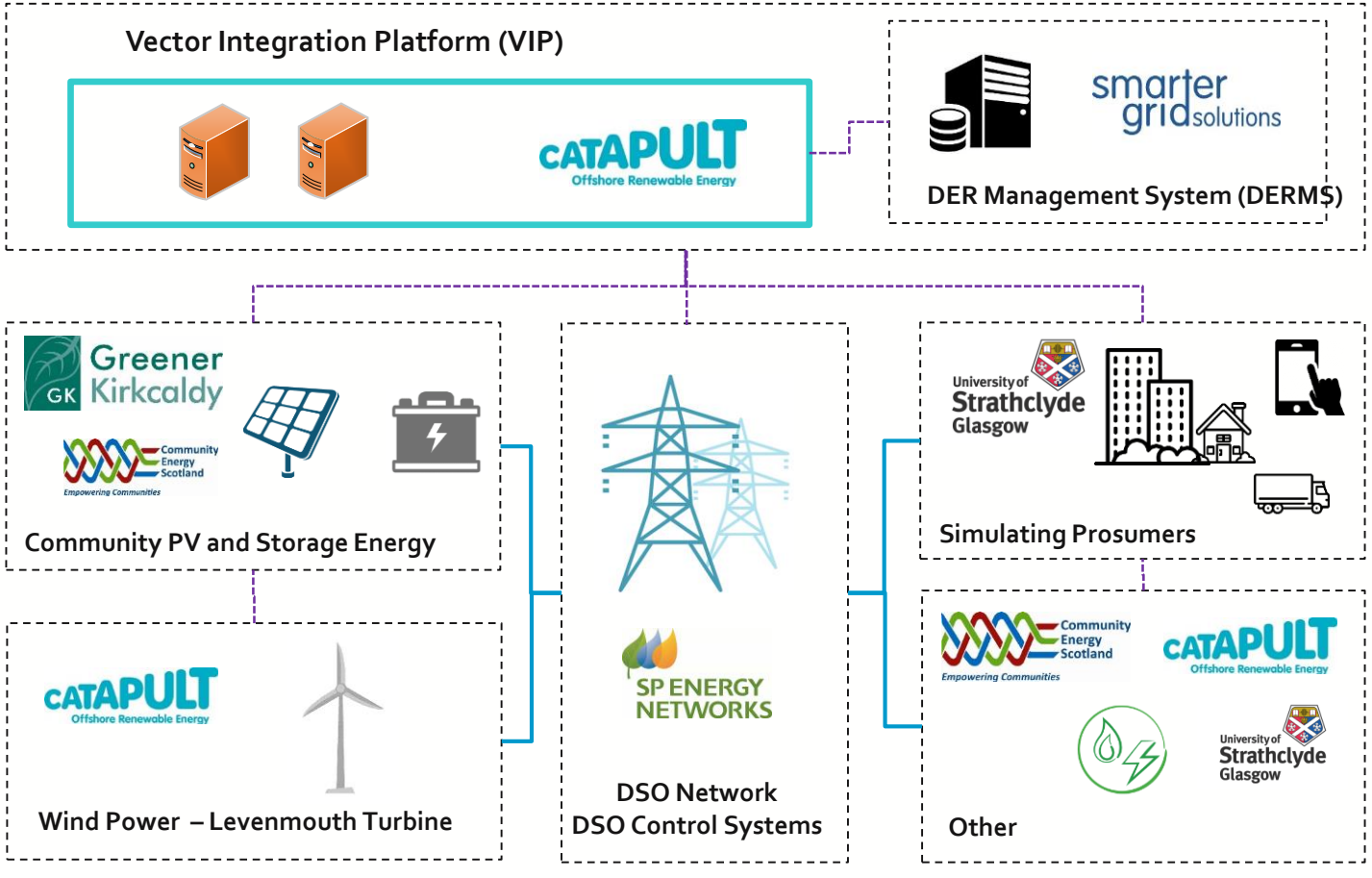
Academic partners – Scottish Universities' track record of relevant research

ORE Catapult -
Demonstration project pipeline

ScotCLUE @ Levenmouth

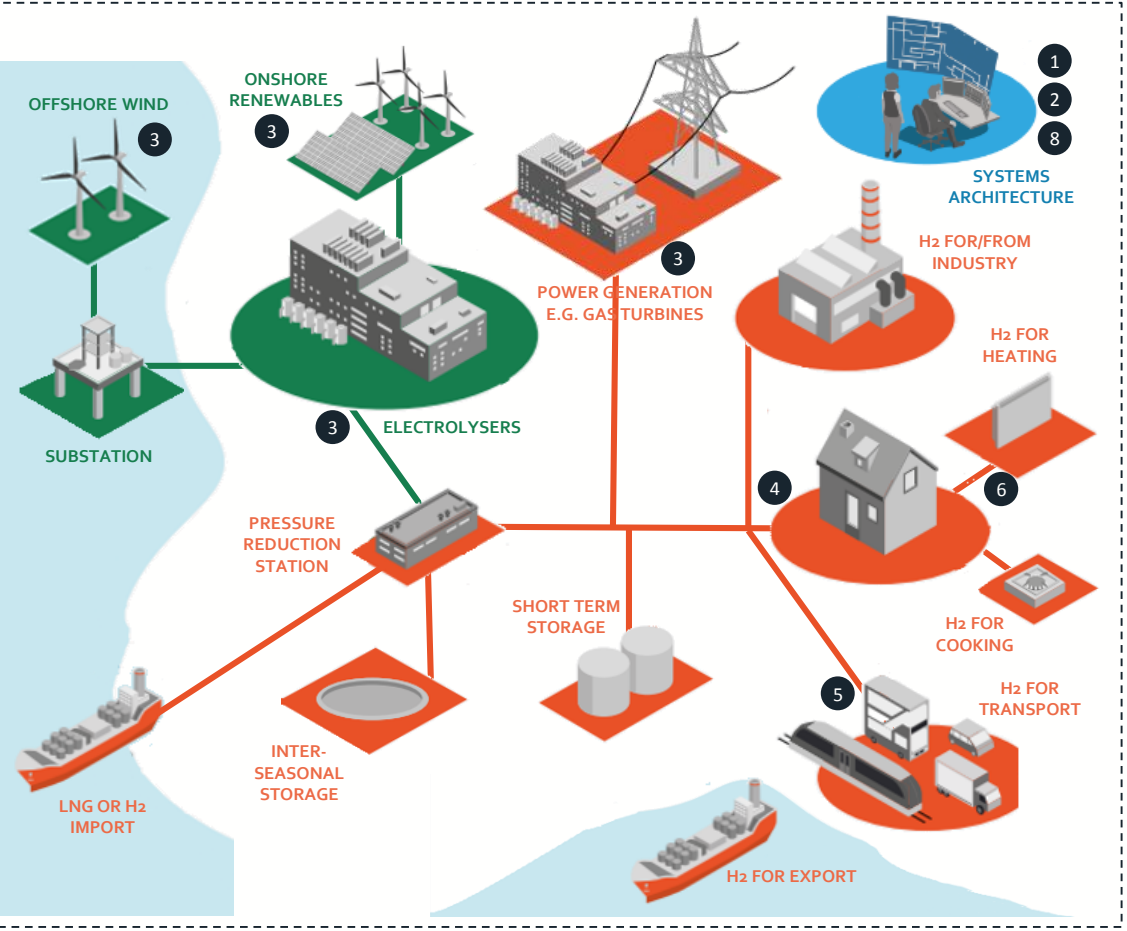
- **Concepts, Planning, Demonstration and Replication of Local User-friendly Energy Communities (CLUE)**

- €7million project delivered over 3 years from December 2019
- Demo of a new more local/regional approach to flexibility
- Stakeholders: cooperatives, project developers, DSOs, owners, operators of LECs, utilities, supplier



Milford Haven: Energy Kingdom in a wider context of a hydrogen

MH:EK detailed design & future implementation



Objective

- To accelerate the transition to an integrated hydrogen and renewables energy system, by creating diverse, community-based seed markets that integrate with the cluster of major energy infrastructure along the Milford Haven Waterway

ARUP riversimple Port of Milford Haven Llywodraeth Cymru Welsh Government

CATAPULT Energy Systems CATAPULT Offshore Renewable Energy WALES&WEST UTILITIES Pembrokeshire County Council Cyngor Sir Penfro

Summary - Integration Challenges/Opportunities

- Building the system to exploit offshore assets and **how to coordinate onshore and offshore**
- Pathways to **enabling flexible integration** of renewables into the grid
- Pathways to **improving techno-economics** (innovation and deployment)
- **The role of hydrogen** with very high deployment of low cost offshore wind?
- Aligning different sectors and **exploiting synergies** (electrical vs hydrogen for heat, power and transport)
- Creating a **regulatory framework** for delivering the offshore transmission networks and accelerating deployment

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Dr Graham Ault

Executive Director

Smarter Grid Solutions

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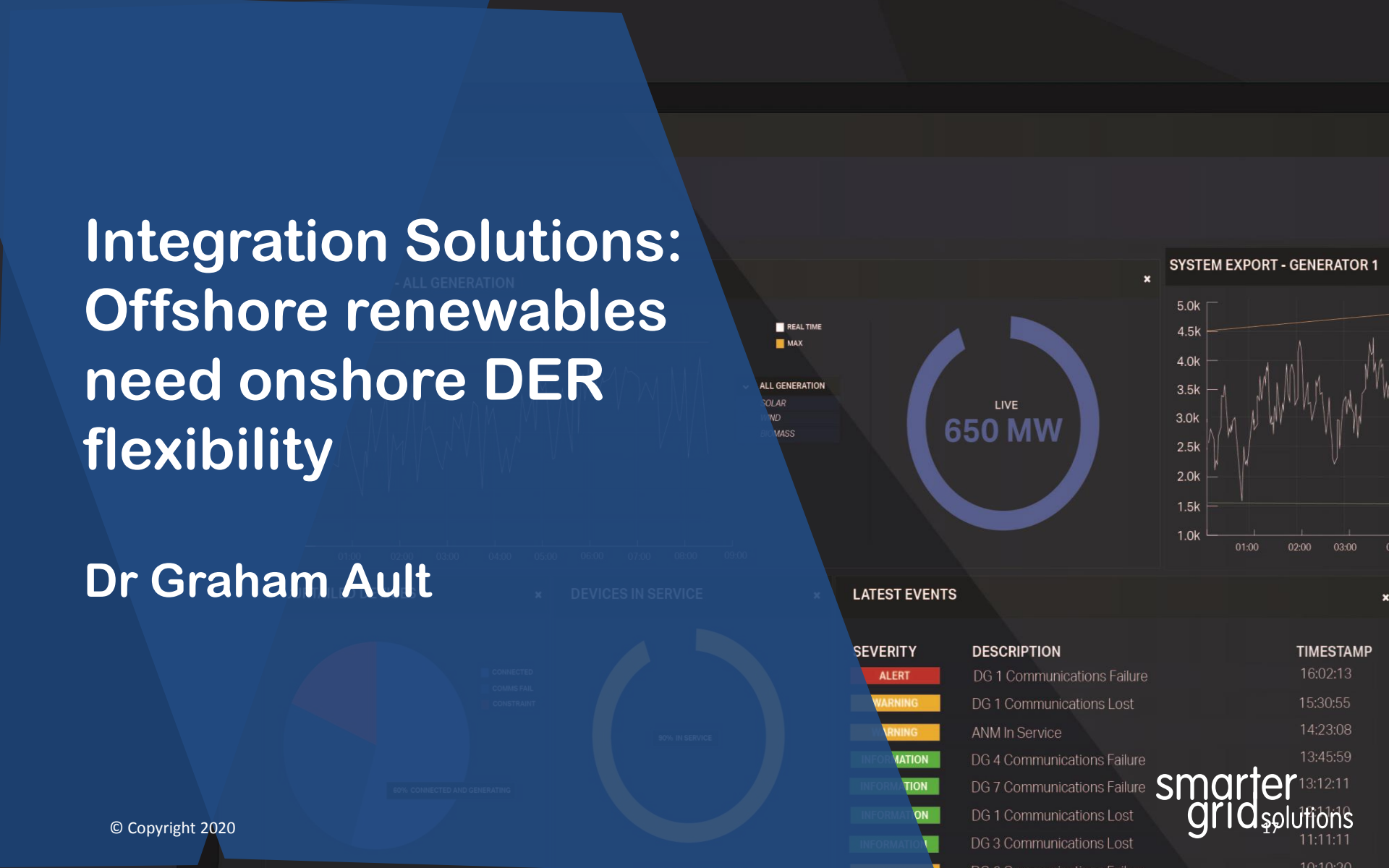
Integration Solutions: Offshore renewables need onshore DER flexibility

Dr Graham Ault



Smarter Grid Solutions: DERMS software vendor

Global energy software company with Glasgow Head-Quarters and NYC / California offices

Multiple use case DERMS products interfacing to grids and markets, unlocking the true value of DER

Managing 0.5 GW DG , implementing projects connecting a further 1.5 GW, with pipeline stretching to 3 GW under management

System availability of 99.99% for all operational systems; working with partners and customers for the long-term

Ongoing investment in R&D to add to foundational ANM technology ensures continued market leadership

World-class reference projects and customers deploying and operating our ANM/DERMS products

Mature managed services dedicated to ANM/DERMS operational platforms and customer needs

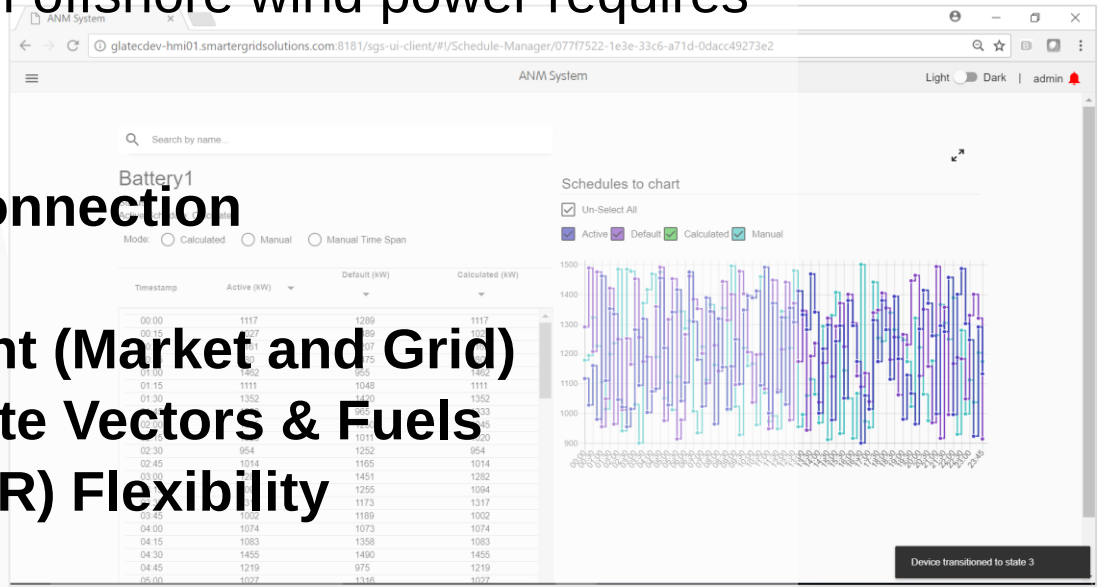
Flexible architecture enabling configuration and scaling to customer requirements and other systems

smarter grid solutions

There are multiple solutions to the renewables grid integration and management challenge

Reaching 30GW and 75GW of offshore wind power requires mature, scalable solutions:

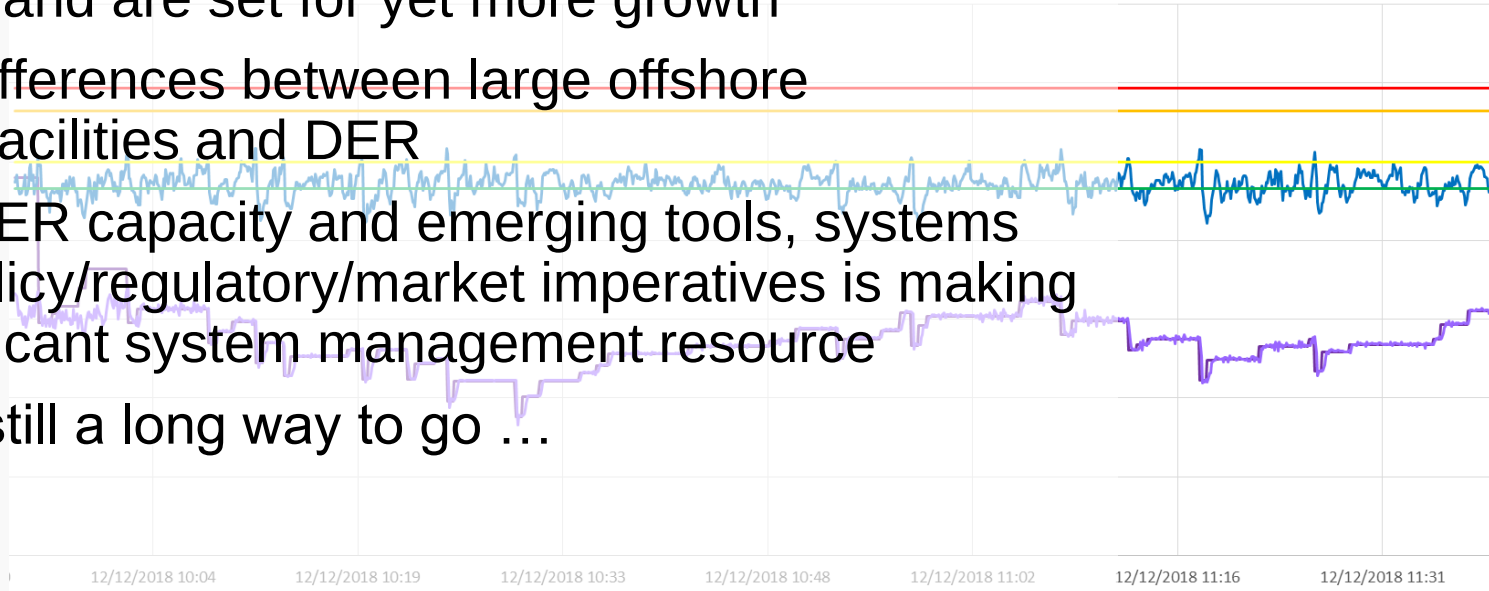
1. **Transmission / Interconnection**
2. **Energy Storage**
3. **Generation Curtailment (Market and Grid)**
4. **Conversion to Alternate Vectors & Fuels**
5. **Demand Side (and DER) Flexibility**



smarter grid solutions

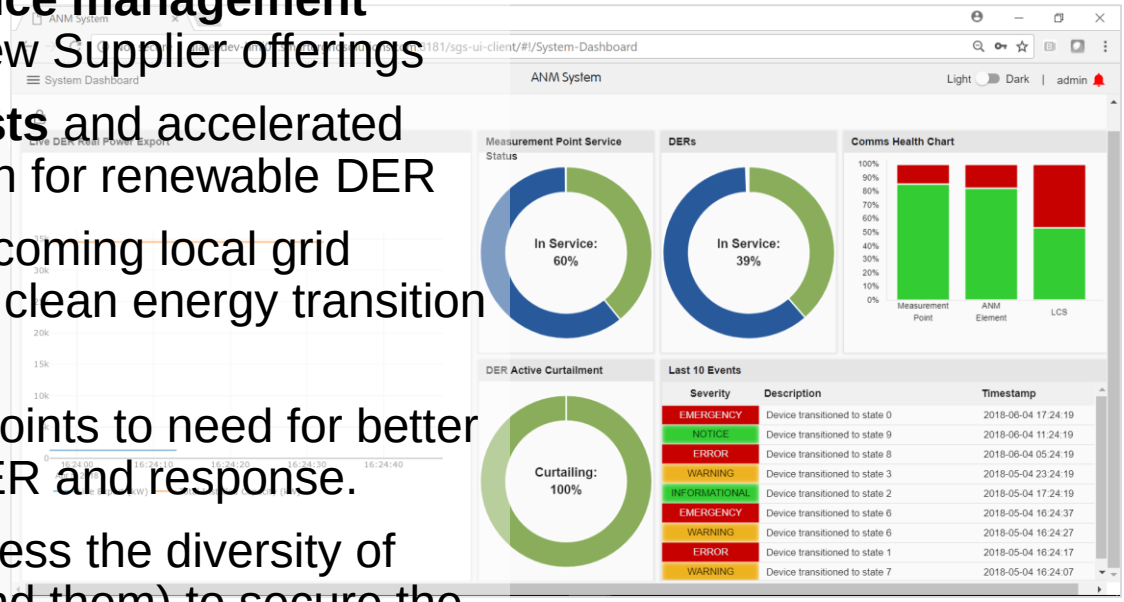
Decentralisation is (possibly?) as big a trend in the energy system as Decarbonisation

- Distributed Energy Resources (DER) have grown substantially and are set for yet more growth
- Significant differences between large offshore renewables facilities and DER
- Aggregate DER capacity and emerging tools, systems and other policy/regulatory/market imperatives is making DER a significant system management resource
- But there is still a long way to go …



Recent developments and events show the value of coordinated DER management to support a clean energy system

- Renewable operators **imbalance management** products for DER and other new Supplier offerings
- Lowered **grid connection costs** and accelerated **timeframes** for grid connection for renewable DER
- DSO **flexibility services** overcoming local grid constraints and containing the clean energy transition costs
- August 2019 partial blackout points to need for better **visibility and control** over DER and response.
- We need capabilities that address the diversity of DER (and the customers behind them) to secure the grid



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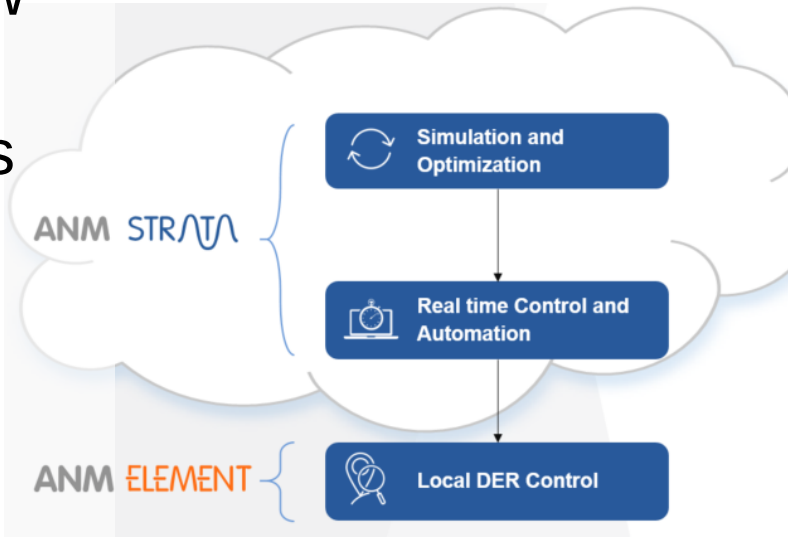
New approaches and capabilities are required to make DER a key component of a flexible system

