GLOBAL CCS INSTITUTE

Q2 2021 KEY OBSERVATIONS

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GLOBAL CCS INSTITUTE

KEY OBSERVATIONS

Porthos takes a big step forward with SDE++ funding

- The Dutch government will be setting aside €2.1bn in subsidies for Porthos' initial capture plants. Notably the CCS projects represented the lowest cost means of decarbonisation amongst successful projects. The subsidies valued at around €2.1bn and granted over a 15-year period, will enable the storage of 2,34Mtpa, equivalent to €60/tonne. By comparison subsidies provided to rooftop solar photovoltaic projects represent a cost of € 1.12bn and will deliver 0.32Mtpa of CO_2 reduction, an equivalent cost of €233/tonne.

CCS clusters are growing

- Q2 announcements have demonstrated how CCS clusters will expand to enable wider decarbonisation.
  - In Canada, an additional project has announced plans to store CO_2 via the Alberta Carbon trunkline.
  - In the Mid-West United States, the scope of the proposed Summit Carbon Solutions CCS project has expanded to now include some 30 biorefineries.
  - Northern Lights continues to grow with the Borg Cluster and Future biogas planning to store CO_2.

Low Carbon LNG is gaining traction

- During the last year announcements have been made regarding the proposed use of CCS on LNG facilities in the four largest LNG producing countries globally – Australia, Qatar, USA and Russia.
- In Q2 related announcements were made by Venture Global, Cheniere, Sempra and Qatar Petroleum.

Carbon Capture on ships represents a new application of CCS

- A number of initiatives and technologies focused on implementing Carbon Capture on ships have emerged. The EU has recently outlined plans to add shipping to its emissions trading system.

CCS is expanding to new regions

- While Europe and the US continue to dominate new project announcements, Alberta, Canada is seeing a flurry of activity, and CCS projects are appearing in several new regions.
  - Four separate projects located in Alberta, two involving hydrogen production, were announced in Q2
  - A number of CCS related initiatives have been announced in Russia, Lithuania, and Timor-Leste.

KEY OBSERVATIONS

Policy and financial support for CCS is increasing around the world

- In the United States, the CATCH bill is one of 7 bipartisan CCS bills introduced in the past 5 months – the most legislative action in the history of the technology.
- In China CCUS was included in the 14th Five-Year Plan for the first time. President Xi has increasingly reinforced China's commitment to climate targets. The first phase of China's emissions trading scheme, the largest in the world, launched on July 9th (CCS may be included in a later phase).
- During Quarter 2 EU allowance prices reached their highest levels, exceeding €50 per tonne and more than doubling the 2020 average. Analysts anticipate that this price will continue to rise.

Interest in Voluntary Carbon Markets is growing

- The Taskforce on Scaling Voluntary Carbon Markets (TSVCM) is a private sector-led initiative working to scale such markets to meet Paris goals. TSVCM highlights DACCS and BECCS as important growth categories relevant for short-to-mid term scaling of CDR.
- An alliance of organizations formed the CCS+ Initiative during the quarter. This new venture will leverage carbon markets to scale up decarbonization and carbon removal efforts.
- Fortum Oslo Varme Waste to Energy plant announced plans to collaborate with Puro.earth to generate CO_2 removal credits. South Pole and Mitsubishi have also announced plans to collaborate in such markets .

INSTITUTE NEWS

New CEO announced

- Following the prior announcement regarding the pending retirement of current CEO Brad Page, in early July the Institute's Board announced the appointment of Mr Jarad Daniels as the Institute's new Chief Executive Officer.
- Commenting on his appointment, Mr Daniels said:

"The Institute has a global reputation as a trusted partner and adviser, a centre of knowledge, an advocate and a facilitator bringing people together.", "I look forward to working with all our Members and helping the Institute achieve its mission to accelerate the deployment of CCS globally."

New Members

- During Q2 the Institute passed the 100 Member milestone with the following new Members joining:

- ENI
- Brevik Engineering
- Chevron
- Denbury
- Dril-Quip
- EQT
- Halliburton
- Horizon Oil
- MAN ES
- Mitsui OSK
- NEXT Carbon Solutions
- NYK
- Prime Marine
- Silver Point
- Tenaris
- Torishima
- Whitecap

