ZEP Briefing – IPCC Sixth Assessment Report, 'Climate Change 2022: Mitigation of Climate Change'

Background

The Intergovernmental Panel on Climate Change (IPCC) published a report called 'Climate Change 2022: Mitigation of Climate Change' on 4 April 2022. The report *"provides an updated global assessment of climate change mitigation progress [...]"*. The report emphasises that *"without immediate and deep emissions reductions across all sectors, limiting global warming to 1.5°C is beyond reach"*.

The IPCC explains, among other things, that:

- Greenhouse gas (GHG) emissions must peak by 2025 to limit warming to around 1.5°C.
- New technologies, including carbon capture and storage (CCS) and hydrogen will be needed.
- CCS will be essential to offset residual emissions from the energy sector, although they could allow fossil fuels to be used longer.
- Production processes will need to be transformed through increased use of electricity, hydrogen and CCS.
- Global rates of CCS deployment are far below those in modelled pathways limiting global warming to 1.5°C or 2°C.
- Enabling conditions such as policy instruments, greater public support and technological innovation could reduce these barriers.

There is a wide recognition throughout the report that CCS and CCU will have a role to play across multiple sectors – the extent to which CCS is deployed does vary across scenarios, nonetheless it is now viewed an integral component to mitigate climate change.

The document shows that the need for CCS to be deployed at scale globally continues to grow, and much like the conclusions of the CCC 2020 Sixth Carbon Budget report, CCS has to be a key pillar to prevent climate change. One topic which has received a significant revision is Carbon Dioxide Removals (CDR) – where in the majority of scenarios, BECCS plays a significant role (up to 780Gt pa), with DACCS (up to 310Gt pa) playing a role (which varies to extent and confidence depending on the scenarios).

The report paints a stark picture of the challenge ahead including the social challenge against the UN Sustainable Development Goals. In this context the main report notes that CCS infrastructure projects, such as those in Rotterdam and Teesside, are a good example of how industrial cluster regions can drive decarbonisation.

Key statements on CCUS

- All sectors of the global economy must change dramatically and rapidly, and new technologies including CCS and hydrogen fuel will be needed.
- Nearly all electricity in pathways likely limiting warming to 2°C or 1.5°C is from low or no carbon technologies, with different shares across pathways of nuclear, biomass, non-biomass renewables, and fossil fuels in combination with CCS.
- The technical geological CO2 storage capacity is estimated to be on the order of 1000 gigatonnes (Gt) of CO2, which is more than the CO2 storage requirements through 2100 to limit global warming to 1.5°C.
- CCS is a mature technology for gas processing and enhanced oil recovery. CCS is less mature in the power sector, as well as in cement and chemicals production.
- Limiting warming to 2°C or 1.5°C will strand fossil-related assets. The economic impacts of stranded assets could amount to trillions of dollars, a cost that CCS can reduce.
- Evidence suggests that without carbon capture, the worldwide fleet of coal and gas power plants would need to retire about 23 and 17 years earlier than expected lifetimes, respectively in order to limit global warming to 1.5°C and 2°C.
- Until a very low GHG emissions alternative binder to Portland cement[1] is commercialised – which is not anticipated in the near to medium term – CCS will be essential for eliminating the limestone calcination process emissions for making clinker, which currently represent 60% of GHG emissions in best available technology plants.
- Reducing emissions from the production and use of chemicals would need to rely on a life cycle approach that includes CCUS.
- Retrofitting existing installations with CCS switches to low carbon fuels are among the major options that can contribute to aligning future CO2 emissions from the power sector with emissions in the assessed global modelled least-cost pathways.
- Pathways likely to limit warming to 2°C or 1.5°C require some amount of carbon dioxide removal (CDR) to compensate for residual GHG emissions.
- Scaling up biomass crop production for the deployment of bioenergy with carbon capture and storage (BECCS) may displace croplands, and in doing so, threaten food security and spur additional deforestation.
- Direct Air Capture with Carbon Storage (DACCS) is currently at a medium technology readiness level.
- In modelled pathways that report CDR and that limit warming to 1.5°C, global cumulative CDR during 2020-2100 from BECCS and DACCS is 30-780 GtCO2 and 0-310 GtCO2, respectively.
- In modelled pathways that limit warming to 2°C, global cumulative CDR during 2020-2100 from BECCS and DACCS is 170-650 and 0-250 GtCO2 respectively.
- Communities may consider CCU to be lower-risk and view it more favourably than CCS.

