2024 Advancing Climate Solutions

Executive Summary

ExxonMobil

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Advancing Climate Solutions Executive Summary

Getting the planet on a path to net zero requires unprecedented innovation and collaboration at immense scale. The ongoing societal effort is critical but must avoid economic hardships and market disruptions that result from energy and product shortages.

Solving this challenge is not an "either/or" proposition. It's an "and" equation. One that requires an increase in energy supply **and** reduction in greenhouse gas emissions – improved energy security **and** thoughtful progress in the energy transition.

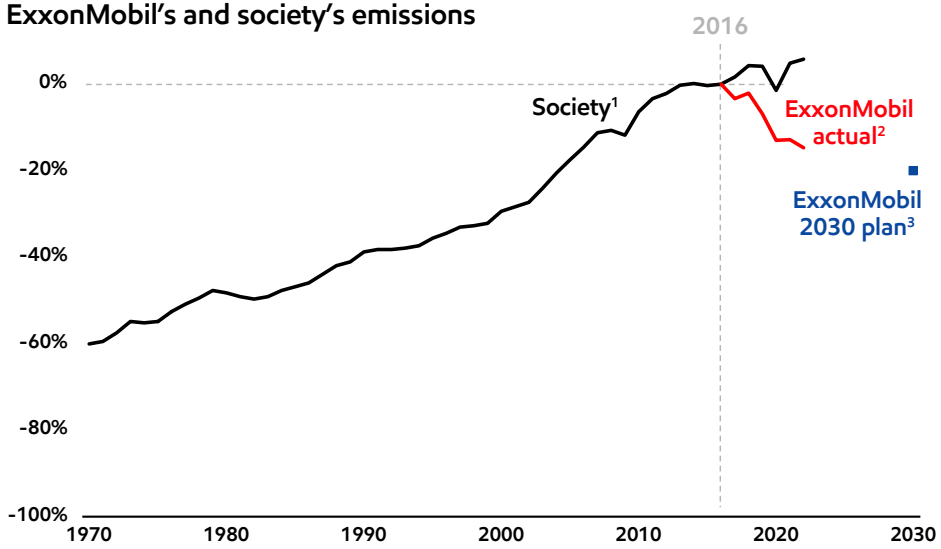
Given the skills and capabilities required, there's no question that the energy industry plays a critical role – on both sides of this equation.

ExxonMobil is doing our part.

Since 2016, we've significantly reduced our Scope 1 and 2 operated emissions.

And we've got plans to do more.

ExxonMobil's and society's emissions



2050 net-zero ambition (cont'd)

Our net-zero ambition is backed by a comprehensive approach centered on detailed emission-reduction roadmaps. We completed these roadmaps in 2022 and continue to update them to reflect technology and policy, and to account for the many potential pathways, and the pace of the energy transition. We are using this approach in our Permian Basin unconventional operations, where we are on track to achieve our industry-leading plans to reach net-zero Scope 1 and 2 emissions by 2030.

Beyond reducing emissions in our own operations, we see the opportunity to use our core capabilities to help other essential industries and customers lower their emissions. This is an immense opportunity with an addressable market potentially measured in the trillions of dollars by 2050.[4] That's why we established ExxonMobil's Low Carbon Solutions business.

We're working to profitably grow a leading position in these new emission-reduction markets, with a focus on the global economy's hard-to-decarbonize sectors – like heavy industry, power generation, and commercial transportation. These are critical sectors where cost-effective solutions are lacking and where we can make a unique, significant, and lasting contribution.

Competitive advantages

The same competitive advantages that have underpinned the success of our traditional businesses for more than 140 years are the foundation of this world-scale Low Carbon Solutions business.

Corpus Christi Chemical Complex

The challenge is enormous.

To tackle it, the world needs industrial-scale solutions.

We need them deployed globally and at a much lower cost than today.

That will require continued advances in technology, and clear and consistent government policies that catalyze investments in the near term. Additionally, the world will need to establish a new industry – a carbon-reduction industry – and a market that pays for the cost of emission reductions.

