Project Name	**OFFSHORE WIND & CCUS CO-LOCATION FORUM 6th PLENARY MEETING**
Meeting Venue	Held online via Microsoft Teams
Date & Time of Meeting	10:00am – 12:00pm on Wednesday 1st March 2023

Chair of the Meeting	Adrian Topham (The Crown Estate)	
Names of the Attendees	• James Musgrave – TCE • Amy Bloomfield – Clarke – TCE • Farhad Zaidi – TCE • Abby Haines – TCE • Evelyn Ryan – Grayling (TCE Comms Support) • Ross McWilliams – Grayling (TCE Comms Support) • Tristan Bromley – BEIS	• Wael Khatib – BEIS • Philippa Parmiter – CES • Nick Richardson-NSTA • Ronnie Parr – NSTA • Viana Iancu – NSTA • Juliette Webb – Renewable UK • Iain Wilson – DEFRA • George Sutton – MMO • Coco Dietz – MMO

Item	Notes
1.0	**WELCOME AND INTRODUCTION** The Chair opened the plenary meeting by welcoming everyone. With this being a virtual meeting and including several new members brief introductions took place. Review of the agenda and meeting structure. Recap of the Forum objectives – to refresh existing members and update the new members as to the aims of this group. Providing a summary on the five key objectives and how these relate to the forum.
2.0	**REVIEW ACTIONS & MINUTES FROM LAST MEETING** Action 1) Questionnaire to be sent to Developer event attendees suggesting similar events, meeting dates & to identify best future attendees. • Closed - Feedback was received from the previous developer event in September and will be used when planning future events. As well as trade bodies, knowledge of specific companies could add benefit to future events. Action 2) Issue suitably redacted minutes and slides to Forum Members from all plenaries to date for publication on website. • Closed - the 5th plenary minutes will be uploaded with the 6th plenary minutes. Action 3) Project Management proposal for Workstreams 7-10 to be circulated asap. • For discussion – to be shared alongside minutes of 6th plenary meeting.

	Action 4) Suggested dates for next plenary meeting Jan/Feb'23 to be agreed and invitation, agenda and pre-reading issued. Hybrid event combined with separate in-depth Workstream sessions. • Closed – OREC sent meeting invitation and pre-read materials. Action 5) Consider forum and meeting structure (members, meeting frequencies etc.) and feedback views. • For discussion – summary of discussion in section 4. Forum & meeting structure Action 6) OW to host a trial to gather seismic data, BS, RP and NR to speak and develop plans offline. • Closed – update was provided, summary provided in 3. Updates from Active Workstreams, sub-section MMV seismic
3.1	**UPDATE FROM ACTIVE WORKSTREAMS** **Workstream 1: CLF** The Chair updated on the status of the workstreams and shared workstreams timeline: • Workstream 1 (CLF) remains ongoing. • Workstream 4 (Spatial characterisation) – work has been completed for this workstream and the report was included in the plenary pre-read documents. Next step to request approval to publish. • Workstream 5 (Spatial planning) – Follows on from Spatial characterisation, potentially difficult for forum to progress, to be discussed. • Workstream 6 (MMV seismic) – NSTA made progress on this and published material on their website, summary document to follow for TCE to publish. • Workstream 7 (OW/CS simops) – to be discussed, proposal was included in pre-read. Simops opportunities part of this workstream. • Workstream 11 (Stakeholder engagement) – initiated by bringing in new members to the forum (MMO, Marine Scotland, Welsh Gov, Defra). Specific engagement to be discussed. The Chair proposed replacing spatial planning workstream with test and demonstration projects. Summary provided of discussion in spatial planning section.
3.2	**WORKSTREAM 4: SPATIAL CHARACTERISATION OF HIGH VALUE CCUS AND OW SITES** Outcomes of work has been summarised and shared in the pre-read. The Chair updated on report outcomes. The key points were: • Larger and more diverse (geologically/geographically) stores required • More carbon store appraisal required The summary report will also be shared on forum website following the plenary. The Chair took an action to publish the report and thanks all involved parties, workstream complete.