PROJECTS – SELECTED DEVELOPMENTS

Porthos
CO_2 TRANSPORT & STORAGE

Netherlands

Porthos SDE++ funding – Port of Rotterdam

- The Dutch government will be setting aside €2.1bn in grant money for Porthos' four customers: Air Liquide, Air Products, ExxonMobil and Shell.
- Funding bridges the gap between CCS costs and the EU allowance price.
- Notably the 6 CCS projects, all associated with Porthos, represent the lowest cost means of decarbonisation. The subsidies granted over a 15 year period will enable the storage of 2.34Mtpa , equivalent to €60/tonne.
- By comparison subsidies provided to rooftop solar photovoltaic projects represent a cost of €1.12bn and will deliver 0.32Mtpa[1] of CO_2 reduction, an equivalent cost of €233 per tonne over 15 years.
- The onshore infrastructure proposed has been oversized and is capable of handling 10Mtpa.
- Given the rising cost of EU emissions allowances, the necessary contribution from the SDE++ scheme can be expected to reduce over time.

[1]https://www.rijksoverheid.nl/documenten/kamerstukken/2021/06/08/kamerbrief-voorlopige-resultaten-sde-2020-en-voortgang-sde-2021

PROJECTS – SELECTED DEVELOPMENTS

Norway

Future Biogas Northern Lights MOU – Various UK

- An MoU has been established between Northern Lights and Future Biogas to develop carbon removal and CCS initiatives.
- Future Biogas is one of the UK's largest biogas producers and plans to build 25 new biogas plants by 2028. Through CCS Future Biogas plans to actively remove CO_2 from the atmosphere.
- The companies will explore a value chain for BECCS which includes CO_2 capture from biogas plants and transportation to Northern Lights.

puro · earth

Fortum Oslo Varme Puro.earth Marketplace agreement - Oslo

- Puro.earth and Fortum Oslo Varme have entered an Agreement to provide CO_2 removal certificates in the European waste-to-energy sector.
- Puro.earth allows companies to neutralize their carbon footprint, by purchasing verified CO_2 Removal Certificates.
- In June Nasdaq bought a majority stake in Puro.earth and is vowing to scale it up to meet the growing global demand to offset carbon emissions.

PROJECTS – SELECTED DEVELOPMENTS

United Kingdom

Peterhead CCS Project - Peterhead

- SSE Thermal and Equinor have unveiled plans to jointly develop a new CCS equipped CCGT power station at Peterhead.
- The 900MW gas-fired power station will capture up to 1 Mtpa.

Keadby 3 and Keadby Hydrogen - Keadby

- In April, Equinor and SSE Thermal unveiled plans to develop two low-carbon power stations in the Humber region.
- Keadby 3 would be a 900MW power station fueled by natural gas, fitted with carbon capture technology and storing via the Humber facility.
- Keadby Hydrogen may become the world's first 100 per cent hydrogen-fired power station, with peak demand of 1,800MW of hydrogen.

Drax – Agreements with MHI and Bechtel – North Yorkshire

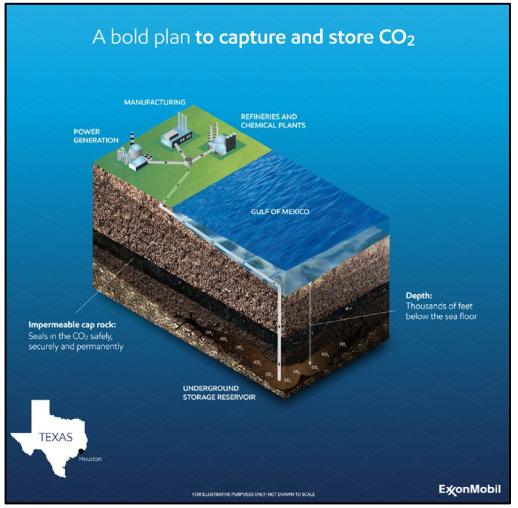
- Drax Group and MHI have agreed a long-term contract for Drax to use MHI's carbon capture technology, the Advanced KM CDR process™
- The project is potentially largest deployment of negative emissions in power generation globally.
- As part of the agreement, MHI plans to locate its core CCS team at the company's European headquarters in London.

PROJECTS – SELECTED DEVELOPMENTS

USA

ExxonMobil Houston Ship Channel CCS Innovation Zone - Texas

- ExxonMobil's Low Carbon Solutions business has introduced the concept of a Houston Ship Channel CCS Innovation Zone. The proposed initiative will bring together stakeholders to advance the policies and investment needed for large-scale CCS deployment.



