Evolution of the UK Electricity Transmission: Challenges and Opportunities in Impact Assessment

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Overview

1. ‘State of Play’
2. Technical Solutions
3. Key Challenges (Inc. IA)
4. Forward Look
5. Conclusions

State of Play

An aging transmission network - geared toward a “conventional” energy system

Urgent need for decarbonisation

Successes in Offshore Wind (UK and Ireland), plus increasing growth of FOW

50 GW of offshore wind by 2030?

Greater penetration of renewables on the network

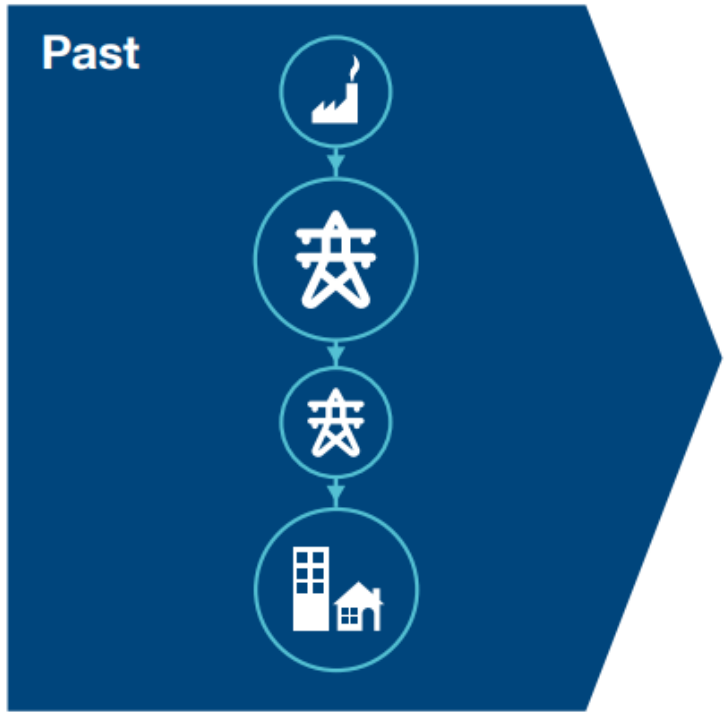
Changes in consumption (electric vehicles / electrification of heat for e.g.)

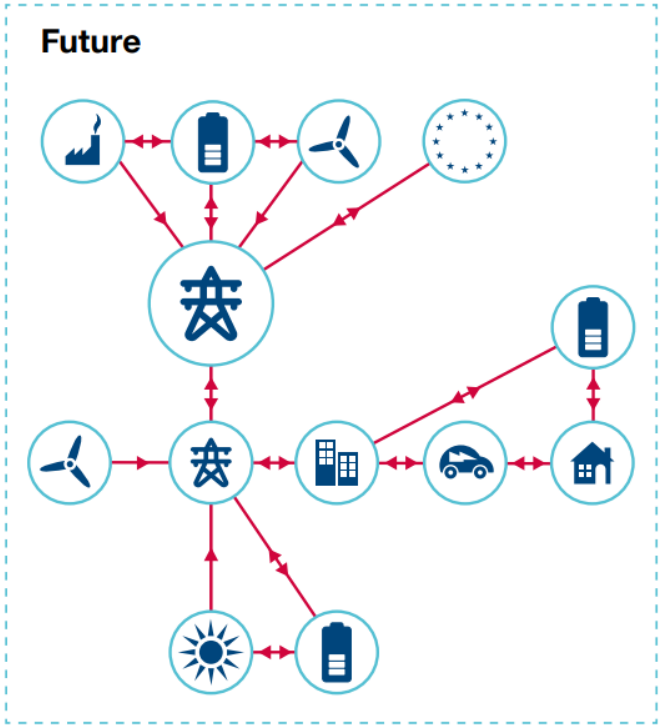
UK Government – full decarbonisation of the electricity system by 2035

Credit: Hywind; National Grid ESO; Hartlepool Power

State of Play

- Past: electricity flows from large transmission-connected generation to the end consumer
- Future: wider range of decentralised, low-carbon energy sources connected in a sophisticated way





Credit: National Grid ESO – FES (2018) (Link)

