IEAGHG

Annual Review 2024

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Kelly Thambimuthu at GHGT-17

In the decade since COP 15 in Paris we have had a period relative calm (albeit not without hiccups) in achieving agreement on climate policy to limit the radiative forcing of earth's climate from anthropogenic greenhouse gas (GHG) emissions. The global consensus on climate policy in-turn spawned intentions, emission reduction targets and indeed also concrete actions aimed at achieving net zero emissions (NZE) of GHGs into the atmosphere by 2050.

Our own reflection supported by our work since 2022 to support NZE, has underlined a deep conviction that CCS has a very significant role to play in the pathway ahead as it relates to the energy sector and perhaps also in a much more limited and qualified role in removing excess CO_2 directly from the atmosphere or in facilitating CO_2 utilisation with its chemical transformation.

Our conviction of the significance of CCS is supported by a very simple analysis of the efficiencies of energy conversion technologies to end use ('carbon free') energy vectors of electricity or hydrogen. Findings supported by this analysis include the following[i]:

- CCS equipped fossil fuel and biomass (BECCS) energy technologies have amongst the highest net time averaged primary energy conversion efficiencies[ii] to electricity/ hydrogen in comparison to other renewable and nuclear (fission) energy. In the case of hydrogen, the net efficiency for hydrogen production is significantly higher by wide margins. Time averaged energy efficiencies

[i] https://doi.org/10.1088/2516-1083/ad371f

[ii] Time averaged primary energy conversion efficiencies account for the intermittency of energy supply and/or the need for energy storage

Chairman's Message for 2024

determine the relative role, scope, scale, and the environmental impact of deployment of all net zero energy technologies[iii].

- Achieving CO_2 capture rates at +99% efficiency with CCS can significantly reduce at marginal energy use and cost, the quantum of atmospheric CO_2 removal otherwise required by mid-century (see below).

- There is a need to adjudicate the role and relative merits based on energy efficiency, cost, and environmental sustainability of DACCS[iv] and BECCS in removing atmospheric CO_2 to facilitate 'net negative' emissions. The deployment of BECCS provides an additional source of energy as well as requiring very much lower energy use per ton of CO_2 removed compared to DACCS, while the availability and efficient conversion of other renewable or nuclear energy resources is key for the deployment of DACCS.

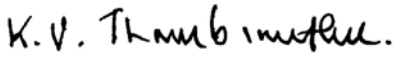
- The scope and scale of CO_2 utilisation with capture (CCUS) in mitigating climate change is also highly likely to be constrained by the additional availability and efficient conversion other renewable and nuclear energy resources to facilitate the 'net zero' chemical transformation of CO_2

With these findings, and a personal viewpoint tempered by the impact of energy price shocks and energy security issues of the 1970's and 1980's, I cannot fathom a world where some primary energy resources are pursued to extinction or ignored in favour of others judged in the light of hastily defined green labels that ignore environmental impacts beyond GHG emissions.

Expressed more rationally, I do not see a transformation to a global energy infrastructure that drastically reduces the net efficiency of primary energy conversion - due to its impact on the significantly increased scale and cost of energy technology deployment that which hitherto has not been properly accounted for in the assessment of environmental impacts beyond GHG emissions reduction.

With some political developments challenging climate change policy, we have the technological ability to pursue with CCS a 'no regrets' approach to achieve net zero (and with a more limited scope net negative) emissions. Buckle in for the ride about to unfold in 2025 and beyond!

Prof. Kelly Thambimuthu, FTSE
Chairman



[iii] IEAGHG Report 24 -304 - Efficiency Cost and Scale of Net Zero Energy Technologies for Electricity or Hydrogen Production (in press)

[iv] DACCS – Direct air capture with CCS

General Manager's Summary of 2024

Tim Dixon, General Manager

IEAGHG had many activities in 2024, set against the increase in CCS and CDR activities worldwide and the increased urgency of action on climate change. This message of urgency was summarised in the IEA's 'From Taking Stock to Taking Action – How to Implement the COP28 Energy Goals' report which showed that even with the increase in the number of CCS projects in development, we still need to do a lot more.

Our biggest event of the year was GHGT-17. And this turned out to be the biggest CCS event ever! With 1547 delegates from 47 countries, it represented the world's greatest gathering of the CCS sector. It had several firsts: in addition to the seven technical streams it had an eighth stream on business to business topics; prizes for the best student posters, first IJGGC panel and new best paper award; first session on Indigenous people and lands; first short-notice discussion session on out-of-zone migration news; as well as the excellent technical content of over 850 presentations. It concluded with a Future Leaders panel with illuminating perspectives from the students and early career researchers.

We held our first Members meeting of the year in Copenhagen, hosted by INNO-CCUS, and visited the Orsted biomass power station. We held our second members meeting in Calgary in conjunction with our GHGT-17 conference. We welcomed new members from Ecopetrol (Colombia) and Heritage (Trinidad and Tobago).

We held our 16th International Summer School in Darwin, hosted by Australian Energy Producers, CO_2CRC, CSIRO, Eni, INPEX, the Northern Territory Government and Santos. 766 alumni from 60 countries are now out in the world, many becoming CCS leaders.

General Manager's Summary of 2024

Our involvement in the International Conference on Negative CO_2 Emissions series continued, with our work being showcased in the plenary in the 3rd conference hosted by The University of Oxford.

In terms of our engagement with climate policy, we led the organisation of a UNFCCC Side-event at COP29. This was focussed on financing CCS, as it was a 'Finance' COP. This was well attended with good media coverage. This was our tenth UNFCCC Side-event at COPs, and we have the evidence that we do reach out and influence beyond the CCS community through these. There was also success in the Article 6.4 area, with a "Standard" on Removals being agreed. This new mechanism includes CCS as well as all forms of CDR, and deals with the reversal risk in a sensible way. This area has been a focus of attention and input for IEAGHG over the last three years to try and ensure it was sensible and evidence based. Also to note at COP29 was the Carbon Management Challenge high-level meeting to which we were invited at the table.