The skills and capabilities required to address these complicated challenges play to ExxonMobil's strengths and align with our **strategic priorities**:

- **Leading performance**
  Industry leader in operating and financial performance.
- **Essential partner**
  Value through win-win solutions for our customers, partners, and broader stakeholders.
- **Advantaged portfolio**
  Portfolio of assets and products outperform competition and grow value in a lower-emission future.
- **Innovative solutions**
  New products, technologies, and approaches to accelerate large-scale deployment of solutions essential to modern life and lower emissions.
- **Meaningful development**
  Diverse and engaged organization with unrivaled opportunities for personal and professional growth doing impactful work to meet society's needs.

Corpus Christi Chemical Complex

Making progress

Over our history and across the globe, we have built industries where none existed before.

We see this today with our developments in Papua New Guinea and Guyana.

At our core, we're a technology company that uses our science and engineering capabilities to bring value-added solutions to partners and customers. We do this in a variety of ways using unique advantages in scaling technology and delivering complex, large-scale projects safely, reliably, and at industry-advantaged cost. We're developing molecules that cost-effectively meet the ever-evolving needs of society. We're unlocking critical oil and natural gas resources trapped in geologic formations around the world. And we're capturing and safely storing emissions for hard-to-decarbonize industrial processes.

Of course, our past successes and current strengths stem from the commitment, experience, and capabilities of our people. Their skills, tenacity, and resiliency are the bedrock on which our company is built.

If you were to make a list of the biggest challenges facing humankind right now, addressing poverty and climate change would be at the top.

At the same time, if you were to make a list of the companies that have a credible chance of improving access to affordable energy and other products that are critical to improved living standards and reducing emissions, ExxonMobil would also be at the top.

The strategy we've developed, the organization we've built, and the businesses we're focused on position us to grow and create value for many decades to come, regardless of the pace of the transition.

About this report

This year's edition of ExxonMobil's Advancing Climate Solutions Report describes our **resolve** to drive meaningful change, the **results** we're already delivering, and the **resiliency** of our plans under a wide range of future scenarios.

This Executive Summary highlights the significant progress we continue to make toward:

- Achieving our 2030 emission-reduction plans and our 2050 net-zero ambition.
- Reducing methane emissions.
- Building our Low Carbon Solutions business.

We encourage you to visit our website to explore greater detail on these topics and others related to our actions to address the risks of climate change across our businesses.

At our core, we're a technology company that uses our science and engineering capabilities to bring value-added solutions to partners and customers.

Guyana Prosperity FPSO

Making real progress toward solving the "and" equation

ExxonMobil is delivering both sides of the "and" equation – meeting society's needs for energy and essential products **and** reducing emissions.

Increasing energy and product supply

- We achieved record production from our projects in the Permian Basin and Guyana in the second quarter of 2023, up more than 20% from a year earlier.[6]
- We added 250,000 barrels per day of refining capacity in early 2023 in Beaumont, Texas. The extra supply helps reduce rising price pressures, easing the impact on consumers and businesses. It was the largest refinery expansion in the U.S. since 2012.[7]
- We started up a chemical expansion project at Baytown, Texas, that has capacity to deliver 750,000 tons per year of products that are used by manufacturers to make stronger and lighter auto parts, construction materials, packaging, and more.[8]

Reducing greenhouse gas emissions[5]

- We've cut operated methane emissions in half since 2016, eliminated all of our high-bleed pneumatic devices in U.S. operated unconventional production, and established our Center for Operations and Methane Emissions Tracking (COMET). When fully deployed, COMET is expected to provide around-the-clock remote monitoring capabilities in the region.
- We eliminated routine flaring in our Permian Basin operated assets, in line with the World Bank's Zero Routine Flaring Initiative,[9] which is a key part of our 2030 goal of achieving net-zero Scope 1 and 2 greenhouse gas emissions from our unconventional operated assets in the Permian.
- We electrified our drilling fleet in the Permian Basin and deployed our first electric fracturing units to further reduce emissions intensity.[10]
- We acquired Denbury Inc., which expands our Low Carbon Solutions business opportunities by leveraging the largest CO_2 pipeline network in the United States.[11]
- We signed landmark CO_2 offtake agreements with a major fertilizer producer, a steel manufacturer, and an industrial gas company to capture, transport, and store up to 5 million metric tons of CO_2 per year. That's equivalent to replacing approximately 2 million gasoline-powered cars with electric vehicles,[12] which is roughly equal to the total number of EVs on U.S. roads today.[13,14,15]
- We began drilling for lithium in southwestern Arkansas – a process that holds great promise to address the growing needs of the EV battery markets.

