# ANNUAL REVIEW 2023

## INTERNATIONAL CENTRE FOR SUSTAINABLE CARBON

THE GLOBAL RESOURCE ON THE SUSTAINABLE USE OF CARBON

INTERNATIONAL CENTRE FOR
SUSTAINABLE CARBON

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INTERNATIONAL CENTRE FOR
SUSTAINABLE CARBON

Technology Collaboration Programme
by iea



## MESSAGE FROM THE GENERAL MANAGER

Dr Andrew Minchener OBE
General Manager ICSC

**Welcome to the 2023 Annual Review of the International Centre for Sustainable Carbon (ICSC), a Technology Collaboration Programme operating under the auspices of the International Energy Agency. Our work comprises wide ranging studies and assessments of policy relevant carbon related issues from a global perspective, namely:**

- The development and deployment of carbon-based energy technologies that are clean, reliable, with high efficiencies and minimal environmental impact, while being commercially competitive, in line with the UN Sustainable Development Goals,
- Technologies that create high-value carbon-based non-energy products,
- The processing of coal to extract critical minerals including rare earth metals for use in a very wide range of advanced technologies with considerable market applications,
- Reviews and analyses of markets for low- and near zero-carbon technologies that have low overall environmental impacts, together with enabling policies and regulations that are required to accelerate their global market introduction.
- The potential role for coal and other carbon-based energy sources worldwide. This includes expanding our complementary work on the use and sustainability of biomass in various industry sectors together with examining options for the sustainable use of organic wastes in industrial applications. In all cases, a key aspect of our work is to highlight the differences in such applications between OECD countries and developing nations, reflecting on the heterogeneous nature of energy availability and use.
- Equally importantly, recognising that the energy transformation is not limited to power plants we continue to address other aspects such as system flexibility, smart grids and virtual power plants, digitisation of electricity grids, distributed generation, as well as the need to economically integrate carbon capture, utilisation and storage (CCUS) under such conditions.
- Such assessment studies have continued to represent our core activity, with each output comprising a comprehensive but succinct report and a separate policy-relevant executive summary, backed up with a webinar covering the key takeaways. We have also maintained delivery of our popular Mandarin version of the summary, which is distributed by our sponsor member, the Beijing Research Institute of Coal Chemistry.

## HIGHLIGHTS OF THE 2023 WORK PROGRAMME INCLUDED:

We continued our Energy Transition workshop series, with a policy relevant event in Cape Town, South Africa, working with Eskom. Eskom is the largest power producer in Africa and is among the top utilities in the world in terms of generation capacity and sales. They also represent South Africa on our Executive Committee. We established a wide ranging programme, examining the issues from a developing country perspective while balancing that with our own global information, together with the input of several external experts who provided in-depth commentary that complemented our own.

A significant part of our work has been a comprehensive capacity building initiative, with support from the US Department of State. The focus of this USDOS project has been to establish a cost effective and efficient means for the reduction of mercury emissions from the Indian coal utility sector through identifying methods, procedures, and where possible, political drivers for mercury reduction. This has been complemented with accelerating the basis for emission reduction from the coal sector in Indonesia, with a focus on mercury. The project has explored strategies which would accelerate the emissions of all pollutants from coal utilities with the understanding that almost every strategy for emission reduction, be it enhancing plant efficiency or retrofitting control technologies for pollutants (such as particulate matter, $SO_2$ and NOx), will reduce mercury as a co-benefit.

In July 2023 the ICSC sponsored the 3rd Ramaco Research Rodeo in Sheridan, Wyoming. Debo Adams and Dr Ian Reid were members of the Organising Committee and attended the event together with Dr Andrew Minchener. All three delivered presentations and participated in the lively discussions. Debo also chaired a session. The event, organised by Ramaco Resources explored innovative ideas on the future of coal – there is a strong focus on extracting critical minerals and rare earth elements from coal and converting coal into various products.

A further complementary cooperative approach has been with the IEA Coal Industry Advisory Board, which represents most of the major OECD coal producers worldwide. During 2023, we have produced two studies for the CIAB, and a third is imminent, which was presented at the CIAB Plenary meeting in November at the IEA offices in Paris, and at other venues.

We continue to collaborate with the United Nations Economic Commission for Europe (UNECE) and are a part of the Bureau for Cleaner Electricity Systems and Sustainable Energy. This has included raising awareness amongst governments, industry, academia and international organisations about the potential of low- and zero-carbon technologies and their interplay to attain carbon-neutral energy systems in the UNECE region.

3rd Ramaco Research Rodeo and Ramaco Research Facility

Finally, we have fulfilled invitations to speak at meetings and events that have been organised by independent organisations. Dr Andrew Minchener's outreach included:

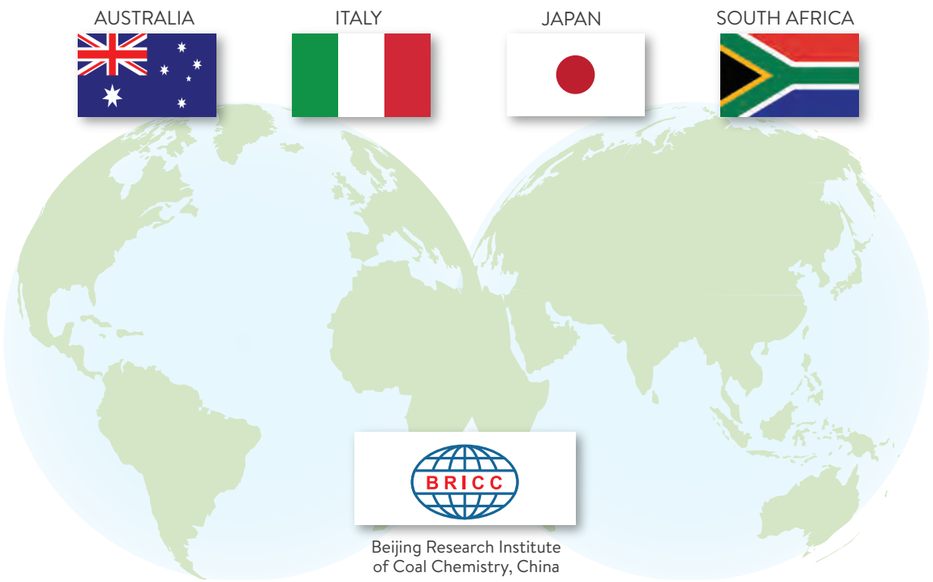
- *Chairing a session and presenting at a significant conference organised by Tsinghua University, China, covering options to achieve carbon net zero.*
- *Presenting and participating in a discussion session at a Coal Day meeting organised by JOGMEC and others in Tokyo.*
- *Presenting on CCUS and participating in a strategic discussion at an IERE Japan meeting in Singapore.*

All our work is underpinned by our overall communications approach. During 2023, we have continued to maintain our contacts while seeking ways to generate broader interest in our activities, particularly via virtual platforms. We have stepped up our social media activity with the aim of making the ICSC content readily available to our users worldwide. Finally, our website (www.sustainable-carbon.org) has continued to attract visitors from the USA (19%), India (17%), the UK (9%), China (6%) and Australia (5%) – closely followed by Japan and Indonesia. Between March – September 2023 a total of 17,636 people visited the website. On our social media sites, primarily LinkedIn and YouTube, we have seen more extensive engagement, with those accessing our content being ever more positive about our output.

Dr Andrew Minchener OBE
General Manager, International Centre for Sustainable Carbon

## STATUS

**We are a Technology Collaboration Programme mandated by the International Energy Agency, but functionally and legally autonomous. The ICSC is a non-profit organisation supported by the governments of Australia, Italy, Japan and South Africa, and the Beijing Research Institute of Coal Chemistry, China as a sponsor. Our membership has a depth and breadth of character, which helps us maintain a truly global outlook.**




INTERNATIONAL CENTRE FOR SUSTAINABLE CARBON

Technology Collaboration Programme by IEA

Representatives of the members convene twice a year for the Executive Committee meetings of the ICSC. In 2023 the April meeting was in Cape Town, South Africa and the October meeting was held at the IEA office in Paris, France. At the meetings, the ExCo agree the work programme and budget, comment on our studies and outreach activities, and work with us to suggest topics for assessment. Our members have immediate access to all our output, in accord with the programme objectives described on the following pages.