State of Play

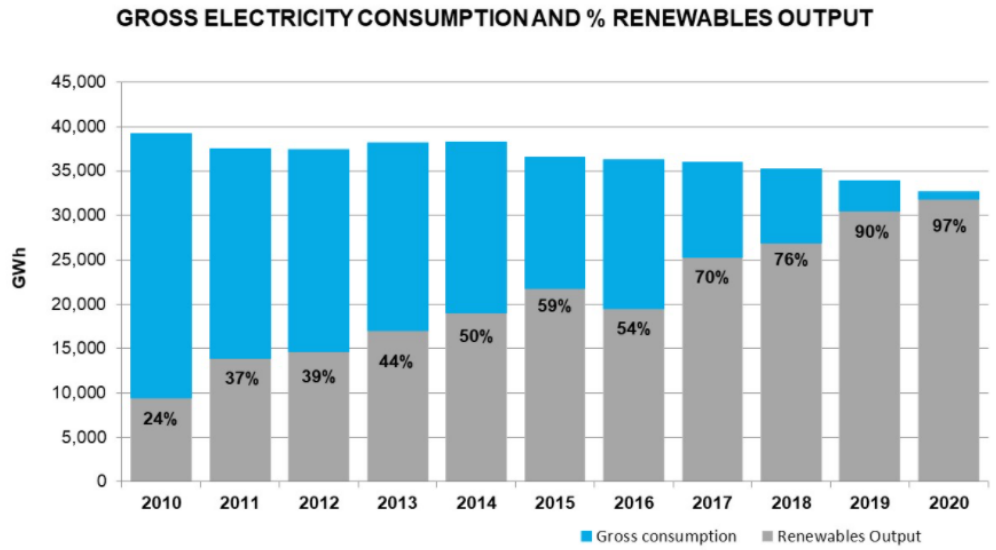
Past

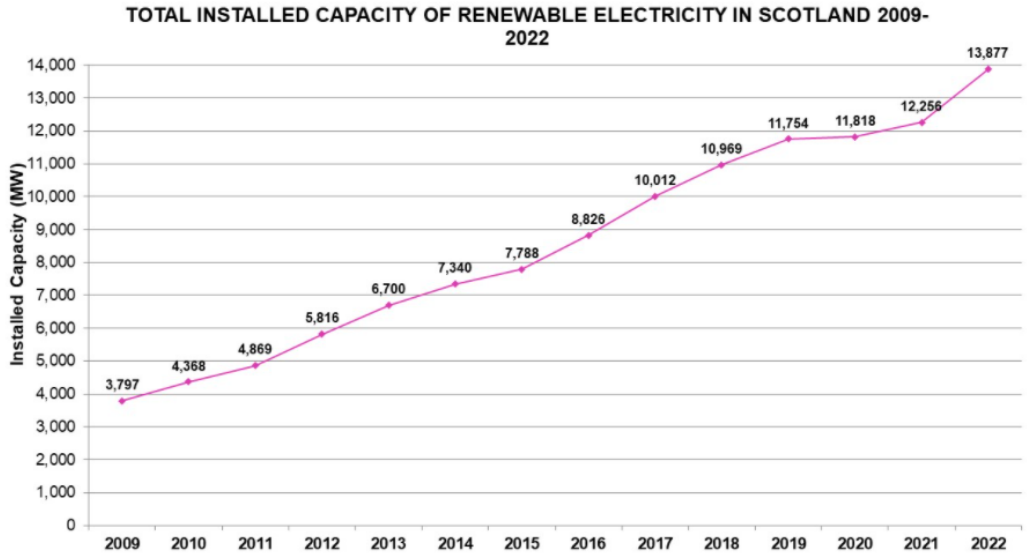
Future

Credit (L to R): UKCA; Drax Power; BBC; Walker, E; Sizewell C / CGN; Narec Dist. Energy [Decerna]; Rolls Royce Group; Xodus Group

State of Play

- Increasing challenges of balancing up renewable and low-carbon generation with the demand centres
- Taking Scotland as an example, frequently on an energy (electricity) surplus
- Renewable electricity = ~97% of Scotland's gross electricity consumption
- However, significant onward planned growth of OWF in Scotland…





Credit: Scottish Renewables (2023) (Link)

Solutions

Investment in upgrade to the transmission system

Combination of onshore and offshore reinforcement

So-called ‘Great Grid Upgrade’

Wide range of UK HVDC reinforcement

Credit (T – B): National Grid ESO; Xodus Group; Global Offshore; National Grid

Solutions

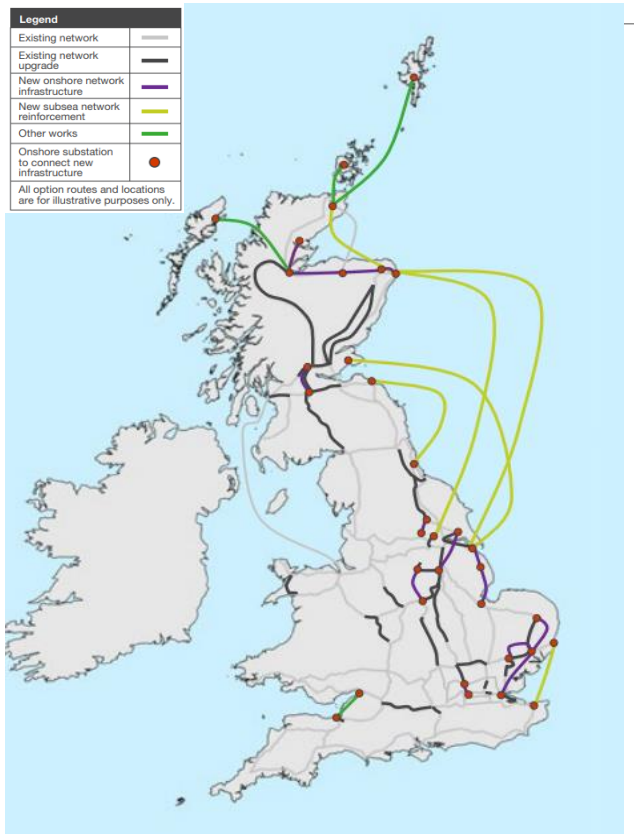
Onshore reinforcement + offshore

National Grid ESO ‘Pathway to 2030’ sets out a vision for a new network to support movement toward net zero

