



# LAUNCHING THE LOW CARBON SOLUTIONS BUSINESS

ExxonMobil established its Low Carbon Solutions business in early 2021, leveraging its unique combination of capabilities such as geophysics expertise and complex project management to establish a new business in carbon capture and storage, hydrogen and biofuels to accelerate emission reductions for customers and in its existing businesses.

## **CARBON CAPTURE AND STORAGE**

Carbon capture and storage is the process of capturing CO<sub>2</sub> emissions from industrial activity or power plants at the source and injecting it into deep underground geologic formations for safe, secure and permanent storage.

Carbon capture and storage on its own, or in combination with hydrogen production, is among the few proven technologies that could enable reduced CO<sub>2</sub> emissions from high-emitting and hard-to-decarbonize sectors, such as power generation and heavy industries, including manufacturing, refining and petrochemicals. According to the Center for Climate and Energy Solutions, carbon capture and storage can capture more than 90% of emissions from power plants and industrial facilities.<sup>(29)</sup>

The International Energy Agency's NZE report concluded that more than 7.6 billion metric tons per year of CO<sub>2</sub> will need to be captured and stored by 2050. By comparison, the world's current capture capacity is about 40 million metric tons of CO<sub>2</sub> per year<sup>(30)</sup>. The agency has also said "reaching net-zero [emissions] will be virtually impossible" without carbon capture and storage<sup>(31)</sup>.

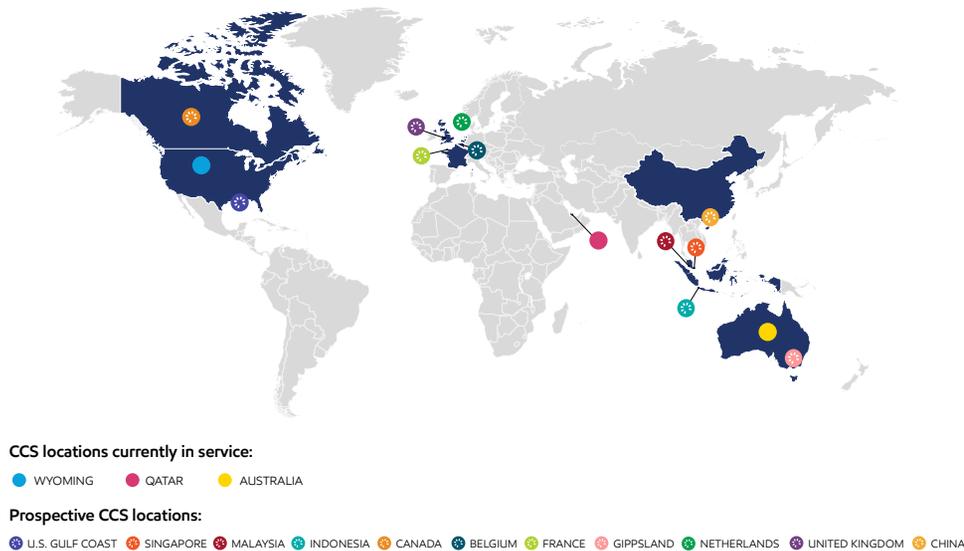
The U.N.'s Intergovernmental Panel on Climate Change estimated in its Fifth Assessment Report that the cost of achieving a 2°C outcome would more than double if carbon capture and storage was not among the decarbonization solutions.<sup>(32)</sup> Carbon capture and storage is also recognized as one of the only technologies that can enable negative CO<sub>2</sub> emissions when combined with bio-energy or direct air capture.

ExxonMobil has more than 30 years of experience capturing and permanently storing CO<sub>2</sub>, and has cumulatively captured more anthropogenic CO<sub>2</sub> than any other company. It has an equity share of about one-fifth of the world's carbon capture and storage capacity<sup>(33)</sup> at about 9 million metric tons per year, which is the equivalent of approximately 2 million passenger vehicles per year<sup>(34)</sup>.

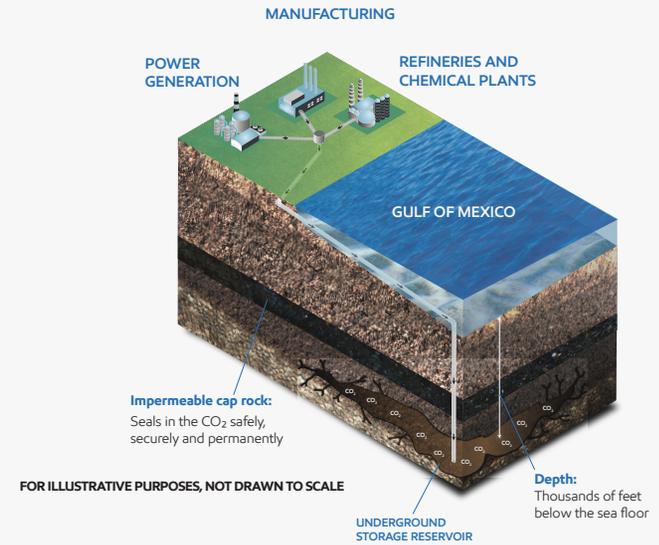
ExxonMobil has announced progress on multiple carbon capture and storage opportunities since establishing its Low Carbon Solutions business, including Houston; LaBarge, Wyoming; Edmonton, Canada; St. Fergus, U.K.; Southampton, U.K.; Fife, U.K.; Normandy, France; Malaysia; Indonesia; Singapore; Australia; and China. These are in addition to previously announced projects in Qatar; Antwerp, Belgium; Rotterdam, Netherlands; and Australia.