## OBJECTIVES

**Our overall objective is to provide our members, the IEA Working Party on Fossil Energy and other interested parties with definitive and policy-relevant independent information on how various carbon-based energy sources, including coal, biomass and organic wastes, can become cleaner sources of energy, compatible with the UN Sustainable Development Goals.**

We promote best practice in all aspects of resource production, transport, processing, utilisation, including energy trilemma issues with the need to balance security of supply, affordability, and environmental issues. All work continues to be aligned with the UN Sustainable Development Goals (SDGs), which include the need to address the climate change mitigation targets as set out by the United Nations Framework Convention on Climate Change (UNFCCC).

## OPERATIONAL APPROACH

- *The overall work programme includes:*
- *Independent, peer-reviewed, policy-relevant studies, on energy subjects selected by the Executive Committee, which are disseminated through our highly regarded web-based system.*
- *Regular webinars are presented by ICSC staff members and associates every month (on a Wednesday at midday, UK time). These presentations summarise the key messages of our published studies. There is a growing number of attendees following our webinars live, or after the event on YouTube www.youtube.com/c/InternationalCentreforSustainableCarbon.*
- *Blogs on related energy/environmental issues provide a less formal but still comprehensive commentary on various sustainable carbon-related issues, often being linked to the topic of a current webinar. This approach supports some of the more well-liked content on social media.*
- *Outreach activities that focus on sustainable energy issues including capacity building and training on energy and environmental topics related to low carbon emissions technologies, especially those relevant for use in developing countries.*
- *Specialist workshops and conferences to support international collaboration on various sustainable energy options with a focus on limiting emissions, which we hold in member countries.*
- *Continued development of our website to further disseminate key aspects and successes of the overall programme.*
- *We list and publicise our members' events in our Weekly News dispatch.*
- *Our staff contribute features to publications in member countries when requested.*
- *Follow us on LinkedIn. During April - October 2023 our LinkedIn page had 12% more page views and on YouTube we had 14% more followers.*

## SCOPE OF WORK

While the sustainable use of coal remains a key part of our programme, we have expanded our complementary work on the use and sustainability of biomass in various industry sectors together with examining options for the sustainable use of organic wastes in industrial applications. An energy transformation is underway that is beginning to have a major strategic impact on operational issues and consequently, this is becoming a key aspect of our work programme. This is not limited to power plants, but encompasses other aspects such as system flexibility, smart grids and virtual power plants, digitisation of electricity grids, distributed generation, as well as the need to economically integrate carbon capture, utilisation and storage (CCUS) under such conditions. This includes operation of power grids with high capacities of variable renewable energy sources, while integrating dispatchable fossil power with CCUS to provide the necessary stability in a cost-effective, low-carbon manner.

Our work has a broad geographic focus, which reflects the heterogeneous nature of global energy use since there is no 'one size fits all solution' to the energy and environmental challenges being faced worldwide. The approaches adopted in developing countries will be different to those in OECD countries, with each nation having its own priorities and resources. For example, in developing countries with growing populations and inadequate power supply systems, there is a need for massive increases in power generation capacity, which should be provided by reliable low-cost power systems. In these situations, all options, not just variable renewable energy, will probably be needed, including carbon-based systems. Consequently, this requires a far more flexible operating approach than is currently available in many developing countries and is not typical for many OECD countries. These challenges must be addressed if stable power production is to become the norm. Given the important role of helping developing countries achieve the UN SDGs, we will focus most of our capacity-building and training efforts in these regions, based on our deep understanding of global technologies, policies, economics and market developments.

Our current coal-based activities remain valid, with the expectation, for example, that coal to non-energy products will have a still higher profile in the near and medium-term future. For biomass, we will consider coal-biomass mixes but will also expand the options to 100% biomass operation, in line with the approach that is being taken in China, Japan and the UK. For organic wastes, this can include anything from industrial residues such as paper through to sludges together with agricultural crop residues that in Asia cause major air pollution when burnt indiscriminately in the field.

## OVERVIEW OF TOPICS AND RELATED ACTIVITIES FOR THE STUDIES PROGRAMME

**The studies programme of 2023 covered a broad range of topics related to sustainable and secure energy and other environmental and development concerns. The subjects reviewed include:**

- *Analysis of the problems of industrial scale agriculture such as soil erosion and over application of fertilisers. Lignite-based fertilisers can improve the carbon content of the soil and the retention of fertilisers, meaning that lower rates of application are needed.*
- *The potential development of a hydrogen economy and the role for coal within it as a low-cost method of hydrogen production.*
- *Hard to abate, coal using industries are still required during the energy transition and much can be done to reduce their emissions, including increasing energy efficiency, cofiring and increasing the use of CCUS.*
- *The need for bioenergy with CCS (BECCS) as the most reliable method of achieving negative emissions, which is increasingly important in net zero scenarios. The technologies for BECCS are described and there is a detailed case study of Drax power plant, UK.*
- *The gulf between current levels of CCS deployment and what will be needed to reach net zero, and the challenges in financing large-scale fossil fuel power with CCS projects. Climate finance flows to CCS are small.*
- *Exploration of the beneficial uses for old coal mines and power plants, such as energy storage, nature reserves, and energy-based options.*
- *CCS has a vital role in achieving net zero. There is growing interest in developing CCS hubs and clusters, where industries and power generation can feed their $CO_2$ to a hub, from where it is then transported for utilisation or storage.*
- *Carbon utilisation can also have a role in achieving net zero. Carbon utilisation includes in various chemicals, fuels, polymers and building materials. $CO_2$-curing can improve the performance of concrete.*

Drax Power Station uses compressed wood pellets sourced from sustainably managed working forests in the US, Canada, Europe and Brazil. The pellets are largely made up of low-grade wood produced as a byproduct of the production and processing of higher value wood products, like lumber and furniture.

# ICSC PUBLICATIONS 2023

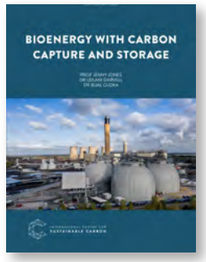
**In 2023 the ICSC published a total of six reports including four studies on subjects selected by our Executive Committee, and two on behalf of the ICSC-CIAB. Five reports as part of the outreach programme with the US Department of State were also published. All our reports are available from our website and the majority have been presented as webinars which can be found on the ICSC YouTube channel.**

## ICSC STUDIES

### BIOENERGY WITH CARBON CAPTURE AND STORAGE – ICSC/326

April 2023

Prof Jenny Jones,
Dr Leilani Darvell,
Dr Bijal Gudka




Carbon dioxide removal (CDR) technologies are an essential mechanism, together with emission reduction strategies, to limit atmospheric $CO_2$ concentrations to 430–480 ppm and so restrict global average temperature rise to less than 2.0°C. According to the Intergovernmental Panel on Climate Change (IPCC) Integrated Assessment Modelling (IAM) scenarios, this would mean an average annual removal of 12 $GtCO_2$/y until the end of the century. This needs to begin immediately and ramp up rapidly. IAMs and sustainability modelling show that sustainable bioenergy with carbon capture and storage (BECCS) is pivotal technology with the potential to sequester 2–4 $GtCO_2$/y. BECCS is the most mature engineered CDR technology, but its deployment has been slow. Currently in 2022, <0.5 $MtCO_2$/y is captured from biogenic sources of $CO_2$ from power, energy from waste, and cement manufacturing. In the next five years this could increase 10-fold with planned projects at Drax in the UK, Klemetsrud in Norway, Twence in the Netherlands and Stockholm Exergi CHP in Sweden. This report studies the status and potential of BECCS, particularly in Canada, China, Europe, India, Japan, the UK and the USA. It examines the suitable technologies and approaches for BECCS, their technology readiness level (TRL) and performance, and the development priorities particular to biomass systems. These technologies cover current state-of-the-art solvent-based carbon removal methods, as well as developing technologies such as chemical looping combustion, oxyfuel combustion, carbonate looping, and gasification with physical absorption. It also presents a detailed case study of the decarbonisation of Drax power station and its plans for first-of-a-kind commercial BECCS deployment. Shared $CO_2$ storage infrastructure in industrial hubs and clusters will be a crucial factor for BECCS projects and should be developed as a matter of urgency. Clearly, there are barriers and challenges, both technical, environmental, social, and ethical, and some of these are summarised. They include biomass supply chain sustainability and its impact on the environment, wider ecosystems, and potential land use change issues. In addition, the biomass supply impacts the downstream carbon and energy efficiencies that can be achieved, and therefore the socio-technoeconomics of the whole BECCS system. Just as greenhouse gases are transboundary pollutants, so the biomass supply chain is often global. Development of sustainable, resilient BECCS systems that meet the United Nations Sustainable Development Goals (SDGs) will require careful management. Robust policies and supply chain governance, together with incentives that reward biogenic carbon removals are essential instruments for successful deployment at the scale required.