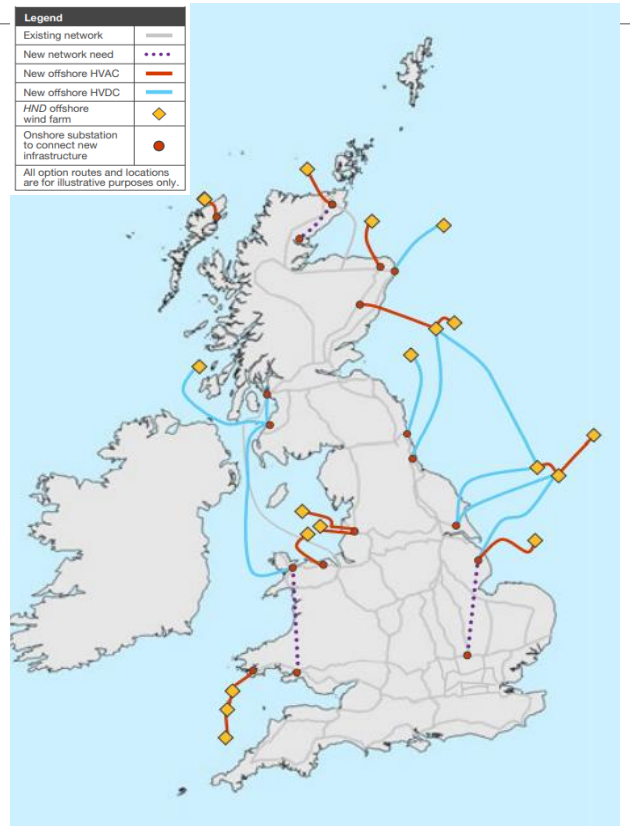
‘Holistic Network Design’ – onshore and offshore design that can facilitate UK ambitions for offshore wind

Credit: National Grid ESO

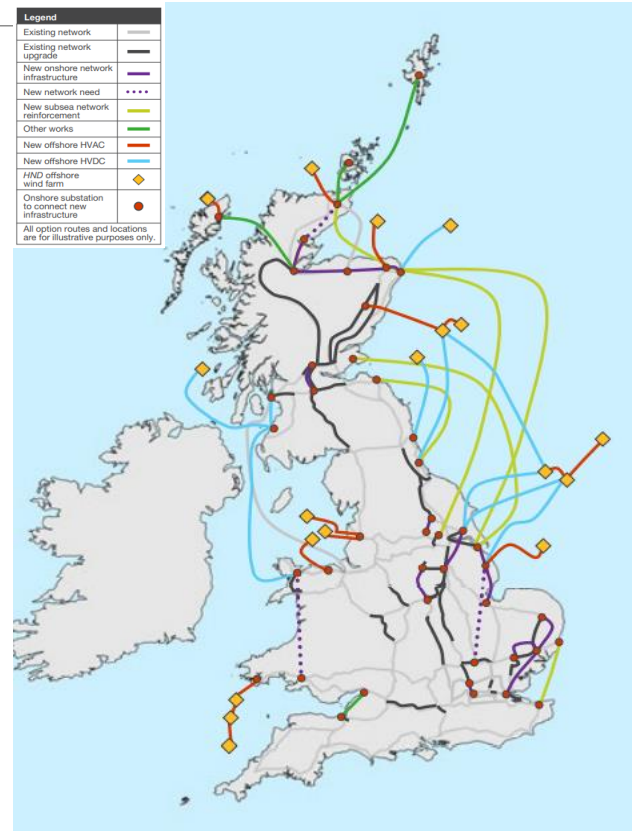
Solutions



HND: Recommendations identified previously



HND: New network needs to be identified



HND: Full set of major network requirements recommended

Credit: National Grid ESO

Key Challenges for Impact Assessment (IA)

- In UK and Ireland, transmission upgrades in the Marine Environment require Marine Consent
- Requirement for supporting Environmental Impact Assessment or non-statutory equivalent
- Often long infrastructure length = myriad environmental interactions
- Critical for IA to achieve a balance between various environmental, technical and commercial considerations
- Following slides consider challenges in further detail
- IA is not in isolation – other wider challenges therefore considered alongside…

