Energy symbiosis for decarbonising India's hard-to-abate sectors

Preparing a comprehensive roadmap for estimating the energy savings possible through energy symbiosis could be a good first step.

By Gopala Krishnan

At the recently concluded 27th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP27), India submitted its long-term strategy to achieve zero emissions by 2070. A key feature of this strategy relates to increasing energy efficiency of industries and exploring decarbonisation options for hard-to-abate sectors, which draw roughly 50% of India's natural gas, 25% of coal, and 20% of oil resources. Transitioning to net zero for these sectors is not straightforward, owing to extremely high process-temperature requirements, limited decarbonisation options, and the associated huge capital costs.

The hard-to-abate sectors in India include large-scale industries such as iron and steel, as well as the micro, small, and medium enterprises (MSMEs) such as bricks, refractories, etc. A 2022 study by the Massachusetts Institute of Technology (MIT) says that in India, CO 2 emissions from these sectors are expected to rise by about 2.6 times between 2020 and 2050.

Energy efficiency measures alone cannot decarbonise these sectors as the reduction in energy use and GHG emissions is likely to be nullified by the future growth of industries. Moreover, energy savings generated by individual energy efficiency measures stagnate beyond a certain level. Thus, collective approaches such as energy symbiosis, which can substantially improve energy efficiency, are needed to tackle the hard-to-abate sectors.

In an energy symbiosis network, the industrial units in a cluster exchange steam, compressed air, and waste heat, and can also share centralised assets such as a renewable energy microgrid. Waste heat at high temperatures (above 500°C) from refractories, die casting, etc. can reduce or meet the heat demand within the sector as well as in low- and medium-temperature processes outside the sector. Steam procured from the energy symbiosis network is usually cheaper than that produced on-site. Reusing residual energy reduces the use of primary energy for production, thereby increasing the network's overall efficiency. The operational and installation costs also come down, since the amount of energy and fuel purchased decreases, industries gain revenues from energy exchanges, and investments can be shared by the participants.

Over the years, energy symbiosis has happened in many industrial complexes around the world. A World Bank article mentions that in Korea, 1,000 companies have been practicing energy symbiosis in the Ulsan Mipo and Onsan Industrial Park, because of which they brought down CO_2 emissions by 665,712 tonnes and saved 279,761 tonnes of oil equivalent in energy use in 2015-16.

For India, energy symbiosis—by effectively handling the hard-to-abate sectors—can enhance the overall energy efficiency of the industrial sector and reduce energy costs and GHG emissions significantly. Industrial clusters where units are co-located provide tremendous opportunities for resource sharing, risk sharing, and demand aggregation. Large-scale industries can help upgrade MSMEs' understanding of energy efficiency and equip them with the relevant expertise and decision-making skills.

In 2018, globally around 250 energy symbiosis networks were in operation or under development. But in India, energy exchange in industrial clusters is not prominent, when compared to material exchanges.

A variety of factors make it challenging to set up or retrofit an energy symbiosis network in India. Investments as well as heat losses increase with pipe length, necessitating units to be located close to each other. As this is not the usual case, identifying such clusters is difficult. Lack of trust, fear of dependency on partners, and loss of autonomy also pose significant barriers to implementing energy symbiosis, since even one partner's exit can disband the network.

Given the enormous potential of energy symbiosis for boosting energy efficiency, it is important that timely and appropriate steps be taken to deal with these challenges. Industrial clusters where industries are in close proximity (such as the SIDCO, SIPCOT, and MIDC industrial complexes) can be considered for energy symbiosis, and energy service companies can be roped in to take care of financing, building, and maintenance of the network.

To boost the growth of these networks, the government, along with bilateral and multilateral institutions, can support pilot demonstrations of energy symbiosis projects, with dedicated funds earmarked for them. Cluster associations can serve as promoters for the energy symbiosis network within the cluster. Further, for building an understanding of the benefits of energy symbiosis networks among all stakeholders, awareness campaigns should be conducted.

Government policies can play a key role in enabling the development of energy symbiosis in India. For example, a legislation that sets energy/emission reduction targets for a group of industries in a particular area can enable energy symbiosis there. Within the area, industries can agree to collectively obey the targets. Incentives in the form of energy saving certificates (ESCerts) or capital subsidies can also be provided to the coalition. This concept, known as 'umbrella license', is practiced in the Hardenberg eco-industrial park in the Netherlands. Also, a study by the Finnish Environment Institute suggests that a waste policy that encourages the reuse of energy by other companies can aid the formation of energy symbiosis clusters.

Energy symbiosis holds promise for effective decarbonisation of the hard-to-abate sectors, taking India closer to its climate commitments. Preparing a comprehensive roadmap for estimating the energy savings possible through energy symbiosis could be a good first step towards the adoption of this approach.

[This piece was written exclusively for ETEnergyworld by *Gopala Krishnan, who* works in the area of renewable energy and energy efficiency at the Center for Study of Science, Technology and Policy (CSTEP), a research-based think tank]