

Abstract

The e-CO₂MET project: From renewable electric energy to methanol

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Total has integrated climate into the company strategy, using the International Energy Agency's (IEA) 2°C scenario as a baseline. CCUS is a critical element for carbon neutrality in that scenario, with 6 billion tons of carbon dioxide needed to be captured and then stored or utilized per year by 2050. Total recognizes CCUS as an emerging industry representing a business opportunity on par with the current Exploration & Production business. Our goal is to be a leader in CCUS technology by 2035. To achieve this goal Total will commit 10% of its overall R&D budget to CCUS research over the whole value chain, including capture, transport, utilization, storage, and sustainability aspects.

One important part of our carbon dioxide utilization program is the use of renewable electric energy. Today fossil resources serve both as energy source and as mass source for hydrocarbon products, tomorrow renewable electric energy could be the energy source and carbon dioxide could be the mass source to make these products. Given an expectation of renewable electric energy prices falling below the level of fossil energy prices, carbon dioxide utilization could become a disruptive technology, producing the same products cheaper and with a lower carbon footprint than from fossil resources. This can happen even without regulation, but any regulatory impact would only accelerate this development. We believe that we need to start to develop this technology now, to be ready in time for when it is needed.

Sunfire is the world leader in high-temperature solid oxide electrolyzer technology and partner of Total for the development of its CCUS strategy. Sunfire's electrolyzers provide significant efficiency gains over conventional alkaline and PEM electrolyzers when coupled to industrial heat sources and, particularly, exothermic processes such as the production of methanol. Such deep process integrations of electrolysis with a downstream chemical conversion are paramount to achieve cost-efficient solutions that are required to bring CCUS technologies and products to market.

Because both of our companies strongly believe in this technology, we are financing together an integrated industrial demonstration pilot that will convert renewable electricity, water, and carbon dioxide into methanol, at a 1 MW - 1 ton/day scale. The 1 MW-class electrolyzer of Sunfire will be the largest of its kind. The CO₂ to methanol unit will convert CO₂ of the Total refinery in Leuna, and the green methanol produced will be sent back to the refinery, to be integrated with the existing methanol production there. In a 10,000-hour research program over three years, the integrated pilot will enable research on the integration of the different technologies under stable and intermittent electricity supply situations.