3.3	**WORKSTREAM 5: OW/CCUS SPATIAL PLANNING** The Chair proposed replacing this workstream with T&D projects. Previous workstream - spatial characterisation - shows carbon store location relative to windfarms, to move forward with co-location ability, practical demos are required. Need to look at range of issues – the Chair mentioned that discussions are underway to scope out potential projects with two universities (University of Aberdeen and Durham University). Request for more information on specific project details. The Chair will share this following the meeting. Marine spatial prioritisation work at Defra raised, researching spatial issues and conducting stakeholder engagement. TCE are aware of this and caught up regarding OW, work ongoing to collaborate on CCUS. Defra working on stakeholder engagement plan. Need to understand differences between T&D and Defra work. The Chair mentions this would look at what kind of projects could be achieved, as well as MMV issues, power etc. Not so much policy. Question asked about the intended output of the T&D work. The Chair mentions likely to be a desktop study looking at mechanics of opportunities. CES has also been approached by the universities, will discuss with TCE to ensure no overlap of work.
3.4	**WORKSTREAM 6: MMV (MEASUREMENT, MONITORING AND VERIFICATION)** NSTA supplied a detailed update on Workstream 6, commenting on slides (supplied with minutes). <u>Overview / reminder</u> Measurement, Monitoring and Verification report published in August 22 – this was phase 1 of work. Phase 1 was rolled out Q3 last year and has been presented to the Forum – detailed broad spectrum of MMV – focussed on ocean bottom nodes, seismic detection and windfarm noise. Phase 3 published has been requested – holding off till all subsections are complete. Had discussions with seismic operators to understand potential field trials that NSTA could support – should be completed end of March. NSTA taking lead on MMV work – more detailed look into MMV technologies. To discuss CAES and work on process, flow assurance and power. <u>Phase 3A</u> With the aim to support seismic imaging of CCS, NSTA hoping to support field trial in 2023/24.

	Looking at wide spectrum of companies and operators to cover legacy to new technology. Focussing on southern North Sea, looking at Bunter and Leman reservoir stores. Engagements on what a field trial could look like to close end of March. Map shared on sub-surface stores in the southern North Sea, noting existing licenses and the 4 offered areas for carbon storage license round. Seismic technology does not work effectively with shallow water. Image shared explaining issues. Bunter works well with 4D imaging. Rock salt creates issues with seismic imaging, signals are distorted. OBN can create high-res imaging but creates data gaps. Seismic access is difficult in shallow waters. Main CCS targets • Bunter – aquifer stores and immediate monitoring of overburden • Leman – main depleted gas field stores Real seismic image shared - Aiming to improve real seismic imaging quality. <u>Phase 3B</u> Follows on from previously discussed phase 1 report. Goes into more detail of integration of non-seismic methods with 4D seismic. 4D seismic cannot solely be used due to cost and environmental issues, looking at more passive technologies. Assessing technologies for bunter and leman. To be completed by April 2023. <u>Question from The Chair:</u> • What we will be ready to publish and when? • Will PowerPoints be published (like previous phases) to summarise work? • Implications of potential work to research the ability for seismic to monitor CO2 and how this helps co-location? Going to struggle to acquire new seismic in southern North Sea. Hoping parties that receive licenses will produce seismic images before co-location issues. More difficult due to water depth issues and HSE restrictions. Outcomes are to encourage CS operators to produce seismic images and facilitate alternative technologies when in co-location situation. Question asked to what extent have seismic acquisition companies been engaged with on timeline ambitions for seismic imaging and whether there is capacity to achieve this. In discussions with these companies, they are aware of need for getting seismic Grayling clarified the NSTA output would be one report will produce summarising all phase 3 work, short high-level summary available to the public, also including detailed sections at the end. Draft version for NSTA/TCE for end of March, publication at the end of April. Question, breaking down the information to the right audience, currently geology/CCS focused, why should OW be interested? There is overlap in the shallow seismic (<200m), as acquisition companies realise there is this market.

4.0	**WORKSTREAM 7: CCUS AND OW SIMULTANEOUS OPERATIONS** NECCUS (industry body for industrial decarbonisation) put together project to look at simultaneous operations of CCS and OW. The project includes operation and remedial studies for legacy wells and MMV design in co-located areas. Also looking at ways of working together that are non-technical – opportunities and synergies in co-location – identify commercial benefits e.g., co-leasing. Stakeholder mapping and engagement. Looking to be funded as a joint industry programme. The Chair mentions requirement for input from all stakeholders. This is from industry point of view so worth doing the project alongside academic T&D work. This work should build upon key ideas and outputs from previous sim ops workshop session (CG) – access and HSE was identified as a key area to research. To look for outputs from previous workshop (possibly took place 2021). TCE/CSE to review scopes and request feedback from forum/involved organisations on ideas to input, objections and contribution. NSTA willing to comment and provide input on scope and the regulatory section. Will continue to jointly work on scopes and request feedback, will kick-off prior to next plenary meeting and set up ad-hoc meeting for interested parties.
5.0	**WORKSTREAM 11: STAKEHOLDER ENGAGEMENT – CCUS INDUSTRY SURVEY FOR FUTURE LEASING** TCE/CES plan to issue survey to understand market requirement in early March. Survey will be issued to CCUS developers with 2-week feedback period. Results will be used to inform approach to future leasing. Two key areas of focus: • Identify number of stores by 2035 and 2050 – storage capacity levels and injection rates. • Challenges and opportunities in marine sector. Results will be summarised and released approximately 1 month after survey. Press release used to include developers that may have been missed. TCE/CES work will align with relevant NSTA work. Point on survey timing relative carbon storage license round announcements – developer answers may differ depending on results. The Chair mentions survey is aiming to look at 2035-2050 picture. Follow up may be required.
6.0	**FORUM AND MEETING STRUCTURE** The Chair notes successful output from forum on co-location to date. Moving forward might need to rely on wider external studies. There lessons learnt from spatial characterisation and MMV seismic workstreams