ExxonMobil is working with FuelCell Energy to substantially improve the efficiency, effectiveness and affordability of carbon capture through fundamental research into a novel technology that uses proprietary carbonate fuel cells to concentrate carbon dioxide from large-scale industrial and power plants.

The Company is exploring options to conduct a pilot test of next-generation fuel cell carbon capture solution at one of its operating sites.



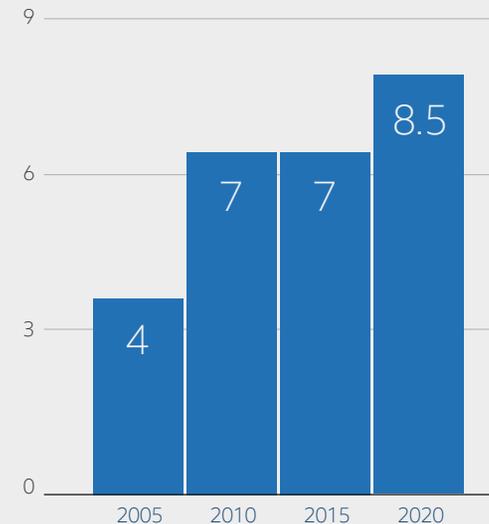
## Houston CCS Hub



ExxonMobil and 13 other companies have announced their interest in supporting the large-scale deployment of CCS technology in Houston, with the potential to capture CO<sub>2</sub> emissions from industrial facilities located there. The CO<sub>2</sub> would be piped into natural geologic formations for safe, secure and permanent storage.

## ExxonMobil carbon capture capacity

(Equity, million metric tons CO<sub>2</sub>e per year)



## HYDROGEN

ExxonMobil is evaluating strategic investments in hydrogen to increase the use of this important lower-emission energy technology. The Company has extensive experience with hydrogen, producing about 1.3 million metric tons annually. ExxonMobil is planning for a hydrogen production plant at Baytown, Texas, that would produce nearly 1 million metric tons per year of hydrogen – increasing our capacity by more than 65%.

Hydrogen is a zero-carbon energy carrier that could serve as an affordable and reliable source of energy for heavy-duty trucking and energy-intensive industrial processes in the steel, refining and chemical sectors<sup>(35)</sup>. Low-carbon hydrogen can be produced from low-carbon electricity via electrolysis of water, natural gas reforming coupled with carbon capture and storage, and other processes. Low-carbon hydrogen from natural gas with carbon capture and storage is called blue hydrogen, and is available for deployment at scale today.

The Company is participating in cross-industry groups to identify the technologies and policies required to deploy low-carbon hydrogen at scale. For example, existing natural gas transmission infrastructure has the potential to be used for hydrogen with moderate upgrade costs.<sup>(36)</sup> New natural gas transportation infrastructure could also be made hydrogen-ready. To rapidly develop a hydrogen economy, additional technology-neutral policy is required. Natural gas-derived hydrogen could provide an economic and readily available option in many settings.

## ADVANCING HYDROGEN THROUGH PARTNERSHIPS

ExxonMobil has joined the U.S. HyBlend consortium, a collaborative research and development project designed to address the technical barriers of blending hydrogen into

natural gas pipeline streams. It also signed a memorandum of understanding with SGN and Macquarie's Green Investment Group to explore the use of hydrogen and carbon capture to reduce emissions in England's Southampton industrial cluster. In addition, the Company is studying large-scale production of hydrogen for the Rotterdam industrial complex and has provided funding to Hydrogen4EU, a cross-sectoral research project confirming that hydrogen is essential to help meet the EU Green Deal's 2050 net-zero targets.

## LOWER-EMISSION FUELS

Lower-emission fuels, like renewable diesel, have the high energy density required to meet the needs of commercial transportation, while significantly reducing CO<sub>2</sub> emissions. ExxonMobil is focused on growing its lower-emission fuels business by leveraging current technology and infrastructure, in addition to continuing research in advanced biofuels that could provide improved longer-term solutions through upgrading lower-value bio-based feedstock.