[1] "Portland cement is the basic ingredient of concrete, mortar and plaster [...]". Genetically-enriched microbe-facilitated self-healing nano-concrete Chattopadhyay (2020).

The report includes the following criticism regarding CCUS:

- Overall mitigation costs and the need for CCS may be overestimated in climate change scenario modelling.
- The adoption of CCS in the electricity sector has been slower than the growth rates anticipated in stabilisation scenarios.
- Emerging evidence indicates that small-scale technologies (e.g., solar, batteries) tend to improve faster and be adopted more quickly than large-scale technologies such as CCS.
- The public is largely unfamiliar with CCUS.
- When presented with neutral information on CCS, people favour other mitigation options such as renewable energy and energy efficiency.
- Specific CCS projects have faced strong local resistance, which has contributed to the cancellation of CCS projects.

Takeaway Figures

The document and especially the figures are still subject to final edits and graphical improvements.

Figure 11.9 Fully interactive, non-sequential strategies for decarbonising industry

Table 11.2 Examples of the potential roles of different actors in relation to different mitigation strategies indicating the importance of engaging a wide set of actors across all mitigation strategies.

Sectors	Demand control measures (DM)	Materials Efficiency (ME)	Circular Economy	Energy Efficiency	Electrification, hydrogen and fuel switching	CCU	CCS
Architectural, and engineering firms	Build awareness on the material demand implications of e.g., building codes, urban planning, and infrastructure.	Education of designers, architects, engineers, etc. Develop design tools. Map material flows.	Design and build for e.g., repurpose, reuse, and recycle. Improve transparency on volumes and flows.	Maintain high expertise, knowledge sharing, transparency, and benchmarking.	Support innovation. Share best practice. Design for dynamic demand response for grid balancing.	Develop allocation rules, monitoring and transparency. Coordination and collaboration across sectors.	Transparency, monitoring and labelling. Coordination and collaboration for transport and disposal infrastructure.
Industry and service sector	Digital solutions to reduce office space and travel. Service oriented business models for lower product demand.	Design for durability and light weight. Minimize industry scrap.	Design for reuse and recycling. Use recycled feedstock and develop industrial symbiosis.	Maintain energy management systems.	Develop and deploy new technologies in production, engage with lead markets.	Develop new technologies. Engage in new value chains and collaborations for sourcing carbon.	Plan for CCS where possible and phase-out of non-retrofittable plants where necessary.
International bodies	Best practice sharing. Knowledge building on demand options.	Progressivity in international standards (e.g., ISO).	Transparency and regulation around products, waste handling, trade, and recycling.	Maintain efforts for sharing good practice and knowledge.	Coordinate innovation efforts, technology transfer, lead markets, and trade policies.	Coordinate and develop accounting and standards. Ensure transparency.	Align regulation to facilitate export, transport, and storage.
Regional and national government, and cities	Reconsider spatial planning and regulation that has demand implications.	Procurement guidelines and better indicators. Standards and building codes.	Regulation on product design (e.g., Ecodesign directive) Collect material flow data.	Continue energy efficiency policies such as incentives, standards, labels, and disclosure requirements.	R&D and electricity infrastructure. Policy strategies for making investment viable (including carbon pricing instruments).	Align regulation to facilitate implementation and ensure accountability for emissions.	Develop regulation and make investment viable. Resolve long term liabilities.
Civil society and consumer organizations	Information and advocacy related to social norms.	Strengthen lobby efforts and awareness around e.g., planned obsolescence.	Engage in standards, monitoring and transparency.	Monitor progress.	Information on embodied emissions. Assess renewable electricity and grid expansion.	Develop standards and accounting rules.	Ensure transparency and accountability