US Steel and Equinor MOU to Explore Hydrogen - Appalachia Region

- US Steel and Equinor will study the potential for CCS and hydrogen development in the tri-state region of Ohio, Pennsylvania, and West Virginia. These states produce more natural gas than Texas.
- The scope of the MOU includes assessments of regional hydrogen and CCS potential, appropriate customer and supplier screenings, blue hydrogen advocacy, CCS, and renewable energy synergies.

equinor

United States Steel

Summit Carbon Solutions Expands Project Scope – Mid West

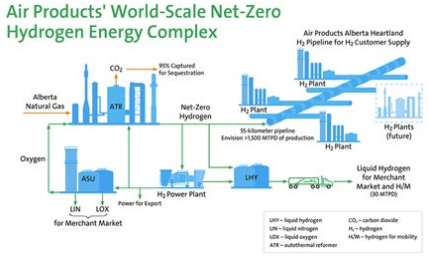
- Summit Carbon Solutions have announced that 12 more biorefineries will join its planned cluster. This brings the total to 30 facilities and committed volumes to nearly 8Mtpa.
- With discussions ongoing, it is anticipated the original target of 10Mtpa will soon be exceeded.

PROJECTS – SELECTED DEVELOPMENTS

Canada

Air Products Hydrogen Complex – Alberta

- In June, Air Products announced their plan to develop a $1.3bn CAD net-zero hydrogen complex near Edmonton, Alberta. Expected onstream in 2024, over 95 percent of the CO_2 from Blue Hydrogen production will be captured and sequestered via the Alberta Carbon Trunk Line.
- The facility is complemented by Air Products' existing 55km Alberta Heartland Hydrogen pipeline.



Suncor and ATCO Blue Hydrogen - Alberta

- Suncor will construct and operate a 300,000tpa hydrogen production facility and associated carbon sequestration site.
- FID is expected in 2024 and the project could be operational by 2028.

The Alberta Carbon Grid (ACG) - Alberta

- Pembina and TC Energy have announced plans to develop the Alberta Carbon Grid, an open access CO_2 pipeline network designed to connect the province's largest emissions sources to a sequestration facility north-east of Redwater. The system will be capable of transporting 20Mtpa.
- A reservoir near Fort Saskatchewan has been selected that can hold two billion tonnes of CO_2. Permits are currently being prepared.

TC Energy

PEMBINA

Caroline Carbon Capture Power Complex – Alberta

- Pieridae Energy has announced the Caroline Carbon Capture Power Complex. CO_2 will be captured from the gas processing facility, power production and third parties.
- Up to 3Mtpa will be sequestered using one of the Caroline Facility's depleted gas reservoirs.

PROJECTS – SELECTED DEVELOPMENTS

Russia

Novatek and PAO Severstal MOU

- During June Novatek and Russian steelmaker PAO Severstal announced the signing of a Memorandum of co-operation to develop alternative energy and emission reduction technologies.
- The parties will consider launching a joint pilot project to produce blue hydrogen from natural gas using CCS technology.

Gazprom and Shell agreement

- In June Gazprom Neft established an agreement with Shell to explore the possibility of deploying CCUS at their joint ventures in Russia.
- Gazprom Neft have also indicated that the companies will discuss the use of CCS in Blue Hydrogen production.

Qatar

Qatar's North Field East LNG liquefaction project

- In February Qatar Petroleum announced final investment decision for its US $29bn North Field East LNG Liquefaction Project. This will include a CCS facility to capture emissions.
- The CCS facility will be the largest of its kind in the LNG industry and will be part of a CCS cluster in Ras Laffan.

ADNOC
JOGMEC
jera
Energy for a New Era
INPEX

INTERNATIONAL CLIMATE POLICY

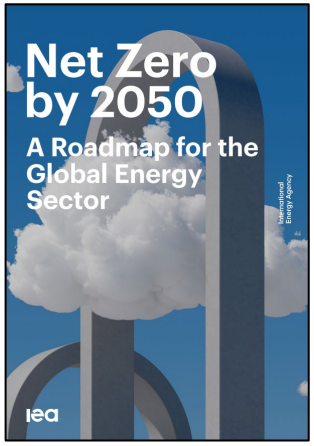
UNFCCC

May-June Climate Change Session

- The three-week informal negotiation session was in practice more of a consultation. The positions of Parties remain firmly entrenched and there was no real progress.
- Article 6 negotiations which are most relevant for CCS, will benefit from a political discussion during a ministerial session in July in the UK.