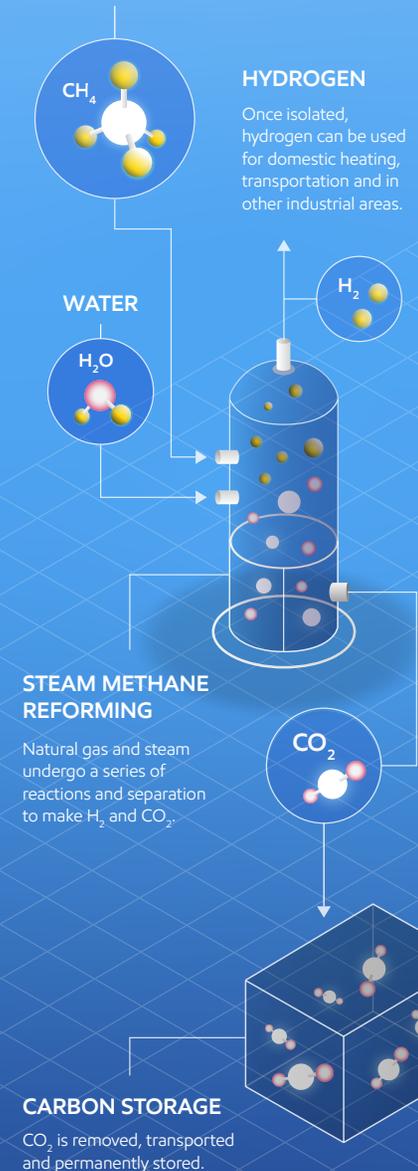
ExxonMobil plans to provide more than 40,000 barrels per day of lower-emission fuels by 2025, and has a further goal of 200,000 barrels per day by 2030. Achieving this goal will help society reduce more than 25 million metric tons of CO<sub>2</sub>e emissions per year from the transportation sector<sup>(8)</sup>.

Markets with lower-carbon fuel policies such as Canada, California and some countries in Europe support accretive investment in a wide range of technologies and bio-feed sources. These policies support the accelerated deployment of lower-emission fuels and incentivize renewable diesel hydrotreating, bio-feed co-processing in existing facilities, and carbon capture and storage.

## Low-carbon hydrogen

### NATURAL GAS

Natural gas is comprised largely of methane (CH<sub>4</sub>) and can be turned into hydrogen through a reforming process.



## ADVANCING LOWER-EMISSION FUELS THROUGH PARTNERSHIPS

ExxonMobil is partnering with Global Clean Energy<sup>(37)</sup>, which is converting a refinery in Bakersfield, California, to annually produce more than 4 million barrels of drop-in renewable diesel – meaning it can be substituted for traditional fuels without additional infrastructure or costly engine modifications. The refinery will begin production in 2022, initially utilizing soybean oil as a feedstock then gradually switching over to camelina oil, which would improve renewable diesel carbon intensity by 50%.

In Canada, ExxonMobil’s affiliate, Imperial Oil, will produce more than 7 million barrels of drop-in renewable diesel annually from the Strathcona refinery in Edmonton, Alberta, starting in 2024<sup>(38)</sup>. The refinery will use canola oil as feedstock and blue hydrogen in the hydrotreating process, reducing transportation-related emissions by about 3 million metric tons of CO<sub>2</sub> equivalent annually.

A joint venture in Norway will provide nearly 1 million barrels of renewable diesel annually by 2024 from woody biomass that meets Europe’s 9A, U.K. and U.S.

advanced cellulosic designations. The venture is also evaluating production of renewable jet fuel through low-cost modifications.

ExxonMobil completed successful co-processing trials in Europe and Canada, where policy supports bio-feed co-processing. The ability to co-process bio-feed through an existing fluid catalytic cracker or hydrotreater will enable large quantities of lower-emission fuels for customers. With enough bio-feed and effective low-carbon fuel policies, ExxonMobil has sufficient capacity to co-process 100,000 barrels per day of lower-emission fuels.

Longer term, ExxonMobil is advancing other forms of lower-emission fuels including advanced biofuels. These technologies include the Company’s research with Viridos, formerly known as Synthetic Genomics, to transform algae into liquid biofuels for the transportation sector. Together, we have improved strains of algae that use CO<sub>2</sub> and sunlight to produce energy-rich bio-oil, which can potentially be processed at existing refineries into renewable fuels. A key focus of ongoing research is further building on the breakthroughs made in developing novel genetic tools to overcome inherent inefficiencies in photosynthesis, improve bio-oil production, and plan for demonstration and deployment of the technology.

### Strathcona renewable diesel unit

The renewable diesel production unit at Imperial Oil’s refinery in Alberta is expected to begin operations in 2024, with capacity of more than 7 million barrels per year. The unit will use crop-based feedstock and get power from blue hydrogen with carbon capture and storage. Estimates show it will reduce Canadian transportation emissions by about 3 million tons CO<sub>2</sub>e per year.

