

# Offshore Wind and CCUS Co-Location Forum

1st Plenary Meeting

16th November 2021



# Agenda

1. **Brief Introductions.**
2. **Review actions / minutes from last meeting.**
3. **Updates from work-stream leads on each work-list item.**
4. **Confirm actions on work-streams.**
5. **Next meeting dates (work-streams, next plenary etc.)**

# Actions from Plenary #1

Item	List of Actions for Next Meeting	Action
1. 2. 3. 4.	<p>Contact each Workstream Lead to ensure progress before next plenary.</p> <p>Clarify how plenary and subgroups will communicate in communication policy. Define what information can be shared with any subgroup members that are not plenary members. Remove word "guidelines" in policy table as it refers to the whole document.</p> <p>Investigate opportunity for a single collocation forum logo or use forum member logos.</p> <p>Include OBN presentation from OGA with the minutes (attachment 1).</p>	Chair
5. 6.	<p>Issue 'NEW' worklist to reflect discussion (attachment 2).</p> <p>Suggest dates for next plenary meeting to be held in November, agree and send invite.</p>	Secretary
7.	<p>Present work schedule for workstream #4 'Co-location map' to forum in ad-hoc meeting to be arranged and seek forum agreement to start prior to next plenary.</p>	TCE
8.	<p>Plan work schedules and any budget requests for forum if not covered by sub-group, send to Chair for Secretary to distribute for comment by all forum members. See 'CLF plan' sheet for summary of involvement and draft Gantt chart.</p> <p><i>* Ref. column E sheet 'NEW' of attachment 2) 'CLF Plan'</i></p>	Workstream Leads*
9. 10. 11.	<p>Workstream #6 to seek forum agreement to start prior to next plenary.</p> <p>KD &amp; NR to confirm acceptance of communications policy, subject to above changes.</p> <p>Present work on types of seismic streamer (traditional and short) for monitoring.</p>	OGA

# OW/CCUS Co-Location Forum – Workstreams

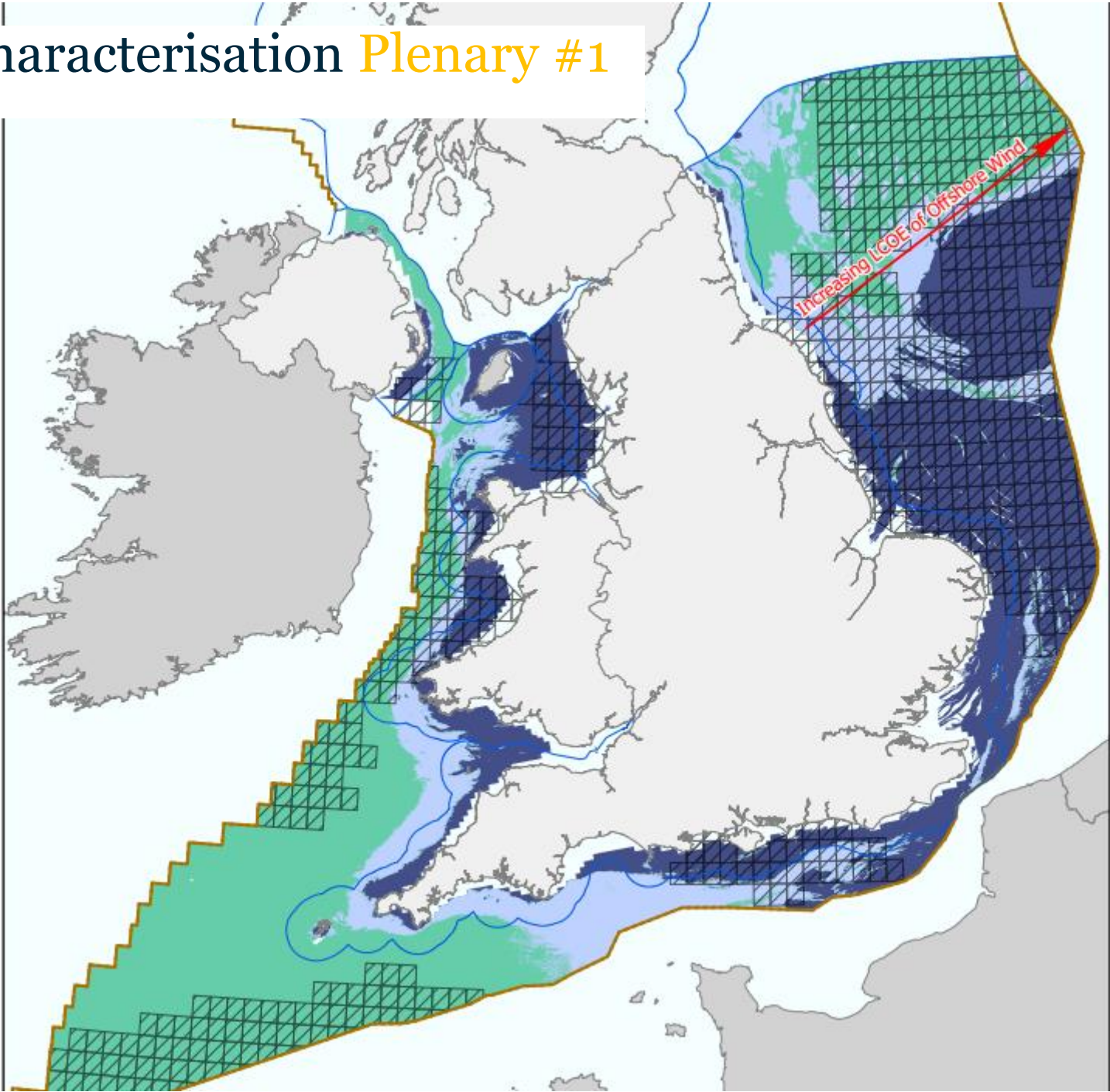
CLF Plan	3Q21	4Q21	1Q22	2Q22	3Q22	4Q22	1Q23	2Q23	beyond CLF
plenary meetings	Aug	Nov	Feb	May	Aug	Nov	(Feb)	(May)	
1-CLF									
2-Operational alignment									
3-Development liability		Plan	OGA Status			OGA Report			
4-Spatial characterisation		Plan	TCE Report						
5-Spatial planning (follows 4)				Plan		TCE Report			
6-MMV seismic		Plan	OGA Status			OGA Report			
7-OW/CS simops				RUK Report					
8-Wider impact				Plan	TCE Report				
9-Simops opportunities				Plan	RUK Report				
10-Geomech/brine impacts		Plan	CCSA Report						
11-Stakeholder engagement		Plan		TCE/CES Report					