MATTHEW TED EDWARD

Tim Dixon at COP29

The London Convention's Scientific Group held a dedicated day on CCS in 2024 and we were pleased to attend and present background and updates on offshore CCS. IEAGHG are the only organisation representing CCS in the important annual meetings of the London Convention, and we can take issues of interest or concern from there and tackie these in our network meetings and Offshore Workshops and share the information back to the London Convention, thus ensuring it continues to be evidence-based. We held the 7th Offshore Workshop in Port Arthur, Texas (organised with the University of Texas) which was timed nicely a month before the annual London Convention meeting. Also at this 7th workshop, the developments in that immediate area since the last workshop there in 2017 were astonishing, with CO_2 storage leases now all around.

Hence our technical work and evidence base was being input directly into these relevant policy and regulatory active areas.

A major achievement was getting the Green Climate Fund to support a CCS activity for the first time. This was with Trinidad and Tobago and took several years of effort. The UN even produced a good-news story on it Trinidad and Tobago secures funding for CCS - UNEP-CCC. Whilst this example is a relatively modest size, we hope that it paves the way for other emerging economies to access the world's largest climate fund.

IEAGHG helped Colombia and Trinidad and Tobago to get started with CCS, with a second national symposia in each this year. Both countries are setting up Centres of Excellence in CCS. We involved these in a scoping meeting for a new Global Network of Centres

General Manager's Summary of 2024

of Excellence in the Global South. This meeting was co-organised with the University of Texas and was hosted by the International CCS Knowledge Centre in conjunction with a visit to the Boundary Dam project for delegates from emerging economies before GHGT-17. Five centres or prospective centres attended this meeting, with two others following, and it became the soft launch of this new network.

"**IEAGHG helped Colombia and Trinidad and Tobago** get started with CCS."

The IPCC held two important meetings in 2024. The IPCC Task Force on Inventories (TFI) was asked to look at Carbon Dioxide Removal Technologies with a view to developing a methodology. They organized an 'Expert Meeting' and a 'Scoping Meeting', attendance by invite only, and IEAGHG's GM was invited and participated in both.

Another significant activity for IEAGHG was the rebranding exercise and new website, only the second rebranding in our 33 year history. This has been well received.

This year we also got involved with inputting directly to news media to counter disinformation on CCS, particularly in the UK because of the positive announcements by UK government and one of the UK projects getting FID on its storage and first CO_2 source.

It is always good to see the IEAGHG team giving presentations at other conferences and meetings around the world, this year including at the NETL meeting in Pittsburgh and at events in Copenhagen, Venice, Calgary, Colombia, Trinidad and Tobago, Geneva, Baku, Austin and London, as well as at our own events. These were in-person, and in addition, given the ease of online meetings now, it is routine for the team to virtually attend meetings and present at events in several different countries in the same day.

Looking forwards to 2025, we will hold our Costs Network in Houston in March, our International CCS Summer School in Regina in July (hosted by International CCS Knowledge Centre), our Monitoring and Risk Management Networks meeting in The Hague in August, and our PCCC-8 conference in Marseille in September. These are in addition to our members meetings, the first of which will be in Rotterdam.

So, we look forward to working with you and seeing many of you in person in 2025.

Tim Dixon
General Manager

2024 in Numbers

350
GHGT-17 Conference **Presentations**

1547
GHGT-17 Conference **Attendance**

534
GHGT-17 Conference **Poster Presentations**

13 IEAGHG presentations at external conferences

537
Attendees to IEAGHG webinars

9
Technical Reports

3 IEAGHG conferences networks and workshops

37
Blogs

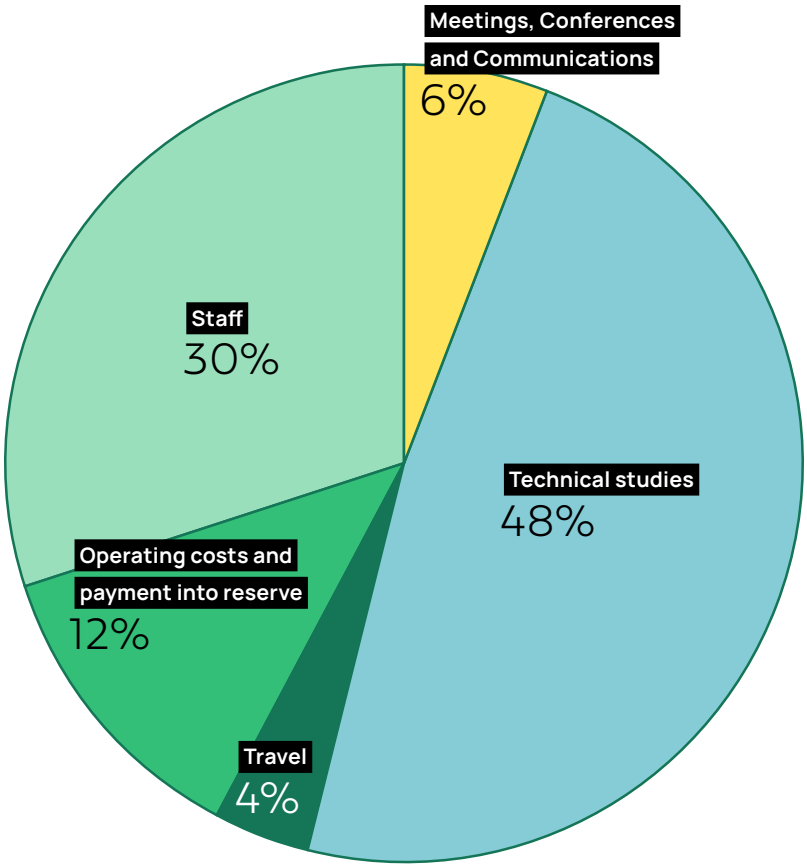
5
Insight **Papers**

4
Technical Reviews

IEAGHG Operations Report

Membership grew to 39 members. We welcomed Ecopetrol of Colombia and Heritage Petroleum of Trinidad and Tobago joining and progressed many enquiries from other organisations as global interest in CCS development and deployment continues to grow. Our total annual income was approximately £2.25m, and the budget was allocated as illustrated below.