Key IA Challenges

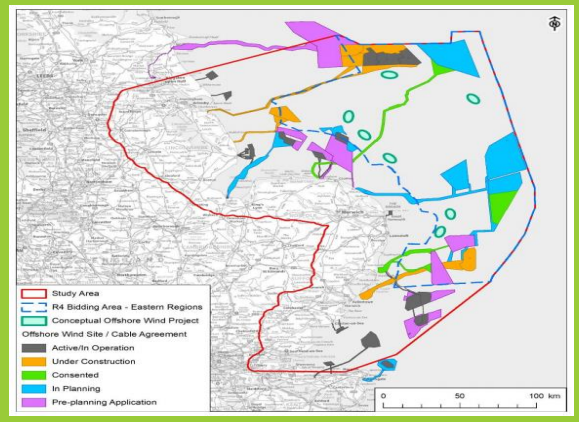
Congestion

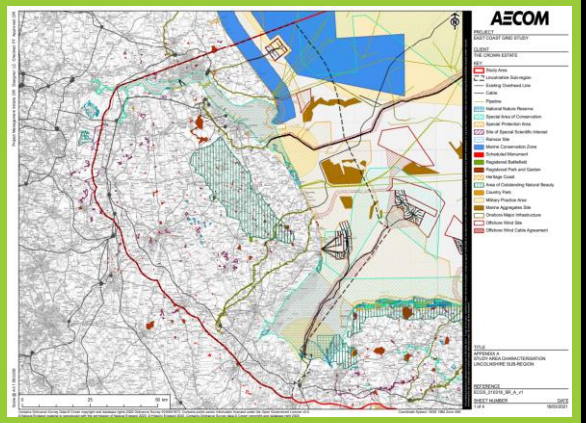
Increasingly more complex to identify and plan transmission

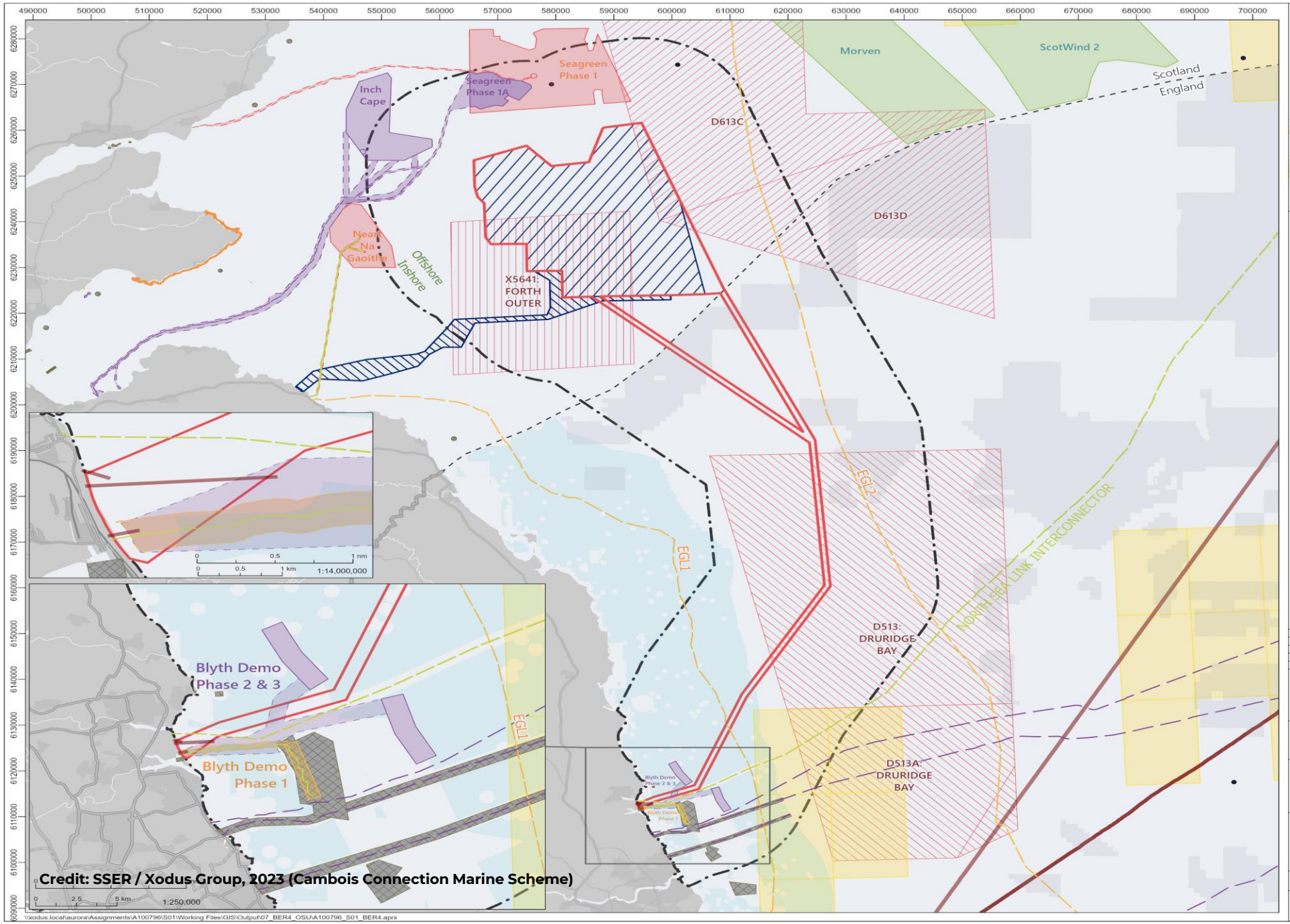
Routeing - how to find the best on-balance solution amidst such a ‘busy’ offshore environment?

