IEAGHG Information Paper 2018-IP41; ICEF Roadmap 2018 on Direct Air Capture of Carbon Dioxide (DAC)

Since 2014, the Government of Japan is hosting the annual Innovation of Cool Earth Forum (ICEF) in Tokyo with the aim of tackling climate change through technological innovation. ICEF's mission is to nurture discussion and collaboration among participants and to disseminate innovations in energy and environmental technology to participants and beyond. ICEF also develops roadmaps on how key innovative technologies can contribute to a transition to clean energy, considering industrial, academic and governmental perspectives. The roadmaps are collaborative documents developed from the annual conference and refined by reviews and suggestions from international experts. The most recent roadmap on direct air capture (DAC) was presented during a side event at COP24 in Katowice on 10 December 2018. The roadmap explores the role of DAC technologies in the context of climate change mitigation and CO_2 utilisation.

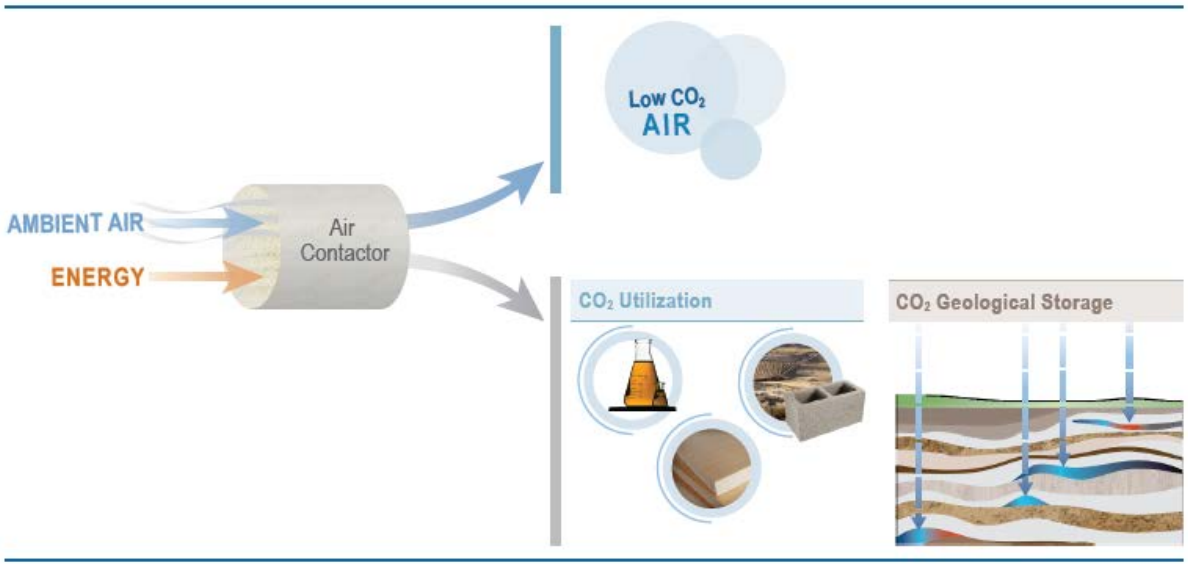

Figure 1 Schematic of DAC [ICEF Roadmap 2018 Direct Air Capture of Carbon Dioxide]

Some of the main findings include:

- Large-scale carbon dioxide removal (CDR) will likely be essential to achieve the 2°C goal, to avoid both overshoot and the associated consequences of global warming. This is in line with findings from integrated assessment models (IAMs), especially those that are used for the IPCC's reports.
- Many engineered and natural pathways can achieve large-scale CDR, including DAC. All approaches have challenges, such as technology readiness, costs, resource availability and social acceptance. A full/broad portfolio will usually have the highest chance of success. However, government recognition and action on CDR is relatively low.
- DAC can play a significant role in CDR deployment. The capacity of DAC with sequestration (DACS) is quite large and limited primarily by costs, energy requirements and geological storage capacity (which several studies have found to be large enough to accommodate reduction pathways). DAC can play a role as a 'backstop' technology on the cost for climate change mitigation technologies, meaning that it marks the cost limit for mitigation technologies.

- The key limitation for DAC deployment are costs. DAC will almost certainly cost more than conventional carbon caption and storage (CCS) in the power sector or in industry. DAC technologies currently operate at 300-600 $/tCO$_2$.
- Both fundamental research and applied engineering can help producing significant costs reductions, with estimates showing 200 $/tCO$_2$ by 2025 and less than 100 $/tCO$_2$ by 2030.
- Companies and technologies exist today for rapid progress in DAC cost-reduction and scale up. (For example, Carbon Engineering, Climeworks, and Global Thermostat.)
- Some DAC technologies can provide additional benefits beyond atmospheric CO_2 removal, such as fresh water separation, or the combination with CO_2 utilisation to make products from CO_2 (for example, fuels, plastics, aggregates).
- Governments, industry and financial institutions will need to recognise DAC(s) as part of a climate mitigation portfolio and work together to scale up DAC. Policies that promote DAC should include investment in RD&D, government procurement, targeted incentives, LCAs, and inclusion in carbon markets.

The roadmap is overall very balanced, dedicating a chapter to advantages as well as challenges of DAC and stressing the importance of a portfolio approach to climate change mitigation in terms of minimising risks.

The roadmap is available for download at:

https://www.icef-forum.org/roadmap/

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