- Clearer market incentives and new mechanisms
- Complementary flexibility products
- Better coordination
- Platforms and systems
- Interfaces between systems
- Business models, Roles and Responsibilities



smarter grid solutions

Conclusions

- We need a toolbox of solutions to manage a grid with 75GW of offshore wind power
- DER and customer flexibility is a growing and valuable resource in system operation
- DER flexibility can complement the other solutions in a coordinated, efficient approach to managing a clean, dynamic system.
- Coordinated management of DER / flexibility requires new approaches and supporting technology platforms

smarter grid solutions

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smarter grid solutions

Lorna Archer

Project Officer, Energy Futures

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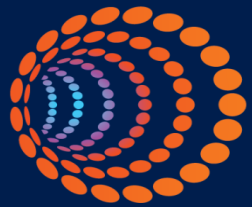
Delivering the Heat Decarbonisation Challenge
SR Offshore Wind Conference 2020

Lorna Archer, Project Officer

29th January 2020



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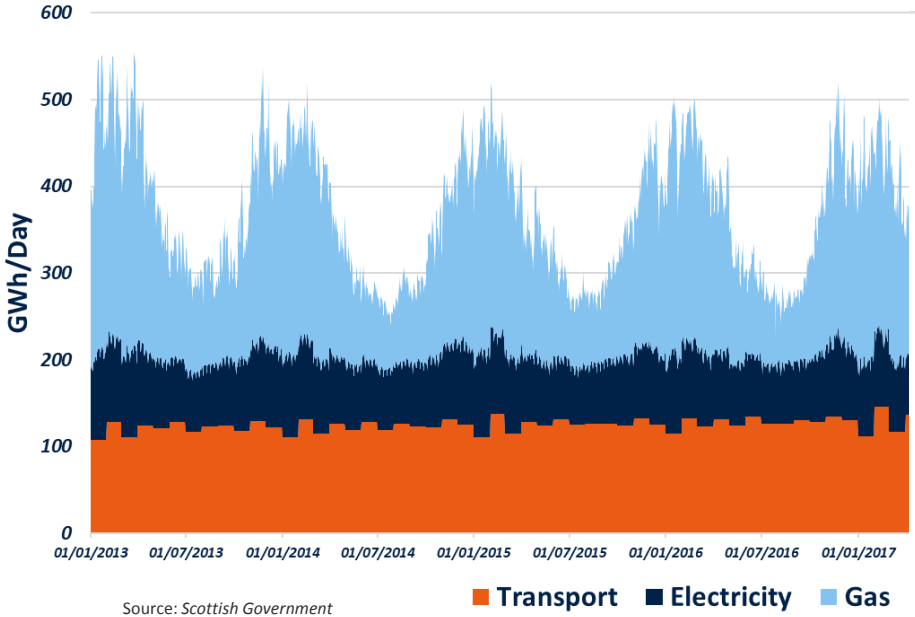
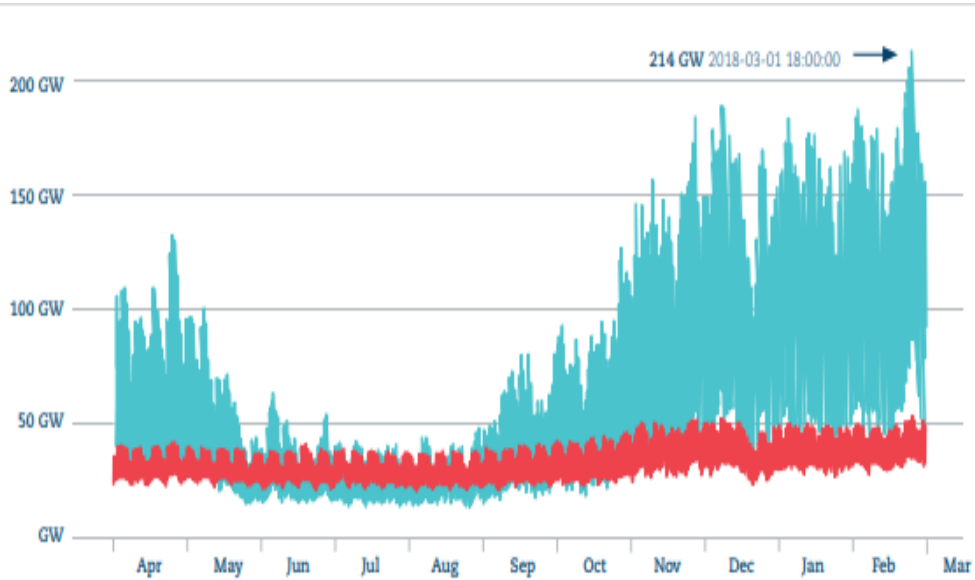
Your gas. Our network.

Whole System Energy Demand - Scotland



Source: *Scottish Government*



Source: *UK ERC Briefing Note – Dr Grant Wilson*

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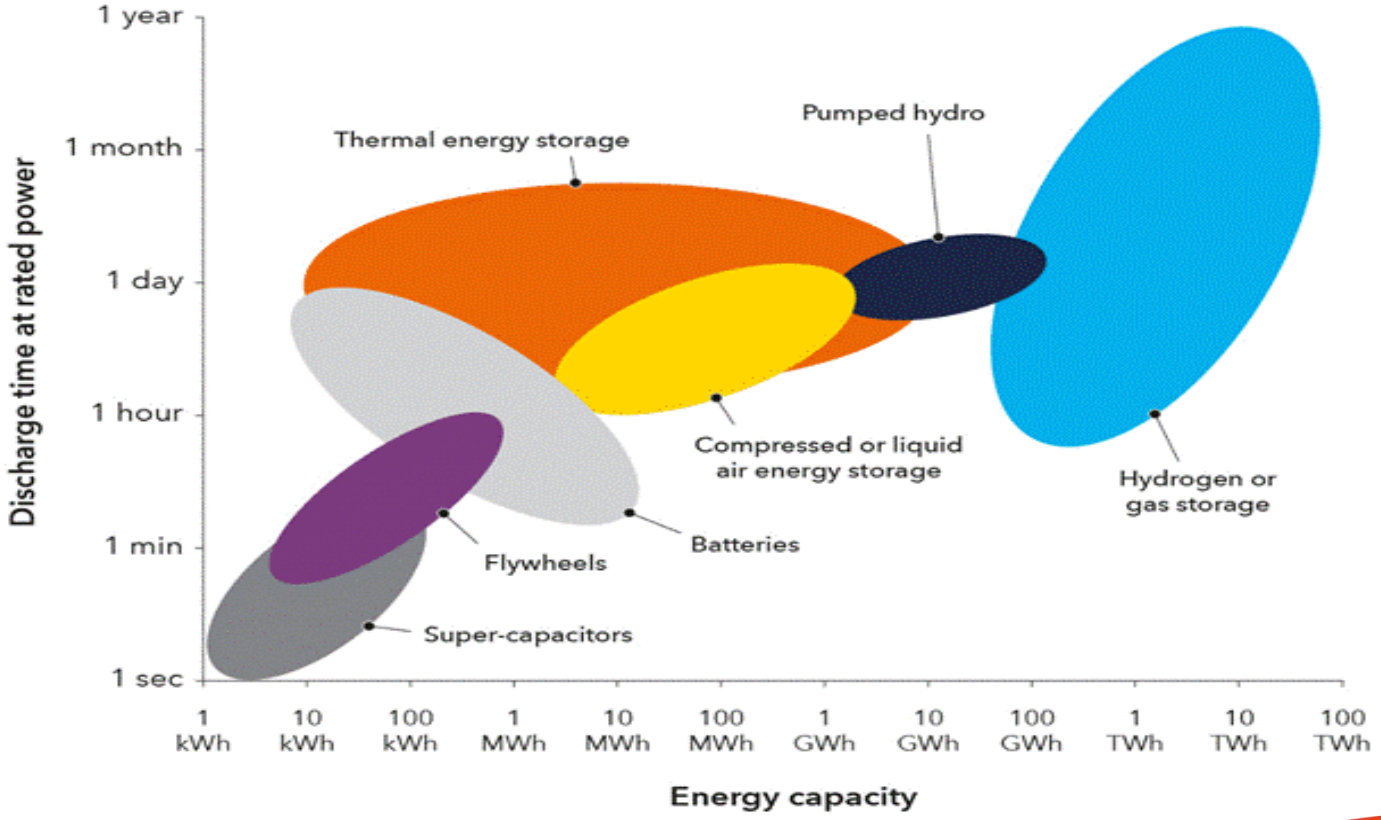
Energy Storage Technologies



Customer Value Proposition

Multiple applications :

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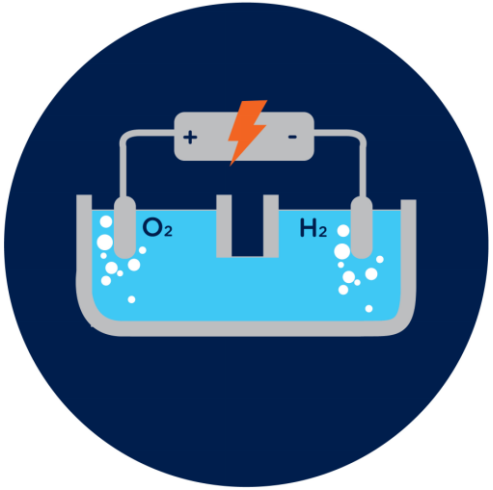
How to decarbonise heat..

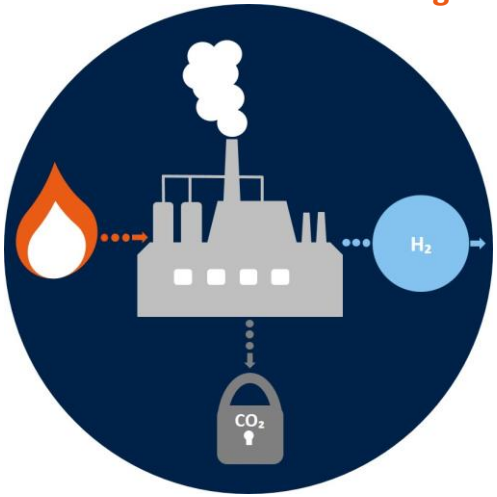
BioSNG
Green gas from household waste

Electrolysis



Hydrogen from water

Steam Methane Reforming



Hydrogen from methane

Biomethane

Green gas from organic material

35 biomethane plants connected to our network, with 11 more planned.

Target of heating 250,000 home equivalent by 2021. Currently supplying biomethane to heat 191,000 homes.

..using our gas networks.

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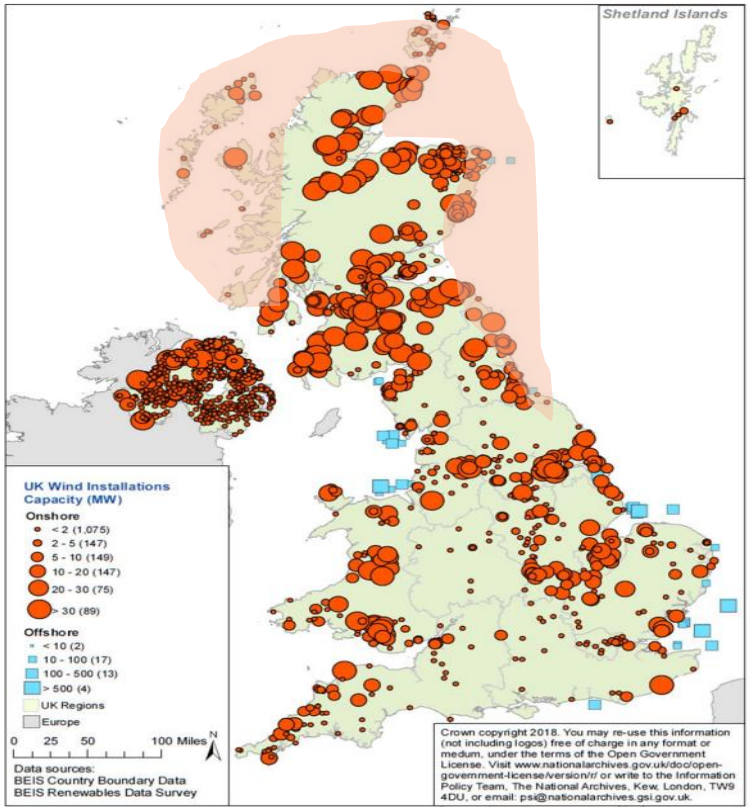
Offshore Wind Opportunity



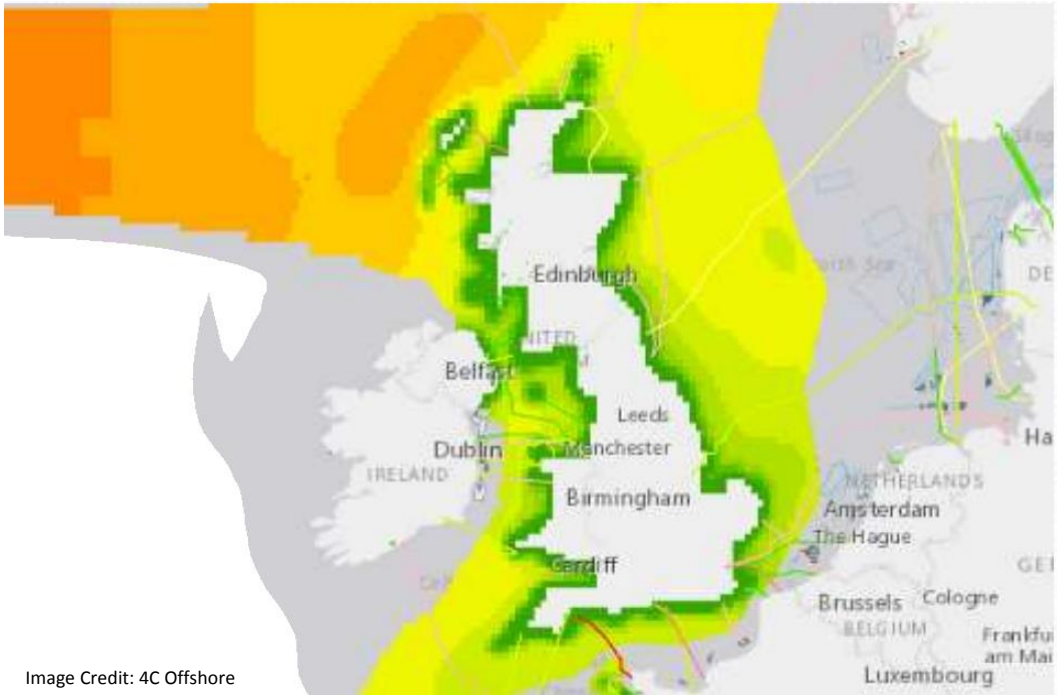
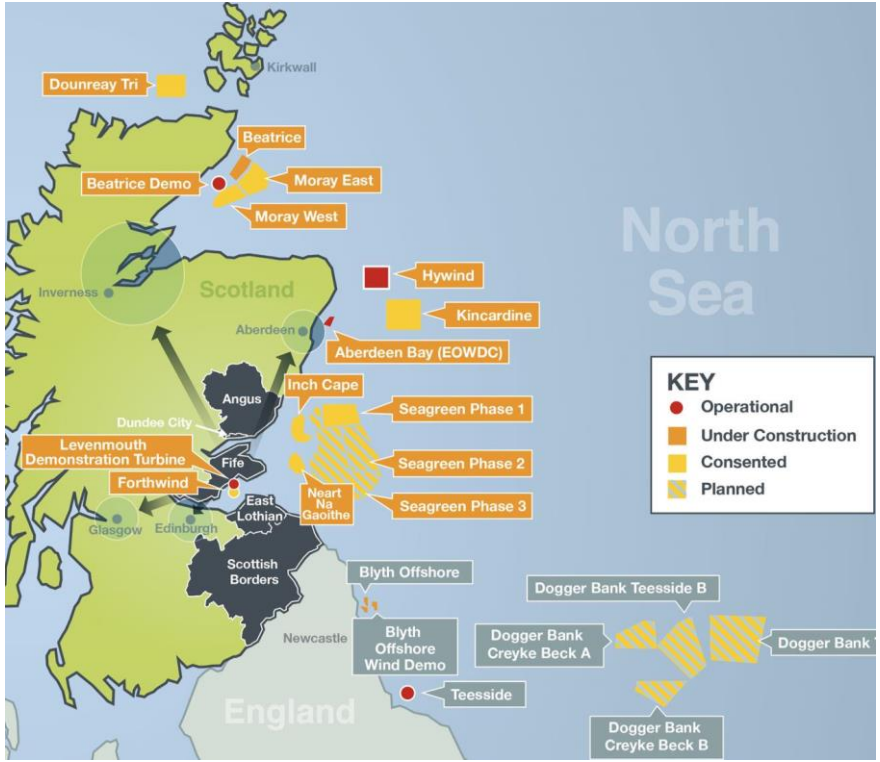


Image Credit: 4C Offshore

East Coast of Scotland



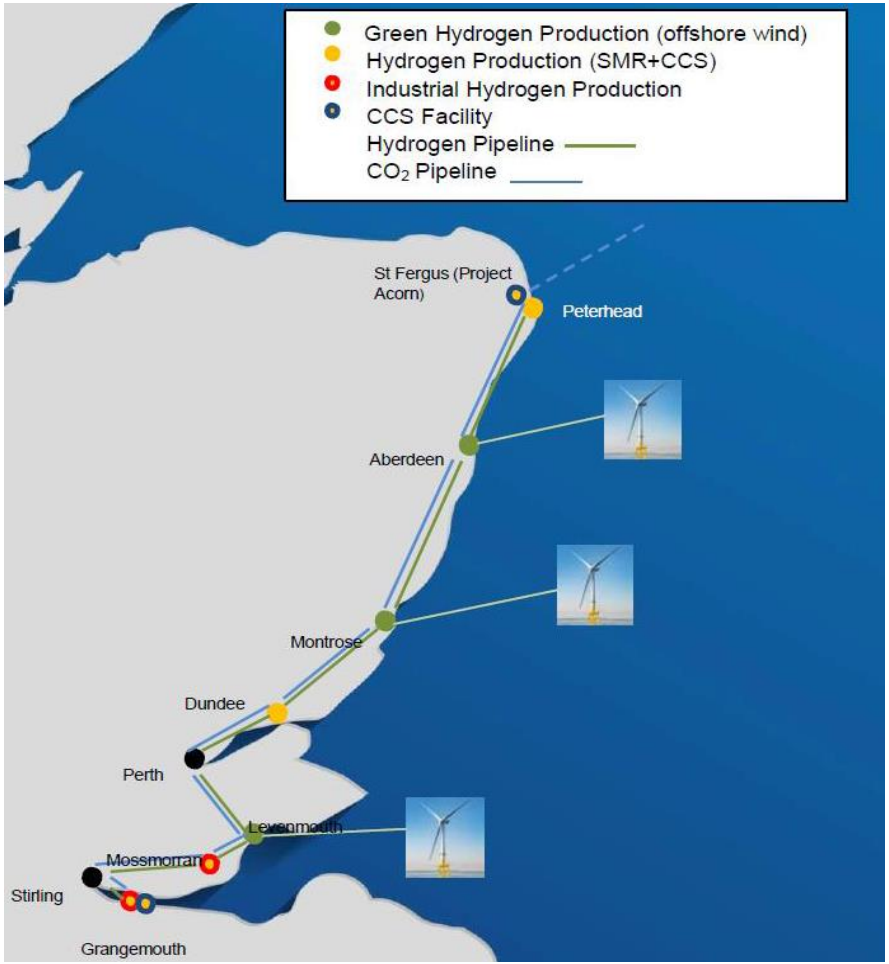


Image Credit: Forth & Tay Offshore

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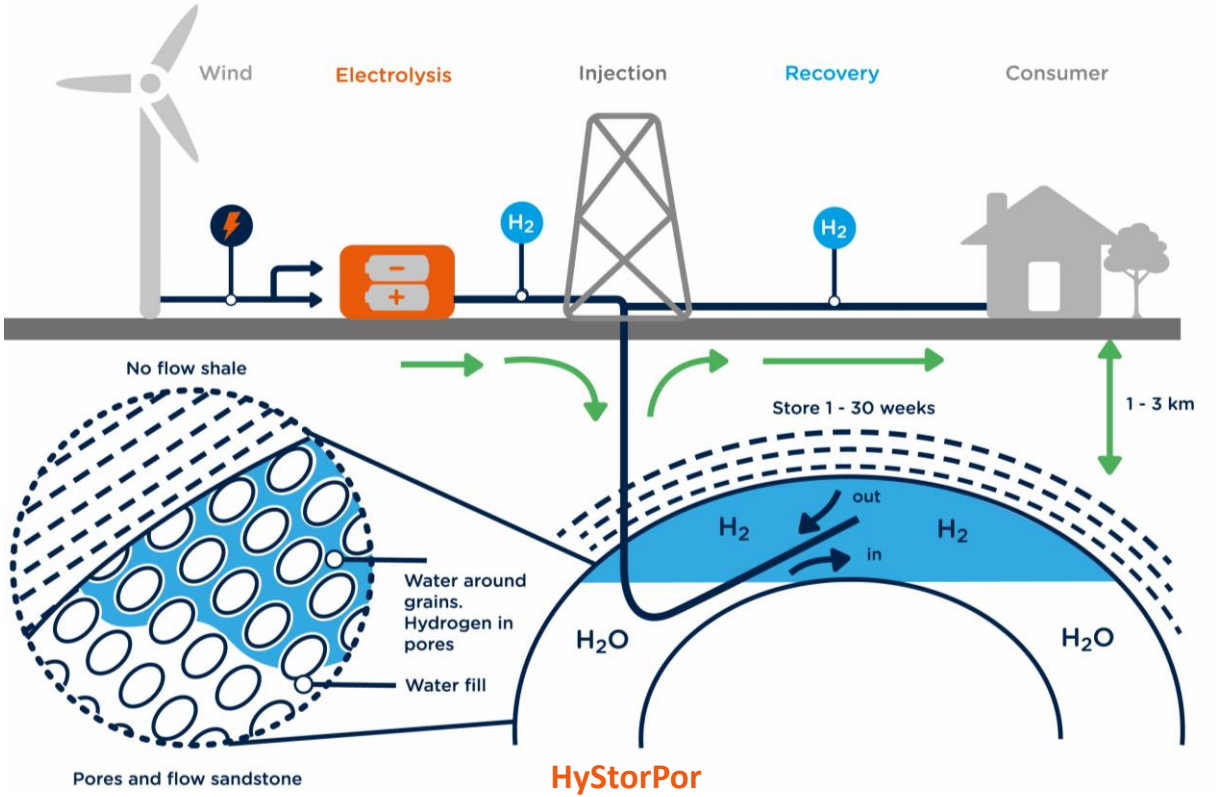
Underground Storage of Hydrogen

