# 2022-IP10 - Carbon Management Project Review Meeting, Pittsburgh Part I August 15th – 19th 2022

This annual review meeting, held every year in August, is an up-to-date summary of all the US DOE funded projects in $CO_2$ capture, storage, transportation and utilisation, and carbon dioxide removal. The review meeting was held in Pittsburgh and was the first in-person meeting since 2019 -- there was a general feeling that it was good to meet up. With an attendance exceeding 700 people, there were new faces as well as those who have been in the industry for many years. All were made welcome by the hospitality of the organising committee and the Westin hotel.

The conference ran over four and a half days and for three of these days started with a morning of plenary sessions (see below), then four parallel streams (point source carbon capture, carbon dioxide removal, carbon conversion and carbon transport and storage), a CCUS demo session, posters and additional lunch time talks. This IP will cover the morning plenary sessions, the SRMS workshop and an update on Regional Programs, a follow up IP will cover the CarbonSAFE III projects, offshore Gulf of Mexico partnerships, stress monitoring technologies, data resources, and an update on NRAP.

The morning plenary sessions included Monday's opening, 'launching the CCUS Industry of the Future', which is detailed in the following blog post. Tuesday's theme was 'Transitioning Energy Infrastructure for Mid-Century Decarbonisation' and was chaired by Tim Dixon. This focussed largely on the coalescing of $H_2$ production and CCUS around 'Hubs' with status updates from the US (Patrice Lahlum- of Great Plains Institute), a regional case study from Pennsylvania (Adam Walters) and examples from the UK's industrial clusters (delivered by Melissa Stark, Accenture) and the Longship project in Norway (Freddie Garcia, TCM). Mark Ackiewicz opened the session with a welcome and stating that transitions were generally challenging, chaotic, disruptive and life changing, while also presenting opportunities. Patrice Lahlum, demonstrated how working collaboratively across many sectors was critical to achieving carbon reduction goals. The work at Great Plains, a think tank, were to benefit the economy, the environment and people through their Carbon Management Program, which brings together stakeholders from industry, labour unions, and government representatives at federal, state, regional and local levels. Patrice detailed some of their initiatives, which included the Carbon Capture Coalition with over 100 members, the Industrial Innovation Initiative ($I^3$), and the Carbon Management Action Network, a community-level action and advocacy initiative. Melissa Stark impressed the room by introducing 10 international clusters and then drilling down by detailing the two UK clusters (HyNet and the Humber) that Accenture was supporting. Accenture's three main KPIs around these clusters were: $CO_2$ emissions, jobs, and value to the community. Both the UK case studies and the Longship overview were well received and showcased what was being achieved outside of the US.

Wednesday morning's panel discussion focussed around the 'Technical Challenges for Leasing and Regulating Government Lands (Offshore and Onshore) for $CO_2$ storage'. This was a lively session and raised many discussion points. The US has a long history in both onshore oil and gas extraction and $CO_2$ sequestration through EOR and demonstration $CO_2$ storage projects. Much of the challenge to onshore projects focuses around optimizing use of pore-space, delineating areas of review, and permitting. Sue Hovorka raised the issue of pressure space and how this might be a critical issue, especially in areas where sequestration projects were located adjacent to one another. She proposed that it wasn't just pore space, but pressure space that would need to be understood better; and in some cases competitors might need to agree how they shared this space. It was a theme that was raised on more than one occasion and was predicted that it would be more important as projects scaled up. Sue Hovorka from the University of Texas presented screening results from the offshore Gulf of Mexico for looking at ideal locations for storage. One of her conclusions was that synclinal areas (rather than your typical oil and gas structural high) were actually better placed to be a $CO_2$ sink since they had thicker sands and few, if any, well penetrations.

In other discussions on the GoM, re-use of existing infrastructure was a theme, as some technoeconomic calculations had potentially overcalculated their value (in one person's opinion) and that the condition of the existing infrastructure would have to be carefully considered. Presentations by Melissa Batum of the Bureau of Ocean Energy Management (BOEM) outlined how the offshore was governed by the state to 9 Nautical Miles (in Texas) and by federal government further out. BOEM was in the process of establishing a rulemaking process for the offshore that would cover: financial, pre-lease, monitoring, environmental, wells, site characterisation, planning, risk assessment and decommissioning. Rules would be established by next year and they were currently inviting input as part of a consultation process. Of particular interest were consequences of $CO_2$ leakage, detection and remediation. Lisa Grant of the Bureau of Safety and Environmental Enforcement (BSEE) also discussed draft rules that would make their way into the Federal Register, these would cover: well integrity (she raised the point 'do we know what failure looks like?'), facility and infrastructure design and installation, life extension and repurposing of existing infrastructure, well service, risk assessment and emergency response. Tomas Ortiz of the Texas General Land Office described some of the challenges of properly 'pricing' offshore real estate for $CO_2$ storage and the need for having accurate expectations of storage capacity. Katherine Romanak from the University of Texas discussed monitoring to detect leakage in the offshore. She acknowledged how much learning had come from the international community (e.g., ACT projects). Monitoring in the offshore represented a challenge, primarily because $CO_2$ is not a pollutant since it is already there in the water and it's hard to attribute the source in the marine environment. The chemical baseline is already highly complex and change is the norm, and leakage is rare. She warned against making monitoring overly complicated as results would be hard to interpret. However, leakage can be 'seen' through bubble streams and chimneys and pock marks. The question is 'how much do we want to do?' During the Q&A a few themes emerged: the potential of overlapping pressure fields with storage sites that were adjacent to each other; the need for an offshore pilot project; blow-outs – it was felt that we were not ready for them, especially offshore; what valuation to place on pore space; what was a fair market value; what learnings could be drawn from the North Sea but also recognise that the GoM has differences and these need to be factored in; policy needed to keep pace with developments in science and technology learnings.

