Opinion: To achieve climate neutrality in the chemical industry, we must also cut demand

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Chemical products, such as plastics, fertilizers and solvents pervade our modern lifestyle. The vast majority are derived from crude oil or natural gas—and producing them generates around 5% of global CO_2 emissions. To transition the chemical industry toward sustainable production in a net-zero society, we essentially have the following options:

We can replace fossil feedstocks with biomass, waste or CO_2 captured from industrial emissions or the atmosphere; or we can continue with the current industry and permanently store industrial waste gases underground. All are valid approaches; the preferred solution at regional level will depend on land and water reserves, renewable power sources and carbon storage options available locally.

However, in many areas of the world, and when it comes to certain chemical goods, technological change in production won't be enough to achieve net-zero targets. We must also strive for a circular economy—which means designing products that are long-lasting and recyclable. And we need to combine industrial transformation with measures to reduce demand for chemical products.

Changing our perception

Let's look at plastics for instance. At present, only about 15% of plastic waste is collected for recycling, and of that, 40% is discarded from the recycling process—either because that type of plastic can't be recycled or on account of low quality. Colleagues at ETH Zurich have calculated that it would take a recycling rate of over 75% in order to manage plastics sustainably and within planetary boundaries in 2030. So we

urgently need better collection and recycling processes.

Their calculations also show that a circular economy with maximum recycling rates simply won't cover the surge in demand for plastic products that is forecasted through to 2050. We'll make no headway in this area unless we can bring demand below the predicted levels. One approach is to use fewer plastic products and use them for longer. Today, plastic items and many other chemically manufactured products are seen as cheap, mass-produced, disposable goods; this perception needs to change.

The same goes for fertilizers. In a recent study, we showed how nitrogen fertilizers could be produced without carbon emissions. But again, rather than focusing solely on production, it's important to tackle the demand side. Key measures here include ensuring farmers use nitrogen more efficiently when fertilizing, for example through precision agriculture, cutting food loss, and promoting a diet with fewer meat and dairy products—as animal-based foods are more resource-intensive to produce.

Shifting economic power

In many regions of the world, and for a number of reasons, achieving a net-zero chemical industry without a circular economy and interventions on the demand side will be difficult, or even impossible. Our new study shows why. In most European countries, land resources are limited, and this restricts the production of biomass as a feedstock. In the Middle East and North Africa, scarcity of water makes it difficult to grow biomass and produce hydrogen, which is needed if CO_2 is to replace fossil hydrocarbons as feedstock and serve as a raw material for the chemical industry. The same applies to other large producers like China and India.

Consequently, transitioning the chemical industry to net-zero might entail a restructuring of the international trade in chemicals. Today, with oil and gas as key feedstocks for chemical production, countries with fossil raw materials play a central role. In the future, production might shift to regions with abundant land and water resources, for example in North and South America. In countries like the United States, Canada, Chile or Brazil, biomass can be grown on arable land for industrial use without endangering the food supply; in addition, water and land resources are available to produce renewable electricity and hydrogen.

However, all countries have the chance to reduce their dependence on chemical imports and to strengthen security of supply if they focus on a circular economy and demand-side measures.

Provided by ETH Zurich

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