Wide range of other sea users – all important to consider…

Need to ensure a careful and balanced consideration at the earliest stage – laying the foundations for a ***Just Transition***







Legend

- Marine Scheme Boundary
- Other Sea Users Study Area
- Berwick Bank Wind Farm Array Area
- Berwick Bank Wind Farm Branxton Connection

Offshore Wind Farm Site Agreements
- Active/In Operation
- Under Construction
- Consented
- Pre Planning

Offshore Wind Farm Site Cable Corridors
- Active/In Operation
- Under Construction
- Consented
- Aquaculture Agreement
- Dredge Disposal Site
- Potential Marine Aggregate Opportunities
- Strategic Areas for Sustainable Aquaculture Production
- 33rd Round Licensing Blocks (NSTA)
- AIAA - Areas of Intense Aerial Activity
- Submarine Exercise Area; Practice and Exercise area (Surface Fleet)
- Surface Danger Area; Firing Danger Area
- Telecom (Active)
- Power (Active)
- Power (Consented/ Planned)
- Pipeline
- Well

Rev	Date	Status	Drwn	Chkd	Appd
04	-	-	-	-	-
03	-	-	-	-	-
02	06/07/2023	Revised	TF	JO	EW
01	06/04/2023	Issued	TF	AMB	EW

sse Renewables

Project

Cambois Connection

Title

Figure 15.2 Other Sea Users Infrastructure

0 2.5 5 10 15 20 nm

0 2.5 5 10 15 20 25 30 km

N

Scale	Plot Size	Datum	Projection
1:700,000	A3	WGS84	UTM30N

Drawing Number: A100796_S01_BER4_2

Sheet No.: 001 OF 001

Credit: SSER / Xodus Group, 2023 (Cambois Connection Marine Scheme)

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Key IA Challenges

Data Acquisition and routeing

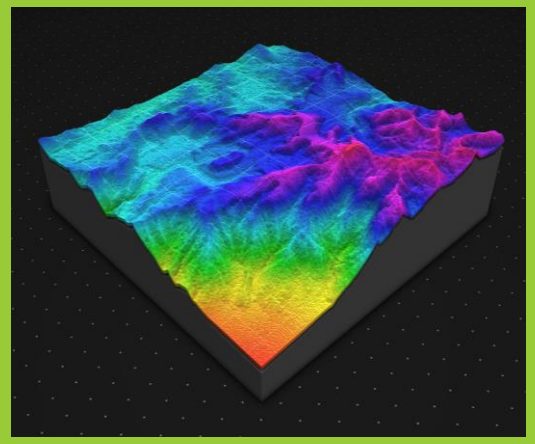
Variable & challenging seabed

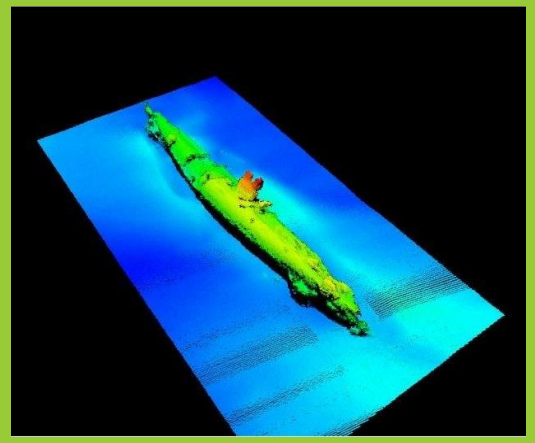
Routeing process can help to avoid many constraints

Not possible to avoid ‘everything’

Data used to inform investigations into burial likelihood etc., which can help inform IA (where programme permits)

Best **on-balance** solution from an environmental, technical and commercial perspective





Credit (T – B): Xodus Group; MMS Offshore; Ocean Ecology; Fugro; WesternLink / SPT

Key IA Challenges

Consenting

- Time to compile Environmental Assessment
- Increasing emphasis on protecting our marine environment, inc. designated sites
- Regulatory experience of transmission growing, but still relatively immature (compared to OWF, for e.g.)
- 'Regulatory burden' – UK marine environment increasingly busy
- Proportionality in IA – balanced decision making is absolutely critical

Marine Management Organisation

Cyfoeth Naturiol Cymru Natural Resources Wales

marinescotland

Scottish Government gov.scot

Credit: MMO; NRW; Marine Scotland; RIBA

Key Technical Challenges

Practical Installation Factors

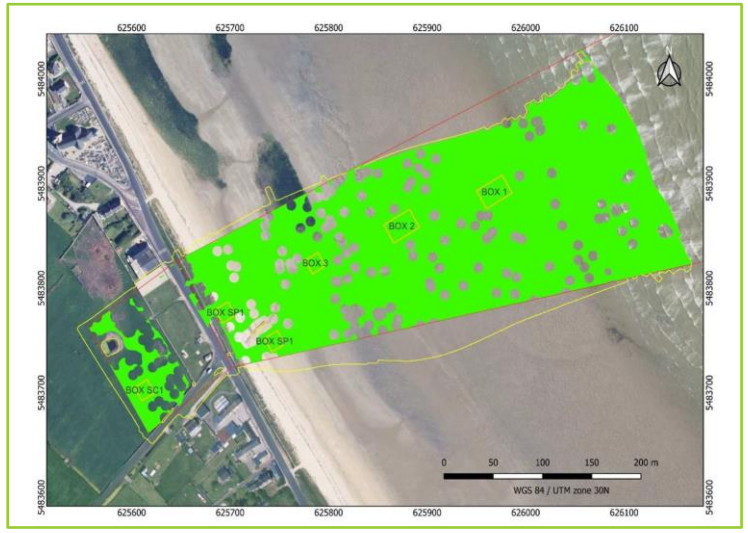
- Physical installation process – highly complex
- Harsh and demanding offshore environment
- Range of installation tools and methodologies to complete