# OW/CCUS Co-Location Forum – Workstreams (Revised)

CLF Plan - v1	3Q21	4Q21	1Q22	2Q22	3Q22	4Q22	1Q23	2Q23	beyond CLF
plenary meetings	Aug	Nov	Feb	May	Aug	Nov	(Feb)	(May)	
1-CLF									
2-Operational alignment									
3-Development liability					Plan?				
4-Spatial characterisation		Plan	TCE Report						
5-Spatial planning (follows 4)				Plan		TCE Report			
6-MMV seismic		Plan	OGA Status			OGA Report			
7-OW/CS simops			ETA Plan		ETA Report	ETA Report			
8-Wider impact				ETA Plan		ETA Report			
9-Simops opportunities				ETA Plan		ETA Report			
10-Geomech/brine impacts				ETA Plan		ETA Report			
11-Stakeholder engagement		Plan				TCE/CES Report			

# CLF#4 Spatial Characterisation Plenary #1

CO2 Storage –  
Offshore Wind  
Potential  
Future  
Overlaps

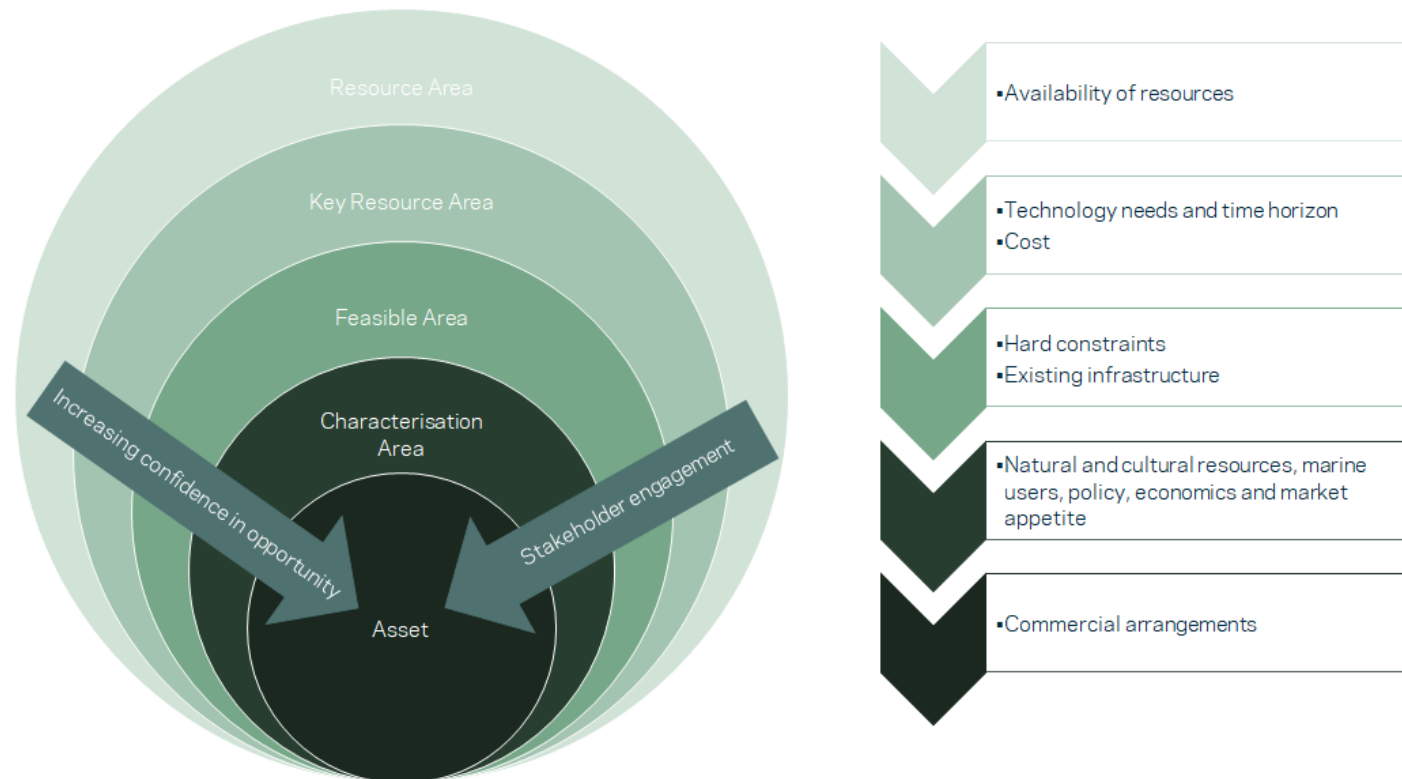


- ▨ Relatively High Potential Carbon Storage
- Floating Wind Key Resource Area
- Fixed Wind Key Resource Area
- Both Fixed and Floating Key Resource Areas
- Base Mapping
  - United Kingdom
  - Territorial Waters Limit
  - - Renewable Energy Zone Limit
  - UK Continental Shelf
  - Europe