IEAGHG Expenditure 2024



Note 1: **This spans over two financial years so values given here are approximated. Audited accounts are available to members.**

The Executive Committee, which is comprised of our member representatives and acts as the governing body overseeing IEAGHG's activities, met twice in the year. Both meetings were held in hybrid format with the majority of members attending in-person. ExCo65 was hosted by our member INNO-CCUS in Copenhagen. ExCo66 was hosted in Calgary in conjunction with our GHGT-17 conference. Relevant site visits were provided with both, to the ARC waste-to-energy plant and Ørsted's biomass power station in Copenhagen, both intending to fit CO_2 capture, and various site visits in Alberta in conjunction with GHGT-17.

We welcomed Michelle Lowe to the IEAGHG team as Administrative Assistant.

Global Impact

IEAGHG helps to facilitate the implementation and deployment of CCS by contributing to the technical evidence base for policymakers, regulators and other decision-makers. IEAGHG participates in key activities to support CCS policy/implementation strategies and by undertaking studies and workshops to provide information that is needed to assist CCS deployment.

UNFCCC COP29

High Level Outcomes

This was intended to be the 'Finance COP', aiming for countries to agree a new climate finance goal, called a New Collective Quantified Goal (with a new acronym, NCQG), at a level higher than the current $100bn goal. This proved to be a contentious area of negotiations, with different requests from different groups of developing countries. The final agreement on NCQG was for $300bn annually by 2035, lower than many developing countries wanted, but three times higher than current. At least the countries reached an agreement, there was a risk of no agreement.

On Article 6, International Cooperation, the COP plenary adopted two important documents. Article 6.4 is a new carbon market mechanism for creation and exchange of carbon credits from project activities across countries, and has a new name, the Paris Agreement Crediting Mechanism (PACM). The two documents were the Article 6.4 Supervisory Body's Standard on Development and Assessment of Methodologies, and their Standard on Requirements for Activities Involving Removals. The Standard on Removals is important for CCS as well as engineered CDR, as although it isn't in the title, it explicitly includes "emission reduction activities with risk of reversal", and that will include CCS. IEAGHG has put a lot of effort into inputting evidence base on geological

storage into the 6.4 considerations on removals, especially drawing from the hard work we and others put into Clean Development Mechanism's modalities and procedures for CCS which were agreed in 2011 at COP17 and from the IPCC GHG Inventory Guidelines (2006). So, it is satisfying to see a Standard on Removals being finally adopted that includes engineered removals.

IEAGHG Activities at COP29

There were several events on CCS at this COP.

The most significant event was from the Carbon Management Challenge (CMC) which held its first Ministerial meeting at COP29 after being launched at COP28. This is a coalition of governments aiming to scale CCS and CDR by 2030 to having projects leading to 1Gt scale. It was great to see the room filled with governments and supporting observers. Sixteen governments gave statements of support and updates on the meeting's theme of "Collaborate to Accelerate", and the CMC secretariat gave an update. There are now 22 countries plus the European Commission as participants, with Mauritania, Senegal, Nigeria, Kenya and Bahrain joining since last year. There are now three workstreams: Finance for Developing Countries (led by Indonesia, Kenya, and US); Project Deployment and Tracking (led by Brazil); and Communication and Engagement (led by UK and Saudi Arabia). This Ministerial was well organised by the secretariat (now provided by Global CCS Institute). IEAGHG had a seat at the table again to offer our support.

The only official UNFCCC Side-Event on CCS was again one that IEAGHG led in co-organising with our partners University of Texas, the CCSA, the International CCS Knowledge Centre and Bellona. Titled "Is there Climate Finance for CCS, Especially in emerging economies?", this Side-Event showcased great talks and presentations, and perspectives were given from Brad Crabtree (US DOE), Katherine Romanak (University of Texas), Olivia Powis (CCSA), James Fann (International CCS Knowledge Centre), Olav Øye (Bellona), Clarine Ovando-Lacroux (UN's CTCN), Donneil Cain (Caribbean Community Climate Change Centre), and IEAGHG. As well as funding and incentives in the US, UK, EU and Canada, the GCF Readiness funds for Trinidad and Tobago were described and are precedent setting being the first for CCS. The COP media, IISD, covered the event, and their article can be seen at https://enb.iisd.org/climate-finance-carbon-capture-storage.

"CCS in the Caribbean Region" was the title of our second Side-Event, and was organised by IEAGHG, the University of Texas (UT), the University of Trinidad and Tobago and the University of the West Indies. We heard more detail and updates about the work underway in Trinidad and Tobago on their storage atlas, capacity building, national symposiums, a perspective on Guyana's potential, the regional context of establishing a centre of excellence, the Green Climate Fund funding to enable some of these activities, and the potential of the Carbon Management Challenge for the region.