The technical sessions covered a broad scope of subjects that may be of interest to members. These included: updates on regional initiatives under the CarbonSAFE program; subsurface stress technologies and techniques; plume detection technologies; pressure management; wellbore integrity; storage deployment; data resources; offshore storage; National Risk Assessment Partnership (NRAP) developments; NETL Research and Innovation Centre (RIC); and Machine Learning. Some of these were parallel sessions, so it wasn't possible to attend them all, but all were of high quality and well presented. In addition to these sessions there was a two-hour workshop on the Storage Resources Management System (SRMS).

The SRMS workshop was delivered by Daniel DiLuzio (Chevron) and Scott Frailey (Illinois Geologic Survey), it covered the SRMS purpose and intended users; how the SRMS was developed; storable quantities; project specifications, classifications and categorisation; and estimating storable quantities. Time was given at the end for a couple of working examples. Established in 2017 by the SPE and based on the Petroleum Resources Management System (PRMS), the SRMS now has a host of sponsoring societies; and this year saw the first published commercial usage by Santos, Australia (used as a case example). The full SRMS guidelines were published in June. The SRMS is a project-based assessment criteria, specific to defined or notional projects, with discovered resources established through drilling of at least one well and further breakdown based on the stage of commerciality of the resource. The process of estimating storable resources and the containment of resources was also covered. Paul Lyford (Reserves and Resources Manager at Santos) and Rawdon Seager (Petroleum Engineer, Gaffney Cline) presented the case studies. Paul Lyford presented work that Santos has undertaken on their acreage in Australia and Timor-Leste. Santos is committed to

understanding and maturing $CO_2$ storage projects and has recognised that communicating the variety of projects to stakeholders was difficult. After reviewing various classification systems they adopted the SRMS as it was recognised as the best placed to become industry standard with concepts that were familiar to people in the industry (on the basis of the PRMS) – internal policy was then revised to mandate compliance with the SRMS. As a result, $CO_2$ storage was assessed and reported in the group's 2021 Annual Reserve Report, with 100 million tonnes of storage booked in the Cooper Basin, South Australia. The Moomba Carbon Capture and Storage Project Phase 1 has been classified as capacity (November 2021) and future expansion phases defined as Contingent Storage Resource. Santos has found that the initial booking exercise has brought greater clarity and alignment than initially expected, particularly across internal and external stakeholders. It has resulted in an organisational consistency on how to implement and classify. Externally, it demonstrates company commitment to $CO_2$ storage and provides external stakeholders confidence on numbers which have been externally audited – these can be used in models and in valuations. Work continues to progress these evaluations and classify the full $CO_2$ storage resource base.

**Regional Programs:**

**SECARB** – The Southeast Regional Carbon Utilization and Storage Acceleration Initiative was presented by the Southern States Energy Board which covers 16 states and 2 territories and is supported by technical staff. SECARB has a broad associate corporate membership. Established in the 2003 with a network of national partnerships, SECARB currently has five ongoing CCUS R&D projects, including regional assessments of infrastructure needs and risks as well as data gathering and field projects. The region accounts for 1.2 billion metric tons of annual $CO_2$ emissions, 1/3 of US annual emissions, and has over 5 trillion metric tons of estimated subsurface storage potential within saline reservoirs. Ongoing work includes: identifying subsurface data gaps by evaluating data density according to US EPA Class VI permit requirements; test well drilling in Alabama and Georgia near large-volume emitting facilities; evaluating regional infrastructure buildout scenarios, considering cost of capture, environmental justice and environmentally sensitive areas. The phased infrastructure buildout results in the capture of 1 billion metric tons of $CO_2$ over four phases, whilst avoiding environmental justice communities. It results in 11% more pipe needed and an increase in cost ~ 7% more than the base case scenario. Future plans include: the acquisition of 2D seismic and drilling additional stratigraphic tests; collaboration with industry partners to build out hubs; focus on disadvantaged communities and tribal lands when planning outreach; and development of an interactive dashboard for educational purposes which includes infrastructure scenarios, costs, risks, societal considerations and impacts, workforce readiness and development.