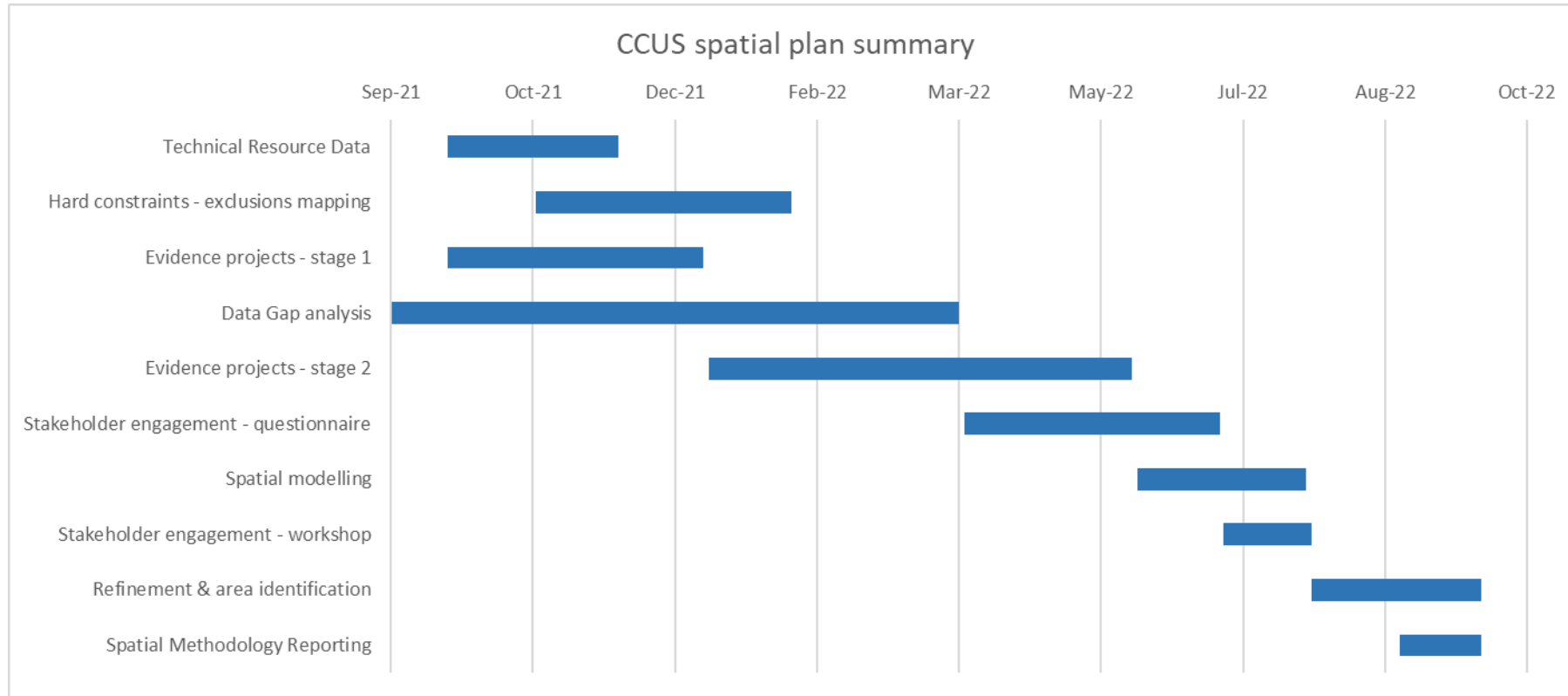


# CLF#4 Spatial Characterisation Plenary #2

- OGA are providing an update to the 'Relatively High Potential Carbon Storage' mapping
- Will account for additional data on subsurface uncertainty due to seal integrity & reservoir quality
- TCE identifying other seabed constraints & commissioning further evidence projects in order to feed these into spatial modelling together with technical resource data