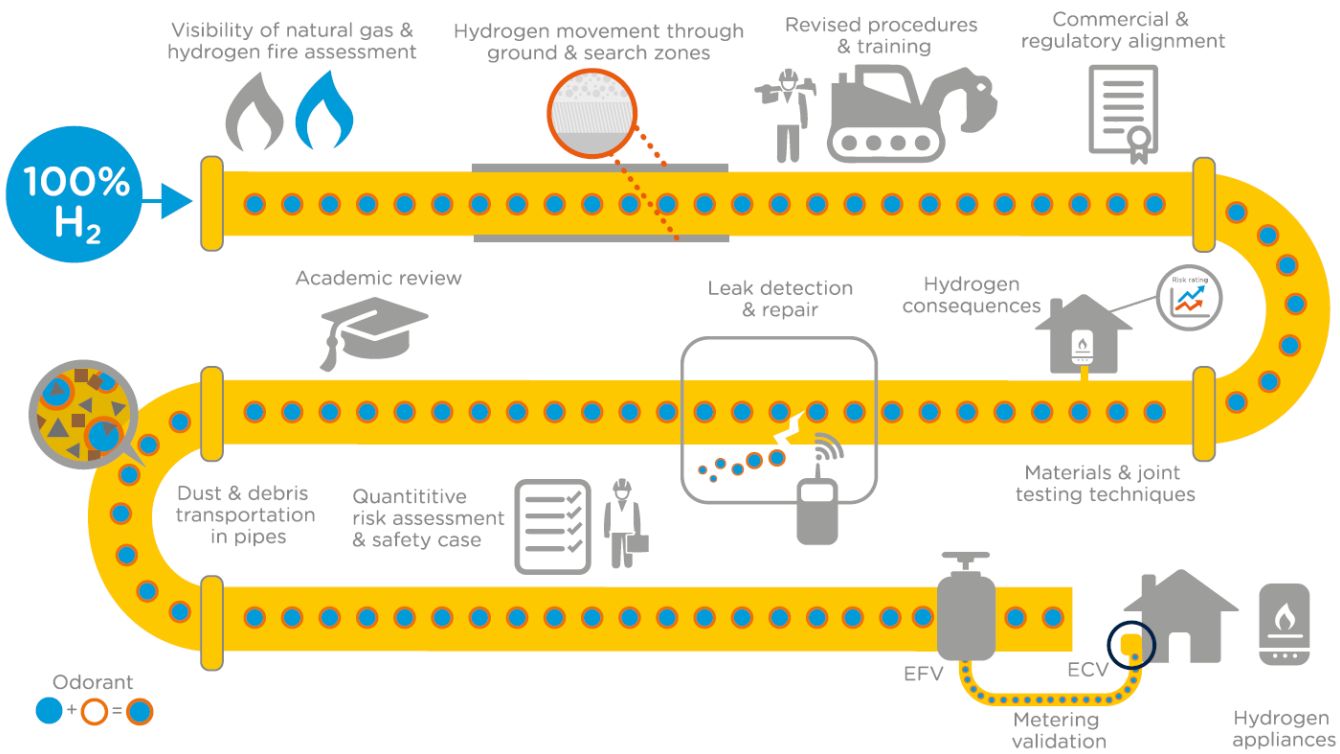


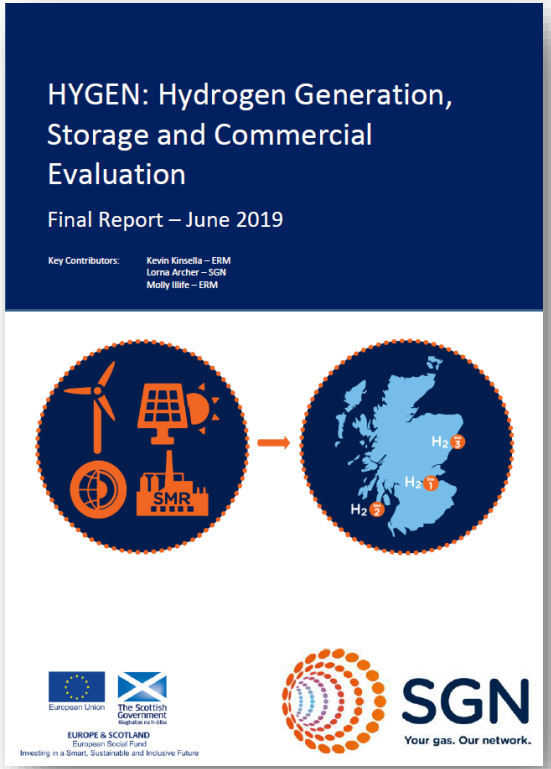
HyStorPor

UofE awarded the UK's first research grant by EPSRC.

For investigating the attributes of sandstones and mud rocks as stores for H2.

100% Hydrogen Network





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Offshore Wind to Hydrogen

ORE Catapult 7MW Turbine
Levenmouth in Fife

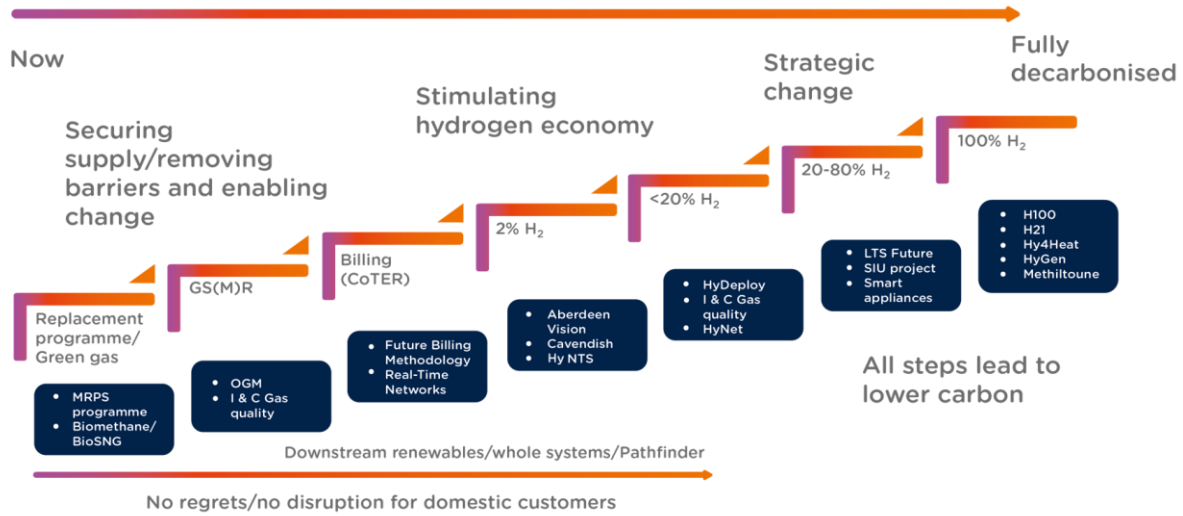
Energy Park
Fife

SGN

Conclusions

Key challenges

1. Complexity of funding for delivering an end to end system.
2. Route to demonstration for market creation.
3. Regulatory intricacies



*Working to achieve maximum energy recovery, at maximum efficiency in the form that customers both want and **need**, working towards a net-zero landscape.*

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Thank you

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Your gas. Our network.

Dr Callum MacIver

Programme Manager - Electrical Infrastructure Research Hub
University of Strathclyde

Tweet @ScotRenew @ORECatapult
#SROFFSHORE20

Regulatory Challenges for Delivering the Offshore Electrical Networks of the Future

Dr Callum MacIver: University of Strathclyde - callum.maciver@strath.ac.uk
Co-investigators: Prof Keith Bell (Strathclyde) & Dr Ander Madariaga (ORE Catapult)

Scottish Renewables Offshore Wind Conference
28th January 2020

Project Background

University of Strathclyde Engineering

Offshore Electrical Infrastructure Research Hub[1]

- Collaboration between Strathclyde, Manchester & ORE Catapult
- 5-year programme with co-funding to address to all aspects of offshore electrical infrastructure
- "Hub & spoke" model - open to collaboration with industry and academic partners

Project Aim:

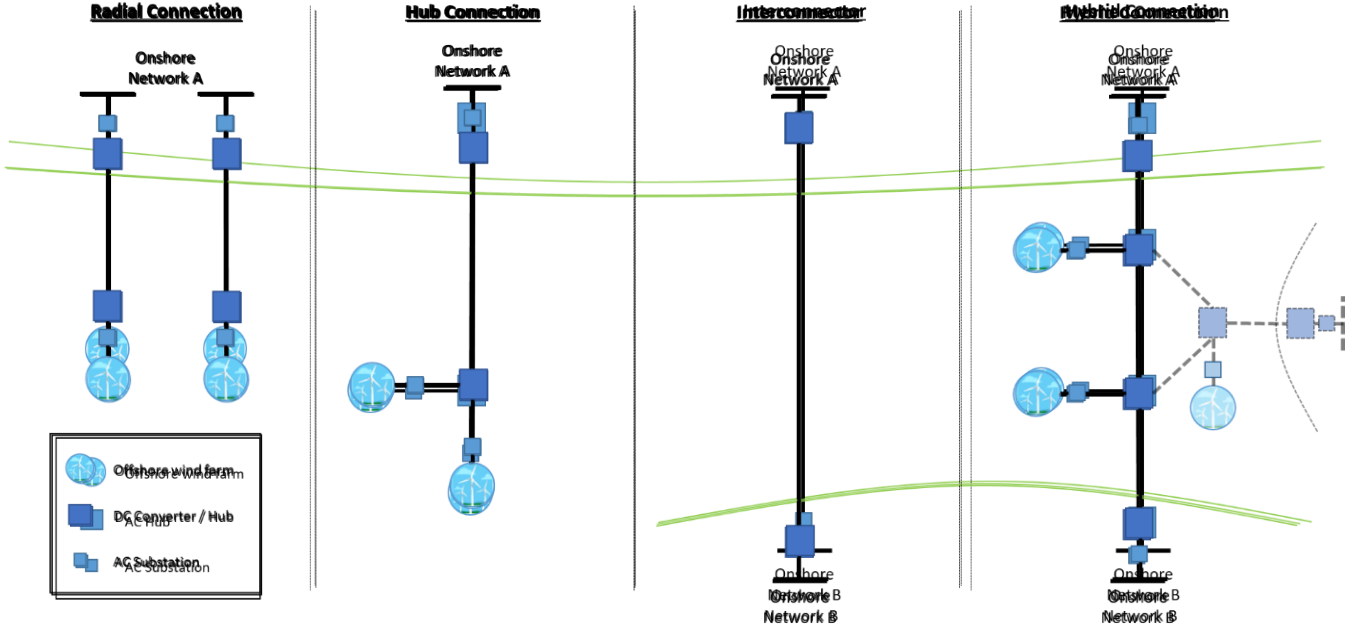
"Identify regulatory issues affecting design, deployment & utilisation of offshore networks in the UK"

- With a view to achieving 75GW UK 2050 offshore wind deployment target
- Via comparison of various high level regulatory models deployed across Europe

1. https://ore.catapult.org.uk/work-with-us/our-collaborations/electrical-infrastructures-research-hub/

Types of Offshore Network

4 main configurations options available for offshore networks



Regulatory Regimes - Overview

Three main possibilities for offshore transmission asset (OTA) development

<u>Developer led approach</u>

- Offshore wind farm (OWF) developer takes responsibility for development and operation of OTA's
- Remuneration for OTA factored into the OWF tender process

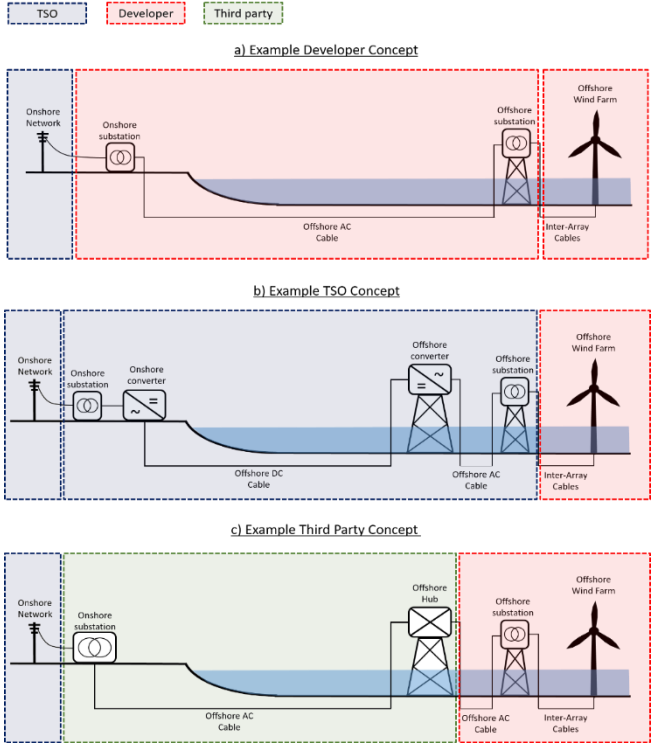
<u>TSO led approach</u>

- Transmission system operator takes responsibility for development and operation of OTA's
- OTA part of TSO's regulated asset base

<u>Third Party approach</u>

- A third party takes responsibility for development and operation of OTA's
- Separate tender for OTA development

Should be noted that build and operation phase can be separated with possibility for hybrid approaches e.g. UK OFTO regime



Regulatory Regimes - Features

Developer led approach

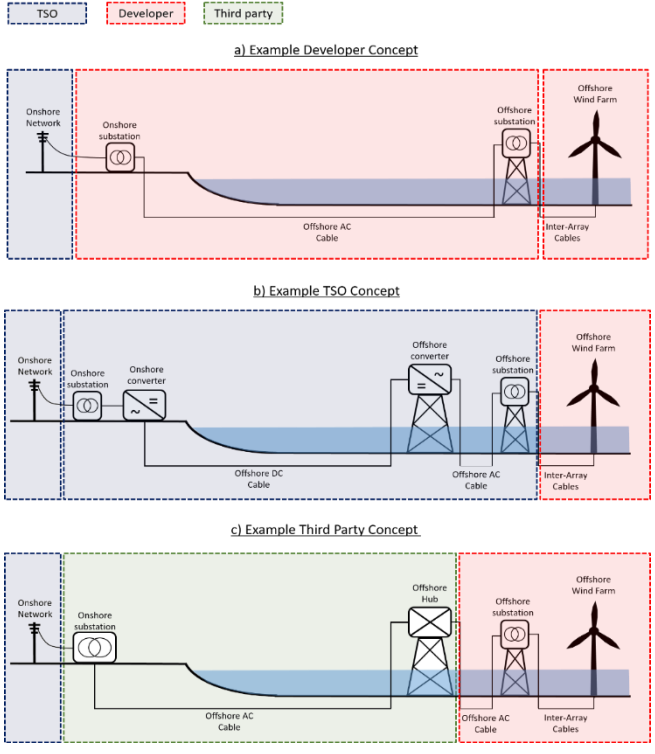
- ✓ Co-ordinated development of OWF & OTA
- ✓ Allows bespoke grid solutions (though typically radial)
- ✓ High incentive to minimise costs via competitive tender process
- ✗ Low incentive to consider long term system requirements
- ✗ Less suited to hub or hybrid approaches

TSO led approach

- ✓ Enables holistic approach to offshore network planning
- ✓ Potential for co-ordinated designs and reduced infrastructure vs multiple individual projects
- ✓ Potential for standardisation & economies of scale
- ✗ Interface risk between OTA & OWF – delays, stranded assets
- ✗ More complex designs – increased delivery risk
- ✗ Low cost pressure associated with regulated monopoly approach

Third Party approach

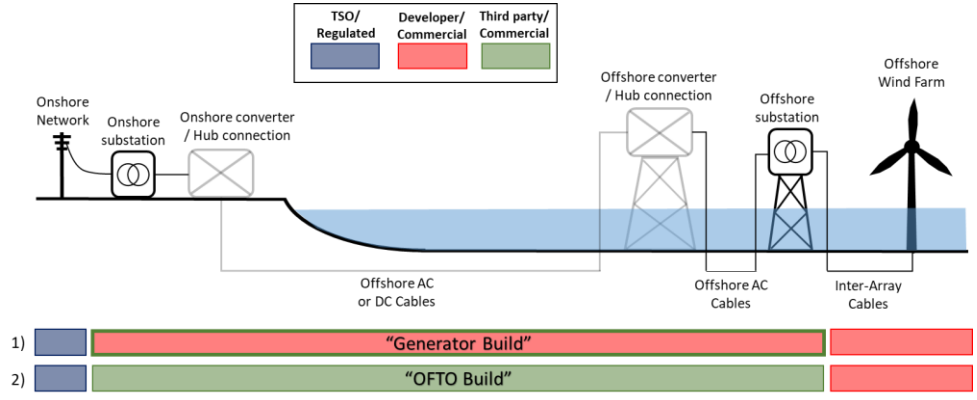
- ✓ Features highly dependent on nature of tender process – could be suitable for radial, hub or hybrid approaches
- ✓ High incentive to minimise costs via tender process
- ✗ Additional interface risks – TSO : OTA : OWF



Country Comparison - UK

Competitively tendered OFTO regime

- Owner and operator of offshore transmission assets in GB is a separate entity (OFTO)
- "Generator build" option
  - OWF developer has option to build OTA but must sell to OFTO after completion
  - Only option used to date
- "OFTO build" option
  - If OWF developer declines to build the OTA a new tender process would be initiated for third party bidder

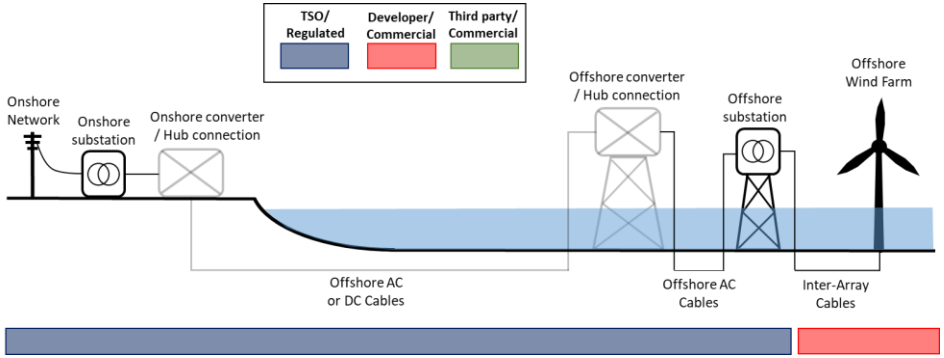


- Only radial developments deployed to date
- Clustering/hub connection possible but subject to single entity success in tender process
- Hybrid connection difficult under OFTO model – legal & regulatory barriers
  - OFTOs & interconnectors treated as separate legal entities
  - Different remuneration regimes

Country Comparison - Netherlands

TSO Monopoly on OTA development

- Since 2015 TenneT have operated as “TSO at Sea”
- Grid connection takes place at OWF
  - TenneT fully responsible for building “Grid at Sea”
- Motivated by co-ordinated OWF development
  - Centrally planned roll-out
  - Standardised 700MW design
  - Opportunity to cluster / share assets
- Study[2] suggests offshore transmission asset costs competitive with if not cheaper than UK developments



- Largely radial developments with some co-ordination
- Hub connections possible but not implemented
- Hybrid connection should be possible under existing regime with few legal / regulatory barriers
  - TenneT own both interconnectors and “Grid at Sea” so fewer legal barriers to merger

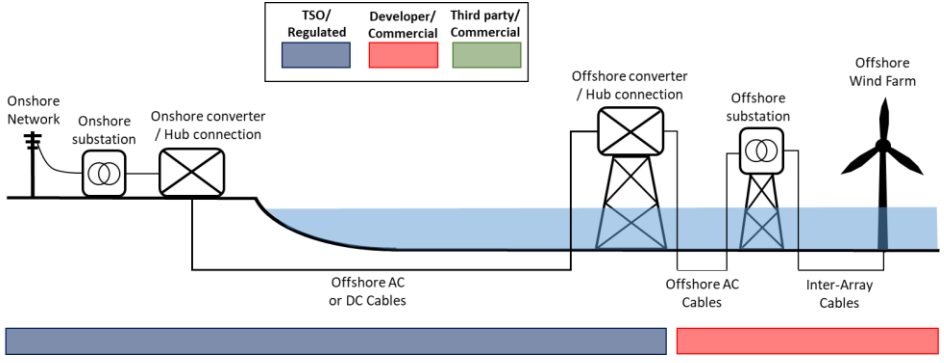
2. Navigant – Connecting Offshore Wind Farms: a comparison of offshore electricity grid development models in Northwest Europe, 2019

Country Comparison - Belgium

University of Strathclyde Engineering

TSO Monopoly on OTA development

- Elia responsible for all OTA development
- Modular offshore Grid (MoG) concept
  - Elia build “plug at sea” offshore hub and transmission link to shore
  - OWF developers responsible for connection to offshore hub
- Motivated by co-ordinated OWF development
  - Centrally planned roll-out to minimise total infrastructure

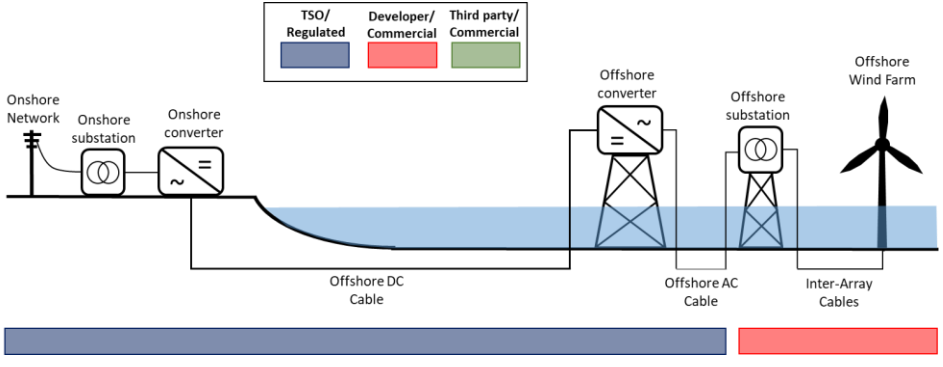


- Hub connections currently being implemented
- Hybrid connections potentially possible under current regime
  - Although 50% TSO ownership rule for interconnectors may be tested in multi-terminal offshore grid scenario

Country Comparison - Germany

TSO Monopoly on OTA development

- TenneT (North Sea) and 50Herz (Baltic Sea) responsible for OTA development out to OWF substations
- TenneT 1st to make use of large scale HVDC deployment in hub design approach
  - 9 operational HVDC platforms and more under development
- Motivated by co-ordinated OWF development and long distances from shore
- Experienced a number difficulties with project delays / stranded assets / interface issues
- Study[3] suggests low cost pressure on TSO lead to higher costs



- HVDC hub connections already implemented
- 1st Hybrid connection under construction with Denmark
- Kriegers Flak Combined Grid Solution
  - 400MW link between existing German and Danish OWFs
  - Facilitated by TSO – TSO co-operation, no third party ownership barriers

3. DIW ECON – Market design for an efficient transmission of offshore wind energy, 2019

Conclusions

- GB OFTO developer led model successful to date
  - Competitive tenders seen to drive down costs but tailored to radial approach
  - Popular with developers – Denmark moving from TSO to developer led approach for next tender
- TSO model can be cost competitive and allows more co-ordinated approaches
  - German experience more costly to date but low prices delivered elsewhere in Europe
- Given…
  - Need to minimise overall infrastructure footprint
  - Limited availability of onshore landing sites
  - Need to export surplus energy (or re-purpose for other uses – power to gas?)