### FINANCE FOR SUSTAINABLE CARBON POWER PROJECTS – ICSC/327

August 2023

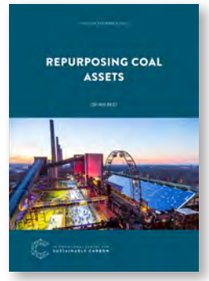
Gregory Cook
and Dr Paul Zakkour

Sustainable carbon technologies such as carbon capture and storage (CCS) are recognised as a key mitigation option within scenarios for achieving net zero, as well as within a large number of Nationally Determined Contributions (NDCs) and longterm climate change mitigation strategies. The case for CCS deployment is particularly strengthened when considering the enormous growth of unabated coal-fired power in the Asia-Pacific. The report describes the gulf between current levels of CCS deployment and what will be needed to reach net zero, along with the challenges in financing largescale fossil fuel power with CCS projects. To address investment barriers and mobilise private resources, a wide range of funding sources, financial instruments and models are needed to scale-up CCS worldwide. However, current climate finance flows to CCS are small, with almost all mitigation funding being directed towards renewable energy, low-carbon transport, and other activities unrelated to CCS. The availability of climate finance worldwide for sustainable carbon technologies in the coalfired power sector is reviewed and assessed, including through development finance, green bonds and carbon markets. With a transition out of coal funding providing the broader international narrative, despite its important role, finance for coal-fired power with CCS is being overlooked in favour of support for other project types.

### REPURPOSING COAL ASSETS – ICSC/328

September 2023

Dr Ian Reid




The energy transition has already led to many coal mine and power station closures. The USA and Europe have witnessed the most rapid change over the last decade and this trend is set to continue. Clearance of these sites is one option, but this study explores beneficial options for both mines and power plants that seek to turn disused sites into attractive projects that support the energy transition.

#### Coal mines

Deep shafts and underground passages which could be formed into a closed system could be the basis of a range of energy schemes, especially energy storage designed to balance variable renewable energy (VRE) generation. The technologies reviewed cover: closed loop pumped underground hydroelectric storage (PUSH); compressed air storage; thermal heat storage; gravitational energy storage; and hydrogen storage with electrolysis. Mine water – heat pump systems may replace district heating schemes formerly supplied by power plants.

#### Coal power plants

Coal power station sites can provide scrap and recycled equipment, switch to residential and office use or be locations for a suite of energy-based options: renewable electricity generation; industrial battery installations; thermal energy storage; flywheels; chemicals production; and nuclear power plants. Molten salt energy storage

reuses the largest portion of a coal power plant, while industrial batteries may just use a high-voltage connection.

The report reviews the advantages and barriers to upgrading coal mine and power plant sites highlighting those solutions already technically proven and adopted and describes progress in the ecological restoration of former coal mines and stations.

## HUBS AND CLUSTERS FOR CCUS – ICSC/329

December 2023

Dr Stephen Mills

Carbon capture and storage (CCS) has an important role in achieving net zero emissions (NZE), according to models and scenarios from bodies including the IPCC and the IEA. Over 20 countries refer to CCS in their Nationally Determined Contributions (NDC) to achieve the goals of the Paris Agreement. The number of CCS projects in development is growing, but at an inadequate rate, partly due to the high cost. There is more interest in developing CCS hub and clusters, where industries and power generators can feed their $CO_2$ to a carbon hub, and it is then transported for utilisation or storage. The CCUS hub and cluster model enables the development of affordable, shared infrastructure, capable of handling $CO_2$ harvested from clusters of facilities. Open access to such shared systems reduces the costs and risks for individual emitters, helping to promote decarbonisation and possibly supporting the retention of industrial activity in a particular area. The availability of a shared transport system may provide affordable access to more remote $CO_2$ storage repositories. Hubs and clusters will also contribute towards meeting national $CO_2$ reduction targets in an effective way.

However, government commitment is required to establish such projects. In Europe and the UK, projects in planning and development include Northern Lights, Norwegian-German (NOR-GE) CCS, Net Zero Teesside Power (NZT Power) and Zero Carbon Humber. In the USA, examples include: Houston CCUS hub; Mississippi River Corridor; Wabash $CO_2$ sequestration project; Shell, Equinor, US Steel Carbon Capture and Hydrogen Hub; The Rockies Denver hub, Texas; and Pueblo, Colorado-area carbon storage hub (CarbonSAFE Eos). Hubs are being developed in China and there are potential developments in Indonesia and India. In Japan, hub developments include Niigata East Port Area and Nagoya, and there are plans for seven advanced role model projects. Proposed hub developments in Australia include the Moomba CCS hub; The South East Australia (SEA) Carbon Capture Hub; Middle Arm (Darwin) CCUS hub; Surat Basin CCS hub; and one in Karratha, Western Australia.

## THE HYDROGEN ECONOMY AND THE ROLE OF COAL – ICSC/CIAB

March 2023

Dr Qian Zhu

Hydrogen has a critical role to play in a clean energy transition to achieve net zero emissions (NZE). Global demand for hydrogen is set to increase rapidly and substantially from about 94 Mt/y in 2021 to more than 500 Mt/y by 2050. Meeting this demand, in particular, for low-emission hydrogen will require the rapid scaling up of its production capacity in a short period of time from less than 1 Mt/y clean hydrogen in 2022 to 32 $MtH_2$/y in 2030 in the IEA's Stated Policies Scenario.

Clean hydrogen can come from renewable-powered water electrolysis, coal gasification with carbon capture, utilisation and storage (CCUS) and natural gas steam methane reforming (SMR) with CCUS. Although coal gasification-based hydrogen production is the most carbon-intensive, the addition of CCUS could reduce $CO_2$ emissions substantially to a level comparable to that of natural gas SMR with CCUS. When the best available technologies are adopted, hydrogen production from coal gasification with CCUS can have life cycle environmental impacts similar to, or slightly larger than, the production of renewable hydrogen.

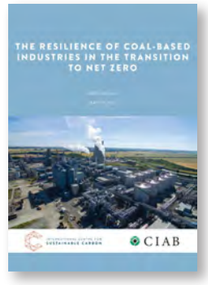
Developing and adopting renewable hydrogen faces several challenges. The high cost is the main barrier to hydrogen utilisation. There is also a requirement to invest in enough renewable energy to make the hydrogen, and in the infrastructure to store and transport the hydrogen produced.

The global demand for clean hydrogen cannot be met by renewable hydrogen production, at least in the near to medium term. Therefore, low-emission hydrogen production from coal and gas with CCUS is essential to bridge the gap. Hydrogen production from coal gasification with CCUS costs significantly less than renewable electrolytic hydrogen. This report examines the regional variations in hydrogen demand and supply and the role of coal in helping to meet the demand for clean hydrogen. Producing lowemission hydrogen from coal with CCUS will be a low-cost option in regions with abundant coal, access to $CO_2$ storage and limited renewable energy availability. Particularly for emerging and developing economies that depend on coal and lack gas and oil resources, coal is indispensable in providing a secure, reliable energy supply and an affordable source for clean hydrogen production.

## THE RESILIENCE OF COAL-BASED INDUSTRIES IN THE TRANSITION TO NET ZERO – ICSC/CIAB

March 2023

Greg Kelsall




Many countries, particularly in Europe, have committed to phase out coal, as part of efforts to achieve net zero emissions (NZE). However, this will be very difficult, if not impossible for heavy industries to achieve in a cost-effective and resilient manner, whilst producing the necessary steel, cement, aluminium and chemicals to provide the future NZE infrastructure.

Consequently, fossil fuels including coal, fitted with carbon capture utilisation and storage (CCUS), will continue to play a role as industry decarbonises and moves towards NZE. Although coal use will inevitably reduce, perhaps by as much as 80% from the current 5 Gt/y, 0.6–1.4 Gt/y it is still forecast to be used in 2050, largely in heavy industry.