2030 greenhouse gas emission-reduction plans[16,17]

view web module

Since 2016, we've reduced our operated greenhouse gas emissions intensity by more than 10%, and our 2030 plans are expected to drive further reductions.

Corporate-wide greenhouse gas intensity

2030 plan:

↓20–30%

Corporate-wide methane intensity

2030 plan:

↓70–80%

Upstream greenhouse gas intensity

2030 plan:

↓40–50%

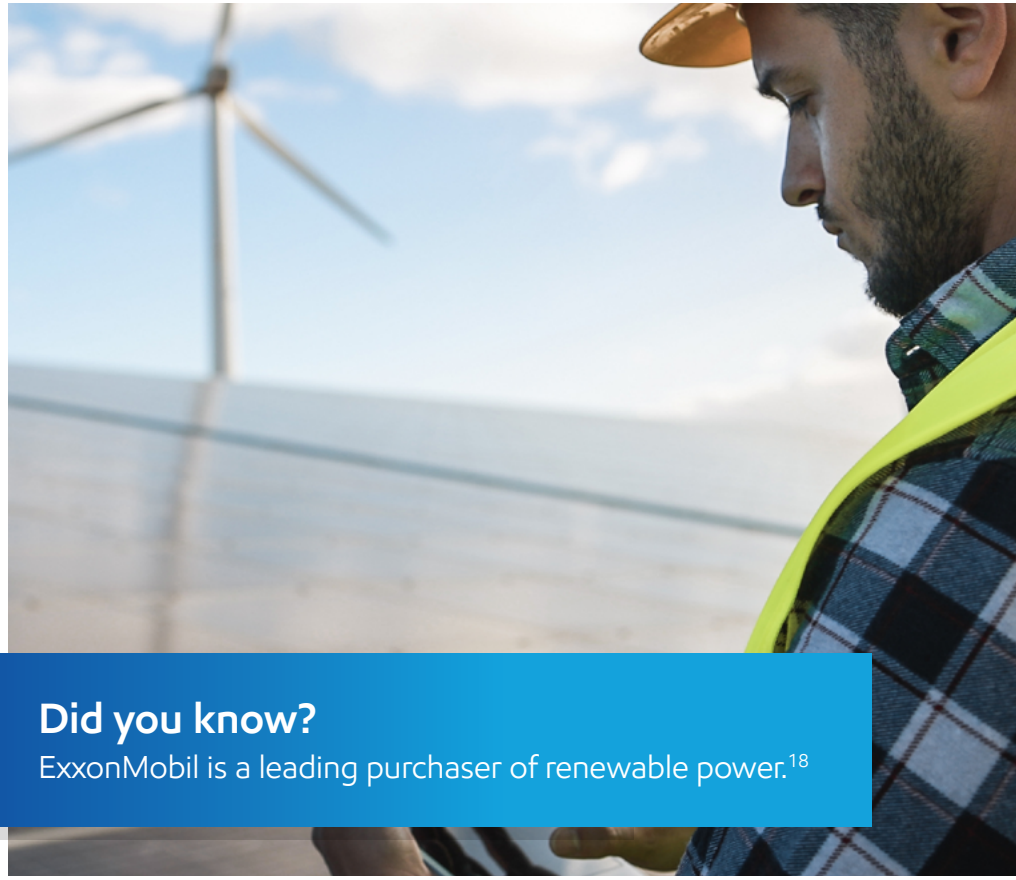
Corporate-wide flaring intensity

2030 plan:

↓60–70%

Our plans to reduce emissions intensity through 2030 include:

- Achieving net-zero Scope 1 and 2 greenhouse gas emissions in our Permian Basin unconventional operated assets.
- Deploying carbon capture and storage, hydrogen, and lower-emission fuels in our operations.
- Further reducing methane emissions at operated assets in alignment with the Global Methane Pledge and with Aiming for Zero Methane Emissions, developed by the Oil and Gas Climate Initiative.
- Further reducing flaring in upstream operations to meet the World Bank Zero Routine Flaring Initiative.
- Integrating lower greenhouse gas energy sources into our facilities through long-term power purchase agreements and electrification.
- Improving energy efficiency in our businesses by evolving operational and maintenance processes.
- Substituting low-carbon hydrogen for natural gas to reduce emissions from furnaces.
- Deploying innovative solutions to further reduce greenhouse gas emissions with future advancements in technology and supportive policies.

