Could Green Methanol Be What China Needs to Reach Net Zero?

Methanol produced with solar and wind energy is a clean and cheap alternative fuel that could slash China’s emissions by as much as 80 percent.

As the largest global emitter of greenhouse gases, China has seen its efforts to mitigate climate change come under constant scrutiny. Its recent promise to reach peak carbon dioxide emissions by 2030 and turn carbon neutral by 2060 is deemed by some as too little, too late. But it is not for lack of trying. Chinese researchers have been developing sustainable energy technologies for more than 20 years in a bid to wean the booming economy off its dependence on coal and tackle widespread pollution. Now, some scientists think they may finally have the answer: “green” methanol.

Methanol is a chemical already widely used for everyday products from disinfectants to cosmetics to plastics. It can also be used as a fuel. Traditionally made from a process fed by natural gas and other fossil fuels, methanol can now be produced with solar and wind energy thanks to years of research, noted Professor Liu Ke, an expert on clean energy who has worked for major corporations and research organisations in China and the United States.

The event was organised by INSEAD’s student-led Asia Europe Club with support from the China Initiative, which aims to help global professionals navigate China’s fast-changing business landscape through research and teaching as well as collaboration with corporations.

“Using green methanol to replace the coal economy, we can reduce emissions by 80 percent,” said Liu, the Chair Professor of the Southern University of Science & Technology, in a keynote speech.

For renewables, the best is yet to come

Liu began his presentation with an assessment of several technologies widely thought to be the pathways to carbon neutrality: wind and solar power, electric vehicles (EV) and hydrogen-fuelled vehicles. He had bad news: None of them is the path to net zero due to storage, safety and cost constraints.

This renewable or “green” methanol has the potential to revolutionise China’s auto industry by enabling safer and less polluting fuel processes. It can also power homes, which were responsible for 13 percent of the country’s CO2 emissions in 2015, Liu said at the recent China Technology Day.

Take wind and solar energy. China’s growth in these renewables has been nothing short of spectacular. It doubled production between 2016 and 2020, producing as much as 400 gigawatts, or about 80 percent of total electricity consumption in the US. But renewables still only account for 30 percent of China’s total energy consumption last year.
Several problems stymie more widespread adoption, Liu said. First, many areas in China are not connected to the grid, so wind and solar facilities often operate below capacity.

The second problem is intermittency, the industry’s term for the on-again, off-again nature of wind and solar power. Liu noted that solar power, for example, is available only 20 percent of the time across China. This calls for large-scale storage as a solution.

But even though batteries have become tiny enough to fit in smartphones, the technology has not improved much on the other end of the size spectrum since lead acid was invented in 1859. The cheapest grid-level energy storage, Liu said, is still the 100-year-old pumped reservoir technology. It is anyone’s guess when technology might reach the stage whereby electricity generated in the daytime can be readily stored for large-scale consumption at night.

**EV is not the answer**

Like renewables, electric vehicles are taking off in China under strong government support, including generous purchase subsidies that have been available since 2009. Some 3 million EVs were sold in China last year, 154 percent more than the year before and about half of all EVs sold worldwide. China aims to have EVs make up 40 percent of all passenger vehicle sales by 2030.

Yet if anyone thought the plug-in fervour would significantly reduce emissions, said Liu, they might want to think again. For one thing, the electricity fed into China’s EVs is still 60 percent coal generated. Then there’s the two-fold problem of batteries. First, they are not very environmentally friendly. Each EV battery is made with dozens of kilos of metals including lithium, cobalt and nickel, and recycling is not prevalent.

“But from day one, when a battery is produced you have to think about how to recycle it, or it will eventually be abandoned and poison your soil, your environment,” Liu remarked.

The other problem, he said, is cost. Prices of lithium, cobalt and nickel have soared in recent years due to growing global demand and unstable supply. BYD, a major Chinese EV- and battery-maker, raised its battery prices by at least 20 percent in November. More expensive batteries are likely to have a knock-on effect on EV prices, and in turn, demand and usage.

**Hydrogen’s limits**

Amid the hype over EVs, hydrogen fuel-cell vehicles seem to have fallen by the wayside. Only 9,000 were sold in the world last year, noted Liu, despite their many selling points, including zero tailpipe emission, higher fuel efficiency and ease of recycling.

The reason is safety. Hydrogen gas leaks easily, rendering it a fire hazard for passenger transportation. “(Leaking) may be okay in open space … but in China, like Shenzhen for example, most carparks are underground,” said Liu.

Parking aside, refuelling stations for hydrogen-powered vehicles would swallow much land in China’s crowded cities since they must be situated away from residential buildings.

But there is now a way to make hydrogen safe for onboard use, said Liu, and it could be the game changer that China needs.

**The future is green (methanol)**

Methanol, which is liquid at ambient temperatures, releases high levels of hydrogen when mixed with water, making it an ideal carrier for the gas in fuel-cell cars. Vehicles that carry liquid methanol instead of compressed hydrogen gas are far less vulnerable to gas leaks and fire.

Liquid methanol is itself an improvement over gasoline and diesel as a transportation fuel, as it doesn’t produce benzene, xylene or particulate matter. It can be carried in standard fuel tanks or even plastic tanks and fits easily into existing fuelling infrastructure.

Currently, green methanol is produced in several countries including Sweden, the Netherlands and Canada from a variety of sustainable raw materials such as household and industrial waste. In China, said Liu, cheap solar and wind energy contribute most of the power required to make green methanol, with coal as a feedstock.

Methanol as a transportation fuel is already widely used in five provinces – Shanxi, Shaanxi, Zhejiang, Guizhou and Heilongjiang, according to the Methanol Institute, the industry’s global trade association. In time to come, Liu explained, green methanol-to-hydrogen processes could also power homes, replacing coal-generated electricity. He estimated this would cut emissions by 80 percent. “This is a feasible path for China to reach carbon neutrality,” he said.

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