Heavy industries can be NZE compliant by 2050. However, the technologies that are likely to be relied upon to mitigate their emissions are largely immature. Fortunately, in the short to medium term, technologies that are already mature or in the early adoption phase can play an important role, including material efficiency gains, switching to bioenergy, and the electrification of low and medium temperature heat as well as the significant low-carbon electricity required for aluminium smelting. In the longer term, fundamental technology shifts are needed, where innovative technologies incorporating CCUS and hydrogen will be key for heavy industry decarbonisation. In order to ensure that these technologies are available for deployment at least cost, development work needs to be caried out.

For heavy industries to decarbonise in a cost effective and resilient way, coal fitted with CCUS will be a key technology for all of the heavy industries assessed, particularly cement.

## 2ND ICSC ENERGY TRANSITION WORKSHOP

THE FUTURE OF COAL IN A TRANSITIONING ENERGY LANDSCAPE

CAPE TOWN, SOUTH AFRICA 19-20 APRIL 2023

**On 19 – 20 April 2023 the ICSC co-hosted with Eskom a two day international workshop focusing on 'The Future of Coal in The Transitioning Energy Landscape'. Delegates from all over the world, Australia, Asia, Europe, South Africa and the USA gathered in the beautiful city of Cape Town, South Africa, to participate in this topical event.**

The packed programme comprised eight sessions covering themes ranging from policies governing the future use of coal, to the realities of what is actually happening on the ground, the integration of variable renewable energy (VRE), coal in the circular economy, repowering and repurposing, and others.

The workshop opened with keynote addresses from senior executives of Eskom and ICSC. In his keynote address the Eskom Group Chief Operations Officer, Mr Jan Oberholzer, emphasised the need for a balanced energy mix.

Energy policies was the theme of the second session. Makoto Nunokawa and Takuya Kanda showcased NEDO's efforts to develop carbon recycling/CCUS technologies to achieve carbon neutrality in Japan by 2050. Japan depends largely on fossil fuels, most of which are imported. Since the Great East Japan Earthquake in 2011, thermal power generation has increased, with dependency on fossil fuels at 84.8% in 2019. Another thought-provoking presentation was delivered by Germany's Dr Oliver Then from vgbe on security of supply, decarbonisation and affordability in Europe. In 2021, the EU imported 83% of the natural gas used for its annual electricity generation, 30% of that used by the power sector came from Russia.

In 2022 Russia gradually stopped gas supplies via the Jamal and Nord Stream 1 pipelines and the EU increased LNG imports. Germany has closed all its coal mines and currently imports coal from countries such as South Africa whenever the need arises.

SANEDI CEO Dr Titus Mathe presented South Africa's cleaner fossil roadmap. Dr Mathe explained that in the short to medium term baseload power will come from coal-fired power plants and the Koeberg nuclear power plant. This means it is important to accelerate the uptake of emissions abatement technologies and energy efficiency initiatives including implementation of robust maintenance programmes at these plants.

Loadshedding in South Africa was discussed by Eskom's' Deon Joubert and Thomas Conradie. Mr Joubert's enlightening talk had a focus on the historic perspective of loadshedding and how current the situation had arisen while Mr Conradie paid particular attention to Eskom's current technical performance and recovery plans.

The realities of the energy transition in Australia were presented by Dr Noel Simento of ANLEC, Australia. The Australian government has set emissions targets with the aspiration of achieving net zero emissions by 2050. In the past 10 years Australia has managed to decommission about 5 GW of coal-fired generation and introduce 22 GW of renewable energy. This in turn has reduced emissions by 30%. However, another result has been large prices hikes in the cost of electricity which is a huge concern for Australian citizens. The second challenge presented by this transition is the threat to the reliability of supply, which is largely weather-dependent as no firm capacity has been built in the last 10 years.

Dr Mai Bui (Imperial College London) described how as more VRE is fed into the grid, coal-fired power plants have to operate increasingly flexibly to maintain grid stability and Karl Bindemann (Luth Consulting, UK) gave practical insights into how to improve the flexibility of a power plant.

Carbon in the circular economy opened with Eskom RT&D's Dr Kelley Reynolds-Clausen's work on ash and gypsum utilisation. She described the potential value of rare earth elements which could possibly be extracted from ash. The session closed with Mr Orevaoghene Eterigho-Ikelegbe's (University of Witwatersrand) presentation on other valuable materials that can be retrieved from coal waste in a more circular economy.

Repowering and repurposing was another theme. Debo Adams (ICSC) opened the session by demonstrating the reasons for repurposing, and giving examples from around the world on how coal assets can be repurposed and used for energy generation, storage, nature recovery and cultural destinations. Nick Singh presented the ongoing repowering and repurposing work at Komati Power Station, one of Eskom's many flagship projects. It includes a solar PV, Battery Energy Storage System (BESS) and wind. He showed how this project will touch the livelihoods of local communities

including socio-economic uplift initiatives such as communities' skills upliftment, staff reskilling and retaining, localisation and manufacturing.

In the Just Energy Transition (JET) session, Beauty Mazibuko described the socio-economic impact of shutting down coal-fired power stations in South Africa. Dr Gianni Serra (Sotacarbo, Italy) outlined the European Green Deal including the European Transition to a circular economy, zero pollution Europe, transformation of rural areas and agriculture. The European Just Transition Fund (JTF) is estimated at €17 billion, only a fraction of that allocated to the REPowerEU programme. The key message of the presentation was that the just transition should leave no one behind and should 'reach the furthest behind first'.

The final session explored the future of coal. Snehal Nagar (Eskom) explained how Eskom is navigating a dynamic coal environment with many challenges to manage. These challenges include the shortfall of coal supply at a number of power stations as long-term contracts come to an end, and increased pressure from local communities for the localisation of Eskom goods and services.

Dr Li Li (Shanghai Shenergy, China) showed how the efficiency of coal-fired power plant in China had been improved in some examples to almost 50%. He described Shanghai Shenergy's three step approach to improving coal plant; first is energy efficiency to reduce emissions, then cofiring with biomass to attain carbon neutrality, and lastly carbon capture. He shared these approaches using a fascinating Shanghai Shenergy project, the Xuzhou Project.

In closing the workshop, Dr Andrew Minchener (General Manager ICSC, UK) thanked all the stakeholders for making the event a success. Special gratitude was expressed to RT&D General Manager Ms Prudence Madiba and her team for their cooperation in producing such a stimulating and insightful event. The ICSC looked forward to further collaboration with Eskom RT&D.





## EXTERNAL PROJECTS

### RATIONALE

**The ICSC undertakes additional activities to further utilise the knowledge base arising from our studies programme. These comprise two types of external initiatives:**

- Cooperation with like-minded organisations to establish strategic sustainable carbon initiatives. Currently, these include our ongoing cooperative activities with the IEA Coal Industry Advisory Board (CIAB), working with the Japan Organization for Metals and Energy Security (JOGMEC) to prepare strategic presentations for dissemination within Japan, sponsoring the Ramaco Research Rodeo, together with our studies in cooperation with several like-minded organisations to support the United Nations Economic Commission for Europe (UNECE) carbon-neutral initiatives.
- Implementation of capacity-building outreach activities to support sustainability in the coal power sectors of developing countries. These include a comprehensive project to pursue opportunities to implement energy and environment improvements through training and capacity building for coal-fired power plant staff in Indonesia and India, which is funded by the US Department of State (USDOS).

# CIAB

**The ICSC, led by Debo Adams, has worked closely with the CIAB since 2018 to manage and implement several strategic studies.**

In March 2023, two reports were prepared and published on behalf of the CIAB. The first report was *Hydrogen economy and the role for coal* by Dr Qian Zhu and the second report was *The resilience of coal-based industries in the transition to net zero* by Greg Kelsall.

Also in 2023 the ICSC undertook a major study on behalf of the CIAB on *Maintaining a stable electricity grid in the energy transition*. This important study was published in January 2024.

Economies depend on reliable, stable, cost-effective electricity grids and associated systems. Interruptions to supply have a direct impact on business, society and economies. This report *Maintaining a stable grid in the energy transition* by Mike Garwood provides an overview of electric power grids in the energy transition from system fundamentals to the complexities associated with future technical solutions, potential impact on system security, resilience and cost. It highlights the emerging risks associated with proposed and ongoing changes to current systems and the associated market environment as well as market developments which may jeopardise previously stable and secure power systems. Costs and cost analysis including the limitations of the commonly adopted levelised cost of electricity (LCOE) metrics and wider system costs, are discussed. In particular, the role, characteristics and associated value of, and need for, dispatchable power capability in the energy system are reviewed, especially in the context of the increasing share of variable renewable power generation. A role for abated fossil power is reviewed and the associated benefits that can be realised as part of the energy transition. Insight is provided into grids, associated developments and challenges being experienced across several key regions including parts of Asia, Oceania, Europe and the USA.

