ROUNDTABLE ON CARBON CAPTURE, UTILIZATION AND STORAGE (CCUS) ROADMAP FOR INDIA: EVENT REPORT

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The energy projections by the Ministry of Power show more than half of the entire electricity being supplied from thermal power in the next decade, signifying continued dependence on coal. There is also an enormous strategic thrust on infrastructure development, which is going to make the country a leading consumer of steel and cement, both hard to abate industries. Together, these industries will continue to add carbon emissions and in turn, add to the problem of climate change.

The IPCC in its Special Report, titled 'Global Warming of 1.5°C' highlighted that the current global efforts to deal with the impending climate crisis are not enough. Clearly, there is an urgent need to increase the pace of decarbonization of power generation and other industrial sectors globally. Following the recognition accorded to Carbon Capture, Utilization & Storage (CCUS) in the IPCC report and discussion at the COP24, interest in CCUS continues to grow in India.

Within this context, the 3rd edition of The Earth Dialogues, a platform focused on highlighting topical issues in the Energy, Environment and Sustainability domain, was held at the India Habitat Centre on 12th June 2019. This edition focused on the opportunities and challenges for the adoption of CCUS in India as well as the necessary enabling policy framework required for its development. The roundtable tried to address the question whether CCUS can be a viable mechanism for decarbonizing the energy sector and hard to abate industries. The end goal of the deliberations was two-fold - to delineate a roadmap for evaluation and adoption of CCUS in India, and to formulate a core group of experts, who shall work on bringing the roadmap to fruition.

The discussion brought together an array of views and expertise from the following participants:

- **Dr. Neelima Alam**, Scientist E, Department of Science & Technology, Government of India
- **Dr. Vikram Vishal**, Assistant Professor, Department of Earth Sciences, IIT Bombay
- **Mr. Aniruddha Sharma**, Chief Executive Officer, Carbon Clean Solutions
- **Mr. Chandra Bhushan**, Deputy Director General, Centre for Science & Environment
- **Mr. Joe Phelan**, Director, WBCSD India

- **Mr. Mahmoud Jardaneh**, Country Representative, India, Department of Energy, US Government
- **Mr. Puneet Thakur**, Senior Investment Manager for South Asia, Austrade
- **Mr. Sahil Ali**, Associate Fellow, Energy & Sustainability, Brookings India
- **Mr. Siddharth Aryan**, Director, Energy & Infrastructure, USISPF
- **Mr. Siddharth Singh**, Lead Country Analyst, International Energy Agency
- **Mr. U.P. Pani**, Consultant, Jupiter Oxygen
- **Mr. Vaibhav Chaturvedi**, Research Fellow, CEEW

It was moderated by **Mr. Abhishek Sood**, Manager- Public Policy, Chase India and **Mr. Subir Gupta**, Founding Partner, Sustainability Advisors.

From left to right - Mr. Saurabh Biswas, Mr. Subir Gupta, Mr. Abhishek Sood, Ms. Rupali Handa

PROCEEDINGS OF THE ROUNDTABLE

Participants were asked to elaborate on their views on CCUS technology in the Indian context, and if the nation's current priorities are aligned to what they should be in order to realize adoption of CCUS.

The discussion was commenced by throwing light on various technologies amongst the suite of CCUS. It was found that while the potential for Carbon Capture and Storage (CCS) is immense in India, the scope of Carbon Capture and Utilization (CCU) is limited, given the fact that it needs established market for end products. However, for achieving deeper decarbonization, each of these technologies will matter. There is need for an assessment of geological storage by a competent agency like the Geological Survey of India.

It was then brought out that the last formal geological assessment in India was done by the British Geological Survey and IEA in 2008 that too based on secondary information. However, no assessment based on actual geological samples has ever been conducted in India. It was pointed out that the scope of such a geological assessment is bound to be immense due to the geological diversity of Indian terrain. The potential for substantial carbon storage capacity exists. CCS may not be the initial priority of India because it only adds cost, whereas CCUS leads to recovery of the cost of injection. Capture

From left to right - Mr. Siddharth Aryan, Mr. Joe Phelan, Mr. U.P. Pani, Mr. Aniruddha Sharma

and transportation account for 65-70% of the entire process cost of CCUS system and the additional resource recovered though EOR/ECBM can offset that cost. CCUS through EOR mechanism is significant for India as it can arrest the declining output from India's ageing oilfields. ONGC can recover an additional 27% from their oil/gas fields through EOR. CBM recovery has been demonstrated to be almost doubled by CO_2 enhanced recovery in studies outside India.