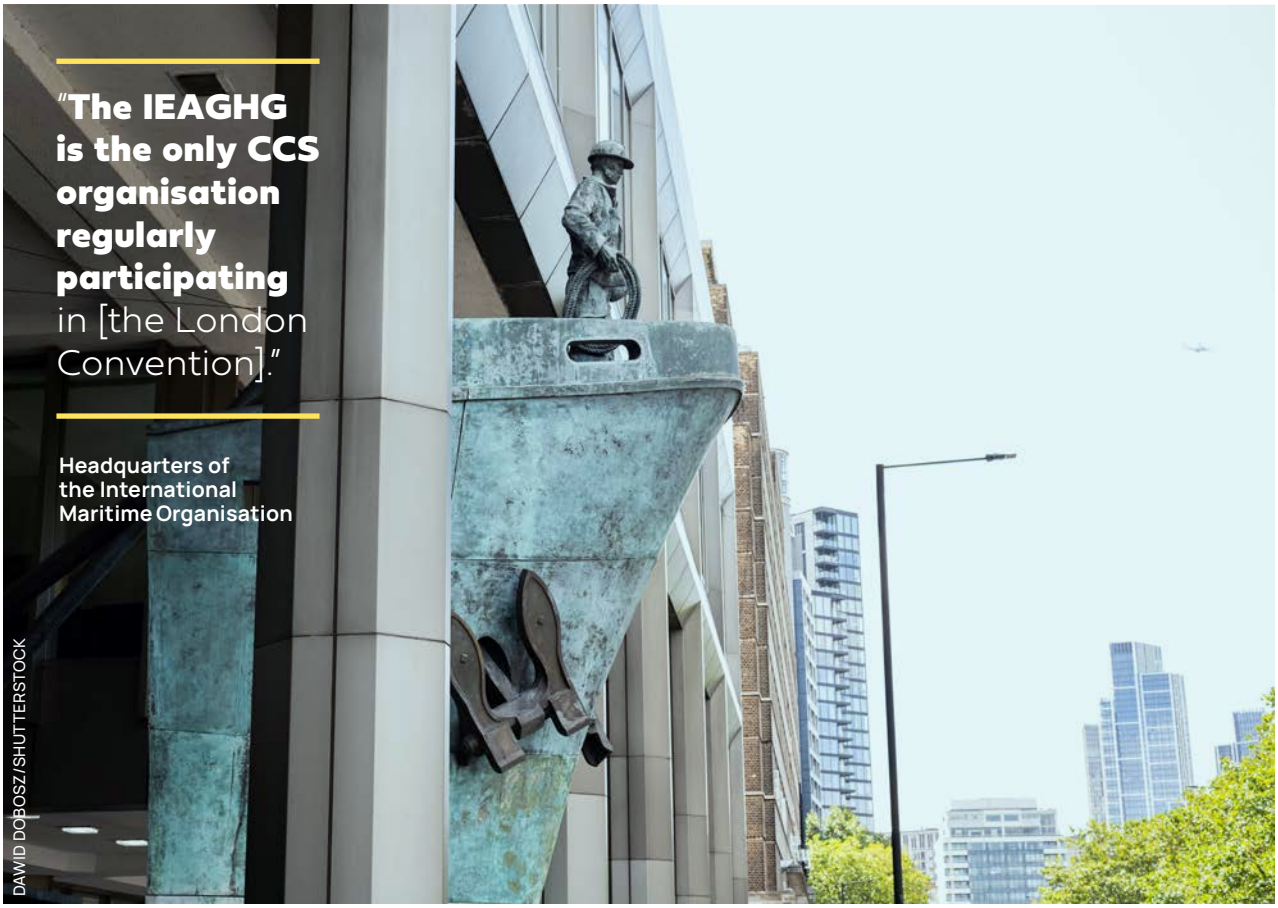
IEAGHG also spoke in other events at COP29, including the Global CCS Institute's event on "Scaling up CCS in the Global South", and our member PDO's event on Engineered Carbon Reduction and Removal Technologies. IEAGHG also participated in a roundtable meeting organised by CATF and US DOE to provide inputs on the Carbon Management Challenge's future work.

Global Impact

IEAGHG also joined in with UT, CCSA, and the International CCS Knowledge Centre to provide a UNFCCC Booth on CCS information in the second week. This was very popular, with a constant flow of delegates seeking it out to learn about CCS, indicating the continuing high level of positive interest in CCS.

LONDON PROTOCOL

The London Convention/Protocol held its annual Scientific Group meeting SG47 in London at the IMO from April 15th – 19th. It was observed by the IMO secretariat that interest in offshore CCS is increasing significantly. Much of the time of SG47 was spent on marine geoengineering issues and on CCS. Since the last meeting, there had been a survey conducted on CCS permitting experiences by countries, and the results were nicely summarised in a paper for this meeting and discussed. This was a good exercise in sharing of experiences and learnings, and prompting many questions from Greenpeace asking for further information in specific areas. It was clear to us from our knowledge from our Monitoring and Risk Networks and the Offshore CCS Workshops that there is much more experience and capability available to share, which we did inform on briefly in our Plenary intervention. The Scientific Group agreed that this work will continue gathering information to report back next year. IEAGHG will input more into this process.



Global Impact

Each year the Scientific Group have a 'Science Day'. This year it was on the topic of Experiences with Permitting CCS projects under the London Protocol. Experiences were shared by Australia, USA, Italy, Korea, Norway and Japan. IEAGHG provided the scene-setting on Global CCS Developments Offshore. We reminded the participants on why CCS is needed, the international regulations in place including from the London Protocol (noting the three 'arrangements' now in place between countries for export), also drawing from the learnings from our report on permitting of an EU project with respect to the London Protocol requirements (IEAGHG report 2016-TR04), and lastly drawing from the 6th Offshore CCS Workshop in September 2023 where around 30 project updates were given (IEAGHG report number 2023-TR06). There were many good questions from Greenpeace and others, and appreciation by Greenpeace for the sharing opportunity this Science Day provided. The recording of the Science Day is available on the IMO's YouTube channel at LC/SG Science Day - IMO 18 April 2024 and it will be summarised in the report of the SG47 meeting.

CCS continues to be a key topic of interest in the London Convention/Protocol. IEAGHG is the only CCS organisation regularly participating in these meetings, sharing scientific and technical evidence-base.

LC46

IEAGHG provided an update, specifically on the 7th International Workshop on Offshore Geologic CO_2 Storage, the IEAGHG Monitoring Network report from 2023 which covered the capabilities for leakage detection (addressing a concern raised by Greenpeace in the 2024 London Convention's Scientific Group meeting – see IEAGHG blog from the 20th April 2024), and the new IEAGHG study underway on contractual and risk allocation aspects of transboundary projects under the London Protocol, between governments and between companies.