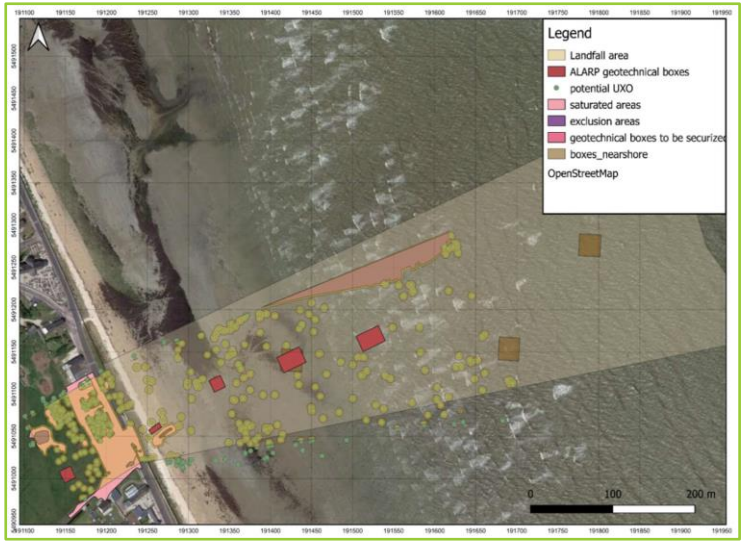
Credit: NKT; Soil Machine Dynamics; IHC International

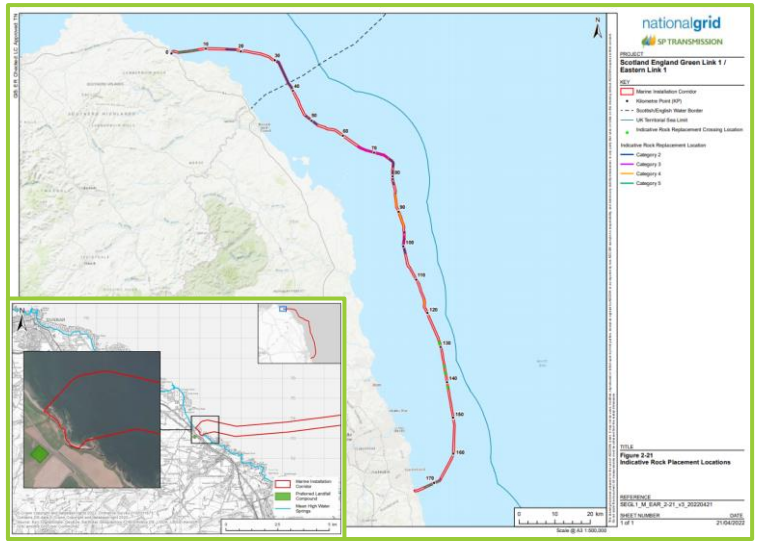
Key Technical Challenges

Landfalling

- Transmission links require landfalls (i.e. the point where offshore meets onshore)
- How to locate a landfall in complex, often sensitive environments?
- Wide range of criteria which need to be considered…