  …Can long-term targets be met without co-ordinated network development?
- Could the UK regulatory model combine benefits of co-ordinated planning and competitive tendering? What would be the key enablers?
- Going beyond the national level - how could the UK facilitate cross-border hybrid offshore grid development?

Andy Hogg
Head of Energy Industries Division, Scottish Government

Dr Zeynep Kurban
Strategy Manager – System Integration of Renewables, ORE Catapult

Dr Graham Ault
Executive Director, Smarter Grid Solutions

Lorna Archer
Project Officer, Energy Futures, SGN

Dr Callum MacIver
Programme Manager - Electrical Infrastructure Research Hub, University of Strathclyde

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Tackling the barriers

Tweet @ScotRenew

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Mike Hay

Commercial Director

RIDG

Tweet @ScotRenew

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Gavin Smart

Head of Insights
ORE Catapult

Tweet @ScotRenew
#SROFFSHORE20

Scottish Renewables Offshore Wind Conference
Session 5a: Tackling the Barriers
ORE Catapult Background Presentation

29/01/2020

Gavin Smart

CATAPULT
Offshore Renewable Energy

Our Mission and Vision

Our mission

To accelerate the creation and growth of UK companies in the ORE sector

Our vision

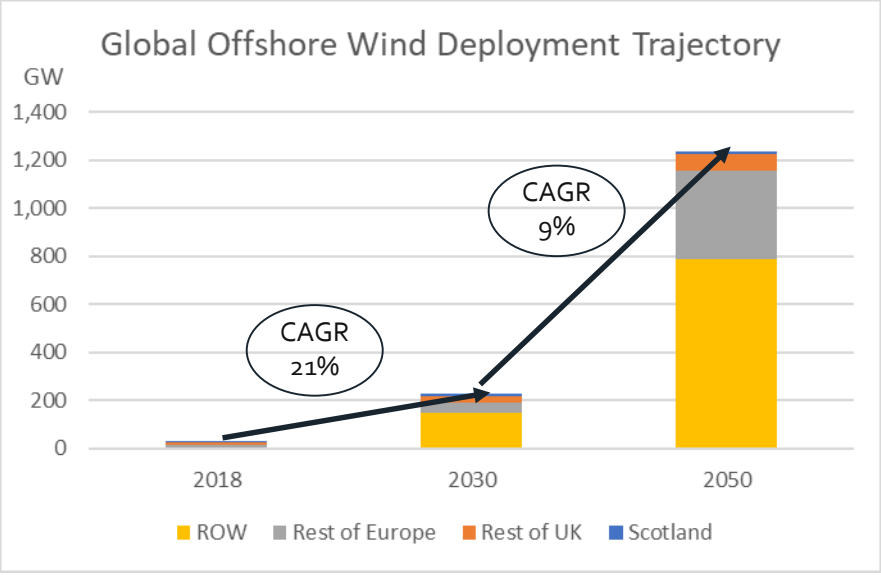
By 2023, ORE Catapult will be the world's leading offshore renewables technology centre

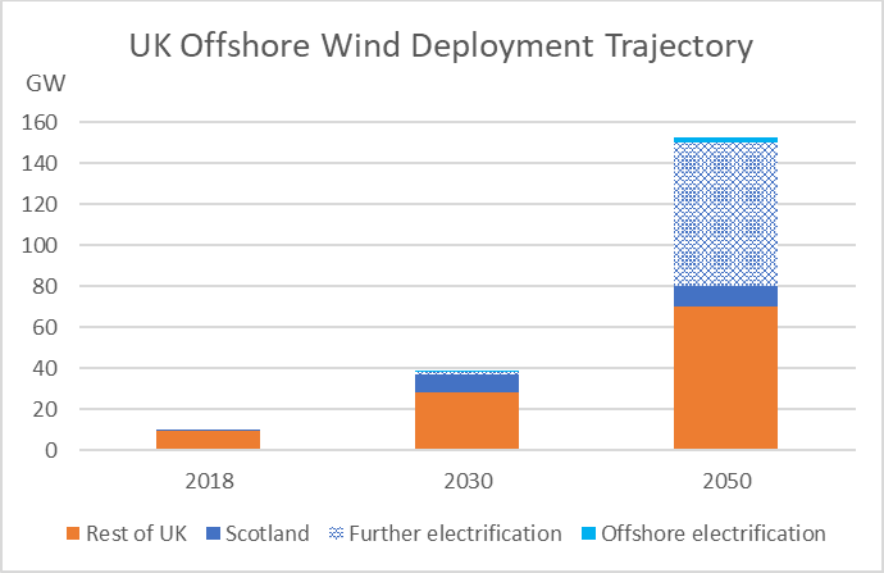
- **Centres of Excellence**
- **Academic Research Hubs**
  in partnership with leading universities
- **Expanding our assets in Blyth and Levenmouth**
  the world's foremost open-access facilities

Agenda

- Scale and pace of deployment
- Deep water challenge
- Grid challenges
- Connecting challenges and opportunities

Scale and pace of deployment





- ROW dominated by Asia (80%)
- WindEurope 2050: Europe targeting 450GW

Sources:

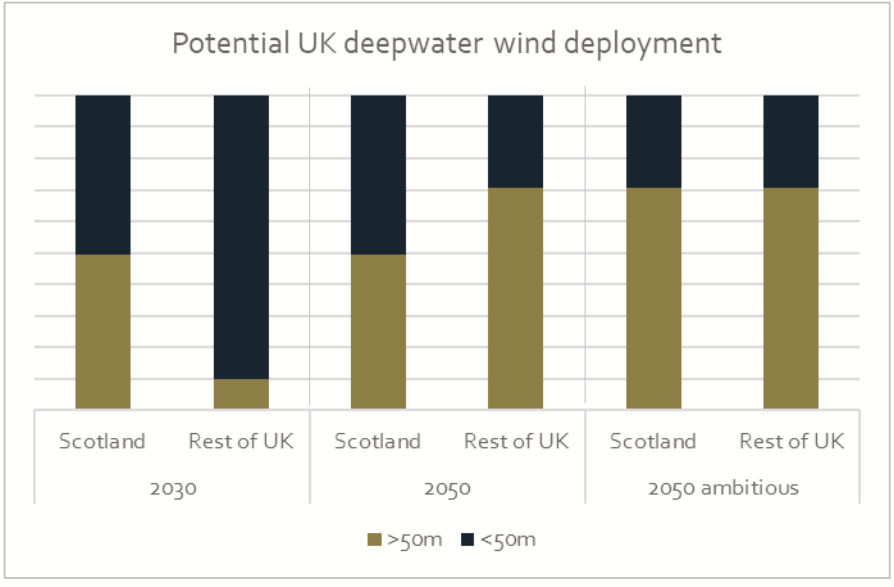
- *IEA Remap, July 2019*
- *WindEurope "Our Energy, Our Future", Nov 2019*
- *UK trajectory based on targeting 40GW and 80GW*

- WindEurope 2050: Scotland 10GW; Rest of UK 70GW
- Implies minimal deployment beyond current pipeline

BUT

- OSW effectively curbed in system modelling to date
- Opportunities for more widespread electrification
- Opportunity to decarbonise offshore hydrocarbons
- Route to market for floating wind likely to be key

Deep water



Deep Water – a UK-wide challenge

- LCOE for current floating 4-5 x £40/MWh CfD
- LCOE for next floating ~3 x £40/MWh CfD

For 80GW in UK by 2050 (inc. 10GW Scotland):

- Scotland has near-term need but relatively modest
- For 10GW in Scotland, 2050 need no greater
- For 70GW in rest of UK, 2050 need is significant

For increased ambition

- At least 70% in waters >50m
- Offshore O&G powering and Hydrogen production

UK-wide Solutions

CATAPULT Offshore Renewable Energy

Floating Offshore Wind Centre of Excellence

CARBON TRUST

Floating Offshore Wind Joint Industry Project

scottish renewables

renewableUK

Floating Wind:
The UK Industry Ambition, October 2019

Scottish grid

Challenges – onshore capacity

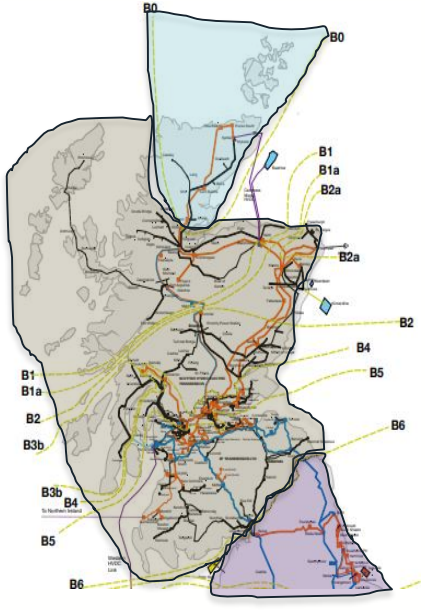
- Scotland already net exporter – 14.7GWh in 2018
- Additional generation capacity

-> Power flows becoming more than grid can accommodate

2020-2030 – B0

2020-2030 – B1-B5

2030-2040 – B6



Work underway
"Scottish Offshore Wind & Grid Connection"

CATAPULT Offshore Renewable Energy

Floating Offshore Wind Centre of Excellence

Solutions

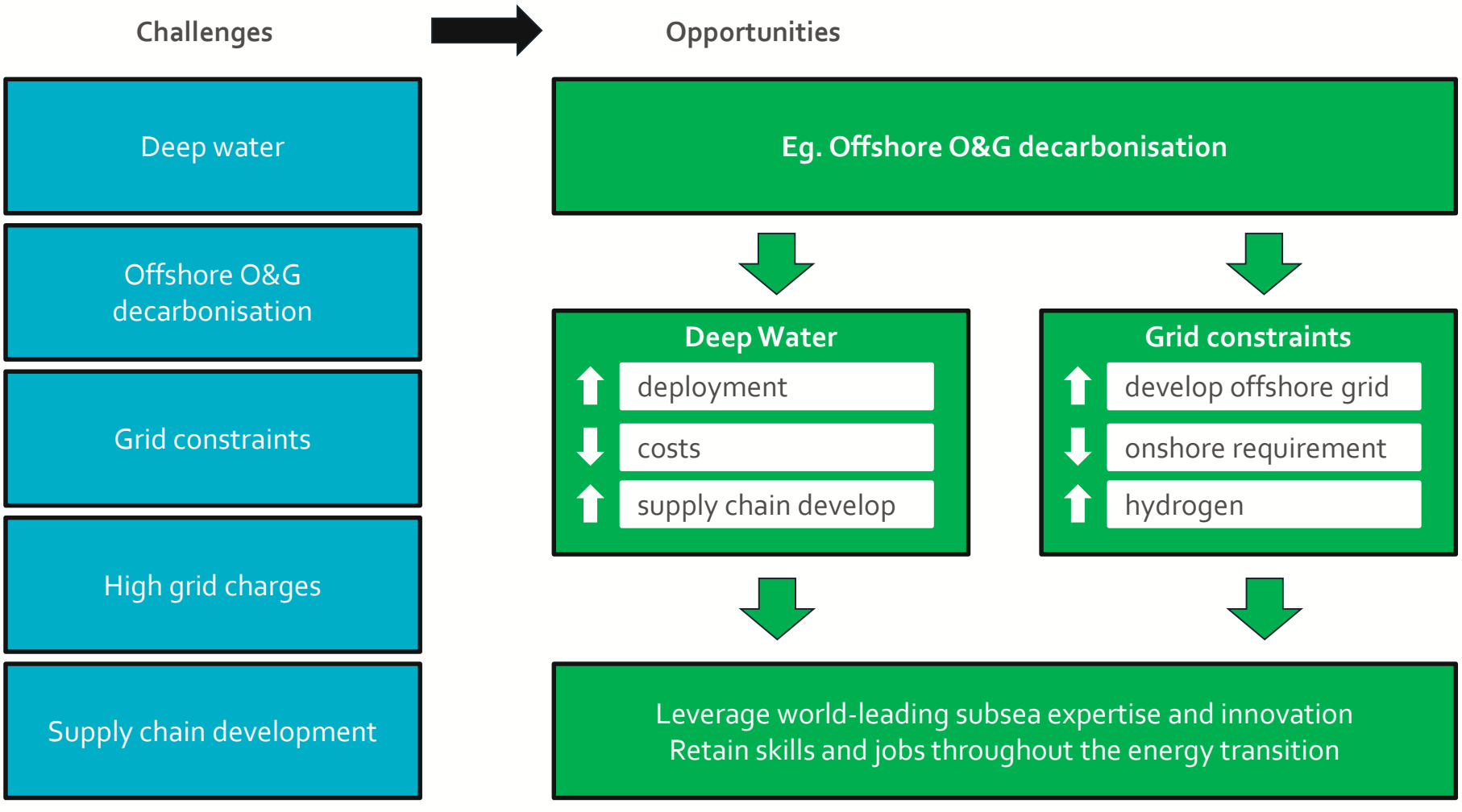
- Traditional passive grid reinforcements
- Active solutions
- Increased interconnection – GB and Europe
- Offshore Hydrogen production

Offshore Wind Innovation Hub

- Large-scale batteries/storage
- Shared offshore connections (eg Germany HVDC)
- North Sea offshore grid

Bernd Radowitz

Challenges and opportunities connected



Contact us

Email us: info@ore.catapult.org.uk
Visit us: ore.catapult.org.uk

Engage with us:

GLASGOW | BLYTH | LEVENMOUTH | HULL | ABERDEEN | CORNWALL | PEMBROKESHIRE | CHINA |

Christianna Logan

Director of Customers and Stakeholders
Scottish & Southern Electricity Networks Transmission

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#SROFFSHORE20

A Network for Net Zero

Scottish & Southern Electricity Networks

Five years. Five clear goals.

Transport the renewable electricity that powers 10 million homes

Aim for 100% transmission network reliability for homes and businesses

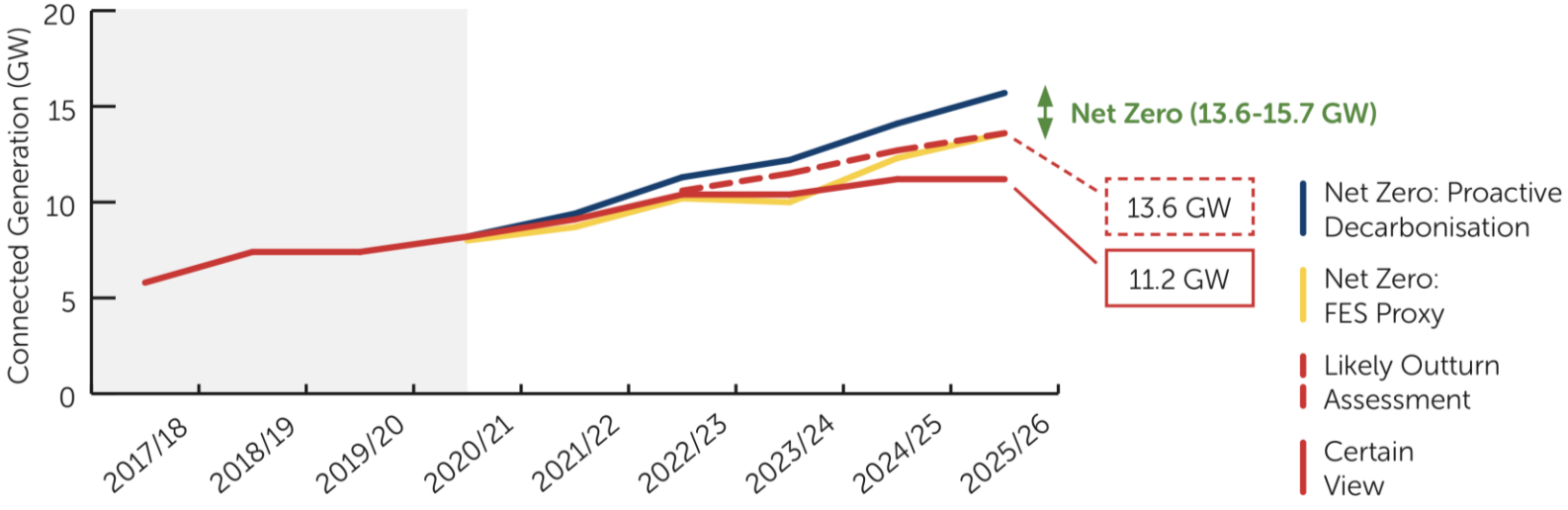
Every connection delivered on time

One third reduction in our greenhouse gas emissions

£100 million in efficiency savings from innovation

Delivered for around £7 a year

Net zero emissions pathways for generation connected in the north of Scotland

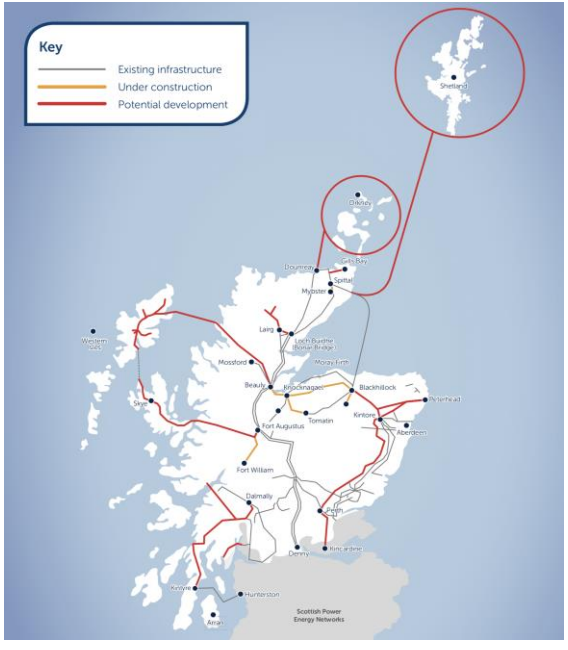


[†]Net Zero – the UK's contribution to stopping global warming, the CCC, 2 May 2019. Available at: www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/

[‡]Includes non-renewable generation, the total connected renewable generation is expected to be 6.8 GW

Scottish & Southern Electricity Networks

Investment – challenges and opportunities



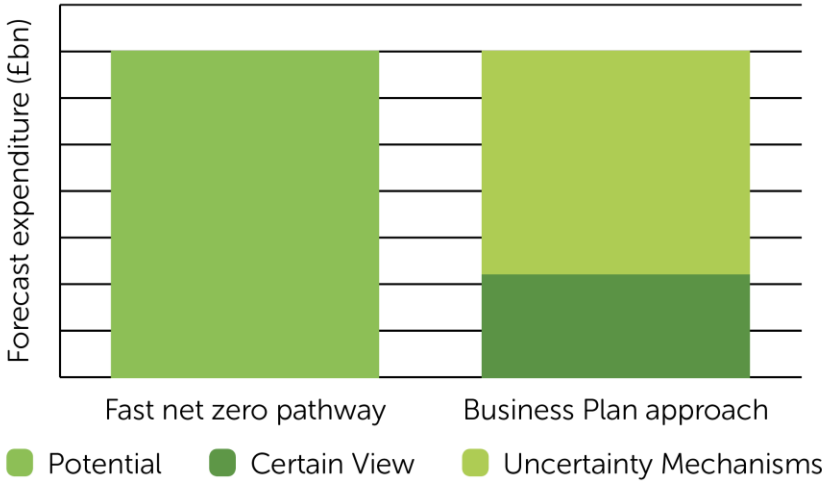


Figure 1.8 Our forecast of the potential expenditure to achieve the 'fast' net zero pathway: certain and uncertain