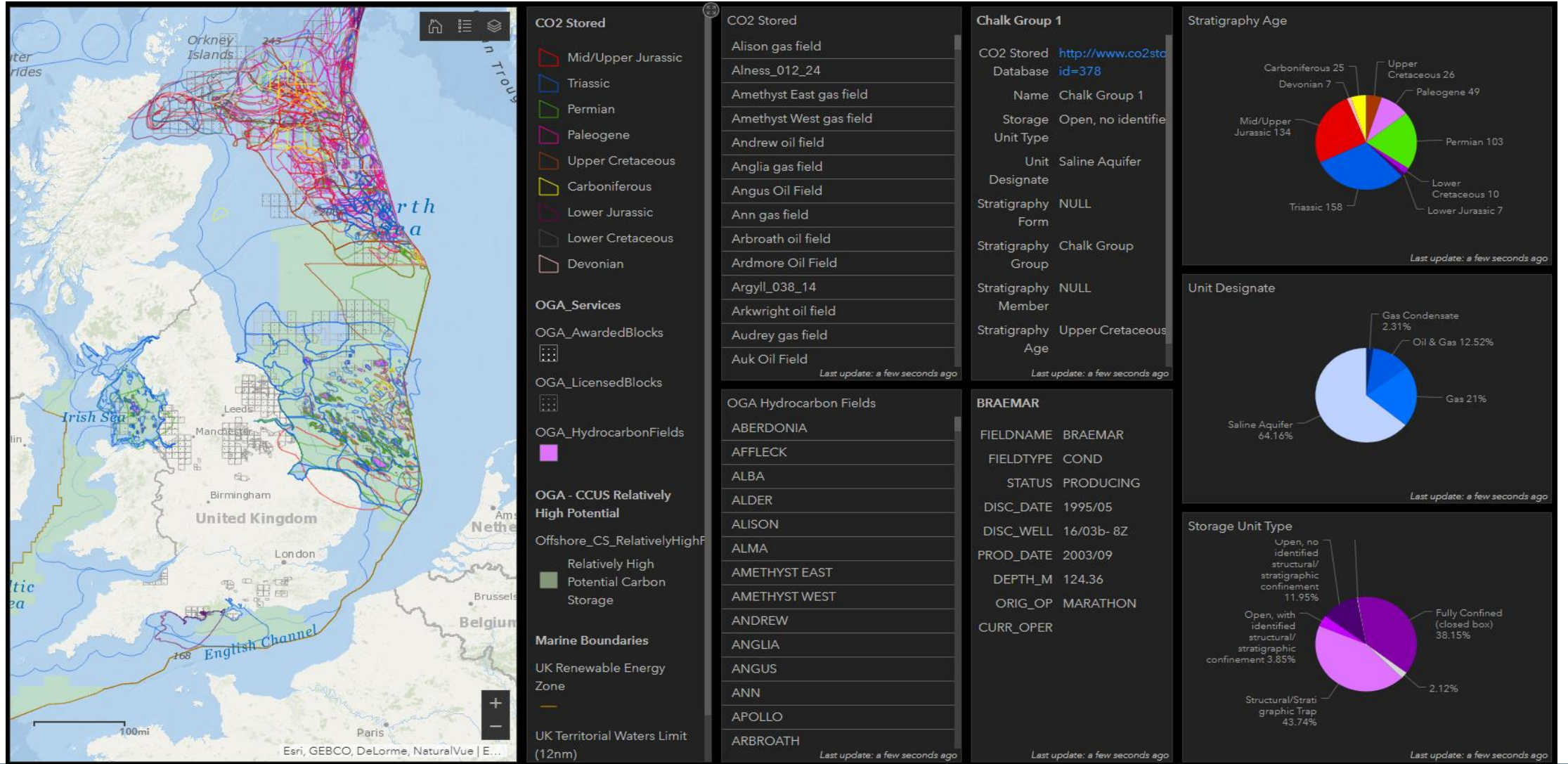


# CLF#4 Spatial Characterisation Plenary #2