Many regions are on course for increased grid-based risks to societies and economies, the impacts of which are starting to be felt, for example in parts of Europe and several US states. Therefore, a more holistic approach to the adoption of variable renewable energy (VRE, mainly wind and solar) is needed including the provision of adequate dispatchable power capability to manage the risks associated with the increasing deployment of VRE. At the same time dispatchable power capability, currently used to backup VRE technologies, is being decommissioned with an associated risk to reliability and security of electricity supply. Regions will develop their own pathways towards decarbonisation reflecting local current and projected future demand needs, addressing opportunities, available resources, challenges and constraints. Accordingly, there is likely to be a continued important and urgent need for abated fossil power plant to help accelerate and facilitate transition as well as to manage the costs. In some regions this will include addressing and appropriately managing the issue of existing and new fossil power plants in the context of meeting future energy requirements, whilst ensuring necessary levels of resource adequacy, system stability reliability, cost and dependability. Modern grids have developed to be robust systems, tolerant to extreme events and have reliably served the needs of society in a secure and affordable manner for many decades. The major concern raised by this report is the real and emerging risk that this will be compromised by current developments, with significant associated adverse impacts on both society and the energy transition agenda.

All the reports prepared on behalf of the CIAB are available from the website.



JOGMEC

In 2021 the ICSC, through Debo Adams, agreed to support JOGMEC for the preparation of four webinars, which were then translated into Japanese and uploaded onto our respective YouTube Channels in 2022. This approach was repeated in 2023, with webinars on ‘Coal and European Energy Security’ prepared by Dr Stephen Mills and ‘Trends Related to Coal-based Clean Hydrogen Production’ (presented internally) by Dr Qian Zhu.

UNECE

The ICSC has a longstanding cooperation agreement with the United Nations Economic Commission for Europe (UNECE) via Dr Andrew Minchener OBE, who is a member of the Bureau for its Task Force on Cleaner Energy Systems, which is a subsidiary body of the Committee on Sustainable Energy (CSE).

In addition, Dr Lesley Sloss is a member of the UNECE Group of Experts on Coal Mine Methane (CMM), which undertakes and promotes activities aiming at reduction of greenhouse gas emissions from coal mines. She also co-leads the UN Environment Coal Partnership under the Minamata Convention on Mercury.

## CAPACITY BUILDING AND TRAINING WITH US DEPARTMENT OF STATE SUPPORT

**In November 2023 the ICSC completed its four year US Department of State (USDOS) project. The goal was to accelerate emission reduction in the Indonesian and Indian coal power sectors through training and capacity building in sustainable strategies for mercury monitoring and control.**

The project team, led by Dr Lesley Sloss, identified the major challenges for emissions reduction in these regions, produced reports, designed training materials, and delivered workshops to empower stakeholders to accelerate the uptake of appropriate emission reduction strategies. Although the deliverables of the project are completed (reports, inventories, training materials, capacity building workshops and so on), unpredicted challenges arose, and lessons were learned about the reality of trying to accelerate change in large and rapidly developing economies.

## INDIA

In India, the project focused on four key topics:

**Emission monitoring:** Hands-on training was provided to over 500 delegates in four regions of India. During the training it became clear that India's adoption of both EU and US standards for measurement has led to confusion and mistakes in the installation of continuous emission monitors (CEMs). Although all coal-fired units are now legally obliged to report particulate matter, $SO_2$, NOx and, increasingly, mercury, in real time to the local regulator, only around 50% of plants are actually achieving this. In Europe and the USA there are guidelines and qualifications for monitoring personnel. This is not the case in India where the only training operators receive is from the CEM vendor during installation. To accelerate skills development within the sector, the ICSC left training materials to allow continuation of teaching and at least three further training workshops have been implemented since the beginning of 2023. A new legacy initiative, CEMEG (CEM Experts Group) India has been created and seed-funding was provided to the Council for Energy, Environment, and Water (CEEW, India) to build and sustain a working group. CEMEG, with experts representing utilities, regulators, testers, and vendors) has met twice online and will hold its first conference, CEM-India, in Delhi in February 2024. https://www.ilmexhibitions.com/cemindia/

CEMEG-India

**Power plant flexibility:** Unlike any other coal fleet, Indian coal plants are now required by Government request to be able to flex plant operation down to 50% to offset fluctuations in capacity on the grid. Since India has no gas and variable renewable energy (VRE) is growing, coal is the only means to balance variability in supply and demand. This non-optimal plant operation results in lowered plant efficiency, increased damage and outages,





and increased emissions (10% or more). ICSC and the Electric Power Research Institute (EPRI) delivered training to over 600 utility delegates with the 'Flexibility Toolkit' which was developed under a separate USAID/US Department of Energy programme. On completion of this training programme, the ICSC launched a legacy stakeholder initiative called Flex-India. Representatives from utilities and government agencies, led by EPRI and the Confederation of Indian Industry, have met online monthly since January 2023 and held their first annual face-to-face Flex-India event in Hyderabad in September 2023.

**Emission control:** Emission limits in India accelerated from virtually non-existent in 2014 to the current limits which are equivalent to those of Europe and North America. To comply, Indian coal plants must make a rapid and expensive technological leap. Although emission control systems can be retrofitted, they have been designed by western vendors and will not be immediately applicable to Indian plants firing coal with a 50% ash content and with limited water availability. Further, even if low-NOx burners and FGD systems are installed, when plants flex down to 50% capacity, as mentioned above, low NOx burners will not perform optimally and FGD systems may need to be bypassed.

Capacity building was delivered to over 400 delegates, but it was not possible to create a legacy initiative – the challenge of emission control is too large and too intrinsic to the utility sector. These issues must be addressed at the government level in cooperation with the utilities.

**Ash management:** Indian coal utilities are now obliged to use 100% of all fly ash, including legacy ash in piles and dams. For some plants, even with the requirement to deliver fly ash free to any end-user within 300 km of the plant, the regional market is saturated. Convoys of fly ash delivery lorries travelling hundreds of kilometres to end users create a new pollution problem. Fly ash dumps witnessed at the side of the roads, allegedly to fix potholes but abandoned, are frequent reminders of the huge logistical challenge of fly ash utilisation in a nation as large as India.

New high-end markets such as cenospheres are growing, but the current interest is around the potential for rare earth element (REE) recovery from ash dumps. REE, used in batteries and high-end electronics, offer significant economic and resource security benefits to a country. However, quantifying the potential and developing the methodologies to harvest REE is beyond the scope of anything an individual plant or utility in India would consider. If the Indian Government choose to aim for REE recovery in India, then it must be a government-led initiative with supporting funding.

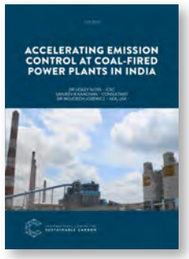
## INDONESIA

Working with the Ministry of Environment and Forestry (MOEF) and the Ministry of Minerals and Energy Resources (MEMR), the ICSC is helping deliver Indonesia's compliance strategy under the UN Minamata Convention on Mercury. For this, we have evaluated mercury emissions from the coal power sector on a unit-by-unit basis, allowing us to rank Indonesian coal-fired power plants and identify those that will benefit the most from targeted mercury emission reduction strategies. Output from this work includes a 'Catalogue' report which summarises generic emission reduction strategies but also incorporates twelve technology and vendor-specific project proposals which could fast-forward mercury control at individual plants. The final goal was to source funding for such emission reduction projects. However, the landscape for coal funding has changed significantly since this project was scoped in 2018/2019. A short paper is being prepared which emphasises that the blanket refusal of international financial institutions to fund anything which 'may extend the lifetime of a coal plant' may simply lock in elevated emissions from young coal plants in Southeast Asia. Potentially, these plants will not face closure for decades, even under coal-phase out plans, and, without external funding, may use stranded asset and lost investment arguments to continue to derogate on emission control.