It was also highlighted that the technology transition to lower emissions will be difficult in industrial sectors like steel, cement and fertilizer sectors. In fertilizers, the technology to manufacture ammonia and urea using hydrogen is existing so it may be possible to make a transition quickly, but steel and cement will continue to face challenges. That's where CCUS will play a role. The necessity of the technology in the Indian cement and steel sectors can be realized by the fact that currently, they contribute around 6-7% each to the global carbon emissions. In 15 years, both the sectors might cumulatively account for12-15% of the global carbon emissions.

However, there is a lack of emphasis on large point sources of CO_2 emissions like thermal power, fertilizer, steel and cement to act on capturing their emissions. The steel industry is going to add 200 million metric tonnes of steel production. Therefore, even if older plants are not

From left to right - Dr. Neelima Alam, Mr. Sahil Ali

retrofitted, new capacity additions need to have CCUS.

It was therefore stressed that economic and technology opportunities of identified sectors should be evaluated for CCUS.

The discussion was further strengthened by classifying CO_2 as a "waste problem". It was opined that the focus should be on reducing, reusing, replacing, and dumping, in that order of priority.

Participants were made aware that Clean Energy Initiative under DST's Technology Mission Group has started to focus on CCUS. Together, DST and DBT are leading the Mission Innovation (MI). Of the seven challenges under MI, one is CCUS. Earlier, DST's approach was limited to biological & agricultural processes towards capture & utilization, now the department has adopted a more holistic approach, shifting to a technology-centric approach with stress on capture and utilization. They are also in the process of advanced talks with DoE, USA, to develop a bilateral R&D programme. They plan to first focus on R&D and then gradually shift to different models. DST is keen to study CCUS and will come out with outcomes in the future. They are also contemplating holding a stakeholder meeting this year to discuss R&D on CUSS with researchers, academia & industry. More models of engagement will

From left to right - Mr. Siddharth Singh, Mr. Mahmoud Jardaneh, Mr. Vaibhav Chaturvedi, Dr. Vikram Vishal

be explored and evolved.

CCUS is amongst the key areas of interest for the US in India. It is one of the three pillars of the ongoing phase 2 of the US – India Partnership to Advance Clean Energy. Hopefully, industries and civil society organizations will be a part of phase 2 (focused on coal), as witnessed during phase 1 (focused on renewables).

It was acknowledged that Australia has taken a lead in CCUS and therefore India can borrow learnings from Australia, as they have a framework of Cooperative Research Centres (CRCs), where pathbreaking research is carried out, looking at the future challenges. Australia also has a CRC, which has been working on CCUS. Though there have been multiple demonstration projects, there is not much uptake of the technology. Australia is looking forward to a fruitful collaboration with India on CCUS technologies.

All the participants reiterated that in order to achieve the 1.5°C target, none of the available technologies can be left out, especially CCUS since it additionally bolsters the energy security perspective, India having large deposits of coal.

CHALLENGES IN ADOPTION OF CCUS

The discussion was carried forward by asking the participants to elaborate on the biggest challenges in the path of making CCUS mainstream in the Indian industries and power sector.

Economic viability is seen as the foremost challenge. Another major issue is the perception barrier. A lot of opposition is anticipated from the people who don't understand the technical angle of the technology. It is believed that government frameworks can help in this regard.

Given the legal and social aspects, technology maturity is not the biggest challenge. Moreover, the country doesn't have encouraging policies to invite funding from multilateral banks, who have CCUS trust funds in place. A recent case was cited where a significant grant from a multilateral agency towards CCUS was returned unused.

How to make storage economically viable in a market that is very cost sensitive is another issue that policymakers are grappling with. The technologies for carbon capture are expensive and lose out when compared with the low-price tag achieved by PV solar energy already. Getting over that perception is very important.

Some challenges to CCUS were highlighted in the Indian context. CCUS technology is not aligned with the Indian government's agenda of energy efficiency & additional clean energy. Land acquisition is a massive issue and the perception that CCUS may detract from other efforts of mitigation.

The discussion was carried further by

From left to right - Mr. Saurabh Biswas, Mr. Subir Gupta, Mr. Abhishek Sood, Ms. Rupali Handa, Dr. Neelima Alam, Mr. Sahil Ali, Mr. Siddharth Aryan, Mr. Joe Phelan, Mr. U.P. Pani, Mr. Aniruddha Sharma

noting that electricity tariff is regulated and therefore, storage may not be feasible until there is some gross subsidy available either from the government or the customer.