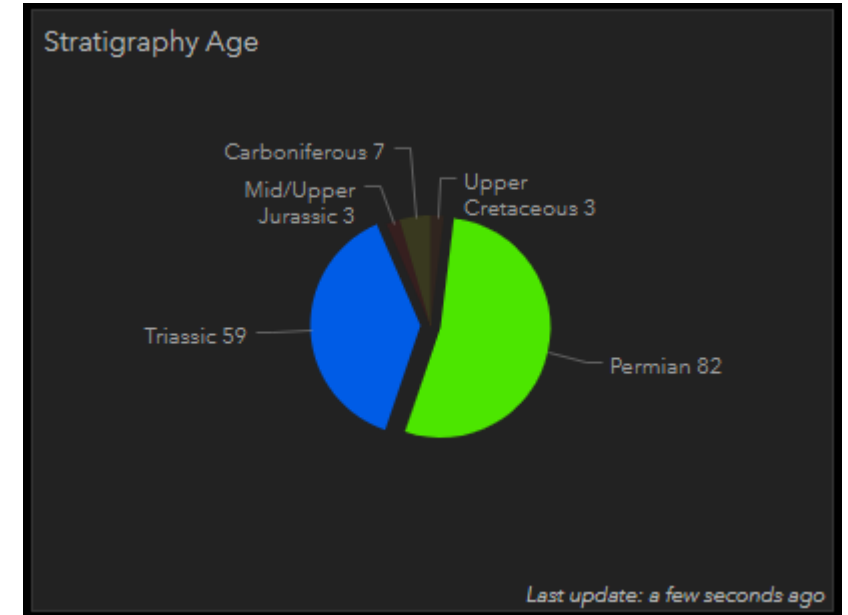
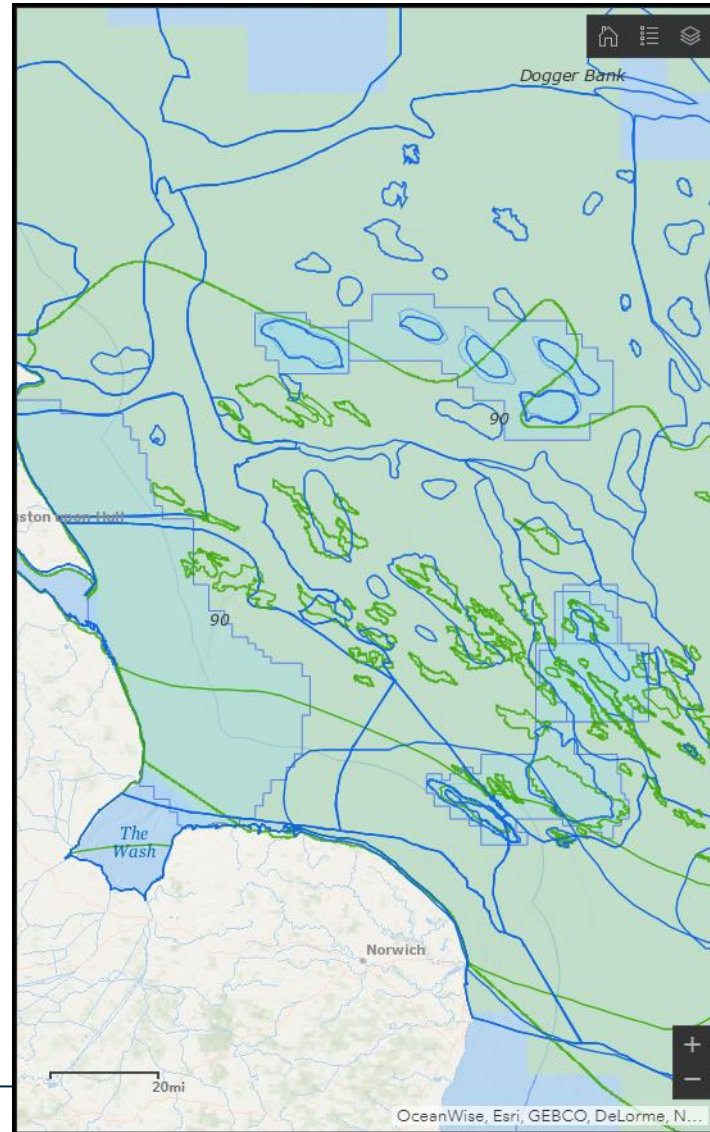
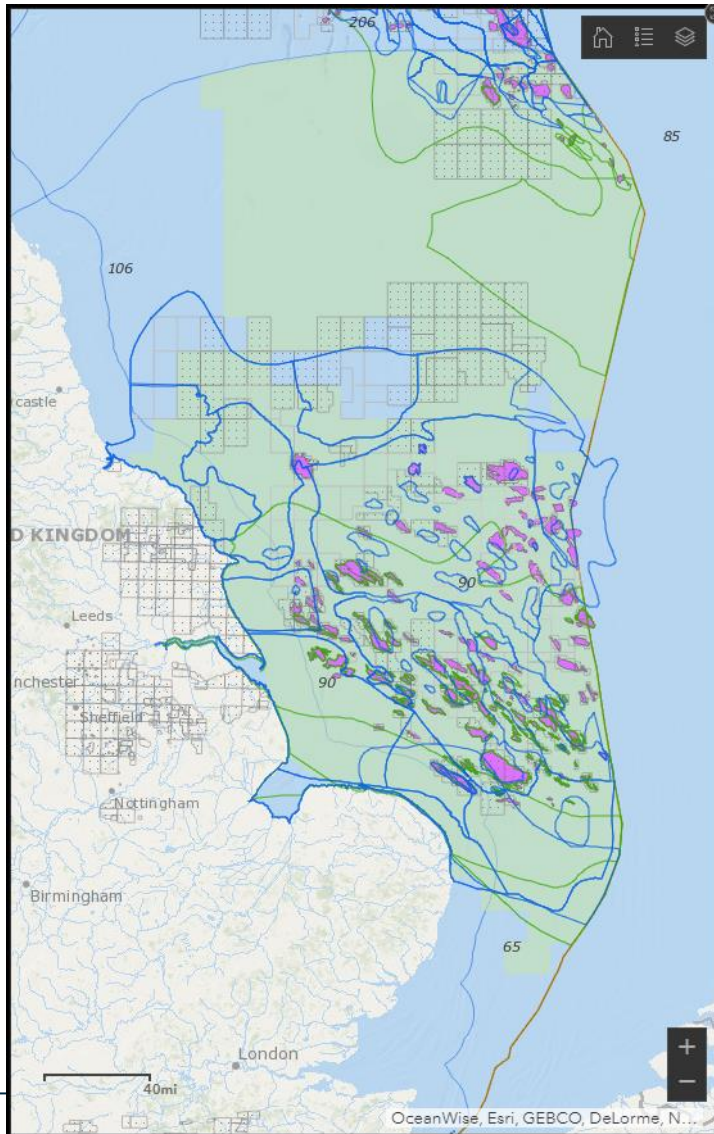