Voluntary Carbon Markets

- Taskforce on Scaling Voluntary Carbon Markets (TSVCM) held a public consultation on several topics, including governance, during May and June.
- In the consultation document, TSVCM highlights DACCS and BECCS as important growth categories relevant for short-to-mid term scaling of CDR.
- DACCS and BECCS projects do not currently appear under the five largest VCM standards but are already operational and issuing credits outside the main standards.
- The new CCS+ initiative, launched in June, seeks to bridge this gap by developing project-based methodologies for the VCM and Article 6 of the Paris Agreement. The Institute is involved in the Advisory Group of the initiative.



IEA Net Zero report

- The Net-Zero Emissions by 2050 Scenario (NZE) presents one possible way to achieve net-zero emissions by 2050. The pathway achieves this objective with no offsets from outside the energy sector and low reliance on negative emissions.
- The NZE scenario requires a dramatic increase in CCS above what was outlined in the Sustainable Development Scenario.
- This is primarily because it presents a mean to deliver Net Zero by 2050 whereas the Sustainable development scenario showed how this could be achieved by 2070.

POLICY – SELECTED DEVELOPMENTS

EU policy

Climate Law

- The European Climate Law has been agreed. The Council and the Parliament have endorsed the text.
- The law establishes EU climate targets of at least 55% reduction by 2030 and climate neutrality by 2050. It prioritizes emission reductions over removals, which are capped at 225Mt CO_2, and states that the EU "*shall aim to achieve negative emissions*" after 2050.

United Kingdom

Cluster Sequencing Process

- The UK Government's cluster sequencing process is ongoing
- Guidance for organisations wanting to take part in Phase-1 of the process was published on May 7th.
- The July 9th Deadline for submissions has now passed.
- The Call for capture projects will be launched on August 9th.

Milestone	Date
Phase-1 Launch	7 May
Phase-1 joint kick-off session	w/c 10 May
Deadline for Phase-1 expressions of interest	21 May
Phase-1 individual submission engagement	w/c 24 May
Deadline for submission of supplementary questions	23 June
Final publication of question responses by BEIS	30 June
Deadline for finalised Phase-1 submissions	9 July
Phase-1 assessment cluster presentations to BEIS	w/c 26 July
Announcement of Phase-1 eligibility assessment	9 August
Phase-1 assessment clarification session	w/c 16 August
Announcement of Phase-1 outcome	From 25 October

Canada

Government of Canada releases draft budget including provisions for CCUS

- The Government of Canada released its 2021 budget which proposes an investment tax credit for capital invested in CCUS projects with a goal of reducing emissions by at least 15Mtpa.
- The budget proposes to allocate $5bn CAD over seven years to the Net Zero Accelerator, bringing the funding to $8bn CAD for this initiative.
- The budget also proposes to provide $319 million CAD over seven years, to Natural Resources Canada to improve the commercial viability of CCUS technologies.

Government of Alberta releases new Carbon Sequestration Tenure Process

- The Alberta Department of Energy issued information in May which describes a planned Carbon Sequestration Tenure Management process. Rights will be issued via a competitive selection process.

TECHNOLOGY

Carbfix technology validated with seawater

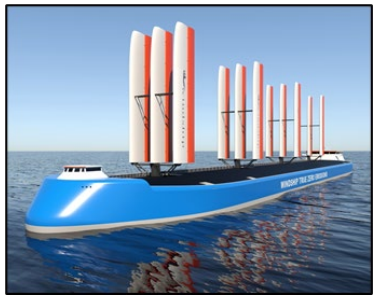
- The Carbfix technology dissolves CO_2 in water and injects into basaltic rocks where the solution mineralizes.
- A recent paper has confirmed that the injection of seawater-dissolved CO_2 could be effective for long-term safe CO_2 mineral storage.
- The use of seawater instead of fresh water is important in water scarce regions and expands the applicability to more regions.

Novozyme plan to demonstrate the feasibility of enzymatic carbon capture as part of ARC project

- Novozymes is included as part of Amager Resource Center's (ARC) EU application to set up a carbon capture facility in Copenhagen
- Novozymes' biosolution for enzymatic carbon capture is to be tested as a possible solution for the future carbon capture plant.

TECO 2030 and Chart Industries collaborate on capture tech for ships

- Norwegian engineering firm TECO 2030 partners up with a US-based cryogenic tank manufacturer Chart Industries to develop cryogenic carbon capture technology solutions for ships
- The technology will separate CO_2 from the ships' exhaust gases. High-purity liquid CO_2 will be stored onboard in cryogenic storage tanks.



Windship Technology Signs agreement with Calix

- Calix has developed the RECAST technology that captures carbon dioxide, nitrogen oxide and sulfur oxide, and particulate emissions from vessel power systems.

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