IPCC

The IPCC Task Force on Inventories (TFI) was asked to look at Carbon Dioxide Removal Technologies with a view to developing a methodology. They organized an 'Expert Meeting' on Carbon Dioxide Removal Technologies, Carbon Capture Utilization and Storage on 1st – 3rd July in Vienna. Participation was by invite only, and IEAGHG's GM was invited to participate. GM attended (virtually from Australia). A key aspect from IEAGHG;'s perspective was to defend the existing IPCC TFI guidance on CO_2 transport and storage (in the IPCC GHG Inventory Guidelines 2006) as these are the basis for all CO_2 storage regulations since and continue to be sound and evidence based. The meeting covered many CDR techniques and there were three parallel break-out

UN headquarters in Geneva

groups: on engineered capture and geological storage; on inorganic processes (rock weathering, oceans); and on biogenic (soils, oceans, blue carbon). The GM attended the engineered group. The scene-setting presentation drew on experiences with the 2006 Guidelines on CCS and drew upon recent IEAGHG work on MRV for CDR. Hence there was good use of IEAGHG work in the engineered group as well as coordination with others.

Following this Expert Meeting, a Scoping meeting was arranged for the 14th – 16th October in Copenhagen. Participation in this is through the normal IPCC application process. As IEAGHG are accredited Observers, we were able to nominate the GM who was selected to participate. The timing was during the ExCo66 week so the GM attended virtually again from Canada. The participants of the Scoping Meeting recommend the title of the Report to be 2027 Methodology Report on Carbon Dioxide Removal Technologies, Carbon Capture, Utilization and Storage: (Supplement to the 2006 IPCC Guidelines). Other elements of the outline for this Methodology Report are included in this Meeting Report as follows: Draft Terms of Reference for 2027 Methodology Report; Draft Table of Contents; Draft Instructions to Experts and Authors; and the Work plan recommended. These recommendations and documents will constitute the basis of the TFI proposal for the outline for the 2027 Methodology Report on Carbon Dioxide Removal Technologies, Carbon Capture, Utilization and Storage: (Supplement to the 2006 IPCC Guidelines) to be presented to the IPCC-62 in early 2025 for the consideration by governments.

The meeting reports from both meetings are available at Meetings - IPCC-TFI.

CEM-CCUS

IEAGHG attended the monthly meetings of CEM-CCUS initiative. In 2024, the CEM15/MI-9 Ministerial Meeting took place in Foz do Iguaçu, Brazil, from 30 September to 3 October 2024. It was held alongside the 4th G20 Energy Transition Working Group Meeting and the G20 Energy Transition Ministerial Meeting. Apart from the G20-related events, parallel sessions were conducted covering a wide range of key issues at the heart of the global energy transition. These included a meeting organised by CEM-CCUS on CCS in the Cement Sector. IEAGHG attended CEM15 and participated in the CCS meetings.

ISO TC265

This ISO committee was proposed by Canada and set up in 2012 with a Canadian Chair and Canadian and Chinese Secretariat. There are 28 participating members, 17 observing members, and 10 liaison organisations (including IEAGHG).

The scope of the group is the 'standardization of design, construction, operation, environmental planning and management, risk management, quantification, monitoring and verification, and related activities in the field of carbon dioxide capture, transportation, and geological storage (CCS)'.

IEAGHG is a Liaison Organisation to TC 265, and a member of WG 3 Storage (Tim Dixon / Sam Neades), WG 5 Cross-cutting issues (Tim Dixon / Sam Neades) and WG 7 Transportation of CO_2 by Ship (Sam Neades). The annual plenary was held virtually on the 3rd – 7th June 2024 and IEAGHG provided an update on IEAGHG activities of relevance.

The 17th Greenhouse Gas Control Technologies Conference

Justin Riemer, ERA

The 17th Greenhouse Gas Control Technologies Conference (GHGT-17) is the premier international conference on greenhouse gas reduction technologies, focusing on carbon capture, utilisation, and storage (CCUS). The GHGT conference series is at the forefront of advancing low-carbon solutions to combat climate change.

GHGT-17 took place in Calgary, Alberta, Canada, in October 2024. This event brought together researchers, industry leaders, government officials, and business partners from around the world to explore cutting-edge technology, innovation, and greenhouse gas mitigation strategies.

This record-breaking conference was attended by 1547 delegates, featured 884 presentations and e-posters, and had 6 panel sessions – all across 7 parallel streams, making this the largest gathering of CCS experts in history.

This conference was co-hosted with Emissions Reduction Alberta (ERA). Based in Alberta, Canada, ERA invests in innovative clean technologies and solutions to lower both greenhouse gas emissions and costs, keeping industries competitive while supporting the growth of new ones. Scaling up innovation will help Alberta and Canada succeed in a low emissions world.

The conference featured keynote presentations from leading figures in the CCS world including:

The 17th Greenhouse Gas Control Technologies Conference

Myles Allen – Professor of Geosystems Science at Oxford University, Mary Burce Warlick – Deputy Executive Director of the IEA, Rebecca Schultz – Minister of Environment and Protected Areas at the Government of Alberta, Jarad Daniels – CEO of the Global CCS Institute, Susannah Pierce – President and Country Chair at Shell Canada.


Professor Myles Allen

For the first time, GHGT included a business stream, providing essential insights, discussions and case studies on the business challenges and solutions of launching CCS projects. As a rapidly growing number of commercial-scale CCS projects are now in development, the need to share best practices and lessons learned has never been greater to ensure successful deployments that make a real-world impact. This was reflected in the excellent attendance and enthusiastic response this stream received from delegates.

Following the conclusion of the conference, delegates were treated to a selection of site visits to see some of Alberta's pioneering CCS projects, including the Containment & Monitoring Institute (CaMI), the Alberta Carbon Conversion Technology Centre, Heidelberg Materials, and the Quest Carbon Capture and Storage facility.

Though the challenges on the road to decarbonising our society are great, this conference has shown that there is a growing community of dedicated professionals who are determined to make net zero a reality.

IEAGHG booth at GHGT-17

The 7th International Workshop on Offshore Geologic CO_2 Storage

RUBEN SOLTVEDT

CO_2 Carrier Ship, Northern Pioneer

The 7th International Workshop on Offshore Geologic CO_2 Storage, organised by the Gulf Coast Carbon Center and IEAGHG, was hosted by the Port Arthur Chamber of Commerce in the Lamar State College at Port Arthur on the 17th – 18th September. These workshops are focussed on 'how-to-do offshore CCS', and at this 7th in the series, we had updates from 45 projects globally and had sessions tackling key topics such as injection, shipping and direct injection, public engagement, monitoring, and regulatory developments. We also had two interactive group exercises on the re-use of depleted fields and evaluating legacy wells.

