The Role of Carbon Capture and Storage in India's 'Hard To Abate' Industries

19/0/2021, Nikhilesh Dharmala

Carbon dioxide levels have hit a record high yet again despite the slowdown caused by the coronavirus lockdowns globally. Based on estimates by the GHG Platform, heavy industries comprising cement, steel, chemicals, and aluminium and heavy-duty transport such as shipping, trucking, and aviation are responsible for more than a third of the carbon dioxide emissions in India.

Notwithstanding efforts to decarbonise, these emissions are projected to increase by more than two to three times by mid-century.

These heavy industries are considered *hard to abate* because they depend on fossil fuels for energy and as feedstock in their production processes. The use of coke for iron-ore reduction in blast furnaces, coal for clinker formation in a cement kiln and crude oil as the primary feedstock in petrochemicals are a few examples. In addition to emissions due to combustion of fossil fuels, these industries also produce process emissions during physical and chemical conversions of raw materials. The conversion of limestone to clinker and the depletion of carbon anodes in the production of aluminium are cases in point.

While policies like the National Mission on Enhanced Energy Efficiency have improved the situation, fossil fuel-dependent production processes have resulted in a carbon lock-in, making these sectors harder to abate. Efficiency improvement and fuel shifts in existing production processes across industries will help reduce only about 22% (600 million tonnes of CO_2) emissions in 2050 compared to a scenario without these measures.

This isn't sufficient to envisage a peak and decline in emissions – let alone a shift to net zero in the latter half of the century. Therefore, additional measures need to be deployed to further reduce emissions from these sectors.

Growing concerns about increasing emissions from hard-to-abate sectors have amplified the interest in advanced technologies to reduce emissions. Prominent among them is the removal of carbon dioxide from the atmosphere, widely known as carbon capture, utilisation and storage (CCUS). The term refers to a group of technologies that remove or capture carbon dioxide from fuel combustion or industrial process, use it to create value-added products or store it underground, mainly in geological formations, to prevent its release back into the atmosphere.

A recent study by the International Energy Agency estimates that currently there are 21 CCUS facilities globally, capturing about 40 million tonnes of carbon dioxide a year. In India, there are four facilities with a negligible capacity (0.003 Mt CO_2/yr). They have been operating for decades in industries such as chemicals and fertilisers, where carbon dioxide is recovered from flue gas and used to manufacture by-products.

The lack of a value proposition for the captured carbon dioxide and the cost of capture, transportation and storage have been major hurdles in CCUS's wider acceptance.

Research suggests that India's estimated carbon storage potential varies from 5 to 400 billion tonnes of carbon dioxide, located mainly in geological formations such as coal fields, oil and gas fields, sedimentary basins and saline aquifers. However, to deploy CCUS at scale commercially, the technology must be economically viable and readily available for emission-intensive industries.

Existing CCUS technologies carry two to three times higher abatement costs than current emission mitigation technologies. The nascent level of technology, very high capital cost and the absence of regulatory frameworks in India make CCUS deployment prohibitive for industries.

The Government of India is trying to overcome these challenges through its 'Mission Innovation', which aims to accelerate innovation and boost public sector investment by identifying groundbreaking technologies and providing impetus for research, development and demonstration pathways.

To honour India's Paris Agreement commitment to limit the average global surface temperature rise to 1.5º C, it needs to deploy more CCUS facilities in the coming decades. This is even more significant given the need for increased capacity in emission-intensive, hard-to-abate industries. Since the typical lifetime of a steel or cement plant is about 30 to 40 years, this creates a technology lock-in whereby the plant will to emit for three to four decades. So the role of CCUS becomes significant in achieving higher emission reductions from the already deployed capacity.

The Government of India should play a critical role in ensuring market support to CCUS while encouraging industries to embrace the technology. Market-based instruments such as a carbon pricing mechanism, which puts a price on carbon emissions, could support the deployment of CCUS. India needs to assess suitable storage sites to drive investments into the capture, transport and storage of carbon dioxide, augmented with a robust legal and regulatory framework that establishes limits on unabated emissions and ensures management of associated risks in deploying CCUS.

At an institutional level, both in the public and private sectors, India needs to increase R&D spending to boost innovation, reduce costs and commercialise emerging technologies in the area. Alongside other breakthrough technologies, adoption of CCUS will allow India to pursue both enhanced climate action and development without compromising either.

Nikhilesh Dharmala is working in the areas of climate, environment and sustainability at the Centre for Study of Science, Technology and Policy (CSTEP), a research-based think tank.