Questions were raised regarding the reliability of storage and the insurance and liability aspect in case of leakage.

There are several questions from the legal perspective too. Who owns the land? Where is the CO_2 going to be dumped? Whose liability is it? Whose resources are these? Who makes payment for them? Therefore, these questions need to be addressed before implementation of such a project.

As mentioned by various participants, in order to materialize the implementation of the CCUS technology in India, we are bound to come across economic, administrative, geo-political, and geological challenges. However, it was unanimously agreed that this technology is a necessity for the nation.

> *"Considering other aspects such as legal & social aspects, technology is not the biggest challenge. However, more and more R&D does bring different perspectives and brings the cost down as cost is a very important aspect."*
>
> ***– Dr. Vikram Vishal***

From left to right - Mr. Vaibhav Chaturvedi, Dr. Vikram Vishal, Mr. Chandra Bhushan, Mr. Puneet Thakur

CASE STUDY

EXPERIENCE OF DEMONSTRATING CCUS IN INDIA

Mr. Sharma presented the case study on the successful commercial implementation of CCU at the Tuticorin Alkali Chemicals & Fertilizers plant in Tuticorin, Tamil Nadu. Key points from his talk are summarized below:

- Location: Tuticorin, Tamil Nadu
- CO_2 Capture: 60,000 tons per year (feeds into the production of 85,000 tons of downstream chemicals)
- CO_2 Capture Source: Coal-based boiler
- CO_2 Capture Cost: $32/metric ton CO_2

Mr. Sharma cited that major cities like Mumbai and Delhi have 350 tons and 700 tons of CO_2 demand respectively per day. Overall, all major cities have a shortage of CO_2. As per his assessment, CO_2 supply in itself is a huge market, which companies can look to fulfil. Additionally, carbon capture is not only a zero-carbon solution but also a zero-pollution solution. In the capture process, soot, ash, dust, SOX and NOX, heavy particulate matter and heavy metals are also removed from the flue gases.

According to him, from an India specific perspective, in the absence of any carbon price, utilization of captured carbon makes more sense. Industrial players with market access, the know-how of operating a business and existing network can make something to sell in the market. He stressed upon the potential for import substitution as well. Given that India has large oil import, manufacturing of methanol indigenously from CCU could save useful dollars. He opined that at around 1000 of CCU plants, the scale will become meaningful and then CCU would start making a difference.

Using an example, he mentioned that UK imports about half a million tons of CO_2 from Europe. The UK government provides incentives to some power plants to be a supplier of CO_2. He suggested that India can also look into a similar arrangement. He summed up by stressing the need for more positive policy engagement, recognition of CCUS as a vital tool for decarbonization and provision of funding for more demonstrations.

PRESENTATION

INSIGHTS FROM IEA'S GLOBAL CCUS EXPERIENCE

Mr. Singh provided an overview of CCUS from the global perspective and laid down a roadmap for the future. Key points from his talk are summarized below:

- Coal-fired power plants continue to be the largest source of emissions at 33% of the overall emissions from the energy sector. Therefore, CCUS has a role to play in this situation.
- Under IEA's new policy scenario, which considers what policies are already in place and what kind of policies will continue to evolve over time, the third biggest contributor to emission reduction is CCUS.
- In the case of India, a range of policy measures can be put into place including grant funding, feed-in tariffs and CCUS obligations. Importantly, carbon price itself does not trigger CCUS adoption.
- Cost reduction in the technology can come from a basket of these measures:
  - Expansion of scale economies, like in case of Boundary Dam project in the USA
  - Optimization of CO_2 in transport and storage
  - Progressive financing mechanisms
  - Facilitation of technology innovation by government
  - Building of CO_2 networks through investments in transportation, etc. and creating an ecosystem
  - Strengthening public-private partnerships (Research centres, early deployment, capacity building)

NEXT STEPS

MOVING TOWARDS A ROADMAP

The participants were then asked to comment on the mechanisms that should be adopted for the next stage of adoption of CCUS in India. Simultaneously, they were asked to throw light on the policy framework that should be needed to give the technology an impetus.

They opined that any solution in this respect should align very well with India's development story. It should aid in manufacturing growth and job creation. From that perspective, CCU has a positive connotation since it can create a bigger manufacturing base for India.