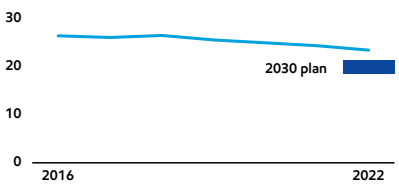


Did you know?

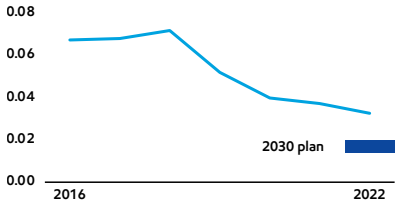
ExxonMobil is a leading purchaser of renewable power.[18]

Progress through year-end 2022

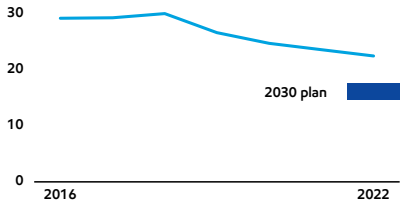
Corporate-wide operated GHG emissions intensity
(T CO_2e/100 T)
2022 year-end actual:



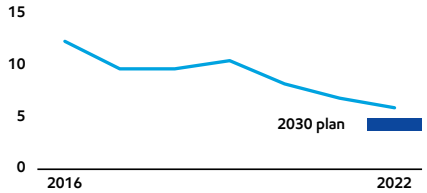
Corporate-wide operated methane emissions intensity
(T CH_4/100 T)
2022 year-end actual:



Upstream operated GHG emissions intensity
(T CO_2e/100 T)
2022 year-end actual:



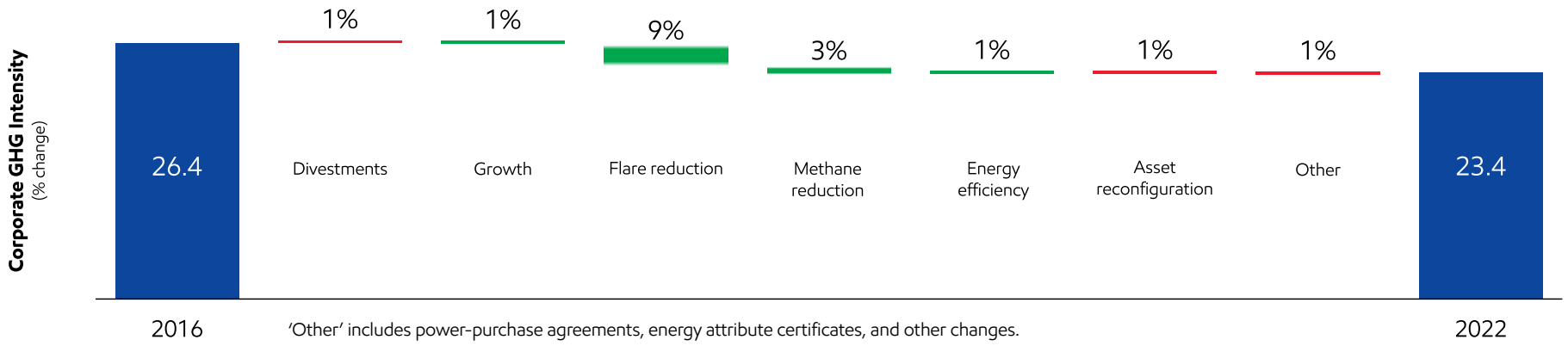
Corporate-wide operated hydrocarbon flaring intensity
(m^3/T)
2022 year-end actual:



Versus 2016 levels. Applies to Scope 1 and 2 GHG emissions from operated assets.

>10% reduction in corporate-wide greenhouse gas (GHG) emissions intensity[19]

Operated Basis
(T CO_2e/100 T)



'Other' includes power-purchase agreements, energy attribute certificates, and other changes.

- Methane and flaring intensity reductions make up the bulk of our improvement.
- Our actions to reduce emissions intensity significantly offset our growth.
- Divestments did not meaningfully contribute to our intensity reductions.

Approach to reducing emissions in business planning

We incorporate actions needed to advance our 2030 emission-reduction objectives into our medium-term business plans, which we update annually. The reference case for planning beyond 2030, including impairment assessments and future planned development activities, is based on our Global Outlook.