### PUBLICATIONS AS PART OF USDOS PROJECT IN 2023

Mercury reduction at Indonesian coal plants – Minamata compliance strategy

Prospects for mercury emission reduction project finance in Indonesia




Accelerating emission control at coal-fired power plants in India

Best practice in continuous emission monitoring (CEM)

Achieving 100% ash utilisation at coal-fired power plants in India

The USDOS project reports are available from:
https://www.sustainable-carbon.org/library/usdos-reports





## In 2023, the ICSC broadcast 10 webinars and published 9 blogs as listed below:

### BROADCAST WEBINARS 2023

**HUBS AND CLUSTER FOR CCUS – THEIR ROLE IN DECARBONISATION**
1 November – Dr Stephen Mills

**EMISSION CONTROL FOR COAL IN INDIA AND INDONESIA: A REALITY CHECK**
11 October – Dr Lesley Sloss

**THE POTENTIAL ROLE OF CARBON UTILISATION IN A NET ZERO EMISSION ECONOMY**
13 September – Dr Qian Zhu

**REPURPOSING OF COAL ASSETS**
10 August – Dr Ian Reid

**FINANCE FOR SUSTAINABLE CARBON PROJECTS**
5 July – Greg Cook

**EMISSIONS AND ASH – THE CHALLENGE FOR INDIA**
11 May – Dr Lesley Sloss

**COAL AND EUROPEAN ENERGY SECURITY IN THE WAKE OF RUSSIA'S INVASION OF UKRAINE**
27 April – Dr Stephen Mills

**THE NEED FOR A BALANCED APPROACH TO ENSURE ENERGY SUSTAINABILITY**
20 March – Dr Andrew Minchener

**THE RESILIENCE OF COAL-BASED INDUSTRIES IN THE TRANSITION TO NET ZERO**
23 February – Greg Kelsall

**GLOBAL STATUS OF BIOENERGY WITH CARBON CAPTURE, BECCS**
19 January – Prof Jenny Jones

### PUBLISHED BLOGS 2023

**CLEAN AMMONIA FUEL FOR THE ENERGY TRANSITION – HOW MUCH CAN WE PAY?**
6 December – Dr Qian Zhu

**THE EVOLUTION OF EMISSION MONITORING – MORE POLLUTANTS, SOURCES, AND SIGNIFICANT FIGURES**
22 September – Dr Lesley Sloss

**INDIA – OUR RECENT WORKSHOPS SHOW MOVEMENT TOWARDS EMISSION REDUCTION, BUT SOME HESITANCY REMAINS**
12 June – Dr Lesley Sloss

**CARBON CAPTURE, USE AND STORAGE (CCUS) IS A NECESSITY, NOT AN OPTION, TO ACHIEVE NET ZERO EMISSIONS**
25 May – Dr Qian Zhu

**SOUTH AFRICA – LIVING WITH LOAD SHEDDING**
9 May – Dr Stephen Mills

**INTERNATIONAL CONFERENCE ON THE ENERGY TRANSITION IN SOUTH AFRICA**
2 May – Morakanele Thiepe

**DOES COAL HAVE A ROLE TO PLAY IN A HYDROGEN ECONOMY?**
21 March – Dr Qian Zhu

**UPDATE FROM OUR MISSION TO JAKARTA AND INDONESIA**
23 February – Dr Lesley Sloss

**WASTE-TO-ENERGY – PLAYING AN INCREASINGLY IMPORTANT ROLE**
12 January – Dr Stephen Mills

## DIARY OF CONTRIBUTIONS – JANUARY TO DECEMBER 2023

### JANUARY 2023

5 Dr Lesley Sloss held an online meeting of the CEM India initiative working group

9 Dr Lesley Sloss chaired an online discussion with EPRI and the Confederation of Indian Industry (CII) to advance the USDOS Flex-India initiative

11 Dr Lesley Sloss held an online meeting with BCRC-SEA, MOEF and MEMR Indonesia to coordinate the Jakarta event for the end of January 2023, part of the US DOS capacity building project the ICSC is running

16 Dr Lesley Sloss chaired the online AGM of the UN Environment Programme Coal Partnership

23-26 Dr Lesley Sloss led a multi-stakeholder mission to Indonesia in conjunction with USDOS, MOEF and MEMR and delivered a 3-day event on emission reduction for the Indonesian coal sector

30 Dr Andrew Minchener participated in a further virtual meeting with Eskom to review progress and to firm up aspects of the presentations for the workshop

### FEBRUARY

1 Debo Adams and Dr Stephen Mills met representatives from IERE (Japan) in London to discuss our work programmes and an MoU

2 Dr Andrew Minchener participated in a planning meeting of the Bureau of the UNECE

7 Debo Adams attended an online meeting with the CIAB working group to discuss comments received on the two draft studies

13 Dr Lesley Sloss attended the online meeting of the UN Environment Programme on mercury emissions from the cement sector

14 Debo Adams and Dr Qian Zhu had an online discussion with Peter Morris (MCA) and Nathan Bongers (LET Australia) on hydrogen production

22 Debo Adams had a meeting with the CIAB working group to discuss a study proposal

28 Dr Andrew Minchener, Debo Adams and Dr Ian Reid participated in a review meeting to determine scope for collaboration with Ramaco Carbon

### MARCH

2 Dr Lesley attended an online meeting of USDOS and EPRI to discuss a potential new JET-IP fly ash project in South Africa

3 Dr Lesley Sloss attended an online meeting the UN Environment Programme secretariat on the Minamata Convention

6 Debo Adams had a meeting with Mick Buffier, Chair of CIAB to discuss a study proposal

9 Dr Lesley Sloss attended the board meeting of the Centre for Energy Policy in Glasgow, UK

14 Debo Adams attended a virtual meeting with Dr Ian Reid and Randall Atkins (Ramaco Carbon) to discuss plans for the Ramaco Research Rodeo

15-16 Debo Adams attended the CIAB Associates Meeting in Washington DC (virtually) and gave a presentation

22 Dr Lesley Sloss attended the online meeting of the UN Coal Mine Methane initiative

22 Dr Lesley Sloss attended the UN Environment Programme session on updates to reporting under the Minamata Convention

23 Benedicte Brocks, Debo Adams and Dr Andrew Minchener participated in a review meeting with Eskom to finalise the programme for the workshop

23 Dr Lesley Sloss attended the online meeting of the Global Environment Fund project steering committee for the Mercury Inventory work at Macquarie University in Sydney

24 Dr Lesley Sloss attended an online meeting with CII India on expanding the USDOS Flex-India work

### APRIL 2023

5 Debo Adams had an online meeting with Mick Buffier, Chair of CIAB to discuss a study proposal

6 Debo Adams, Benedicte Brocks and Rebecca Cameron had an online meeting with the Eskom team co-organising the Cape Town energy transition workshop

14 Debo Adams, Benedicte Brocks and Rebecca Cameron had an online meeting with the Eskom team co-organising the Cape Town energy transition workshop

18 Dr Andrew Minchener, Debo Adams, Benedicte Brocks and Rebecca Cameron attended the ICSC Executive Committee meeting in Cape Town

19-20 Dr Andrew Minchener, Debo Adams, Benedicte Brocks, Rebecca Cameron, Dr Stephen Mills and Dr Ian Reid, organised, presented and ran, with assistance from Eskom, the 2nd ICSC Energy Transition Workshop in Cape Town

25 Debo Adams and Mike Garwood presented progress on the study 'Maintaining a stable electricity grid in the energy transition' at the online meeting of the CIAB working group

26 Dr Andrew Minchener and Debo Adams had an online meeting with Dr Simento and Gianni Serra to discuss progress made on the revised Implementing Agreement

### MAY

4 Debo Adams and Dr Ian Reid had an online meeting with Dr Nick Singh from Eskom to discuss the repurposing of Komati power plant

11-12 Debo Adams attended the 6th Symposium on gas and coal market outlooks at the IEA, Paris

16 Debo Adams and Mike Garwood had an online meeting with Mike Caravaggio and Stephen Storm, EPRI to discuss the US electricity grid for the CIAB study

Dr Lesley Sloss attended (remotely) the first meeting of the UNECE Task Force on methane emission reduction

18 Debo Adams and Mike Garwood had an online meeting with Andy Boston and Geoff Bongers, Red Vector to discuss their work, relevant to the CIAB study

26 Dr Andrew Minchener met a representative of a Chinese film company in London who wished to consider the future role of metallurgical coal, which led to a film-based interview

29-31 Dr Lesley Sloss delivered a training course on multipollutant control and ash management in Raipur, India, as part of the USDOS project work

30 Debo Adams and Mike Garwood presented progress on their study at the online meeting of the CIAB working group

### JUNE

5-7 Dr Lesley Sloss delivered a training course on multipollutant control and ash management in New Delhi, India, as part of the USDOS project work