	Question to forum • Lessons learnt question: which members felt involved and if there is a desire to be more involved? • Commissioning of reports by the forum and then managing the delivery through workstream meetings, could this method of working be used moving forward? NSTA were able to hold open conversations due to being a regulatory body, if projects are commissioned how will these be funded and supported? The Chair mentions momentum from members to complete work is useful, either reports are put forward and members choose to complete them, or a budget is allocated to the forum. Each member contributes different value to forum. Commissioning can be a useful tool for completing reports. Can be difficult to drive workstreams forward and receive co-funding from members, commissioning with someone taking lead can allow members to focus on specific deliverables. Renewable UK (RUK) will take away and discuss internally, can input lessons learnt from relevant projects/OW engagement and will check if data can be shared at a project level. RUK has new recruits from O&G background who are keen to join forum discussions. Moving forward could collaborate with OWEC forum to engage more with OW. They are more focussed on environmental wind industry; this forum focusses on technical aspects of CCUS/OW co-location. The Chair opens discussion on holding workstream meeting between plenary sessions. Specific meetings can be shared throughout forum members and relevant members can join. Plenary can become an agreement session sharing work that is already complete. No comments. Question put to forum on any major issues with additional or existing workstreams. Request for information on Hornsea 4 endurance, high level summary of developments. Difficulty that it is a live commercial debate between HM Government, TCE and developers, hard to provide summary now. The Chair mentions moving forward the plenary meeting could include summary of projects/work in public space to provide updates (rough dates, progress) then ask members for comments. Comments from meeting online chat about getting OW developers and OWEC more involved. Need to raise profile to OW about impact of forum work. TCE happy to coordinate the involvement of relevant OW parties to discussions. Previous event clashed with major OW event. Would be good to build on previous September and organise future session, currently difficult for involved parties to understand outputs from that. The Chair notes read out was sent out prior to 5th plenary, struggled to get feedback from survey. Can update on current thinking and gathered information in future session, also supports workstream meetings. Members asked if a formal review be included in next plenary sessions. Action for members to review this prior to next plenary. Members agreed to have working meetings to support workstream delivery. Forum workstreams will be formally reviewed at the next plenary session. As part of this forum members will think about how to refine workstreams and any additional items to be added prior to next plenary meeting.

7.0	**NEXT MEETING DATES** The Chair proposed next plenary for Wednesday 7th June. Will propose working meeting dates along with the minutes.
8.0	**AOB** Compressed Fluid Energy Storage (CFES) project overview given by NSTA. Summary of presentation: • Storage systems required with increased OW capacity. Batteries are most common but have rare earth and duration disadvantages. • CFES could be solution, there are currently operational systems. Project covers geology, reservoir engineering, production rates from wells and a facilities perspective (electricity required for pumping). • Graphs shown on past and predicted windfarm curtailment. The energy could be stored using CFES to smooth the curve. • Data shown on wind undersupply period with increase in gas turbine usage and minimal supply from additional renewable sources. • Discusses storage option. CFES provides large storage capacity and duration of discharge. Pumped storage is ideal solution but limited by available geography. Batteries discharge very quickly. • Small chance of success but large positive impact if successful. • Schematic of mechanical UK storage options shown. New pipelines are an expensive option, using existing pipelines tend to have small volume capacity. • Could be surface led, infrastructure led, or windfarm led. Windfarm option is of most interest. Various subsurface storage options – sandstone or leached salt caverns. • Trying to understand how much volume of capacity is required to have an impact on bridging gap between periods of no wind power and using gas turbines. • The Chair comments on understanding implications regarding hydrogen and making salt caverns. • Potentially lower costs due to no requirement to produce hydrogen, need to understand full spectrum of storage options. • Actions summary given to Grayling.
9.0	**T&D SCOPE** <u>Aims:</u> • Move the colocation debate into ‘how to’ territory with specific proposals for Test & Demonstration (T&D) projects. • Persuade stakeholders that a T&D project is feasible. Those stakeholders would include: TCE/CES/(Gov)DESNZ/Defra/OPRED/Ofgem/MMO etc./OW Developers/other environmental organisations. <u>Work could explore:</u> • Conformance: What a good monitoring plan looks like (focussed on the geosphere) • Consider spatial scenarios of overlap, clipping, neighbouring. Also, temporal scenarios of appraisal, development, operation, closure. • Containment: Show that this can be verified without disruption to other Marine activities (focus on the biosphere, hydrosphere, atmosphere). • Address the perception of risks to other commercial activity as well as the environment.

	Deliverables: • Types of T&D project that would demonstrate the spatial and temporal scenarios. Examples of risk-based decisions (possibly from other sectors) that could enable different commercial activities to coincide and possibly benefit each other, as well as the environment. **MEETING END**