Key messages included:

- There is a great diversity of projects at a variety of stages. With diverse business models, multiple sources, or country sources, single operator to multi-partner operations. 'Offshore CCS' is not one thing.
- Ship and barge transport being worked on intensively with many different models for the vessels' pressure, temperature and handling.
- There is variable interest in the use of depleted fields for storage (scale, maturity and others affecting countries' priorities).
- Containment and leakage is of significant public interest.
- Thought leadership on CO_2 stream composition aspects by EU stakeholders is active and critical for multi-source and multi-modal transport systems.
- We had overwhelmingly positive interest by the Port Arthur Chamber of Commerce, and local advertising of CCS in the local press, billboards and Spotify ads.
- Lastly, public perception studies demonstrate that a high proportion of the population have very little knowledge of CCS but when given some background can generally warm to the concept – getting well balanced information to the public is key to addressing concerns.

An excellent field trip was organised by Tip Meckel (Bureau of Economic Geology at The University of

The 7th International Workshop on Offshore Geologic CO_2 Storage

Texas at Austin). This included the full CCS value chain, from CO_2 sources at the local refineries, ExxonMobil's Green Line CO_2 trunk pipeline, Baker Hughes well- and caprock-inspection tools, and the shore and offshore geology.

In addition, we considered regional ecosystem aspects and benefits with a talk by John DeFillipo of the National Wildlife Federation, including our work on demonstrating neutral impacts of CCS on avian populations, all very relevant with the large number of potential CCS projects and offshore wind projects in this migration hotspot.

Many thanks to the presenters and 60+ in-person attendees from over 7 countries and the 100+ online attendees for good presentations and discussions, and thanks to the sponsors US Department of Energy, Viridian, Baker Hughes, ExxonMobil and Carbon Ventures. A report of the workshop is now available (Report Number 2025-TR01).

LUKASZ Z/SHUTTERSTOCK

Offshore oil rig

Offshore Workshop Delegates

Technical Reports

Contents

As a leader in CCS research our technical reports are a cornerstone of what we do. Produced in collaboration with world-leading institutions, these in-depth reports are accelerating the development and deployment of CCS projects across the globe.

Technical Reports


RED IVORY/SHUTTERSTOCK

1. The Role of Indices in Assessing the Maturity of CCUS Technologies and their Readiness for Deployment

Managed by Keith Burnard

This study was undertaken on behalf of IEAGHG by Foresight Transitions Ltd. While a technology may be technically mature, it has become increasingly clear that the technology may not necessarily be considered commercially 'bankable' by investors. In this study, the potential for an index or indices to provide that confidence was explored. The findings from the study will be of interest to the broader energy community but, in particular, should benefit technology developers, CCUS end users, investors and policymakers.

2. Clean Steel: An Environmental and Technoeconomic Outlook of a Disruptive Technology

Managed by Abdul'Aziz Aliyu

This study primarily presents a comparative analysis of steelmaking pathways to cost-effectively decarbonise a steel mill, taking a life-cycle perspective on associated environmental impacts. The roll-out of clean steel technologies is envisioned to have a significant implication for support infrastructure. Therefore, a secondary objective of the study is to gain insights into the primary energy and infrastructure implications associated with large-scale deployment of different steel decarbonisation pathways. Clean steel production will likely be more expensive than steel produced today; this poses additional economic strains on steel producers and consumers. Consequently, a third objective is to estimate the price premium that clean steel could command in existing and future markets. Further, this study formulates recommendations for key stakeholders to support the sector and outlines recommendations for further work.


MIHAI SIMONIA/SHUTTERSTOCK

3. Techno-Economic Assessment of Small-Scale Carbon Capture for Industrial and Power Systems

Managed by Keith Burnard

This study, undertaken on behalf of IEAGHG by Element Energy (now a part of ERM), explores the role of CCS in decarbonising small-scale industry and power generation applications. While relatively under investigated compared to their larger scale counterparts, reaching net zero will be dependent on successfully addressing the emissions from small-scale facilities. The findings from the study will be of interest to the broader energy community but, in particular, should benefit project developers, the finance community and policymakers.

FACTORY_EASY/SHUTTERSTOCK

4. Power CCS: Potential for Cost Reductions and Improvements

Managed by Keith Burnard

Many major economies and international organisations have committed to bring their greenhouse gas emissions to net zero by mid-century or earlier. CCS, in the context of power CCS technologies, will be an essential component of the portfolio of technologies required to reach net-zero emissions in the power sector. This study explores the potential to reduce the cost and accelerate the uptake of power CCS technologies. Results will be helpful in devising future policy in support of power CCS and in assessing the potential impact of implementing the policy.

5. Managing the Transition of Depleted Oil and Gas Fields to CO_2 Storage

Managed by Nicola Clarke

This work aims to provide a careful and thorough exploration of the major issues involved in the transfer of use of a field from hydrocarbon extraction to CO_2 storage, to identify both the pros and cons of such a transition. Exploring the technical, economic, regulatory, and commercial factors that need to be navigated. Case studies are included, and recommendations are made on ways to overcome barriers and maximise opportunities.

6. Geological Storage of CO_2: Seal Integrity Review

Managed by Nicola Clarke

This comprehensive seal integrity review, undertaken by CO_2CRC on behalf of IEAGHG, provides a detailed, updated exploration of the critical aspects of seal potential in the context of the geological storage of CO_2. The review focuses on developments in this field since 2011. It highlights the importance of seals in ensuring the containment of CO_2 and the considerations involved in predicting the long-term impact of CO_2 interactions with seal formations.