# CLF#4 Spatial Characterisation Plenary #2



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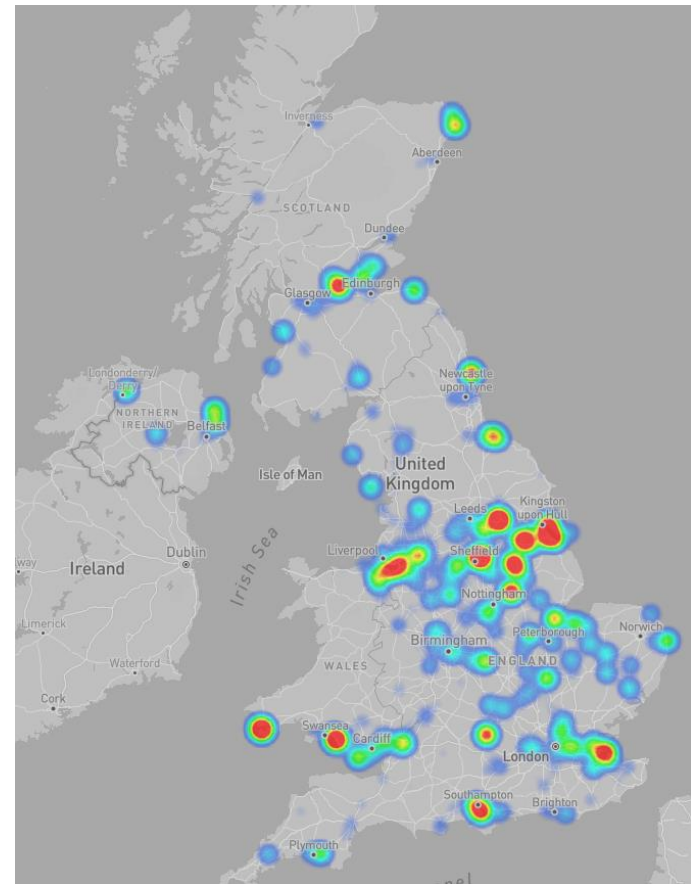
11.

SNS: deeper Permian (Rotliegend) gas fields, shallower Triassic (Bunter) saline aquifers

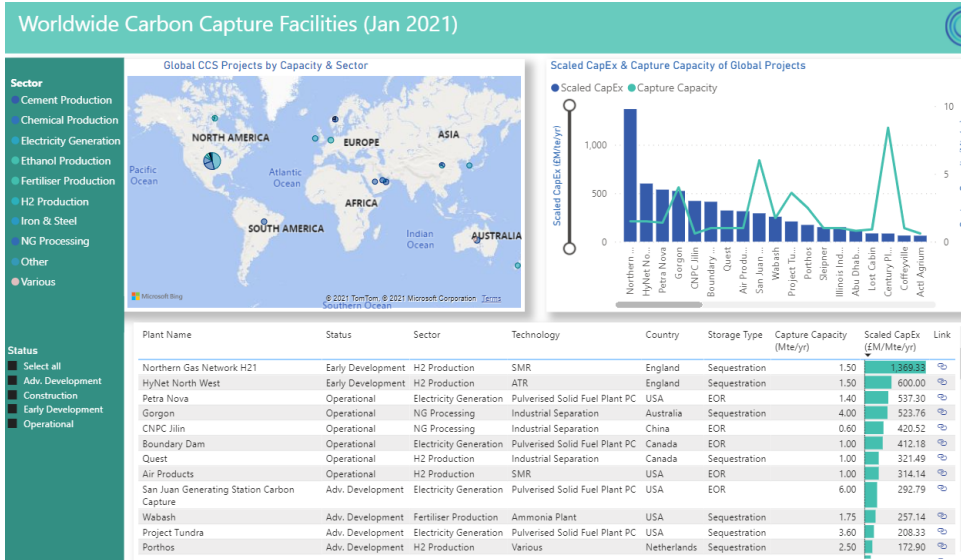


# CLF#4 plenary #2

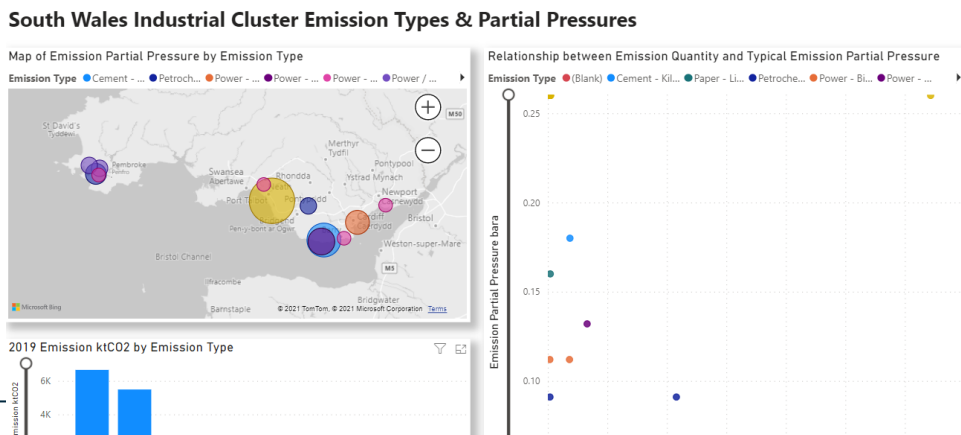
## 1. Emission Heat Map:



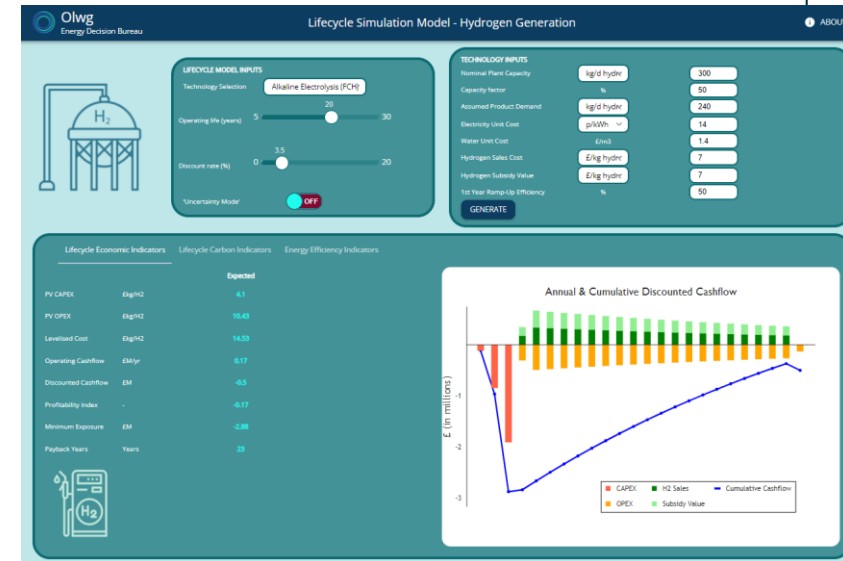
## 2. CCS Technology / Cost Dashboard



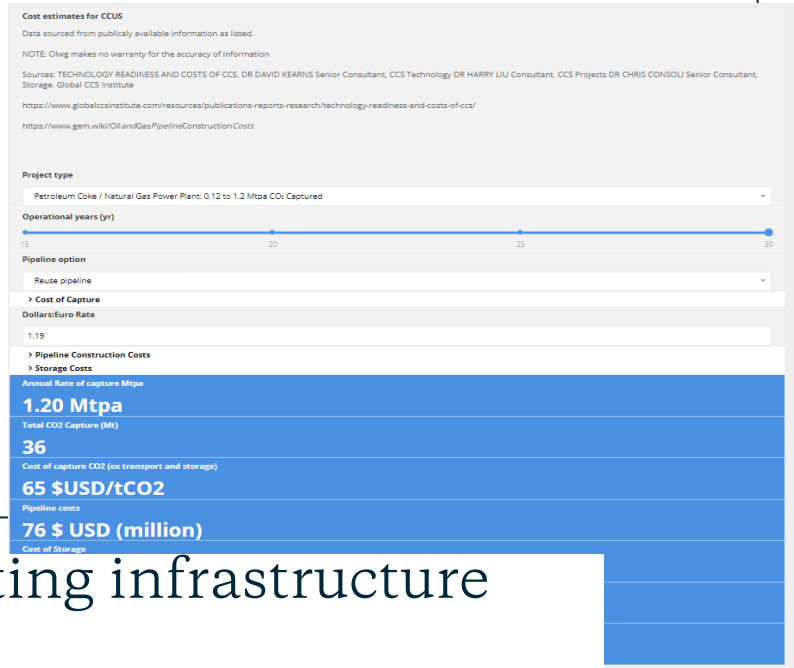
## 3/ South Wales CCS Dashboard



## 4. Development lifecycle simulator



## 5/ 'Simple' cost calculator



# CLF#4 Spatial Characterisation plenary #2



# Co-location Forum #6 (seismic monitoring) 9/11/21



Oil & Gas Authority

- 1) Pre-existing OGA Co-Location seismic monitoring project report: Completion Nov 21
- 2) CO2 Seismic monitoring detection threshold: Predict seismic signal across range of reservoirs
  - Fluid substitution ~ 10 wells around UKCS, to CO2,
  - Defining project scope with petrophysical consultancy, Fully OGA sponsored. Anticipated Completion end March 22
- 3) Review development & future trends of Ocean Bottom Nodes (OBN)
  - Interview & Desktop based study into equipment & processing/imaging trends
  - Fully OGA sponsored, Seismic Acquisition consultant engaged. Anticipated Completion end March 22
- 4) Towed seismic acquisition with confined environment:
  - Scoping out project e.g. acquisition modelling: viability of towing sources & maximum single streamer length within turbine corridor
  - **Likely future request to co-location forum** for modelling study
- 5) Level of Windfarm seismic/ acoustic noise: Significant existing research. Mainly onshore focussed.
  - Post Doc Literature review of existing research: see Research proposal from Heriot Watt
    - Option to analyse some offshore data
  - **Request Co-location forum supports this £35k+VAT** Completion end Mar 2022
- 6) Do turbines provide seismic noise or a potential signal?
  - Propose technology sharing with identified major seismic acquisition contractor
    - Scope OBN survey design & Share windfarm noise study
    - Design future nodes field study
  - **No anticipated cost to co-location forum at this time**
    - Awareness of potential to react to opportunistic 2022 acquisition
  - Potential to be a major acquisition project and/or fully funded PhD from 2023
  - Request: Forum members requested to identify potential locations & upcoming planned surveys for co-location field trials

# Background



Geophysical Monitoring Group,  
School of Energy, Geoscience, Infrastructure and Society,  
Heriot-Watt University

## A PROPOSAL TO REVIEW LITERATURE ON THE CHARACTERISATION OF SEISMIC VIBRATIONS FROM WIND TURBINES

### Background to GMG@HWU

The seismic monitoring group at Heriot-Watt University has been actively involved in measurement and analysis of the operational and structural characteristics of wind turbine vibrations for several years. We have previously analysed seismic data collected from the Sanguhar windfarm to investigate the frequency and amplitude content of vibrations from single and multiple turbines arrays both in the near- and far-field. A primary focus of this study was the decay of these vibrations with distance. The seismic energy was found to depend on direction, wind speed, rotational blade speed, and turbine structure. Further research has utilised finite element modelling of the key structural components of the tower system, to help determine the principal eigenfrequencies and eigenmodes of importance to seismic generation. This has included an investigation of the tower-foundation interaction. These studies, combined with the seismic analysis has helped to understand the wind turbine as a complex multicomponent source of vibration. We continue our further research on this topic by active partnership with Heriot-Watt's Civil Engineering group.

