CAMBRIDGE ZERO $_2$

Hard to Decarbonise Technologies
Special Interest Group

Steel, Cement and Chemicals: Exploring Decarbonisation Options for Energy-Intensive Industries

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Panel

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Challenges

- These Industries contain processes that requires high temperatures, making them extremely carbon-intensive. The processes also release CO2 as part of the reactions.
- The pieces of equipment involved are large, capital-intensive and has to keep running, posing challenges to shut them down.
- There are financial and infrastructure challenges for lower-carbon technologies to supplement these industries.

Discussion Points

- The Industrial sector is responsible for 40% of the global CO_2 emissions. The steel, cement, and chemicals industries make up about a quarter of our emissions, yet we have little knowledge and actions on decarbonizing these sectors.
- Technical challenges in decarbonizing includes abating the process emissions inherent to the chemical reactions (e.g., the calcination process of limestone contributing to 60% of total emissions), the use of fuels for non-energy purposes (e.g., feedstocks), the high temperatures involved and the transport emissions.
- Non-technical challenges in decarbonizing includes understanding the imports and trades of the materials, the complex supply chains (especially for chemicals) and the financial costs of incorporating innovative and lower-carbon solutions in the production routes.
- Digitalization, alternative fuels switching, increasing material and energy efficiencies of current stocks of assets, implementing hydrogen, CCUS and direct electrification are some technological changes to help decarbonize these sectors. Material supply chains and market systems can also be improved.
- For concrete, using less clinker and more innovative materials (self-healing reinforced concrete) are some technological solutions. For steel, these include making existing process as efficient as possible, fully utilizing all available scraps and incorporating breakthrough technologies (e.g., hydrogen-use).
- We cannot just rely on CCUS, Carbon must be reduced as much and as fast as possible. Better process control has to be implemented. End-customer demand should also be monitored across all industries. Collaboration is key here.
- Hydrogen can be advantageous within the steel (good reductant and strip oxygen from iron ore), sement (fuel) and shemical (fundamental components of ammonia and feedstock in steam cracker) industries. Hydrogen infrastructure is still a challenge that needs to be addressed.

Opportunities

- Collaboration between these industries and academic researchers and institutions need to be fostered, focusing on implementation of low-CO_2 hydrogen, process design and system-scale analysis.
- Future PhD researches can focus on the work on making renewable energy as efficient as possible and increasing generation productivity of hydrogen to maximize return on investment from a production viewpoint.

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