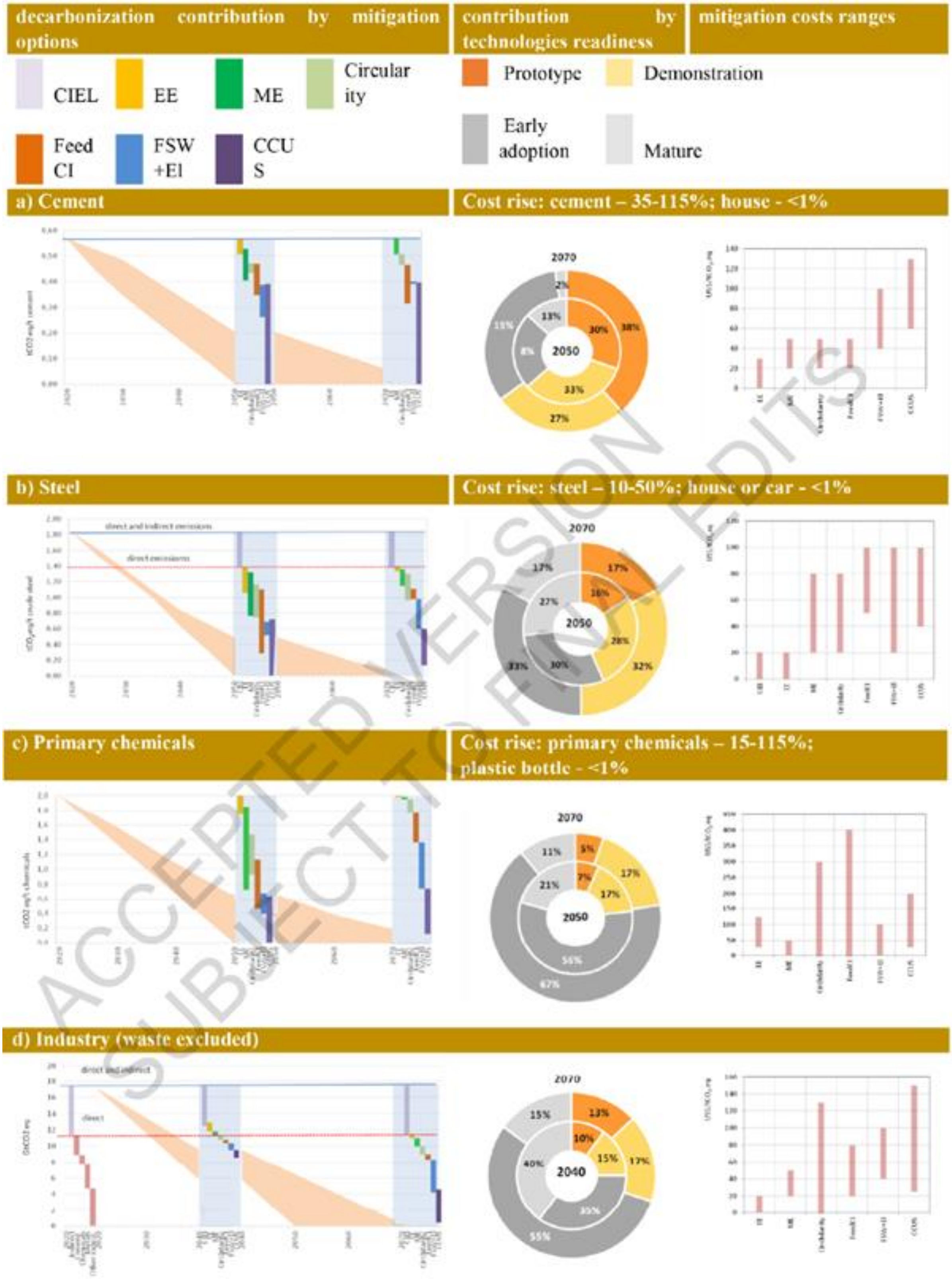

Figure 11.13 Potentials and costs for zero-carbon mitigation options for industry and basic materials ***CIEl* –carbon intensity of electricity for indirect emissions; *EE* – energy efficiency; *ME* – material efficiency; *Circularity* - material flows (clinker substituted by coal fly ash, blast furnace slag or other by-products**