Scottish & Southern Electricity Networks

An Ambitious Plan to meet GB Stakeholders' Needs

Ofgem call for evidence: closes 10th February

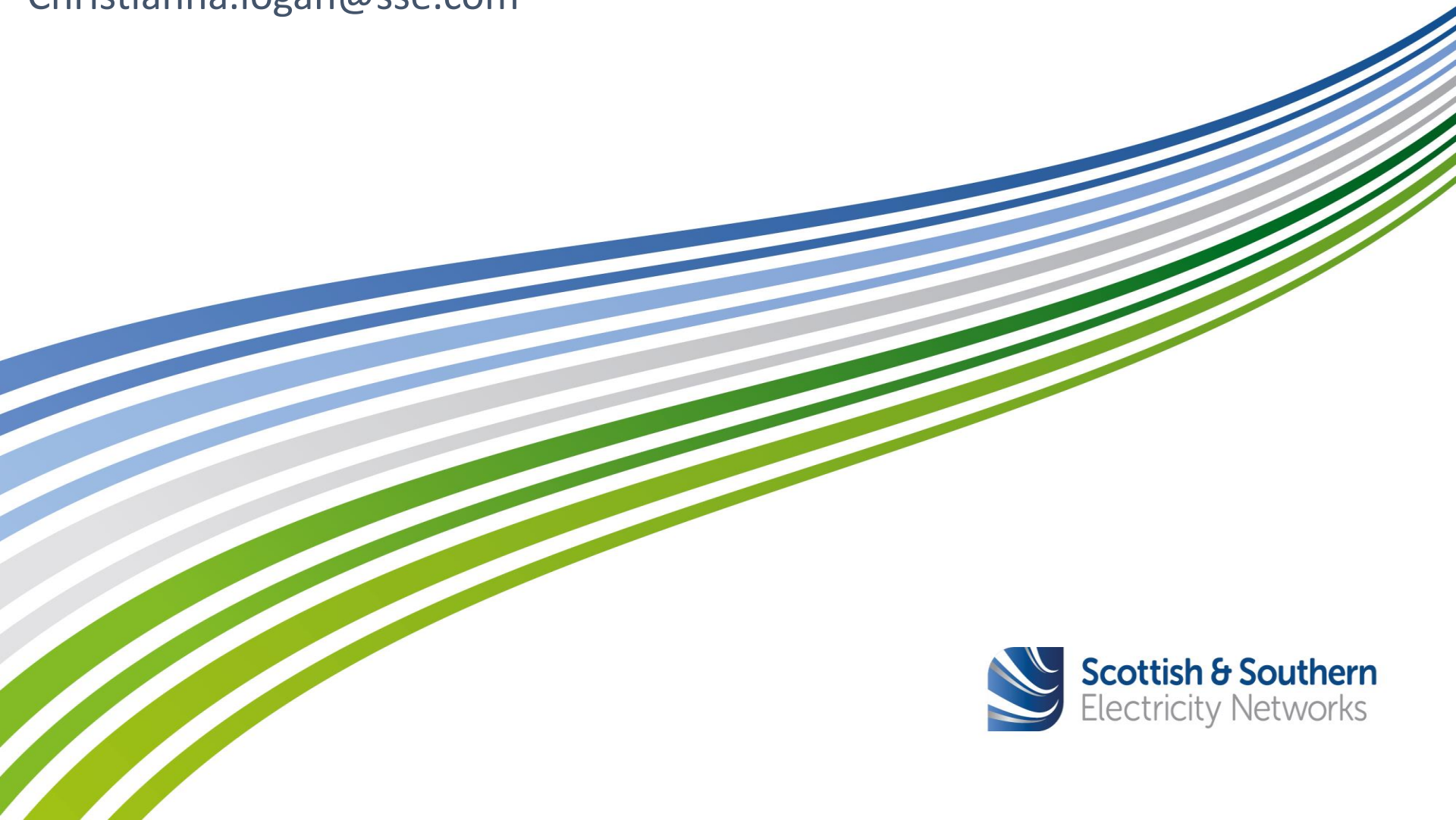
Open hearing: 26th March, Perth

Sign-up online at:

https://www.eventbrite.co.uk/e/ofgems-riio-2-open-hearings-tickets-83632122931

Scottish & Southern Electricity Networks

Christianna Logan
Christianna.logan@sse.com



Scottish & Southern Electricity Networks

Martyn Tulloch

Net Zero Solution Centre Manager

OGTC

Tweet @ScotRenew

#SROFFSHORE20

Your innovation partner

The Oil & Gas Technology Centre

Your Innovation Partner

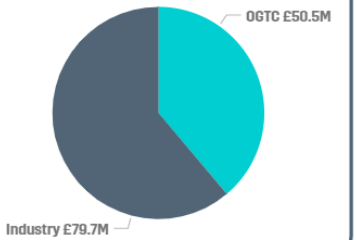
Martyn Tulloch

Net Zero Solution Centre Manager

Our Track Record

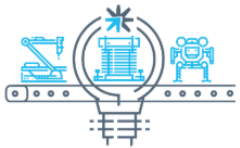
£130M Invested

Co-investing in industry-led projects to develop and deploy new technologies.



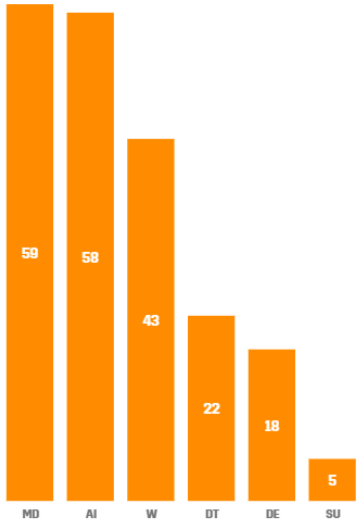
920+ Technologies Screened

Harnessing the power of an ever-expanding range of transformational new technologies.



205 Approved Projects

Delivering technology projects to fix today, maximise recovery and transform tomorrow.

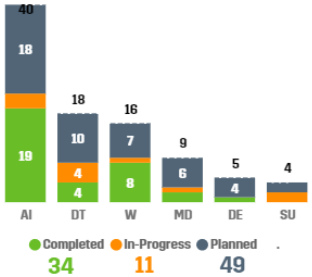


Memberships

126 Bringing together Operating, Supply chain and technology companies to drive innovative new solutions.

- **58** Operating company
- **26** Service company
- **38** Technology developers
- **4** Business Advisors

Field Trials



20+ TechX Startups

Accelerating innovation by helping a new generation of entrepreneurs take their technologies to market - faster.

- **307** applicants
- **2-3** ventures
- **46** countries
- **£1.2M** investment this year

Visitors 20,100+

Government Industry Schools Community

Creating a culture of innovation in the region through exciting events and workshops.

Delivering strong results

Our Technology Vision

Fix today

Data access

Asset inspection

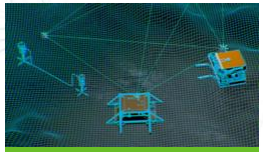
Production optimisation

Revitalise exploration

Efficient decommissioning

Alternative well barriers

Unlock Potential



Tieback of the Future

Integrated energy

Automation

Remote operations

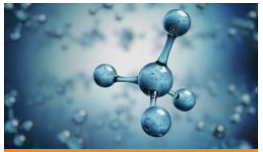
Artificial intelligence

New materials

Transform tomorrow

Low carbon operations

Reusable infrastructure



Hydrogen delivery

Data driven

Unmanned facilities

Zero carbon developments

Decarbonising the industry for the Net Zero future

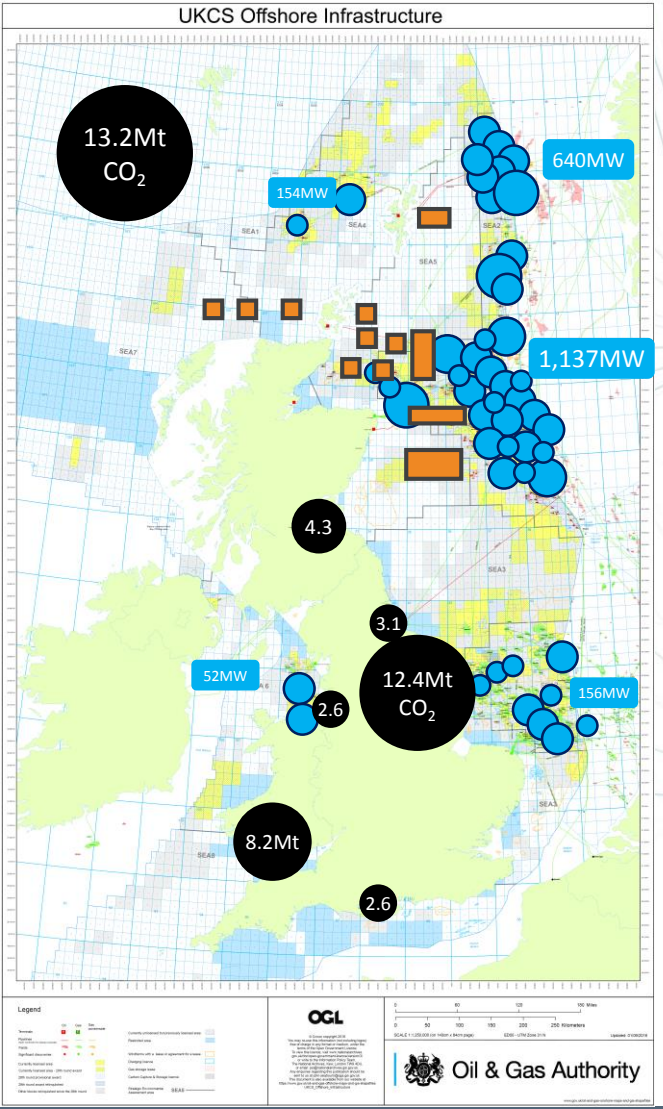
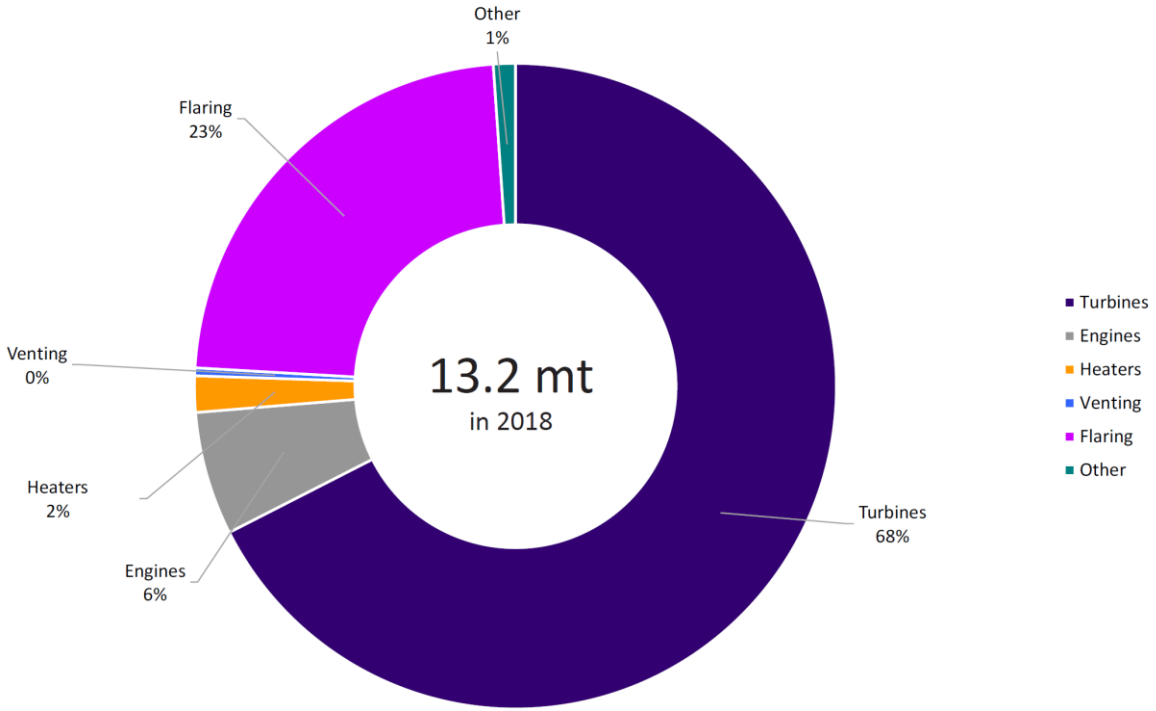


Figure 8: Total Carbon Dioxide Emissions and 2018 Generation Source

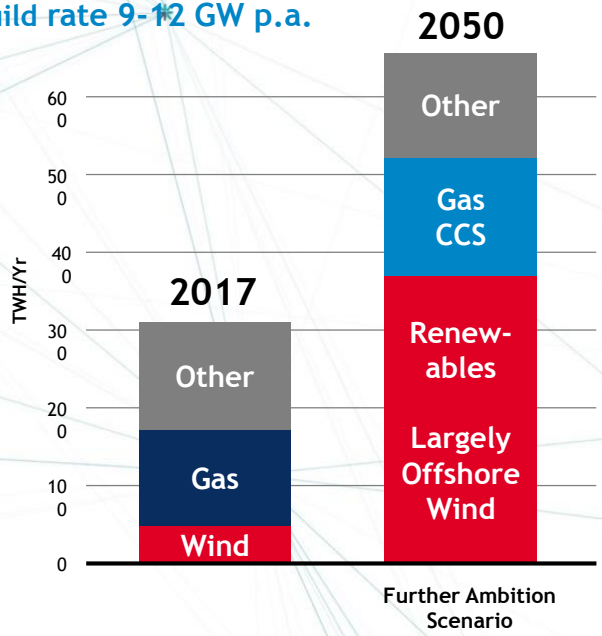


Energy 2050 – A reimagined North Sea

UK

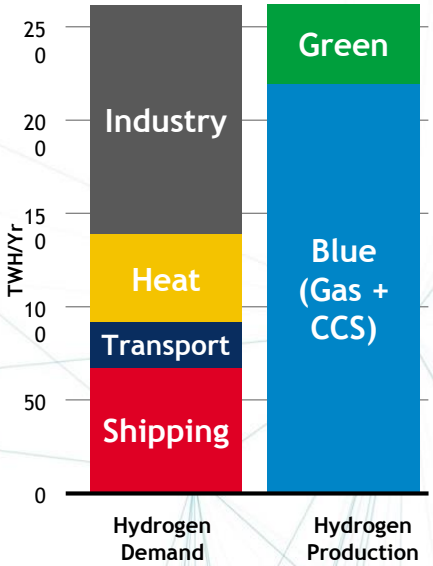
Illustrative power generation mix

645 TWH (300TWh in 2017)
Build rate 9-12 GW p.a.



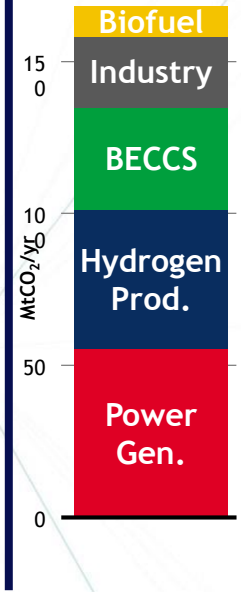
Hydrogen in 2050

270 TWH (27TWh in 2017)
Build rate 2-3 GW p.a.



CCS

176 $MtCO_2$
(0 in 2017)



Carbon neutral basin developing, testing and exporting technology

An Increasing & Changing Prize

Vision 2035 production x today's oil & gas prices

CCC wind x £40/MWH

CCC H_2 x £2/kg

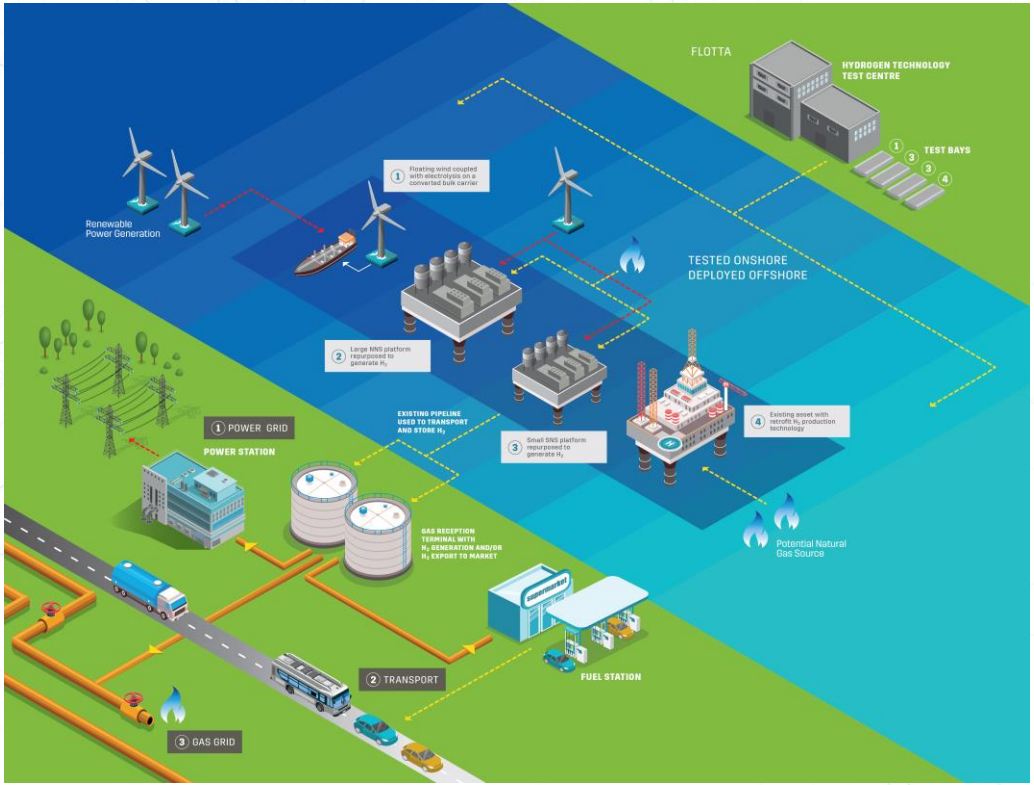
CCC CCS x £50/t

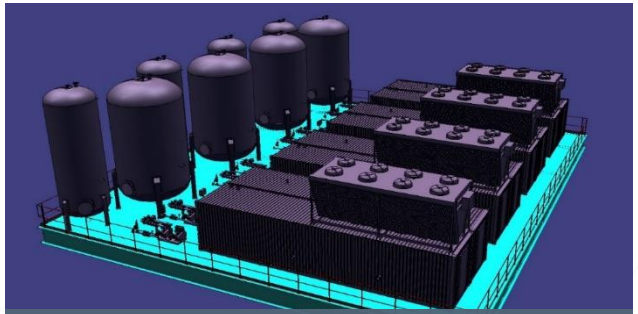
2020

£26Bn

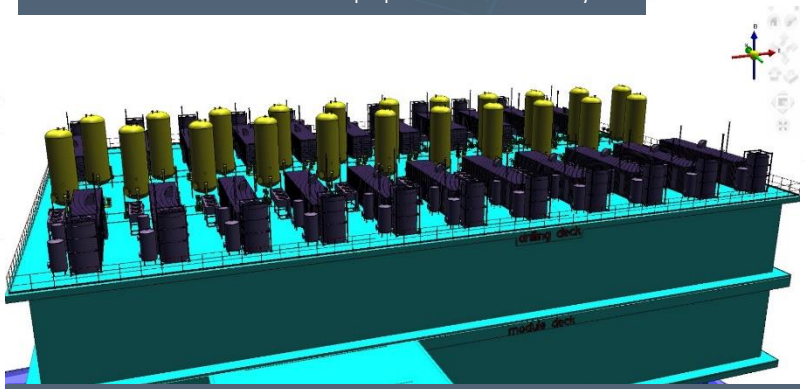
Marine Renewables

Hydrogen Offshore Production (HOP)





Small Southern North Sea Asset re-purposed for PEM Electrolysis



Large Northern North Sea Asset re-purposed for SMR

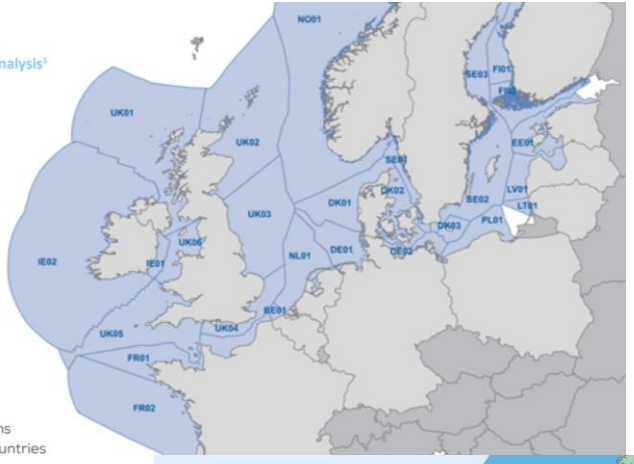
Delivering strong results

Our energy, our future

How offshore wind will help Europe go carbon-neutral

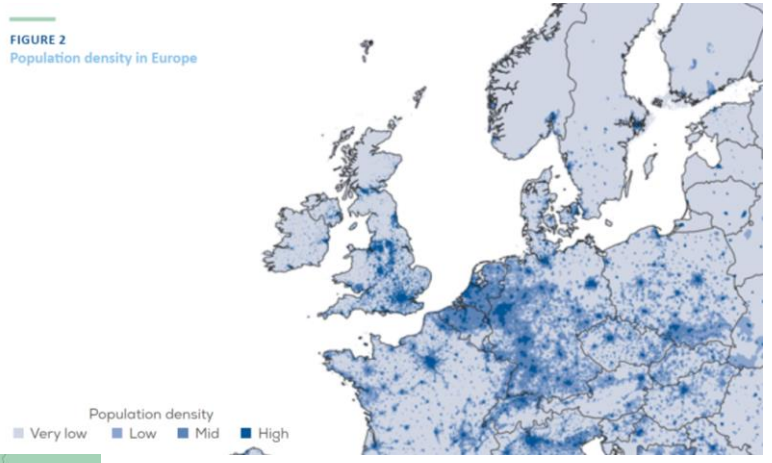
Wind EUROPE

FIGURE 1
Sub-regions used in the analysis[5]



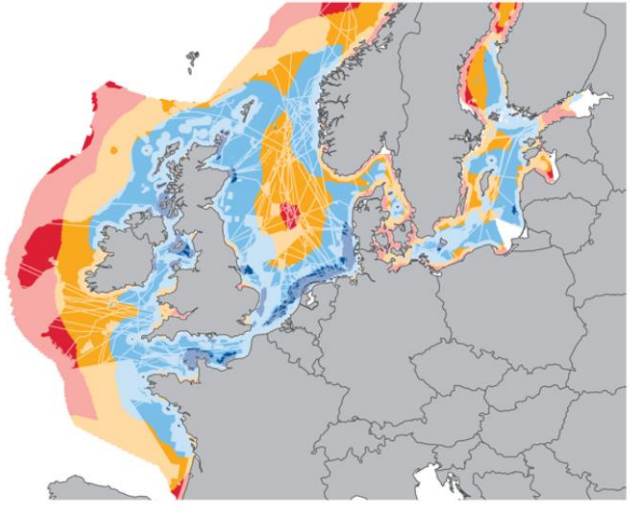
North Seas sub-regions
North Seas coastal countries