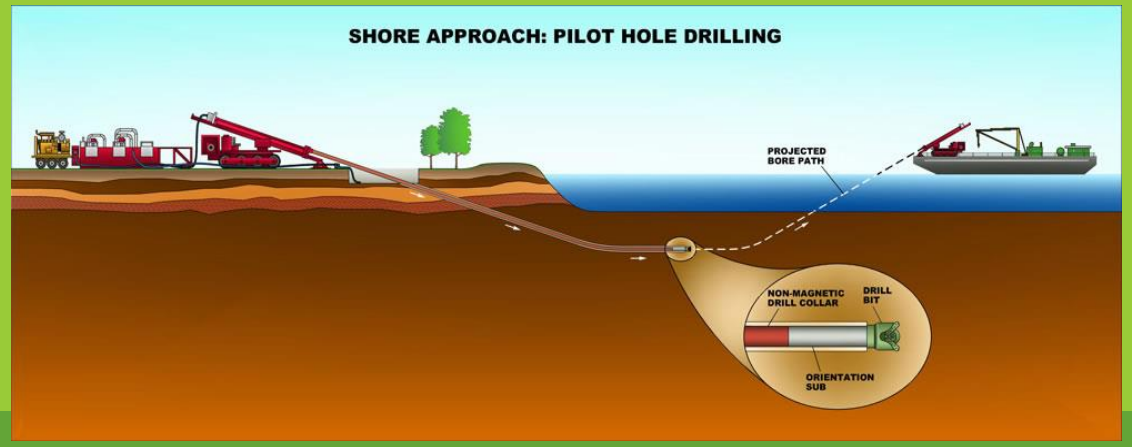


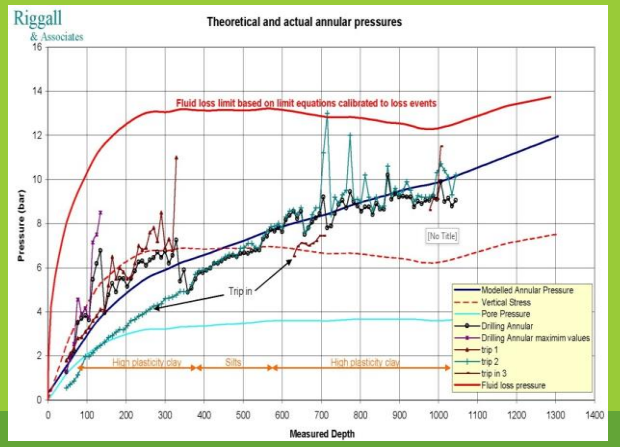
Credit (L – R): Xodus Group; Eastern Green Link 1 / AECOM

Key Technical Challenges

Landfalling

- Selecting a landfall which is technically, commercially and environmentally viable?
- “Consentability”
- Locally acceptable
- Competition (volume of connections vs available space)
- Resilience for lifetime of the project





Credit: FCC Industrial; Flowtex; Riggall & Associates

Key Technical Challenges

Logistical Factors

- Securing vessel availability - “competing” for availability
- Subsea cable manufacturing
- Constrained cable production & installation market

Credit: Prysmian Power Cables; JDR; HDC-Cables Limited

Wider Challenges

Pace

- Scale of these and other challenges significant but need to reinforce at pace
- For example, see below (and this is only one geographical section from the NOA!)

Table 3.1: *HND* essential options for North Scotland

Code	Option description	EISD*	RISD**	Earliest optimal delivery date	Eligible for competition?
BBNC	Beauly to Blackhillock 400 kV double circuit addition	2030		2030	✓
BLN4	Beauly to Loch Buidhe 400 kV reinforcement	2031	2030	2030	✓
BPNC	A new 400 kV double circuit between Blackhillock and Peterhead	2031	2030	2030	✓
E4D3	Eastern Scotland to England link: Peterhead to Drax subsea HVDC Link	2029		2029	✓
E4L5	Eastern Scotland to England 3rd link: Peterhead to the south Humber subsea HVDC Link	2031	2030	2030	✓
PSDC	Spittal to Peterhead HVDC reinforcement	2030		2030	✓
SLU4	New network need between Loch Buidhe and Spittal	2030		2030	✓
TKUP	East Coast Onshore 400 kV Phase 2 reinforcement	2032	2030	2030	✓ (Part)

Table 3.2: List of options and their recommendations for North Scotland

Code	Option description	EISD*	Earliest optimal delivery date	Recommendation	Eligible for competition?
BDUP	Uprate the Beauly to Denny 275 kV circuit to 400 kV	2029	2030	Hold	
DLUP	Windyhill-Lambhill-Denny North 400 kV reinforcement	2029	2029	Proceed	
DNEU	Denny North 400/275 kV second supergrid transformer	2025	2026	Hold	
DWNO	Denny to Wishaw 400 kV reinforcement	2028	2028	Proceed	
DWUP	Kincardine - Wishaw 400 kV reinforcement	2026	2026	Proceed	
LWUP	Kincardine 400 kV reinforcement	2027	2027	Proceed	
TFPC	Power flow control device along Tealing to Westfield	2025	2027	Hold	

* EISD is currently based on the current regulatory and consenting process and acceleration

Forward Look

Transmission System

- UK transmission reinforcement – ‘Great Grid Upgrade’
- Several ‘leading’ schemes (watch this space for schemes such as Eastern Green Link 1 and 2 which have all primary consents - early works have begun)
- Further emerging schemes, as recommended by the NOA

Forward Look

Innovation

- Emerging solutions, such as Multi-Point Interconnectors
- Development of significant volume of Offshore Wind in Irish Waters
- Growth of Floating Offshore Wind – how can this integrate into the evolving transmission system?
- Role of other technologies, such as Hydrogen and CCUS – relationship with transmission system?
- Use of data to help speed up development

Forward Look

Collaboration

- We are in a Climate Emergency
- The old “master-slave” system of Regulator and Applicant is no longer appropriate
- Vital for early and meaningful joint work (between developer, regulator and wider stakeholders)
- Involvement of coastal communities at an early stage
- Meaningful stakeholder involvement at outline routeing / optioneering, followed by detailed technical discussions throughout the IA process
- Sharing lessons learned and cultivating good practices within the industry (IEMA award this week!)

Forward Look

Resource Demands

- Complex infrastructure projects = significant and varied demands for people
- Major opportunity for those considering marine careers
- Existing and future demand for skilled individuals in the IA space
- How can industry help work with the regulator to help up-skill and develop too?