TONTON/SHUTTERSTOCK

7. The Role of Low Emissions Dispatchable Power in the Lowest Cost Net Zero System

Managed by Keith Burnard

This study explores the interdependencies of different power generation technologies in a highly decarbonised future. Via three case studies, the analysis sought to demonstrate what opportunities the Australian and Japanese stakeholders would have to achieve a net zero power system at lowest cost by 2050. While focusing on the lowest TSC opportunities, the analysis showed that all decarbonisation solutions for transitioning to a decarbonised grid were more expensive than maintaining today's high carbon grid. It also showed that while all technologies would need to be available for decarbonisation, CCS was central to the optimum solutions available. Without CCS, especially in conjunction with BECCS to create negative emissions, it was difficult to approach full decarbonisation at a reasonable cost.

R.CLASSEN/SHUTTERSTOCK

8. Analysis of Electrolytic Hydrogen Technologies with a Comparative Perspective on Low-Carbon (CCS-Abated) Hydrogen Pathways

Managed by Abdul'Aziz Aliyu

The primary goal of this study, conducted by ERM is to evaluate various electrolytic hydrogen production pathways focusing on their technical, economic, and environmental aspects and to compare these with hydrogen production routes that involve fossil fuel with CCS abatement. Further, the objectives of the study include assessing the potential impact of global water resources through electrolysis in a net zero context, evaluating the potential impact of hydrogen consumption on water vapour emissions, and assessing the value of oxygen produced via electrolysis.

9. Measurement, Reporting and Verification and Accounting for Carbon Dioxide Removal in the Context of Both Project-based Approaches and National Greenhouse Gas Inventories

Managed by Jasmin Kemper

The subtle shift in emphasis away from a focus on reducing and eliminating GHG emissions (as in the quantified emission limitation and reduction targets of the Kyoto Protocol) towards net zero framing has shone a new light on the role and potential of GHG removal (GGR) or CDR in climate change mitigation. Today, there is growing acceptance that CDR methods are needed to offset some ongoing, hard-to-abate, residual anthropogenic GHG emission sources to achieve and thereafter maintain a state of net zero (IPCC 2022). The aim of this study is to provide a synthesised technical assessment of carbon dioxide removal (CDR) methods and review their measurement, reporting, and verification (MRV) features and accounting aspects.

Webinars

Webinars are an essential part of our knowledge sharing activity. Each event is recorded and publicly available on the IEAGHG YouTube channel. For details of our upcoming webinars, you can subscribe to our email list at www.ieaghg.org.

Techno-economic assessment of commercially available CO_2 conditioning technologies

Tuesday **20th February 2024**

Attendance:

276

YouTube Views so far:

1438

Explore the techno-economics of commercially available CO_2 conditioning technologies, with a focus on their performance, economic viability, and ability to meet the stringent purity requirements established by transport and storage (T&S) projects.

Webinar Clean Steel: An Environmental and Techno-economic Outlook of a Disruptive Technology

Wednesday
25th September 2024

Attendance:

64

YouTube Views so far:

161

This webinar provides an overview and discussion on the IEAGHG report 'Clean Steel: An Environmental and Techno-Economic Outlook of a Disruptive Technology'

COP29 Reflections: A Conversation with Tim Dixon and Wafa Jafri

Tuesday **10 December 2024**

Attendance:

140

YouTube Views so far:

34

Tim Dixon (IEAGHG) and Wafa Jafri (KPMG) shared their thoughts and insights about the recent COP29, which they both attended. The conversation was facilitated by Jen Roberts (UKCCSRC and University of Strathclyde).

IEAGHG Communications

IEAGHG is growing. With increasing demand for our technical reports and events, there is more traffic and engagement through our digital channels than ever before. In particular, we have seen huge improvements in engagement with our website following the relaunch of ieaghg.org in June 2024.

9.9k
Website **Engaged Sessions**[1]
↑ 11%

56s
Website **Engagement time per session** (s)
↑ 47%

7.6
Website **Events per session**
↑ 42%

1.1k
Average **Publication Downloads** per month[1,2]

2.4k
Email List **Subscribers**
↑ 49%

43%
Email List **Average Open Rate**[4]

3.7k
LinkedIn **Followers**
↑ 55%

134k
LinkedIn **Post Impressions**[3,5]

2.4k
Twitter **Followers**
↑ 0%

↑ Growth from last year

Foot notes: 1. All website metrics since July have only tracked consented users. We only obtain consent from 70% of users. Aggregated website metrics have been adjusted upwards to compensate for this. 2. This is a new metric and there is only 5 months worth of data in 2024. 3. Platform does not record sufficient historical data to give a full year's data. Only 9 months of data is available. This has been increased to 12 months assuming that performance was average in this window. 4. This is a new metric and there isn't a previous year with which to compare it. 5. This figure is down 32% from last year for two reasons. Firstly, post frequency was down in the first half of the year due to the redevelopment of ieaghg.org which limited staff capacity. Secondly, in autumn of 2024 LinkedIn brought in a significant change to their algorithm which heavily penalised content that links to other websites. As link posts that point to our website form the backbone of our LinkedIn strategy other options are being considered.

Publication Lists

TECHNICAL REPORTS

Report Title	Contractor/ Colleague	.pdf Creation Date
The Role of Indices in Assessing the Maturity of CCUS Technologies and their Readiness for Deployment	Keith Burnard	2024/02/29
Clean Steel: an Environmental and Technoeconomic Outlook of a Disruptive Technology	Abdul'Aziz Aliyu	2024/03/05
Techno-Economic Assessment of Small-Scale Carbon Capture for Industrial and Power Systems	Keith Burnard	2024/03/21
Power CCS: Potential for Cost Reductions and Improvements	Keith Burnard	2024/07/30
Managing the Transition of Depleted Oil and Gas Fields to CO_2 Storage	Nicola Clarke	2024/08/12
Geological Storage of CO_2: Seal Integrity Review	Nicola Clarke	2024/09/11
The Role of Low Emissions Dispatchable Power in the Lowest Cost Net Zero System	Keith Burnard	2024/09/20
Analysis of Electrolytic Hydrogen Technologies with a Comparative Perspective on Low-Carbon (CCS-Abated)Hydrogen Pathways	Abdul'Aziz Aliyu	2024/12/04
Measurement, Reporting and Verification and Accounting for Carbon Dioxide Removal in the Context of Both Project-Based Approaches and National Greenhouse Gas Inventories	Jasmin Kemper	2024/10/15