The issue of public perception should be addressed and co-benefit agenda inherent to CCUS technology should be pushed.

For CCUS development and deployment, correct set of policies with correct information will be one of the important factors to determine the future direction. Upgrading regulation, incentivizing the technology usage or retribution for the polluters are possible solutions for the inculcation of the technology into the

From left to right - Mr. Vaibhav Chaturvedi, Dr. Vikram Vishal, Mr. Chandra Bhushan, Mr. Puneet Thakur, Mr. Saurabh Biswas, Mr. Subir Gupta, Mr. Abhishek Sood, Ms. Rupali Handa

Indian scenario.

Technology for the various phases of CCUS is at various stages of development. Capture technologies are at a more mature stage, whereas, understanding of storage is less developed. CCS needs more assessment. Technology needs to be evaluated keeping in mind these differences. In one category, only technical evaluation is required. In another category, a holistic kind of evaluation, including, technical evaluation, economic viability and perception studies need to be undertaken. Once the lab and pilot scale studies are done, DST would like to move to actual demonstration and deployment phase. At that point, DST would rope in public sector and private sector enterprises.

The participants opined that considering the kind of capital access as well as the obligation to the larger public, public sector companies should take the lead in CCUS adoption

The session was capped by Mr. Bhushan's emphatic words, "Nothing should stop us from experimenting a technology. Whether the technology will work or not and even if it works, whether the public will accept it or not, is a different issue. But nothing should stop us from exploring and developing a technology."

CONCLUSION

The roundtable concluded with the participants agreeing on 3 key tactical activities in shaping the future of CCUS in the country. These are as follows:

- Frame a Roadmap for CCUS adoption in India;
- Form a core team to work on CCUS Roadmap and take the initiative forward;
- Work with NITI Aayog to formulate the next level of the dialogue on the topic.

SNAPSHOT:

- Carbon capture in power generation, especially for country like India, is not only a zero-carbon solution, but also a zero-pollution solution. When we capture carbon, we also remove soot, ash, dust, SOX and NOX, heavy particulate matter, heavy metal out of the flue gases.
- In the present Indian context, CCS, CCU and CCUS have different relevance:
  - CCS is primarily about storage in geological formations or offshore sites and aquifers;.
  - CCU is about recycling the emitted CO_2 and utilizing it in other industrial processes and products;
  - EOR and ECBM are good examples of utilization and storage working together.
- In the current scenario, CCU is of more interest compared to CCS, which would need more evaluation;
- However, in the longer term, given the volume of carbon that needs to be captured, CCS would be needed for climate change mitigation;
- CCUS in the form of EOR/ ECBM is important as it adds to our energy security;
- In industrial sector, where the technology transition is going to be very difficult, CCUS will play an important role.
- Challenges to CCUS adoption in India:
  - Economic viability;
  - Perception barrier;
  - Lack of assessment of geological storage potential of India; and
  - Land requirement needs to be better assessed.
- India has the capability to develop viable CCUS technology and can become a world leader in supplying low- cost technology.
- PSUs should take the lead in conducting pilot studies.

RECOMMENDATIONS:

The key recommendations emanating from the discussion are:

- CCU is of more interest compared to CCS in the current scenario;
- However, CCS is needed for deeper and faster climate change mitigation;
- Need for assessment of geological storage potential in India by Geological Survey of India;
- Need for CCUS pilots;
- PSUs should lead in pilots.

ABOUT CHASE INDIA

Chase India is India's leading public policy research and advisory firm with growing practices in healthcare, food & beverage, technology, energy, sustainable environment and climate change. The firm provides advisory services to organisations for mitigating business risk through insight based policy advocacy campaigns.

ABOUT THE EARTH DIALOGUES

'The Earth Dialogues' is the flagship policy discussion platform to examine topics related to a wide range of issues in the Environment, Climate Change and Sustainability domain. It is a part of the 'Chase Dialogue' platform that brings together experts from the field of technology, health, energy, sustainability, environment and climate change to discuss issues of pressing concern. The team at Chase India comprises of experts with extensive experience spanning across regulatory and industry bodies, government organisations, academia and media, in roles engaged at various levels of public policy. Chase India is a WE Communications Group company.

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ABOUT THE EVENT PARTNER

Sustainability Advisors was founded in 2017 by Subir Gupta, ex-CEO of ERM India. The organization assists corporates in the areas of decarbonizing the energy sector, ESG Advisory and Sustainability Leadership Training.

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