14-15 Debo Adams and Mike Garwood presented progress on their study to a meeting of CIAB Associates at the IEA, Paris

22 Dr Lesley Sloss chaired an online meeting of the CEM India Initiative with CEEW, India

26 Dr Lesley Sloss attended an online meeting with US Department of State on grant procedures under the Minamata convention

29-30 Dr Andrew Minchener provided a comprehensive presentation on the importance of rare earth elements (REEs) for future green technology options at a Sotacarbo strategic planning meeting in Sardinia

30 Debo Adams attended an online meeting with the organisers of the 3rd Ramaco Research Rodeo to discuss preparations

## JULY

11-13 Dr Andrew Minchener, Debo Adams and Dr Ian Reid presented and chaired sessions at the 3rd Ramaco Research Rodeo in Sheridany, WY, USA. An event which received strong USDOE support. The purpose was to discuss and review the importance of extracting REEs from coal and associated wastes

Dr Lesley Sloss delivered MEC 15 – The workshop on strategies for targeted emission reductions from the Indonesian coal fleet in Jakarta, Indonesia, on behalf of the USDOS project

20 Debo Adams and Mike Garwood presented progress on their study at the online meeting of the CIAB working group

25 Dr Lesley Sloss attended an online meeting of CEN (European Standards Committee) on mercury monitoring standards

27-29 Dr Lesley Sloss delivered a training course on multipollutant control and ash management in Nagpur, India, as part of the USDOS project work

## AUGUST

3-5 Dr Lesley Sloss delivered a training course on multipollutant control and ash management in Chennai, India, as part of the USDOS project work

8 Dr Lesley Sloss chaired an online meeting of Flex India, with EPRI

3-13 Dr Andrew Minchener met with our representatives from BRICC in Beijing, China to brief them on the changes occurring within ICSC while also addressing various administrative issues.

Dr Andrew Minchener travelled to Taiyuan City to participate in the Tsinghua University 10th ISCC event at which he gave a keynote presentation and chaired sessions on the Energy Transition

25 Dr Lesley Sloss delivered a training course on multipollutant control and ash management in Chennai, India, as part of the USDOS project work

29 Dr Lesley Sloss attended the online discussion to advance the global mercury study being coordinated by Macquarie University in Sydney, Australia

30 Debo Adams and Mike Garwood presented progress on their study at the online meeting of the CIAB working group

## SEPTEMBER

2-7 Dr Andrew Minchener gave a keynote presentation, took part in a strategic panel discussion and gave a vote of thanks to the hosts on behalf of all attendees at the Japan Coal Day meeting, Tokyo

12-13 Dr Lesley Sloss launched Flex-India (remotely) in Hyderabad. India. This is a legacy initiative built from the USDOS project

13 Dr Lesley Sloss attended (remotely) the 2nd meeting of the CEMEG (continuous emission monitor experts' group) – India. This is another legacy initiative built from the USDOS project

19-22 Dr Lesley Sloss attended the conference on emissions monitoring in Barcelona, Spain, to represent the USDOS project

22 Debo Adams and Mike Garwood had an online meeting with Andrjez Nowak, PGG Poland to discuss the energy transition in Poland for the CIAB study





26 Dr Lesley Sloss attended an online meeting with OECD on project challenges in Indonesia

27 Debo Adams and Mike Garwood presented progress on their study at the online meeting of the CIAB working group

29 Dr Lesley Sloss attended (remotely) the planning meeting for the International Conference on Mercury as a Global Pollutant (due to take place in July 2023 in Cape Town, South Africa)

30 Dr Lesley Sloss attended the online meeting for briefings on COP5 of the UN Minamata Convention

## OCTOBER

6 Dr Lesley Sloss attended the online meeting of the UN Minamata Convention Fate and Transport Partnership

10 Dr Lesley Sloss attended an online planning meeting for the CEM-EG event in New Delhi, planned for February 2024

14-15 Dr Lesley Sloss presented an update on the US Department of State project to the USDOS, Project Working Group, North Carolina, USA

16 Dr Lesley Sloss delivered a final project report to the USDOS, Washington, DC, USA

20 Dr Andrew Minchener and Debo Adams attended (remotely) the IEA Coal Research Ltd annual board meeting

25-26 Debo Adams attended the IEA Universal meeting of the Technology Collaboration Programmes at the IEA office in Paris

26-27 Dr Andrew Minchener, Debo Adams, Dr Qian Zhu, Dr Stephen Mills, Benedicte Brocks and Rebecca Cameron presented their work at the ExCo meeting in Paris

## NOVEMBER

13 Prof Lesley Sloss attended the online AGM of the leads of the Mercury Partnership Area under the Minamata Convention

15 Prof Lesley Sloss attended the online scientific committee meeting for the International Conference on Mercury as a Global Pollution, South Africa

29 Prof Lesley Sloss attended an online meeting of the GEF mercury project group at Macquarie University

27-29 Dr Qian Zhu attended the Clean Ammonia Europe Conference in Antwerp, Belgium

29-30 Debo Adams and Mike Garwood presented their study 'Maintaining a stable electricity grid in the energy transition' at the IEA CIAB Plenary meeting at the IEA offices in Paris. Dr Andrew Minchener also attended

## DECEMBER

1 Prof Lesley Sloss chaired a planning meeting with Eskom and Sasol on the Plenary for the International Conference on Mercury as a Global Pollutant in Cape Town

7 Prof Lesley Sloss attended the winter Advisory group meeting of the Centre for Energy Policy, Strathclyde University, UK

11 Debo Adams, Dr Stephen Mills and Dr Qian Zhu attended (remotely) a meeting with JOGMEC to review the presentations prepared for JOGMEC

14 Prof Lesley Sloss attended an online planning meeting for the GEF India 2024 workshop

14 Prof Lesley Sloss chaired an online meeting of the UN Environment Programme Secretariat to discuss seawater FGD issues

19 Prof Lesley Sloss attended the online 14th AGM of the UNEP Mercury Partnership Advisory Group

21 Prof Lesley Sloss chaired an online meeting with the USDOS on seawater FGD issues

27 Dr Stephen Mills attended (remotely) a meeting with JOGMEC of Japan to present and discuss an upcoming webinar/YouTube video on European energy during 2023

# COMMUNICATIONS UPDATE

## Our goal is to engage and retain our members as well as to attract new members.

We hope to keep people for longer on the website by pointing them to new and relevant content. Ultimately, we want our resources to be of value to ICSC's stakeholders and connect to a wider community. During March – September 2023 a total of 17,636 people visited the website. Most users reaching our website are from the USA (19%), India (17%), the UK (9%), China (6%) and Australia (5%) – closely followed by Japan and Indonesia. Our social media accounts are seeing healthy activity fuelled by our monthly webinars and our blogs.

https://www.sustainable-carbon.org/





## ICSC KNOWLEDGE PARTNERS

**The ICSC has established a Knowledge Partners Network with organisations that have a positive interest in sustainable carbon production and utilisation. The aim is to:**

- Show global solidarity between organisations that have a positive interest in sustainable carbon utilisation.
- Showcase the breadth of our global knowledge partners to ensure better exchange of information and encourage future collaboration.

ICSC KNOWLEDGE | PARTNERS NETWORK

AUSTRALIA · GERMANY · BRAZIL · CANADA · CHINA · COLOMBIA · CZECH REPUBLIC · FRANCE · GERMANY · GREECE · HUNGARY · INDIA · INDONESIA · ITALY · JAPAN · LATVIA · MONGOLIA · POLAND · RUSSIA · LATVIA · SOUTH AFRICA · SPAIN · SWEDEN · SWITZERLAND · TURKY · UK · USA

We invite likely organisations to become knowledge partners and exchange logos, theirs for inclusion on our new web page and ours on their websites, with links.