TECHNICAL REVIEWS

Review Title	Contractor/ Colleague	.pdf Creation Date
7th Post-Combustion Capture Conference Summary	Abdul'Aziz Aliyu	2024/08/22
IEAGHG Workshop on Comparative Technoeconomic Assessment of Commercially Available CO_2 Conditioning Technologies	Abdul'Aziz Aliyu	2024/07/29
CO_2 Storage Site Catalogue	Nicola Clarke	2024/08/05
Insurance Coverage for CO_2 Storage Projects	Keith Burnard	2024/08/16

Publication Lists

INSIGHT PAPERS

Insight Paper Title	Contractor/ Colleague	.pdf Creation Date
The EC's Proposed Industrial Carbon Management Strategy	Jasmin Kemper	2024/02/14
2023 Annual Experience Sharing Report for Northern Lights Phase 1 Facilities	Abdul'Aziz Aliyu	2024/05/22
Carbon Capture and Storage: Where From and Where To?	Abdul'Aziz Aliyu	2024/05/22
Gold, Geologic, White, Native, Hidden, Natural Hydrogen: Does Earth Hold Extensive Stores of Untapped, Carbon-free Fuel?	Abdul'Aziz Aliyu	2024/06/26
The 3rd International Conference on Negative CO_2 Emissions	Jasmin Kemper	2024/09/12
Confidential - 3rd International Conference on Negative CO_2 emissions	Jasmin Kemper	2025/09/01
Confidential - COP29 Baku's Mixed Results	Arthur Lee	2025/12/01

Note: We also produce confidential insight papers that are only availble to our membership.

NEWS & BLOGS

Blog Title	Contractor/ Colleague	.pdf Creation Date
COP29 – Outcomes and CCS Activities	Tim Dixon	2024/11/25
COP29 Starts withSsuccess on the Article 6.4 Mechanism	Tim Dixon	2024/11/12
London Convention & London Protocol 2024 Annual Meeting	Tim Dixon	2024/11/12
GHGT-17 Closing Plenary	Samantha Neades	2024/11/08
GHGT-17 Future Leaders Forum: Leading the Charge for a Sustainable Future	Nicola Clarke	2024/11/07
GHGT-17 Day 4 Plenary	Timothy Wilson	2024/11/07
IEAGHG at COP29	Tim Dixon	2024/11/06
GHGT-17 Panel Discussion 6 – Trends in Research in Carbon Capture, Removals, Transport, Usage, and Storage.	Nicola Clarke	2024/11/06
Strategies for CO_2 Purification: Insights from GHGT-17 Panel Session 5	Abdul'Aziz Aliyu	2024/11/05

Publication Lists

NEWS & BLOGS

Blog Title	Contractor/ Colleague	.pdf Creation Date
GHGT-17 Site Tour at Heidelberg Materials and Blindman Brewing	Abdul'Aziz Aliyu	2024/11/05
GHGT-17: Technical Plenary Day 3	Samantha Neades	2024/11/01
GHGT-17: Panel Discussion 4 – Let's Get Real About Carbon Dioxide Removal (CDR)	Abdul'Aziz Aliyu	2024/10/31
GHGT-17: Panel Discussion 1 – Advancing Carbon Management in Developing Countries	Tim Dixon	2024/10/30
GHGT-17: Day 2 Technical Plenary	Keith Burnard	2024/10/24
GHGT-17: Panel Discussion 3 - What is Needed to Make CCS a Success Across Regions?	Keith Burnard	2024/10/23
GHGT-17: Panel Discussion 2 - Raising Ambition to Accelerate Carbon Management	Keith Burnard	2024/10/23
GHGT-17: Opening and Welcome	Jasmin Kemper	2024/10/21
UK Green Light on CCS Projects	Tim Dixon	2024/10/04
7th Offshore CO2 Storage Workshop, Port Arthur, Texas	Nicola Clarke	2024/09/24
Trinidad and Tobago 2nd National Symposium on CCS	Tim Dixon	2024/09/10
2024 FECM / NETL Carbon Management Research Project Review Meeting	Abdul'Aziz Aliyu	2024/08/13
US Carbon Management Project Review Meeting 2024 - Overview	Tim Dixon	2024/08/13
IEAGHG International CCS Summer School 2024	Samantha Neades	2024/07/18
Options for regulation of CCS projects in Oman Global CCS Institute's Workshop	Keith Burnard	2024/05/02
Seminar: CCS in Denmark	Keith Burnard	2024/05/24
CCS at the London Convention's Scientific Group meeting SG47	Tim Dixon	2024/04/22
Canada UK Energy Summit	Tim Dixon	2024/03/14
Council for Geoscience (CGS) 2024 Carbon Capture Utilization and Storage Workshop, South Africa	Abdul'Aziz Aliyu	2024/02/01
New CCS Knowledge Shared at UTCCS-7 in Austin, Texas	Tim Dixon	2024/01/30
IEAGHG Report (2023-06) – International Standards and Testing for Novel Carbonaceous Building Materials	Nicola Clarke	2024/01/25
IEAGHG Report (2023-05) - Classification of Total Storage Resources and Storage Coefficients	Nicola Clarke	2024/01/22

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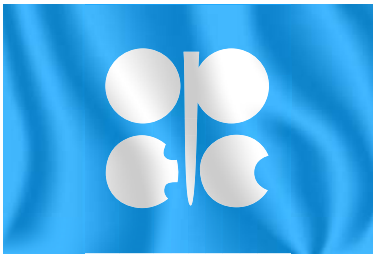

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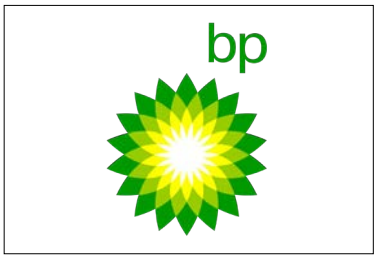

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