### Scope of project

Wind turbines generate semi-continuous seismic vibrations that depend on wind speed in addition to practical and operational considerations. In the UK, these vibrations can interfere with sensitive installations onshore and active seismic operations offshore. Windfarms may also provide a future potential source of useful energy for imaging. Based on our past and current projects on the analysis of wind farm signal and recent work on using a wind turbine as a seismic source, it is proposed to carry out an extensive review of all currently available literature for both onshore and offshore turbine structures. We will use our previous experience to describe and characterise the expected behaviour of the seismic waves, their frequency and amplitude content, their propagation characteristics (including attenuation), and how this might interfere with offshore surveying. Also of relevance is the geological conditions, wind conditions and turbine type and size. We will also provide context for this analysis with an understanding of anticipated ambient noise conditions. This will enable OGA to understand current research in this area and build on this previous knowledge in future survey.

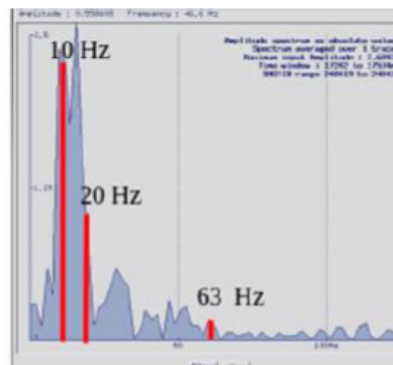
### Costing

The review will take two man-months to complete (8 weeks), with an estimated cost of £30,000 (40 days at £750 per day). This will include the cost of a postdoctoral researcher and supervision time. Note that VAT will be applied to this amount by the university finance department.

### Contact

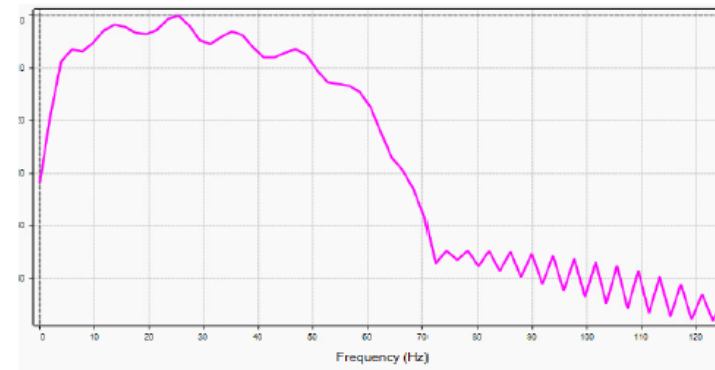
Colin MacBeth  
Professor of Geophysical Monitoring,  
[c.macbeth@hw.ac.uk](mailto:c.macbeth@hw.ac.uk)  
Tel: 07814207634

## Turbine acoustic signal



[The Industrial Wind Turbine Seismic Source | CSEG RECORDER](#) 2019  
Westwood et al. Near Surface Geophysics 2015

## Typical reservoir seismic Frequency/amplitude



[GEO ExPro - Marine Seismic Sources Part I](#)

Wind turbine Pulse is similar to that created by a seismic airgun,  
More limited frequency range: shifted toward the low frequencies (1-20Hz)  
A seismic source is designed with a flat spectrum between ~ 4-70Hz

OGA requested access to High Resolution seismic acquired within marine windfarm.

If successful, the Heriot Watt study will also include

- Review shot gathers (raw data) for level windfarm noise
- Visual inspection and frequency/amplitude analysis
- Additional £5000

Optional Future option to fund PhD 2023-2025 into turbines as a seismic source





## Fluid substitution rock physics

**Summary:** desk-based study focused on the fundamental question of the applicability of OBS 4D seismic to the imaging and monitoring of CO<sub>2</sub> injection in different subsurface formations. The study will also review international experience of 4D seismic for CO<sub>2</sub> monitoring, as well as ongoing geological research on the subject.

**Objectives:** Delivery of a short summary report to include:

- Overview of the boundaries of CO<sub>2</sub> 4D imaging detection by OBS as a function of different storage sites (geology, depth, and in situ fluid composition), building on industry experience
- A rock physics fluid substitution modelling study, which describes the geological storage plays in which a CO<sub>2</sub> injection signal would be expected to be seen, with priority reservoirs for evaluation based on Track 1 cluster sequencing decisions

## OBS Technology Current State Assessment

**Summary:** desk-based study to review OB technology applications and their portability to CO<sub>2</sub> storage monitoring to understand the viability of OBN seismic as a valid alternative to conventional towed-streamer seismic, creating distinct advantages in areas where spatial co-location (with windfarms and/or other surface users) may be an issue.

**Objectives:** Delivery of a short summary report to include:

- OBS current state assessment
- OBS strengths and limitations
- OBS footprint and usage in proximity to existing installations, inferring whether OBS would still create operational conflicts with offshore windfarms (fixed and floating)
- OBS costs, both as a proportion of future CO<sub>2</sub> operating costs, and compared with conventional surface streamers (incl. expected future cost trends)
- OBS future technology developments

**OGA leading and funding 2 projects on behalf of forum, to conclude by 31 March 2022**



# CLF#11 Stakeholder Engagement

- 4<sup>th</sup> November TCE, CES, MMO, NRW/Welsh Govt., Mar.Scot.(apologies)
- Meet quarterly, focus sharing output from the main group
- Forum offers opportunity for early information
- Feed into spatial planning work and understand the implications