We have 109 partners from companies, universities and institutes within 27 countries, with further invitations and requests being processed

ICSC KNOWLEDGE|PARTNERS NETWORK

8RIVERS

ADEX

ATLANTIC ENERGY ASSOCIATES LLC

AFRISCOT

BTИ

AMS ENERGY

assocarboni

ABCM
Associação Brasileira do Carvão Mineral

BETTER COAL

BF2RA

CENTRUM ENERGETYKI

CERTH
CENTRE FOR RESEARCH & TECHNOLOGY HELLAS

Changeover Technologies

国家能源集团
CHN ENERGY

中英国际低碳学院
China-UK Low Carbon College

CIAB

Universidad del Valle

coomtech

CPSI
COAL PREPARATION SOCIETY OF INDIA

CRIEPI
Central Research Institute of Electric Power Industry

CSE

DASTUR ENERGY

DOOSAN
Doosan Lentjes

Energy Industries Of Ohio

LEHIGH UNIVERSITY

ERGO EXERGY
TECHNOLOGY INCORPORATED

ERIA

NWU

ETH zürich

EURACOAL
European Association for Coal and Lignite

ETD consulting

FFC

FUEL TECH

GE

Global Energy Interconnection Development and Cooperation Organization
全球能源互联网发展合作组织

GLENCORE

GMOS TRAIN

GOLDER

HANOVER COLLEGE
Engineering

华能清洁能源研究院

IChemE

The institution of environmental sciences

ICHP

IEE JAPAN

icb INSTITUTO DE CARBOQUÍMICA CSIC

INTERNATIONAL CCS KNOWLEDGE CENTRE

J-COAL

JD Energy
Delivering the Future

JOGMEC
Japan Oil, Gas and Metals National Corporation

Lignite Energy Council

LOESCHE
INNOVATIVE ENGINEERING

LUMENION

MACQUARIE University

ME2C

Mineral and Energy Economy Research Institute
Finnish Academy of Sciences

Minerals Council of Australia

MHPS

mcoal Mongolian Coal Association

NALCO Water
An Ecolab Company

nic NATIONAL INSTITUTE OF CLEAN-AND-LOW-CARBON ENERGY
北京低碳清洁能源研究院

ONGC

PSA

Peabody

PennState College of Earth and Mineral Sciences
Earth and Mineral Sciences Energy Institute

POLSKA GRUPA GÓRNICZA

RAFAKO
GRUPA PBG

RAMACO CARBON

RJM INTERNATIONAL

SANDVIK

SBB ENERGY

SD GROUP
CEZ GROUP

申能电力科技
SHENERGY POWER TECHNOLOGY

SICK
Sensor Intelligence.

SIEMENS

SOMERSET COAL INTERNATIONAL

SYNFUELS AMERICAS

TAURON

THE COAL INSTITUTE

GLOBAL MERCURY PARTNERSHIP

uniper

USEA
United States Energy Association

UNIVERSITY OF ALBERTA

GLOBAL ENERGY MANAGEMENT
BUSINESS SCHOOL

Center for Applied Energy Research

UNIVERSITY OF LEEDS

UNIVERSITY of STRATHCLYDE
CENTRE FOR ENERGY POLICY

University of Stuttgart
Institute of Combustion and Power Plant Technology (IFK)
ifk

SCHOOL OF ENERGY RESOURCES
UNIVERSITY of WYOMING

UR ONE INC

VGB POWERTECH

VSB TECHNICAL UNIVERSITY OF OSTRAVA
ENERGY RESEARCH CENTER

VUHU

GORE

UNIVERSITY of GREENWICH
The Wolfson Centre for Bulk Solids Handling Technology

YALOVA ÜNİVERSİTESİ

## 2024 PROGRAMME

**We are looking forward to an ICSC workshop in collaboration with Eskom in Cape Town, South Africa on 24-25 April 2024. The theme of the workshop is 'practical routes to net zero'. We hope to hold a further workshop in Japan towards the end of the year. The reports that we will publish in 2024 are listed below:**

### REPORTS IN 2024

- GAS SEPARATION TECHNOLOGIES FOR ENERGY PRODUCTION (ASU AND CPU)
- BIOMASS RESIDUES AND THEIR PRETREATMENT FOR USE IN POWER AND INDUSTRY
- CARBON PRICING AND EMISSIONS TRADING
- PROSPECTS FOR REDUCED EMISSIONS USING CLEAN AMMONIA
- RECOVERY OF RARE EARTH ELEMENTS FROM COAL AND ITS BY-PRODUCTS
- POTENTIAL OF CARBON UTILISATION IN A NET ZERO ECONOMY

### REPORTS IN 2024 FOR THE USDOS

- CHECKLIST FOR CEMS IMPLEMENTATION
- MERCURY EMISSION MONITORING AND CONTROL IN INDIA (BEST TECHNOLOGIES, TECHNIQUES AND PRACTICES FOR COAL-FIRED POWER PLANTS)
- BEST TECHNOLOGIES AND PRACTICES FOR COAL-FIRED POWER PLANTS IN INDIA

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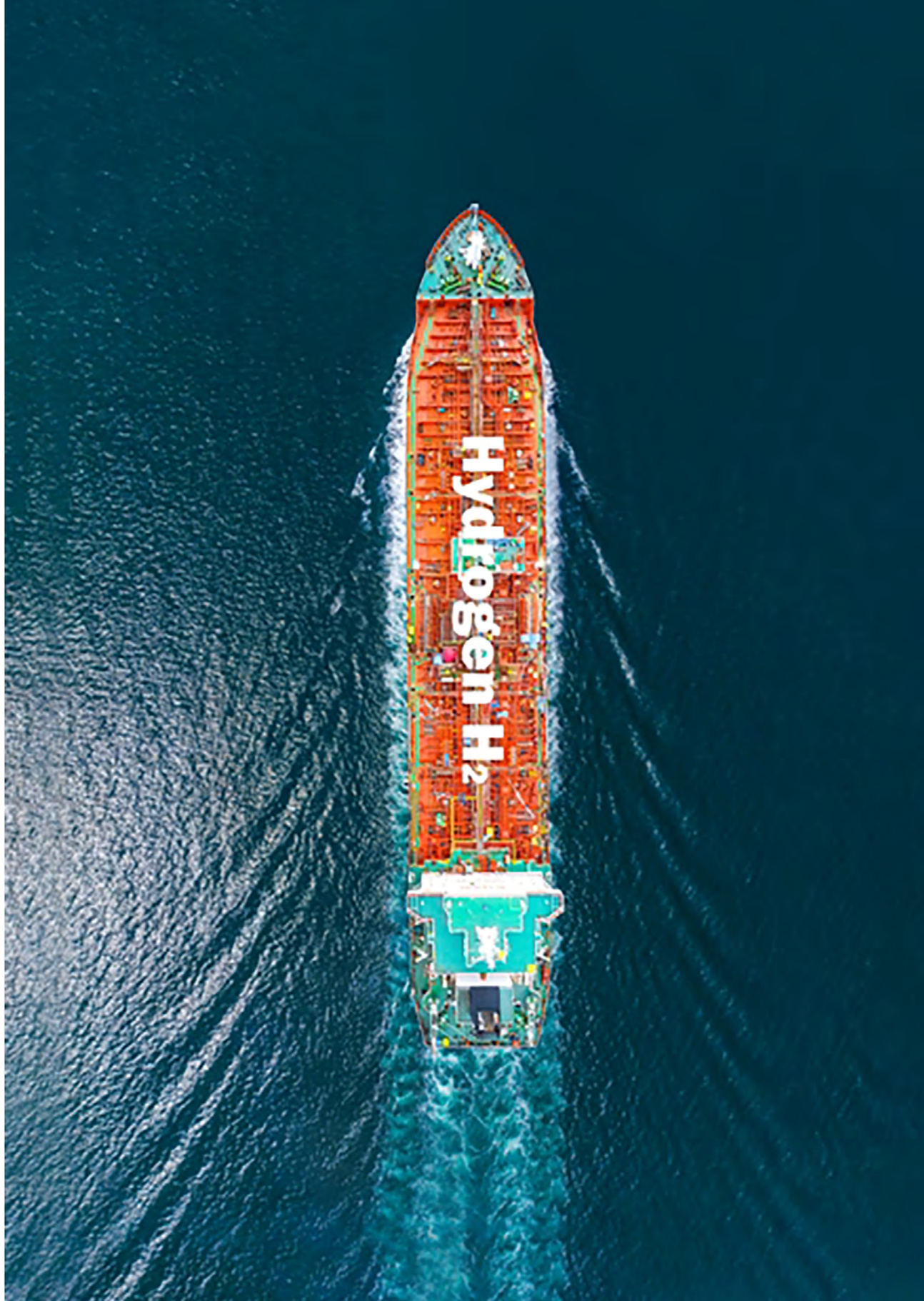

You can access our website at **www.sustainable-carbon.org** and we encourage you to register so as to be kept in touch with our ongoing activities.

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