**MRCI** – the Midwest Regional Carbon Initiative covers 20 states in the Midwest and Northeast and works with state Geological Surveys and universities, and collaborates with industry, government and NGOs, to accelerate the deployment of CCUS. Tasks include: addressing key research challenges; facilitating data collection, sharing and analysis; evaluating regional infrastructure and promoting regional technology transfer. They presented on a range of these activities and included technical work on carbon storage systems: geological mapping and development of a map database; modelling injectivity and containment; compiling regional Pre-Cambrian structure maps and earthquake focal mechanism distribution; compiling earthquake data to evaluate seismicity potential; and compiling legacy seismic data. Regional infrastructure is evaluated, both current and future needs, and includes social, economic, and workforce development factors. Five distinct projects have been identified: Ohio/Pennsylvania/West Virginia; Northern Michigan; Indiana; Central Ohio; and offshore Mid-Atlantic. Emerging technologies such as Blue Hydrogen, BECCS and DAC are also considered. Lastly, a key part of the work is to promote regional technology transfer across multiple stakeholders both regionally and globally. Methods include newsletters, podcasts, presentations, workshops, fact sheets, videos, story maps and infographics. Part of the focus includes Environmental Justice with a working group established to explore the issues particularly as they intersect CCUS.

**PCOR** – Plains $CO_2$ Reduction Partnership Initiative to Accelerate Carbon Capture Utilisation and Storage Deployment – established in 2003 - is now in the Deployment phase and has expanded to include Alaska, British Colombia, Wyoming and Montana. With over 230 industrial partners, of which 55 are new since 2019, they help set the priorities and the focus is on: strengthening the technical foundation for geologic $CO_2$ storage and enhanced oil recovery (EOR); advancing capture technology; improving application of monitoring technologies; promoting integration between capture, transportation, use and storage industries; facilitating regulatory frameworks; and providing scientific support for policy makers. Highlights of 2021/22 include in-person meetings, new public and partner website, and several new products and white papers published. New monitoring tools to monitor the $CO_2$ pressure plume and plume saturation have been developed in collaboration with RITE, Red Trail Energy (RTE), EERC and NETL, and are now available for use. Several policy and regulatory developments are reported; several states have implemented legislation addressing pore space ownership (e.g. Montana, Alaska, Alberta, North Dakota, Nebraska, and Wyoming); long-term liability (Alberta and North Dakota); Montana is awaiting primacy concerning Class VI applications; and Alaska and British Columbia are developing regulatory frameworks for CCS. Several products are coming soon including Class VI wellbore construction and design guidelines using corrosion resistant alloys, Class VI injection well pressure transient analysis, pore space leasing considerations regarding pressure interference, $CO_2$ purity specifications and compatibility with pipeline materials, CCS Hydrogen Roadmap, and guidelines for repurposing existing carbon steel pipelines. Future plans include a pressure interference study, injectivity interference study, pore space resource competition, storage hubs with blue hydrogen, $CO_2$-EOR business case and messaging, plus public and industry outreach.

**CUSP** – Carbon Utilization and Storage Partnership – is administered by New Mexico Tech and the University of Utah and includes parts or all of three original RCSPs (Regional Carbon Sequestration Partnerships): SWP, WESTCARB and Big Sky. The states are represented through a state agency (e.g., geological survey), a university or a research institute, and other involvement comes from Los Alamos, Pacific Northwest, and Sandia Laboratories with additional collaboration with Indiana University and industrial engagement. 15 CCUS commercialization projects have been funded to date in the western US, and 4 additional projects are wholly funded by industry. The original scope of work established in 2019 focused on collecting, synthesizing and using existing data sets and has expanded with additional funds available to cover technology transfer and education, and funds to jumpstart 45Q-ready projects in: the Farnsworth EOR project conversion to storage focus; CarbonSAFE III San Juan Basin Project support MRV planning; and the Red Hills and Metropolis separation facilities. Source-sink mapping has focussed on localised regions (Kansas, Oklahoma, Nevada, California, Four Corners and the Permian Basin regions); potential hubs and local opportunities have been identified; and the Permian Basin and the Northwest US are in the queue for detailed mapping. Areas of environmental sensitivities in relation to environmental justice (EJ) have been factored into potential pipeline routes and add cost to the total cost of $/t$CO_2$. Three case studies and 12 focussed projects were presented, most projects have industry partners and timelines of 1-3 years. These include: an R&D project on a commercial scale $CO_2$ storage in basalt; a regional storage hub in California and Kansas & Oklahoma; assessing the potential of using $CO_2$ as a geothermal working fluid; characterisation studies in Iron Mountain and Harquahala Basin; feasibility study of CCUS in Colorado; and downhole source tomography.

Nicola Clarke

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