Forward Look

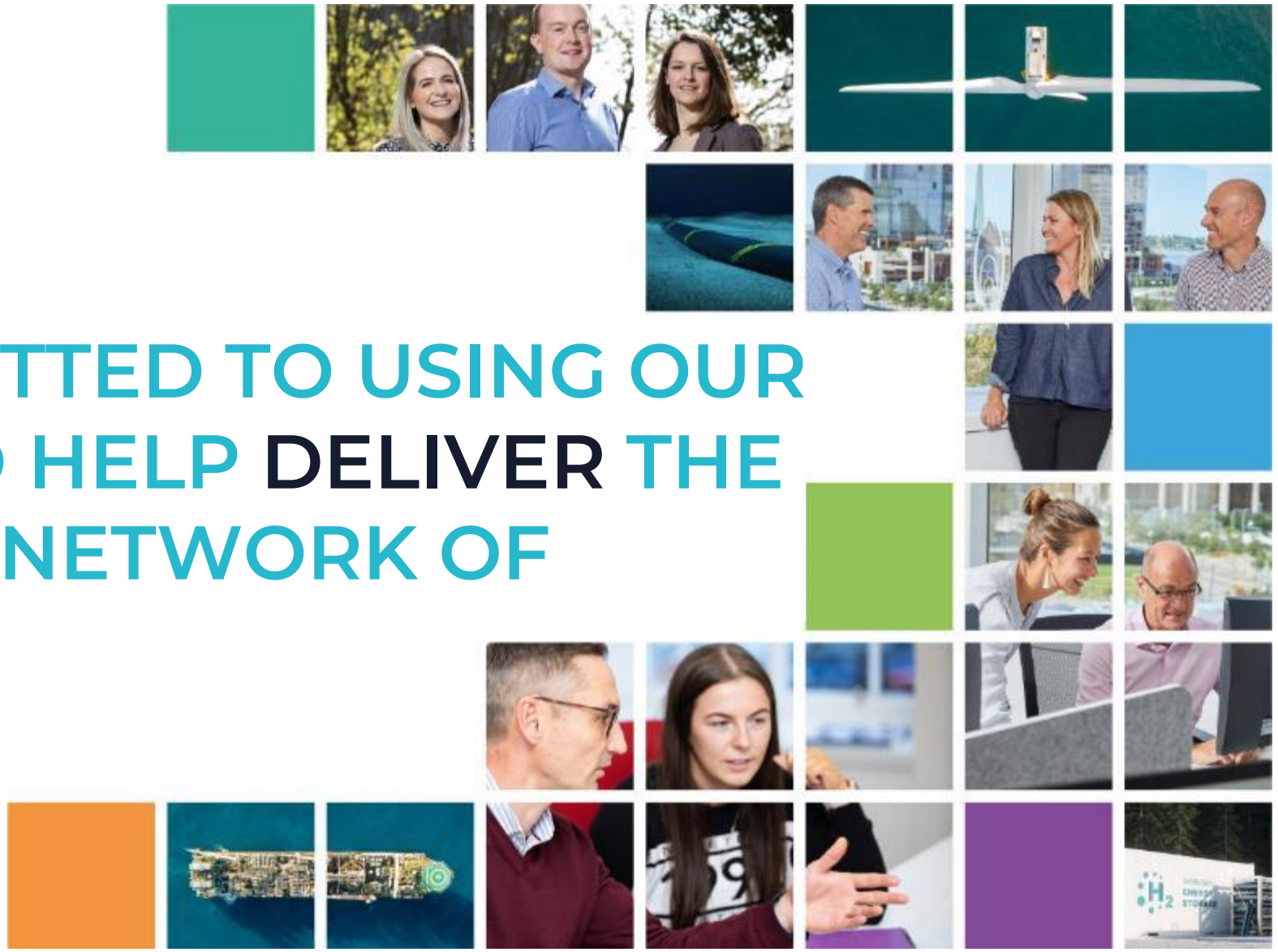
Pace

- Urgency of required upgrades
- In order to tackle the challenge at hand, urgent need for coordination
- More coordinated network? Shared landfalls?
- Whilst working at pace, need to do so whilst maintaining **safety as the top priority**

Conclusions & Key Takeaways

1. Embracing Challenge
2. Collaboration with Regulator
3. Pace
4. Opportunity
5. Ongoing Industry Actions

WE ARE COMMITTED TO USING OUR EXPERIENCE TO HELP DELIVER THE TRANSMISSION NETWORK OF TOMORROW.



Further Reading

- Future Energy Scenarios ('FES') – National Grid ESO (Link)
- East Coast Study – The Crown Estate (Link)
- Offshore Coordination Project – National Grid ESO (Link)
- The Great Grid Upgrade – National Grid (Link)
- Pathway to 2030 Holistic Network Design ('HND') (Link)
- Network Options Assessment ('NOA') / NOA Refresh (Link)
- Offshore Transmission Network Review ('OTNR') (Link)
- 'Finding Space for Offshore Wind' – The Crown Estate (Link)
- Information about the three UK transmission owners (Link)
- Carbon Trust CBRA Guidance – The Carbon Trust (Link)
- Xodus Interconnectors and Cables – case studies available on request (Link here; contact details follow below)

Let’s continue the conversation!

Post questions and comments in the IAIA24 app.

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