FIGURE 2
Population density in Europe

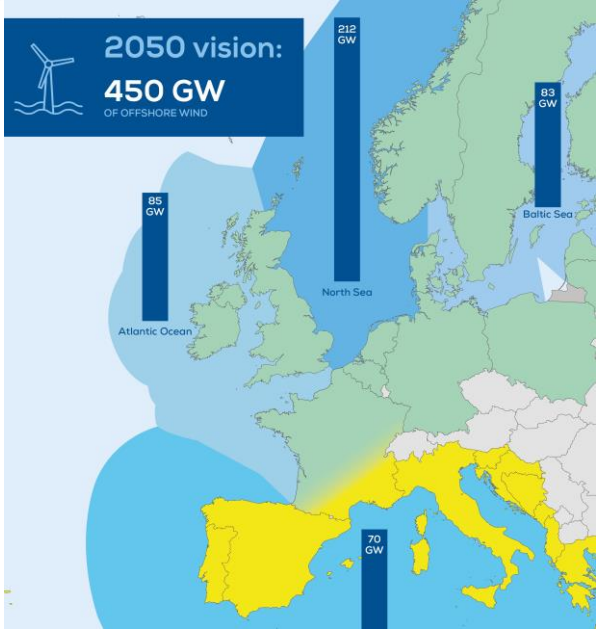


Population density
Very low Low Mid High

FIGURE 7
Relative LCOE for offshore wind in the North Seas (with spatial exclusions)



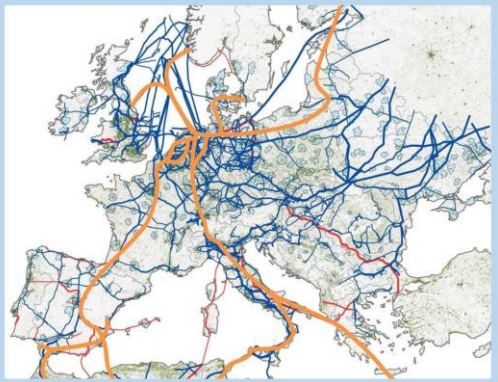
LCOE ranges in
Areas available Very low Low Mid High
Areas excluded Very low Low Mid High



		Capacity Allocated (GW)	VL Capacity (GW)	L Capacity (GW)	%V.low Dev.	%Low Dev.
	BE01	6	2.6	1.6	100%	100%
	SE01	7.6	0.0	5.7	X	100%
	DE02	4.5	0.0	5.2	X	86%
	DK02	5.2	0.0	8.4	X	62%
	PL01	27.9	0.0	66.0	X	42%
	UK04	22.9	3.5	46.7	100%	42%
	NL01	60	32.2	67.5	100%	41%
	IE01	6.7	0.0	21.1	X	32%
	DE01	31	12.4	59.9	100%	31%
	DK01	27.7	6.0	105.1	100%	21%
	FI01	11.3	0.0	58.0	X	19%
	LT01	3.6	0.3	18.1	100%	18%
	FR02	19.6	0.0	112.5	X	17%
	FI02	4.2	0.0	28.9	X	15%
	SE02	9.4	0.0	82.1	X	11%
	IE02	15.5	0.0	145.8	X	11%
	FR01	20.9	14.0	70.1	100%	10%
	DK03	2.1	1.2	9.8	100%	10%
	UK03	27.2	5.9	223.0	100%	10%
	NO01	29.6	0.0	346.0	X	9%
	UK06	11.6	9.0	33.1	100%	8%
	UK05	8.5	0.0	195.0	X	4%
	EE01	1.5	0.0	40.1	X	4%
W. Scotland	UK01	2.6	0.0	190.8	X	1%
	LV01	2.9	2.8	63.8	100%	0%
E. Scotland	UK02	7.2	10.5	440.0	69%	0%

Government of the Netherlands

European Hydrogen Backbone

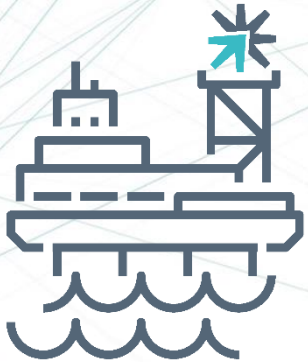


Carbon neutral basin developing, testing and exporting technology

Net Zero Roadmap V3

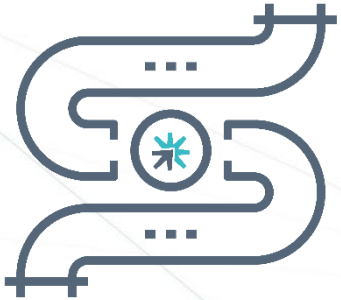
Net Zero Basin

Net Zero UK Economy enabled by the UK Continental Shelf Industries, including Oil & Gas



Net Zero Offshore Operations

Offshore Renewables Integration



Hydrogen Production

Carbon Capture Utilisation & Storage

Carbon neutral basin developing, testing and exporting technology

Lorraine Monaghan

Interface Manager

K2 Management

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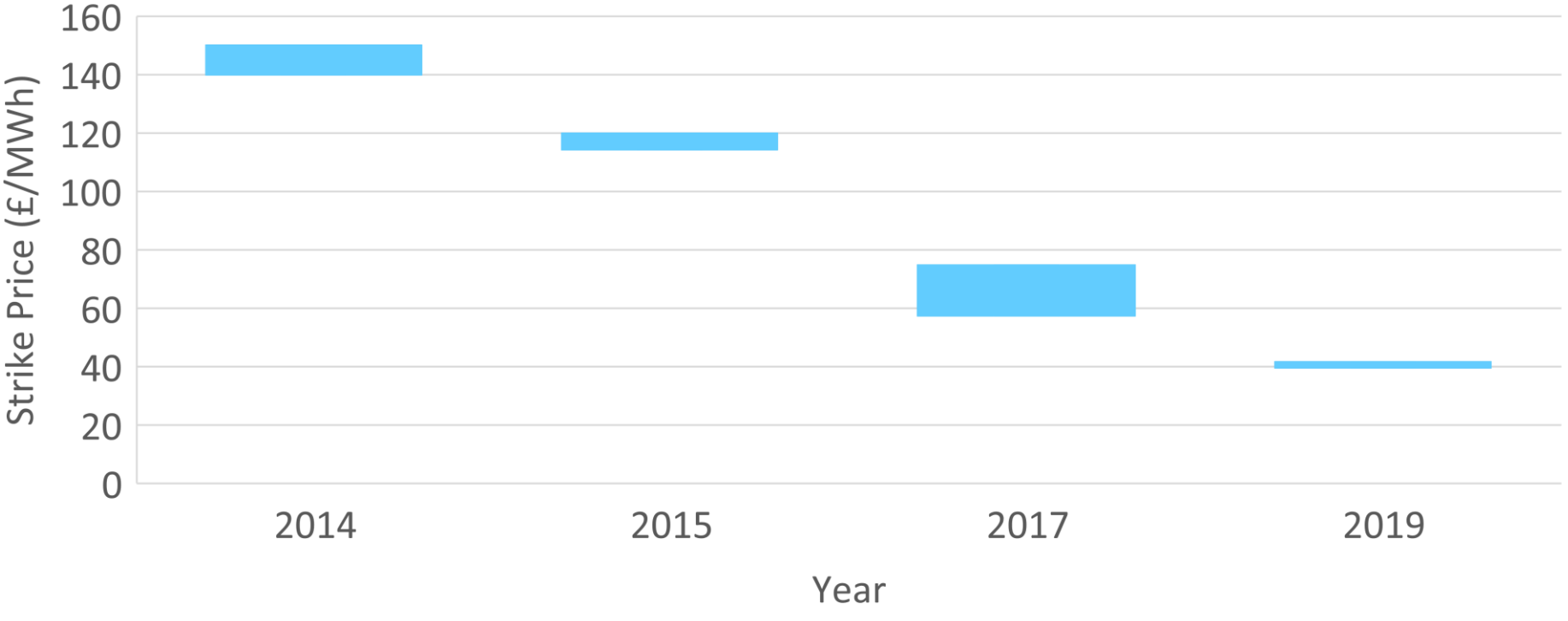
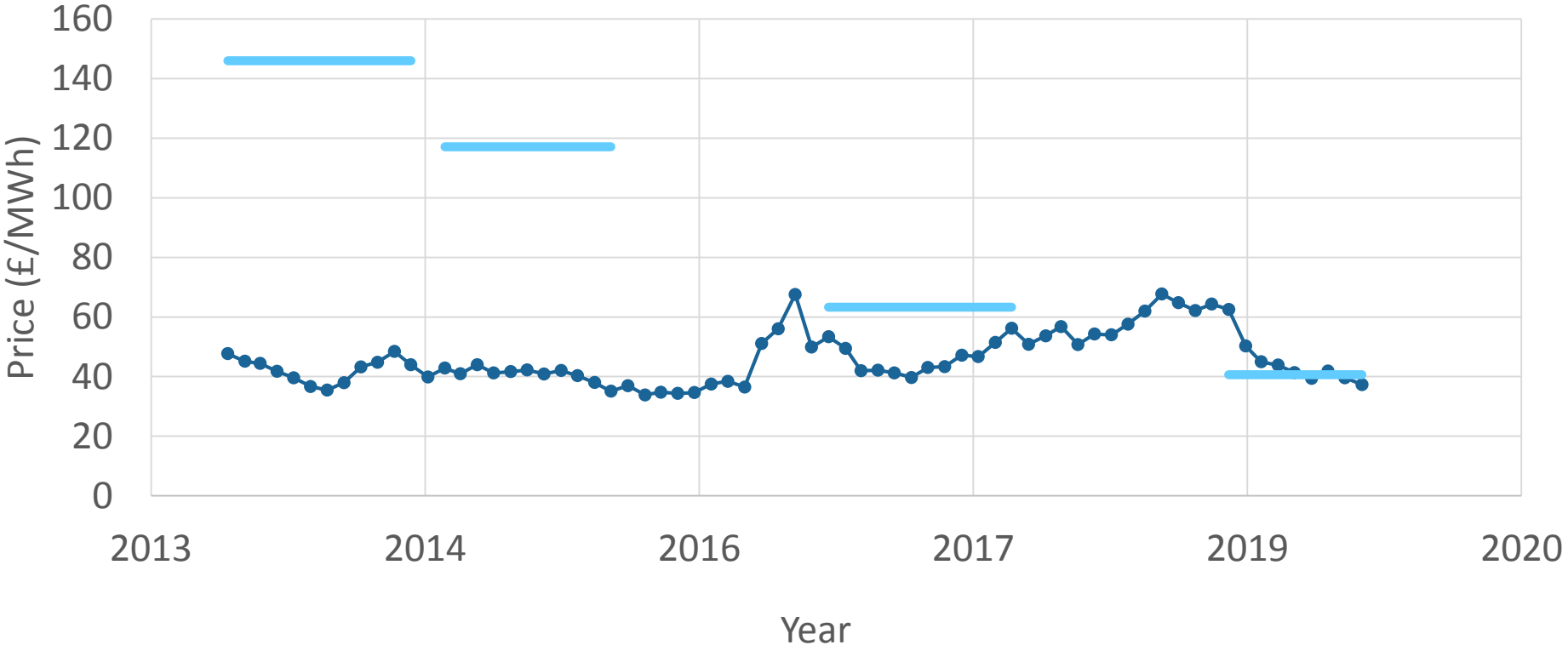
Challenges of Low Offshore CfD Strike Prices

Lorraine Monaghan

Offshore CfDs: A declining price trend



CfD Strike Price Vs Wholesale Electricity Price



Investment

- High risk and low return
- Attracting and maintaining investment
- Supply chain

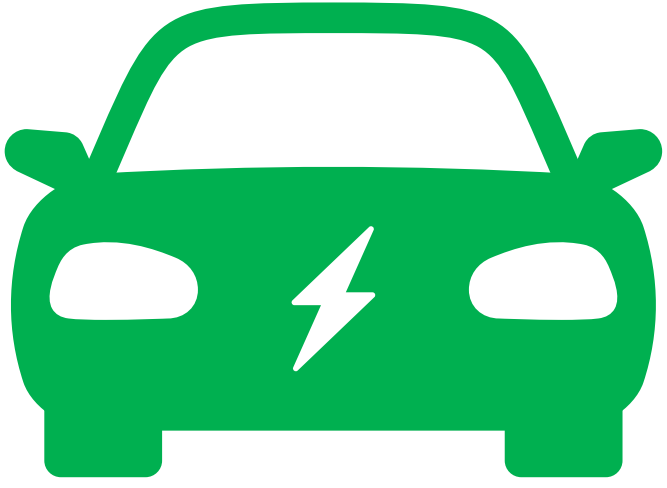
Supply Chain

- Sustainability
- Local contribution requirements vs competitive global business
- Time

Innovation

- Funding
- Delivery
- Impact

Driving Forward



- Investment
- Supply chain
- Innovation

Mike Hay
Commercial Director, RIDG

Gavin Smart
Head of Insights, ORE Catapult

Christianna Logan
Director of Customers and Stakeholders, Scottish & Southern Electricity Networks Transmission

Martyn Tulloch
Net Zero Solution Centre Manager, OGTC

Lorraine Monaghan
Interface Manager, K2 Management

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OFFSHORE WIND CONFERENCE, EXHIBITION & DINNER

28 & 29 JANUARY 2020 **GLASGOW**

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Aberdeen Renewable Energy Group

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FORTH & TAY OFFSHORE

HIE
Highlands and Islands Enterprise
Iomairt na Gàidhealtachd 's nan Eilean

Ørsted

SDIC
Red Rock Power Limited

reNEWS

energynorth

Developing the supply chain - the Offshore Wind Growth Partnership in action

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Zoe Barnes

Strategy Manager
Everoze

Tweet @ScotRenew @ORECatapult
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Claire Canning

OWGP Programme Manager

ORE Catapult

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Offshore Wind Growth Partnership

OWGP Funding Competition

Claire Canning

29th January 2020

Funded by Offshore Wind Industry Council

Delivered by CATAPULT Offshore Renewable Energy

Pilot Funding Competition

Offshore Wind Growth Partnership

Strand B: Business Competitiveness Call

Competitiveness from advanced manufacturing/fabrication techniques

- £200K funding pot
- To encourage and support UK companies to explore new manufacturing methods and techniques to improve productivity and facilitate cost reduction.
- Funding will enable access to specialist expertise to overcome a manufacturing challenge that cannot otherwise be solved by the company by itself.
- Projects must include work with external specialists (Delivery Partners) to bring new knowledge to the company.

Pilot Funding Competition

Offshore Wind Growth Partnership

Strand D: Supply Chain Futures

Advanced sensors, IoT and communications solutions for offshore wind

- £200k funding pot

- To support companies developing innovations and Intellectual Property (IP) to expand their range of products and services for the future needs of the sector.

- Funding will enable the development of innovative concepts in the area of advanced sensors, Internet of Things (IoT) and communications solutions, e.g.
  - Sensors for data collection, local communications, IoT
  - Long-range communications (satellite, RF, mobile, fibre)
  - Data logging and pre-processing e.g. cloud/web-based service platforms
  - Immersive content e.g. Virtual Reality (VR), Augmented Reality (AR)

Pilot Funding Competition

Offshore Wind Growth Partnership

Company	Strand	Project	Delivery Partner
Global Energy Group	B	Application of AIML to renewables fabrication	National Composite Centre (NCC)
Cedeco	B	Composite Spoon Wedge Feasibility Study	Nuclear Advanced Manufacturing Research Centre (NAMRC)
W3G Marine	B	Robotic welding feasibility study	Cyberweld
Magnomatics	B	ROBOMAG (Robotic placement of large rotor magnets)	Advanced Manufacturing Research Centre (AMRC)
Cognitive Business	D	WAVES: Wind Accessibility Verification for Enhanced Safety	N/A
Sennen Tech	D	Improved efficiency of O&M through generation of lost production metrics	N/A
Smart Component Technologies	D	Remote monitoring of safety and performance critical fasteners for OSW cost reduction	N/A

Projects will aim to commence March 2020

Steve Chisholm

Operations Director

Global Energy Group

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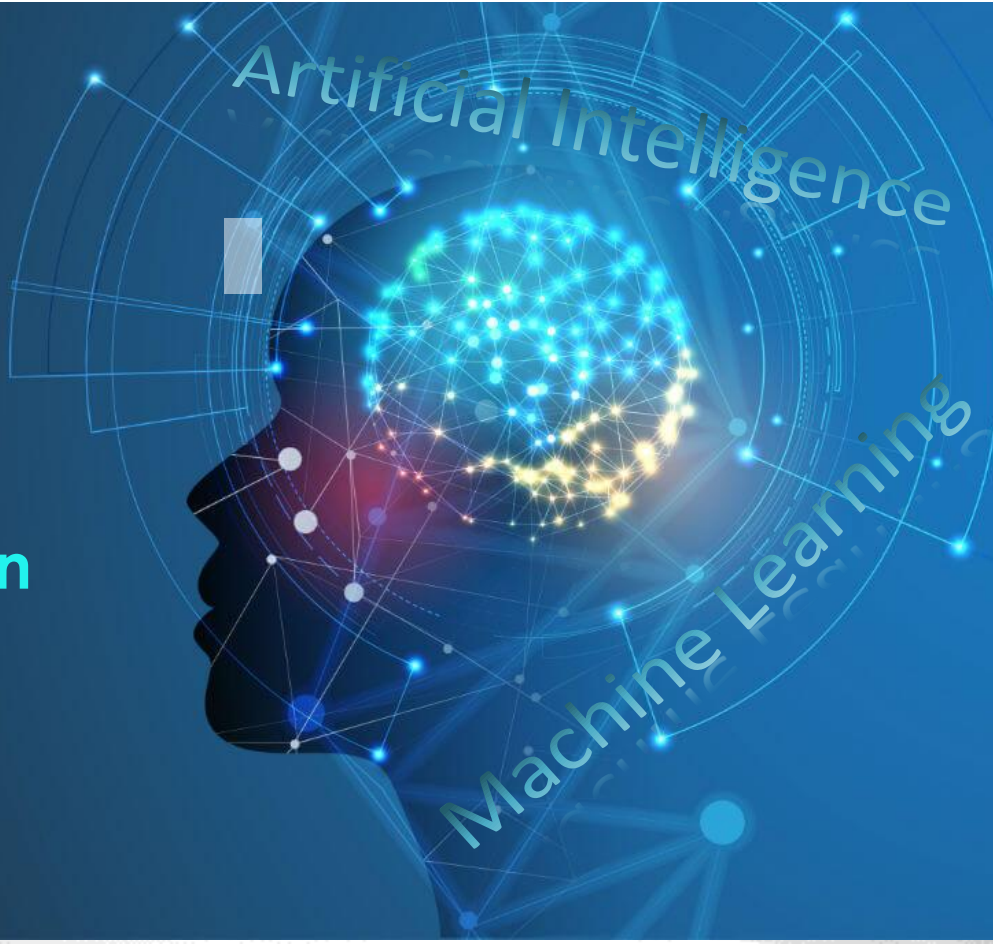
GLOBAL ENERGY GROUP

WORKING with the NUCLEAR AMRC

The Application of AIML To Renewables Fabrication



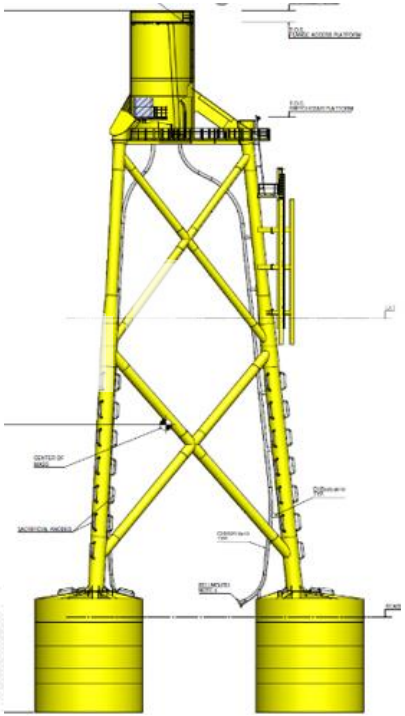
Offshore Wind Growth Partnership

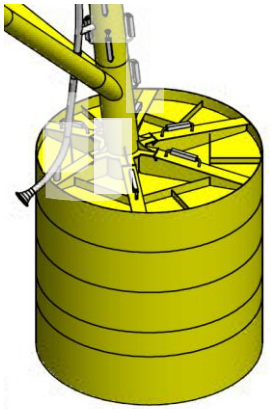
The Challenge

To compete requires ground breaking innovation. Matching "state of the art" or "best in class" only gets you to where your rivals were yesterday. Not cost of labour or infrastructure dependent.

The Solution

Create intelligent machines that can emulate best human performance for welded manufacture and enable new methods of inspection. Enhance existing automation and open up new product applications.





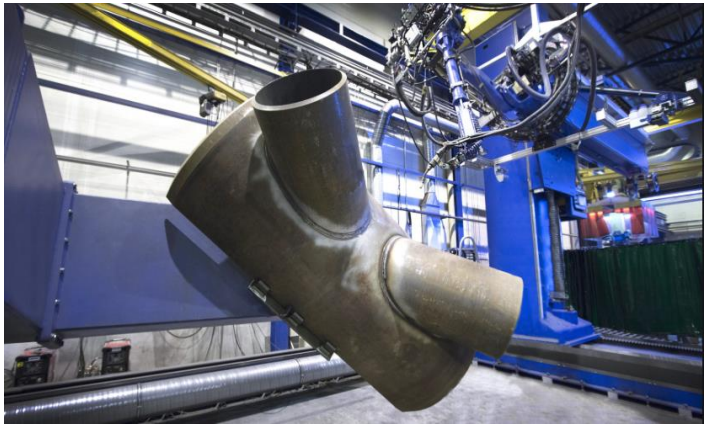
The Nuclear AMRC – Partner of Choice

- Launched 2012
- Faculty of University of Sheffield
- £27 Million Capital Equipment
- c £1.5 Million Relevant R&D Works
- Delivering Savings of 25% to 50%

Research Scope

- Welding Robotics
- In Process Monitoring & Controls
- Machine Learning
- 4IR – Autonomous Decision Making

Welding – Today's Leading Edge



Current Inspection Practice

Welding Innovation For Tomorrow

- Spatially Aware, Self Set Up
- Adaptive to Changing Geometry
- High Quality / High Deposition
- Platform for Grinding / Inspection

Future In-Process Inspection

- Defect / Anomaly Detection
- Reduce / Eliminate Traditional NDT
- Deploy Intelligent Vision Systems and Real Time Data Analysis

Jacqueline Morrison

Business Development Lead

Cedeco

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An improved installation technique for offshore wind

Saving £215,000 - £290,000 per foundation installation

CEDECO

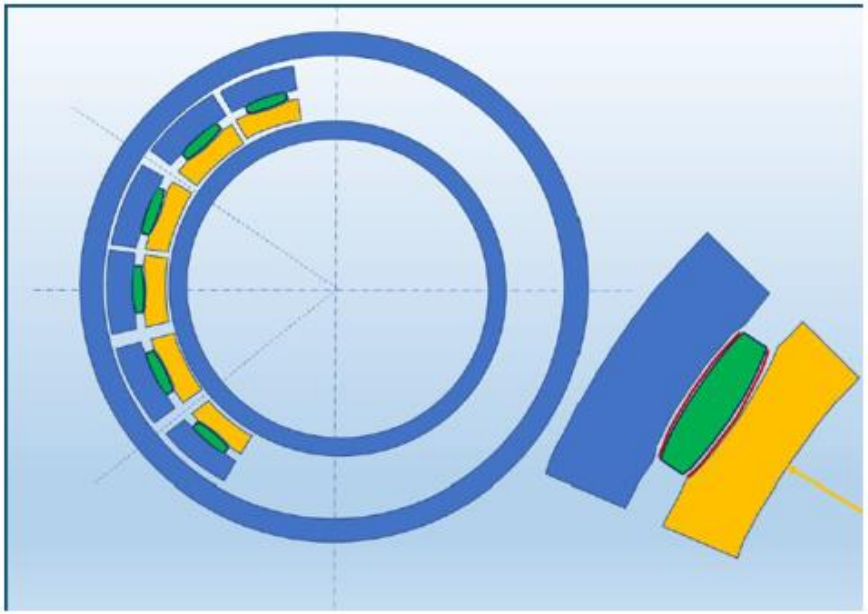
Powered by CATAPULT Offshore Renewable Energy

+

(lots of)

Imagination

=



CEDECO

The challenges we believe composites help us overcome…

Weight

Lighter means easier to handle

Lighter means easier to transport

Manufacturability

Non-corrosive

Lower carbon footprint

CEDECO

Jacqueline

https://www.linkedin.com/in/jacquelinemorrison/

Iain

https://www.linkedin.com/in/iain-steven-98b75680/

CEDECO

Powered by CATAPULT Offshore Renewable Energy

David Latimer

CEO

Magnomatics

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Magnomatics®

The dawn of magnetic gears

David Latimer – Magnomatics
OWGP Project

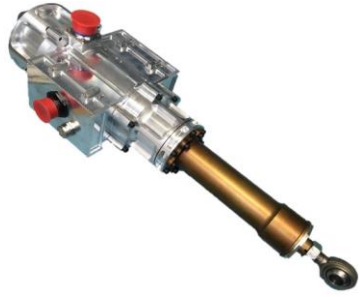
Magnomatics – Current Engagement

Magnomatics®

Hybrid Vehicles
Application Ready Gate Review
Completed Jan 2020

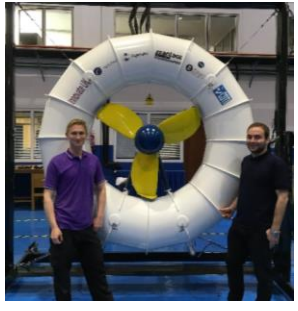
Marine Propulsion
Electrification partner SMD
Electric Quantum ROV

Oil & Gas
In small volume production
Artificial lift with ZiLift



Aerospace
Grant funded development
CleanSky Project award Jan 2020

Consultancy Services
F1 KERS Motors
High efficiency drives for industrial use



Renewable Energy - Ocean
Eurostar Marine Current - Seaplace
Eurostar Turning Tide – awarded Jan 2020

Renewable Energy - Wind
INNWIND.EU and DemoWind
500 kW demonstrator

Rail
Development of 9,000 Nm traction motor for global OEM

Independently verified low cost energy

Magnomatics®

Magnomatics 10MW PDD versus Geared Permanent Magnet

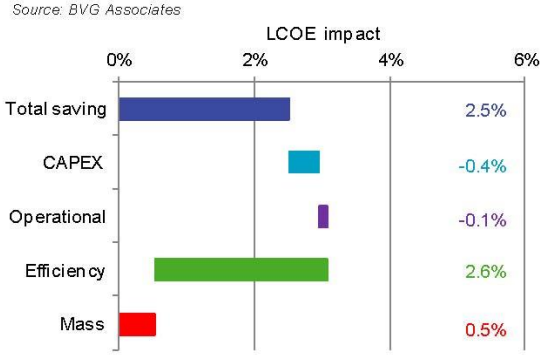


Figure 1 Source of LCOE saving for PDD compared to the conventional direct-drive drivetrain.

Magnomatics 10MW PDD versus Direct Drive Permanent Magnet

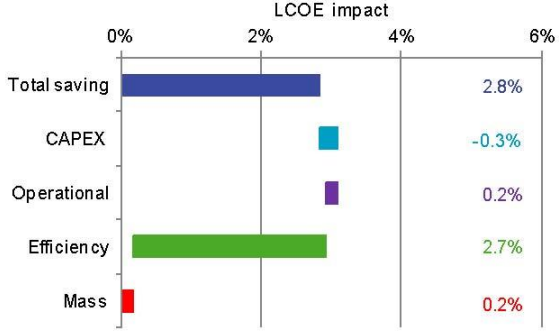


Figure 2 Source of LCOE saving for PDD compared to the conventional geared drivetrain.

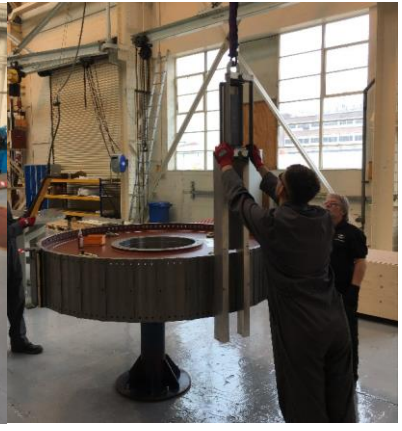
INNWIND.EU

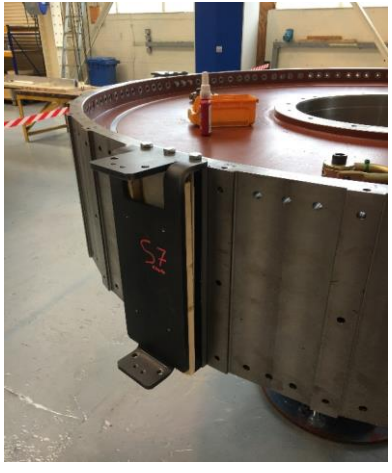
BVGassociates

High speed magnet rotor – prototype build

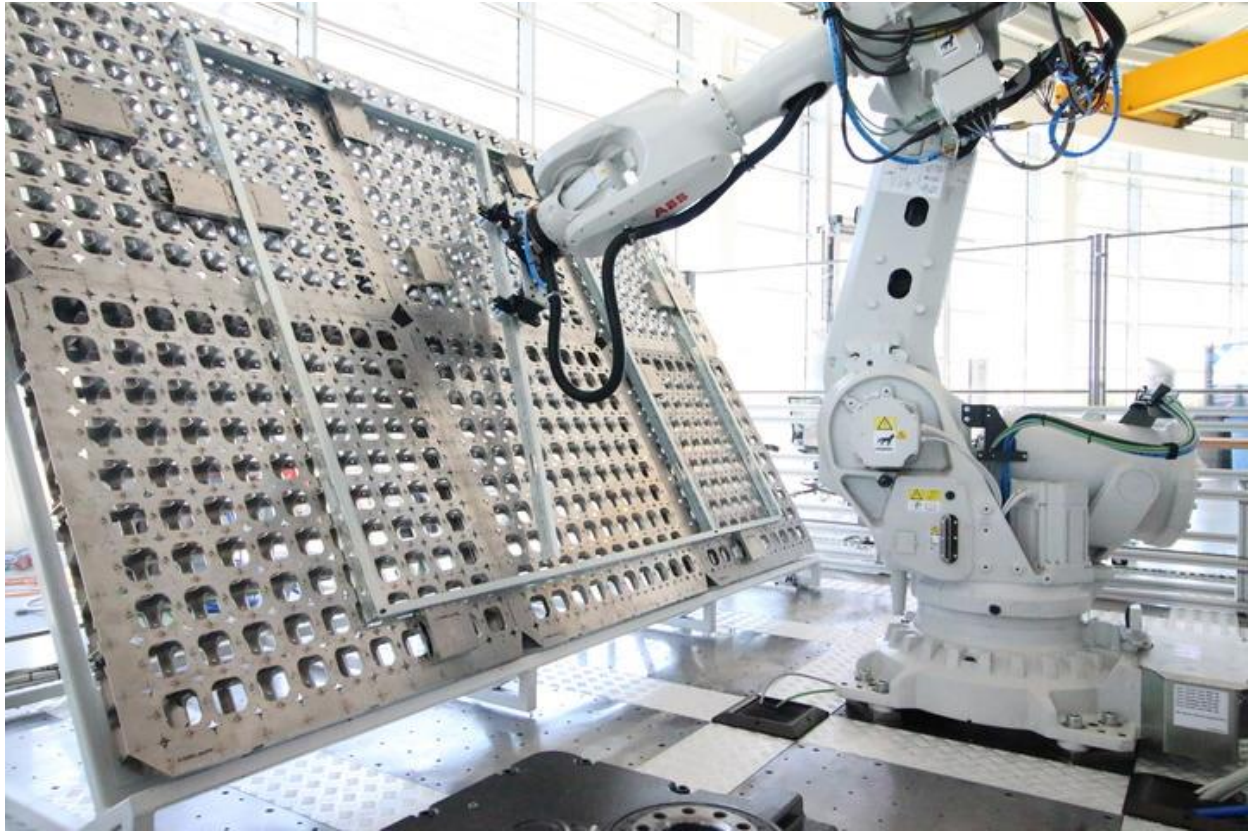
Magnomatics®





Robotic magnet placement



- Quicker
- Cheaper
- Safer

Anchoring manufacture in Sheffield City Region and the UK

Questions?

Magnomatics Limited
Park House
Bernard Road
Sheffield
S2 5BQ
UK

Tel: (+44) 114 241 2570
Email: magnomatics@magnomatics.com

www.magnomatics.com

John Giles

Technical Director

W3G Marine

Tweet @ScotRenew @ORECatapult

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SCOTTISH OFFSHORE WIND CONFERENCE 2020

W3GM PILE GRIPPER SYSTEM

Delivering Marine & Subsea projects

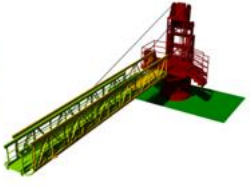
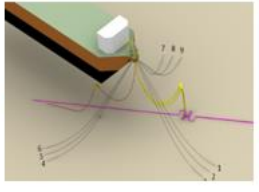
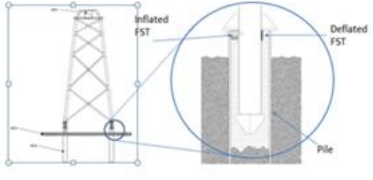
W3GM Background Information

W3GM started as an O&G offshore construction contractor, and has migrated into the offshore renewables sector.
Now 90% of our income is from the renewables sector
Here are some of the projects we have been involved with over the years



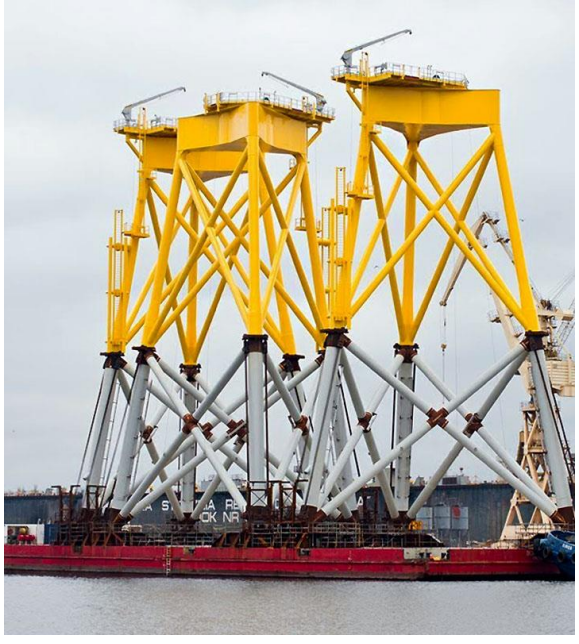






OWGP supported project



- Typically jacket type foundations are used to support offshore wind turbines.
- They are secured to the seabed with pin piles hammered in, and the jacket is lowered into the piles
- The mechanical connection between the pile and the jacket leg is a grouted connection
- To ensure a good grout connection, the leg must be held still while the grout cures
- The W3GM tool is an inflatable gripper that creates a radial force to hold the jacket during the curing process

- The W3GM FST has been developed to including:
  - An offshore trial on EA1
  - Interest from domestic and export projects
  - OWGP is giving support to develop a quicker and more consistent way of making each element using robots

ROBOTIC WELDING PRODUCTION

- A potential project requires 750 units to be made per month
- Robotic welding ensures consistent quality and production rate
- Robotic technology is readily available from other sectors of manufacturing industry
- Most of the supply chain is NE Scotland based

OWGP FUNDING BRINGING ROBOTIC TECHNOLOGY TO OFFSHORE RENEWABLES

- This funding will allow us to investigate and develop robotic welding technology and bring it to the NE of Scotland
- W3GM will increase the number of people employed (expected 14)
- Most the products fabricated during this project will be exported

Ty Burridge-Oakland

Managing Director

Cognitive Business

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Cognitive

Project WAVES - Cognitive partners with RWE and JFMS for Offshore Wind Growth Partnership (OWGP)

We create software that uses Industrial Internet of Things (IIOT) data to make power generation more efficient, and reliable.

Challenge

The safe management of offshore transfers is a well-recognised challenge within the industry, involving a complex interaction of many meteorological and oceanographic variables alongside individual vessel and crew capabilities. Often the conditions are highly variable at different turbine locations, even within the same wind site. Due to the complexity of this multivariate interaction the industry has been unable to forecast access accurately, instead relying on the vessel and transferring crew to dynamically assess the situation and make a decision on whether a transfer can take place safely. Influencing factors such as: production pressure, risk appetite, inexperience, job insecurity, bravado, and appetite to work can all influence a decision, which has significant consequences either in terms of putting personnel at risk or resulting in significant under-utilisation of the workforce. Amidst the digital era, there is a better, safer, way to support these decisions

> Access to turbines has been one of our largest headaches through this winter period
>
> RWE Renewables Operations Team

RWE JFD Powered by CATAPULT Offshore Renewable Energy

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cognitive.business

OWGP - WAVES

2020

Project WAVES - Cognitive partners with RWE and JFMS for Offshore Wind Growth Partnership (OWGP)

Cognitive have agreed partnership with RWE and James Fisher Marine Services for project WAVES (Wind Accessibility Verification for Enhanced Safety) to develop a unique data-led decision tool to enable highly accurate, localised assessment of safe conditions for vessels to turbine transfers. Providing a step change in safe transfer decision making and optimising scheduling of costly resources.

Using accessibility modelling from industry benchmark data [OREC] combined with O&M costs [RWE], £156m/yr of resources are wasted due to inaccessibility

WAVES could enable the reduction of these losses by ~15%.

> Access to turbines has been one of our largest headaches through this winter period
>
> RWE Renewables Operations Team

RWE JFD Powered by CATAPULT Offshore Renewable Energy

Have some news to share? Get in touch: info@cognitive.business

cognitive.business

OWGP - WAVES

2020

Project WAVES - Cognitive partners with RWE and JFMS for Offshore Wind Growth Partnership (OWGP)

Cognitive have worked extensively across wind and other power generation sectors.

They provide tools for industry and the outcome from WAVES will be designed for integration into existing platforms including systems like JFMS OWMS, and our own Discovery platform.

> Access to turbines has been one of our largest headaches through this winter period
>
> RWE Renewables Operations Team

RWE JFD Powered by CATAPULT Offshore Renewable Energy

Gaby Amiel

CEO

Sennen Tech

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Sennen Tech

Your technology partner for simpler, safer operations

About Sennen

We are a **technology partner** for offshore wind, not just a software company.

We **understand**. We get the technical and logistical challenges in operations and asset management, and we know how to digitise work processes effectively.

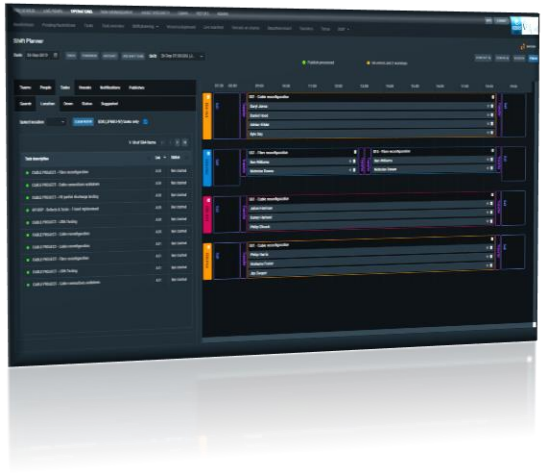
We are **unique**. We rapidly configure applications to fulfil specific work processes incorporating, not replacing, your existing systems.

We are **experienced**. Our team has extensive, hands-on experience in offshore wind projects.

Harnessing Site Record Data

Work Optimization

Personnel & qualifications
Work orders
Shift planning
Vessel manifest
Defects

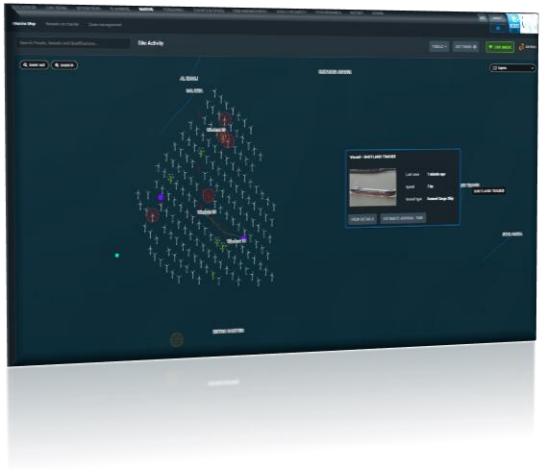


Safety Assurance

Incident reports
Automated validation and alerts
Location restrictions
Workflow process with management oversight
Risk tracking and mitigation

Marine Control

Real-time GIS maps with full history
Departure board
Transfers of control (WTSR)
Personnel tracking
SCADA integration
Met-ocean forecast



The Project


Site status
Aborted transfers - (IN DEVELOPMENT)
Aborted transfers summary
Aborted transfers by reason (in field)
Aborted transfers by vessel (in field)
Aborted transfers timeline

Jack Hughleigh

Technical Director

Smart Component Technologies

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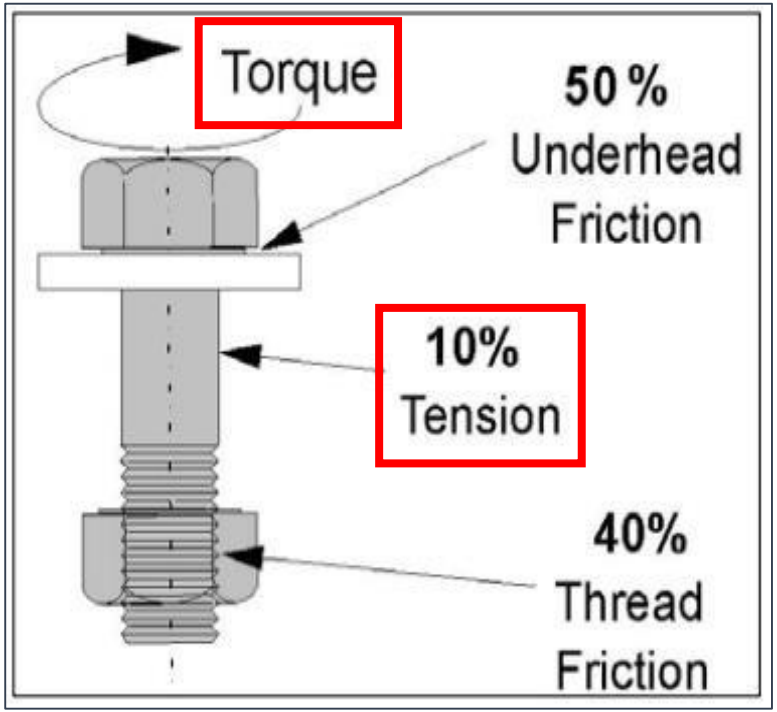
Remote Condition Monitoring of Bolted Connections

Dr Jack Bryan Hughleigh – Technical Director

Smart Component Technologies

Stop torqueing, start tensioning



Condition based maintenance

&S risks

Smart Component Technologies

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Project updates

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Morag Watson

Director of Policy
Scottish Renewables

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Mark Timmons

Offshore Bid Manager

SSE Renewables

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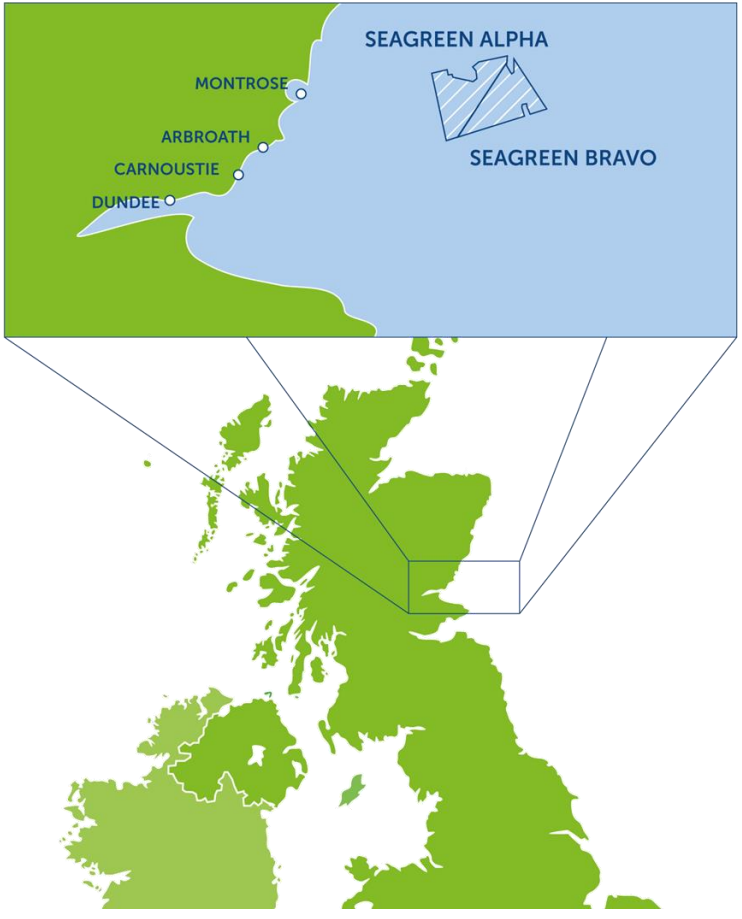
Mark Timmons, Offshore Bid Manager
Seagreen Project Update
Scottish Offshore Wind Conference – January 2020

Seagreen

- Scotland’s largest windfarm, wholly owned by SSE
- 1,075MW export capacity, CFD for 454MW
- Expected to generate c5,000GWh annually
- Final investment decision in first half of 2020

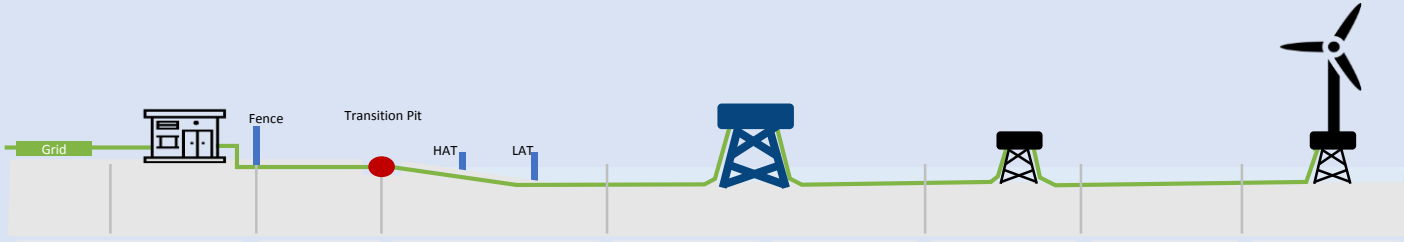


sse Renewables | Seagreen WIND ENERGY

Timeline


2013
Onshore consent granted
Extended 2016
2014
Offshore consent granted
Confirmed 2017
2018
Optimised Application submission
Submitted 2018
2019
CFD Award
Autumn 2019
2020
Construction start
Q1 2020
Financial close 1H 2020
2021
First power
Q4 2021
2022
Full power
Q4 2022
We are here

Contracting strategy



	Onshore Substation & Grid Connection	Onshore Export Cable	Offshore Export Cable	OSP Topside	OSP Foundation	WTG Offshore Foundations	IAC	WTGs
Design	Petrofac	Nexans	Nexans	Petrofac		RAMBØLL		
Supply / Fabrication						TBC	TBC	MHI VESTAS OFFSHORE WIND
Transport and Installation								
Commissioning								

PORTS:

- O&M Base - ***Montrose***
- WTG pre assembly - **TBC**
- Foundations Staging - **TBC**

Supply Chain Plan

- UK content
- Offshore wind sector deal
- Meet the buyer
- WTG apprenticeships
- STEM skills fund £100k pa in construction
- Community benefit fund

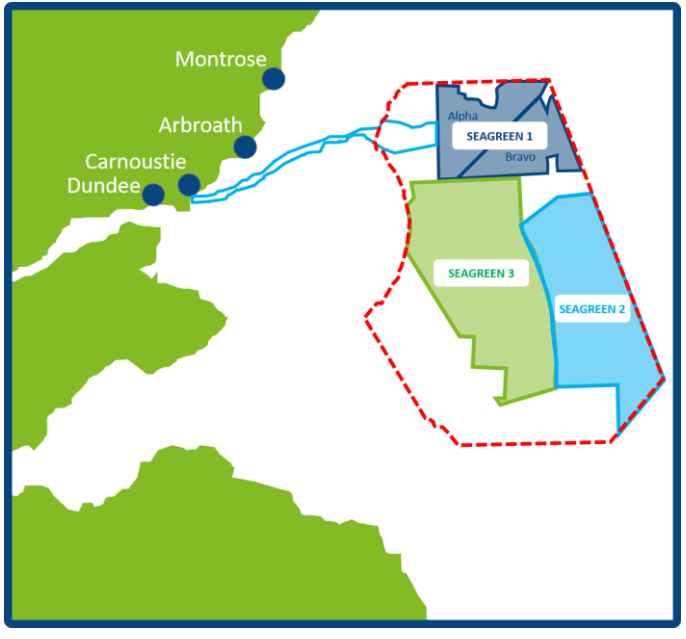
O4B
HIGHLANDS AND ISLANDS
OPEN4BUSINESS

sse Renewables | Seagreen WIND ENERGY

Seagreen 2 and Seagreen 3

- Indicative Capacity
  - **Seagreen 2 – 1400MW approx.**
  - **Seagreen 3 - 900-1850MW**

- 2020 Scoping
- 2022 Consent
- 2025 Construction
- 2027 Operational



sse Renewables

Keeping in touch

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0141 224 7192

Matthias Haag

Project Director - Neart Na Gaoithe

EDF Renewables

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NEART NA GAOITHE

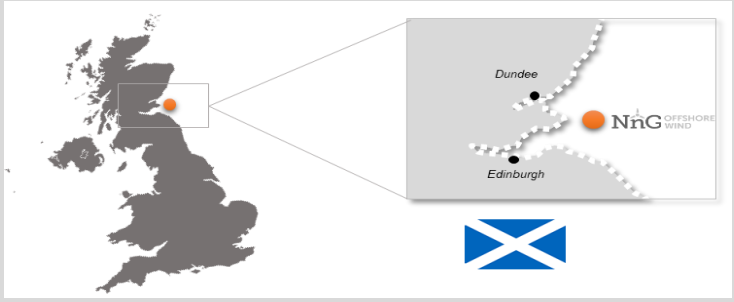
For Tomorrow’s Generation

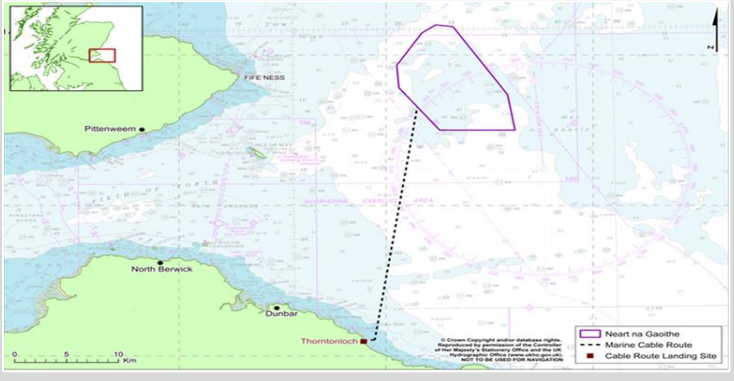
NNG Project Update

Glasgow 29/01/2020

Matthias Haag

High Level Overview





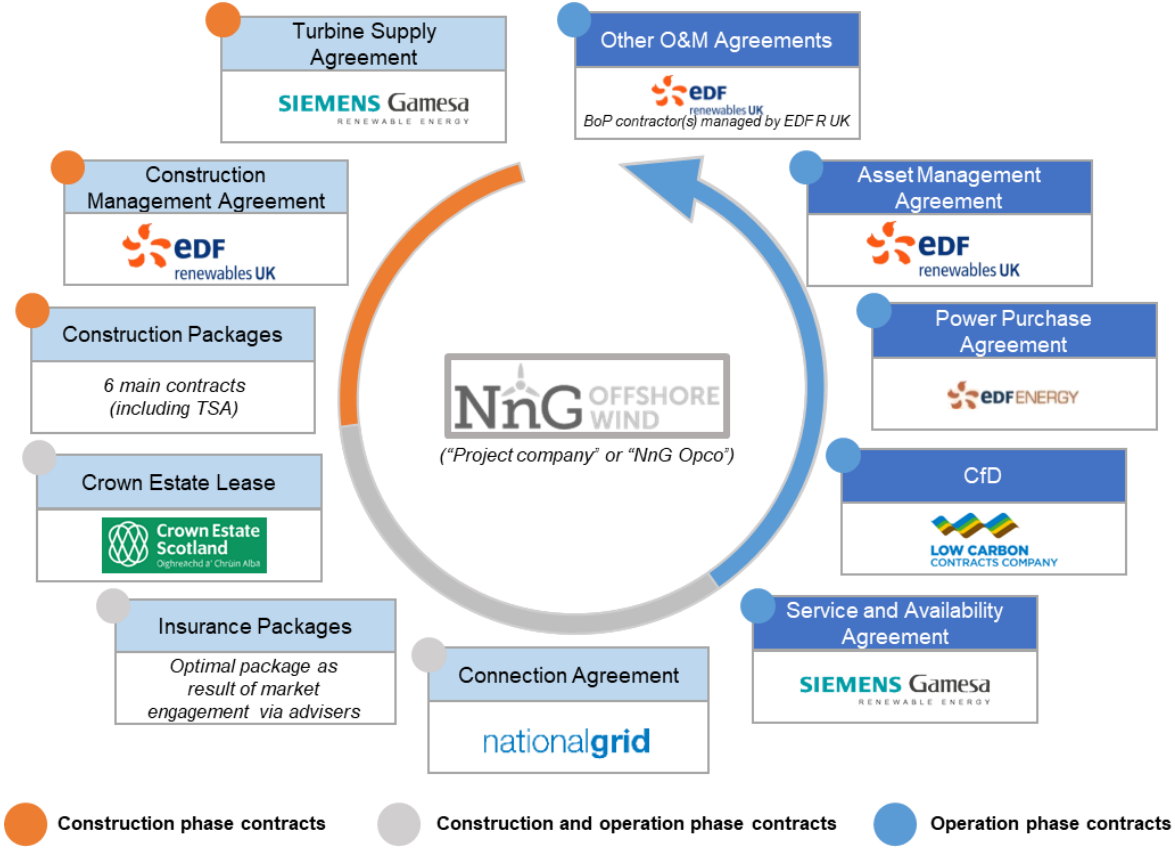
Key data

Project capacity	▪ 448 MW
Load factor	▪ c.48%
Turbines Type #	▪ 8.0 MW SGRE ▪ 54
Foundation	▪ 3 legged jackets with pre-piled pin piles
Maximum rotor tip height	▪ 208 m LAT
Array cables	▪ c. 95 km of 66kV AC cables
Export cables	▪ 2 offshore 220 kV HVAC cables of c.38 km ▪ 2 onshore 220 kV HVAC cables of c.12 km
Offshore substation	▪ 2 HVAC Offshore Substation each comprising one Offshore Grid Transformer
Grid connection	▪ Onshore transformer station adjacent to the existing Scottish Power Transmission substation at Crystal Rig II. Stepping up the voltage to 409 kV for grid connection

High Level Program

2018	• Acquisition from Mainstream • Recruiting and building team √
2019	•Offshore and onshore surveys •Tender/sign all construction contracts •Project Finance and Equity Sale √
2020	•Manufacturing start & Onshore HVS/cables •Clearing boulders/UXO •Drilling of foundation piles
2021	•Foundation & OSS installation •Export/Array cable installation •Power systems live onshore/offshore
2022	•Turbine installation & commissioning •First Power and start of operations •OFTO sale planning and COD for 2023

Overview Main Contract Parties



Construction Contracts

	Construction packages	Scope	Providers
1	Construction Management Agreement ("CMA")	Construction management services and certain asset management services related to the construction and commissioning of the wind farm	EDF renewables UK
2	Connection Agreement ("CA")	Grid connection agreements with National Grid covering the connection to the existing Crystal Rig substation	nationalgrid
Construction Packages 3	Turbine Supply ("TSA")	Fabrication, supply, pre-assembly, installation and commissioning of 54 SG-8.0-167 WTGs	SIEMENS Gamesa RENEWABLE ENERGY
4	EPCI Foundations ("FOU")	Design, fabrication, supply and installation of jacket WTG and OSS foundations Transport and Installation of Substation topsides	SAIPEM
5	WTG Installation Vessel ("WIG")	Charter for WTG installation vessel	Fred.Olsen & Co.
6	High Voltage Stations ("HVS")	Design, fabrication, supply and pre-commissioning of onshore and Offshore Substations, electrical system design and SCADA	GE HSM offshore
7	Export cables ("EXP")	Design, fabrication, supply, installation, termination and pre-commissioning for onshore and offshore export cables	Prysmian Group
8	Inter-Array Cables ("IAC")	Design, fabrication, supply, installation, termination and pre-commissioning of inter-array cables EPCI of the 66kV platform interconnecting cable	Tideway Offshore Solutions

Start of Construction


Thank you
EDF renewables
NnG OFFSHORE WIND
NNG – ‘For Tomorrow’s Generation’

Adam Ezzamel

Project Director - Inch Cape

Red Rock Power Limited

Tweet @ScotRenew

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SDIC

Red Rock Power Limited

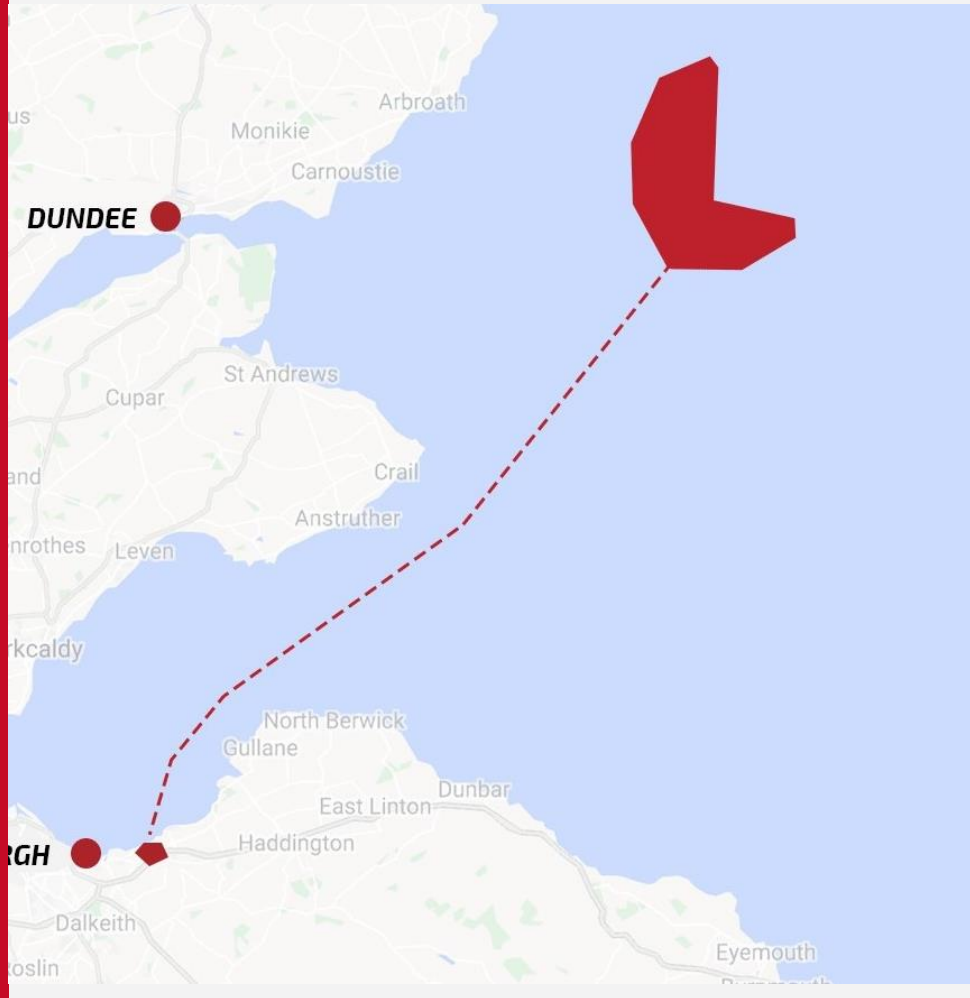
Inch Cape Offshore Limited

Adam Ezzamel, Project Director

January 2020

Inch Cape – post CfD

- Offshore development, up to 72 turbines, 15km off the Angus Coast
- Moving forward without CfD (round 3) and continuing to optimise the project
- Red Rock Power currently engaging with potential partners and considering PPA opportunities
- Expected to start onshore construction in early 2021, and offshore construction in late 2021.



Red Rock Power Limited

Adam Morrison

Project Director - Moray West

EDP Renewables

Tweet @ScotRenew

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MORAY EAST
OFFSHORE WINDFARM

Moray East Offshore Wind Farm Overview

edp renewables

ENGIE

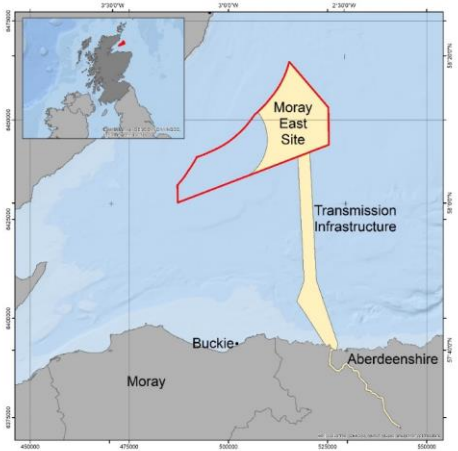
dge

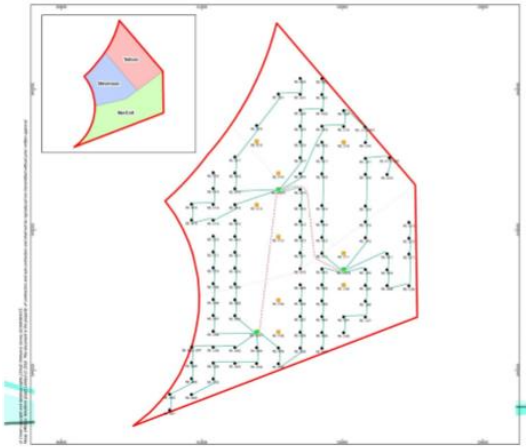
CTG

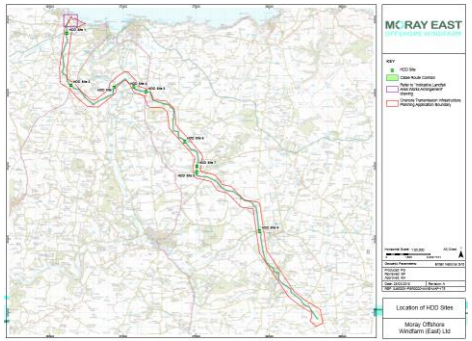
Moray East Offshore Wind Farm

Summary

- 950MW offshore wind farm currently under construction:
  - 2010: Development commenced.
  - 2014 Consent awarded.
  - 2017: CfD signed following success in auction (lowest cost for offshore wind in the UK to date).
  - 2018: Financial close / onshore construction commenced.
  - 2019: Offshore construction commenced.
  - 2021: First generation.
- 22km from the coast.
- Water depths up to 57m.
- 100 turbines (MHI Vestas V164 – 9.5MW).
- 3 offshore substations.
- Largest infrastructure project in Scotland:
  - Equivalent to two Queensferry Crossings.
  - Will power the equivalent of 40% of Scotland's households.







www.moraywest.com

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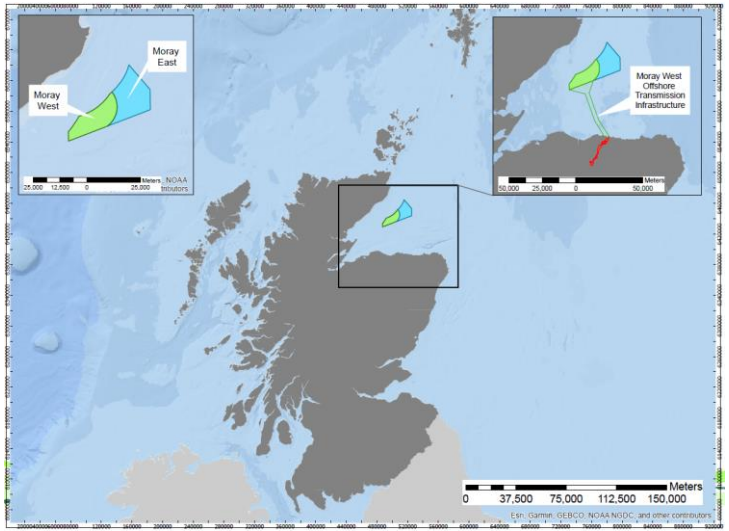
OFFSHORE WIND FARM

Project Overview

Project Summary

- Located over 22km from the coast.
- Water depth range: 35-55m.
- Up to 85 turbines.
- 800MW grid connection secured at Blackhillock, near Keith.
- Offshore and onshore consents in place.
- Sponsors have stated commitment and project team continues to develop and mature the project.
- Major package procurement now underway.



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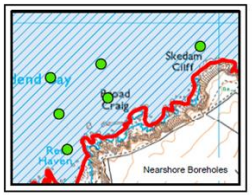
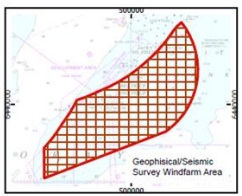
OFFSHORE WIND FARM

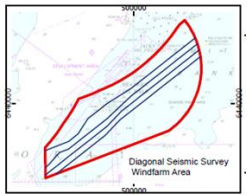
The Last 12 Months

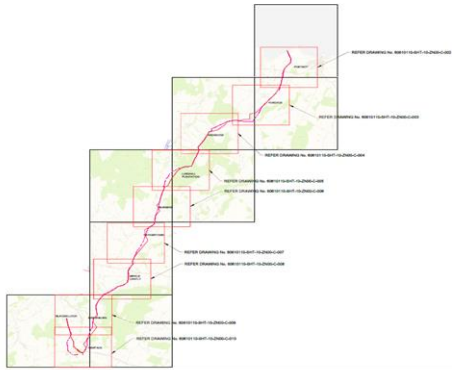
2019 project activities were focused around onshore and offshore consenting, as well as site characterisation.

- Offshore consents awarded in June 2019!
- A floating LiDAR campaign commenced and is continuing.
- Extensive offshore geotechnical and geophysical surveys were undertaken within the wind farm site and along the offshore export cable corridor.
- Landfall site investigation undertaken to inform detailed design.
- Onshore cable corridor site investigation undertaken.









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OFFSHORE WIND FARM

2020 Project Activities

Focus on progression of engineering and major package procurement, as well as continued effort on discharge of consent conditions.

- During 2020 the project expects to advance procurement and associated engineering for all key work packages. Contracting would be finalised for the whole project during 2021.
- The project is also in the process of assessing construction and operations & maintenance ports.
- The project is utilising the Open4Business portal platform which is operated by Inverness Chamber of Commerce for advertising ongoing procurement processes relating to the project.

O4B HIGHLANDS AND ISLANDS OPEN4BUSINESS

SSCC SCOTLAND SUPPLY CHAIN CONFERENCE 25 February Glasgow, Scotland 2020

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28 & 29 JANUARY 2020 **GLASGOW**

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