The Outlook considers the existing global policy environment, announced policy changes, technology advances, consumer preferences, and the historical precedents for each of these areas. It does not attempt to project the degree of future policy, technology advancement, or deployment necessary for the world or ExxonMobil to meet net zero by 2050.

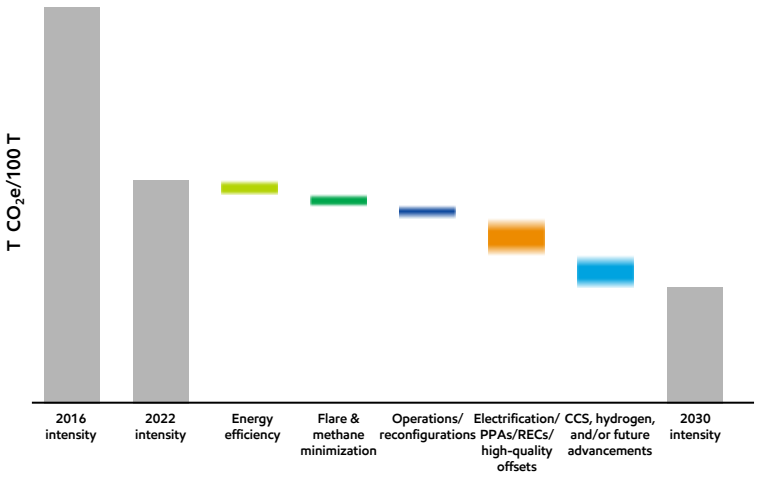
As additional policies are implemented and technology advances beyond our estimates, we incorporate those changes into the Outlook and update our business plans accordingly as part of our annual planning cycle.

Positioning for a lower-emission future

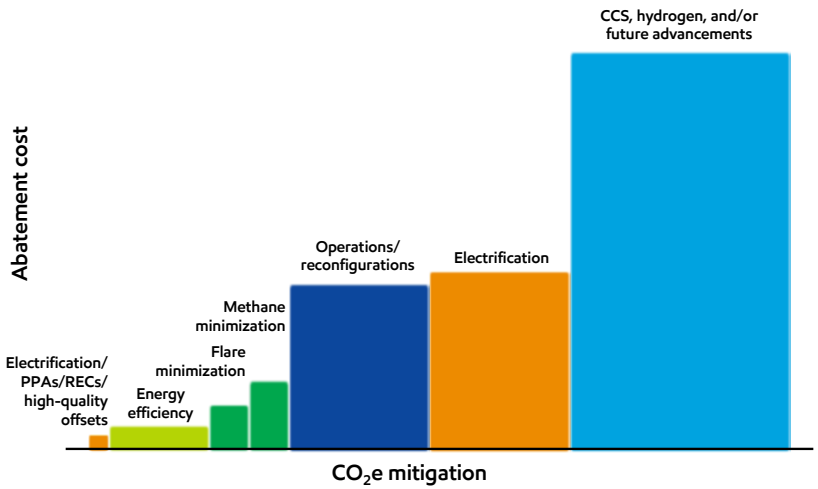
We have evolved our operating model, enabling efficiencies that better leverage the scale of an increasingly integrated company. At the same time, we have centralized many of the skills and capabilities required by our business, allowing us to improve allocation of critical resources; drive continuous improvement, including detection and measurement of emissions; and grow value. This serves us well in a variety of future scenarios, irrespective of the pace of the energy transition.

Potential GHG abatement options for ExxonMobil operated assets supporting 2030 GHG emission-reduction plans[20]

Roadmap



Abatement curve



Higher-cost options reflect the need for additional policy and continued advocacy.

Reducing methane emissions view web module

Our plans to reduce methane intensity across our operated assets remain on track. These include reductions versus 2016 levels of 70%-80% in methane intensity and 60%-70% in flaring intensity by 2030.

To get there, we're developing and deploying enhanced technologies from satellites to on-the-ground sensors for rapid detection and mitigation – starting with a focus on our highest methane emission sources. At the same time, we're continuing to develop and advocate for strong measurement and reporting frameworks to provide consistent, comparable, and most importantly, useful data to inform our methane mitigation efforts worldwide. In 2023, we took additional steps to further collaboration among government and industry partners, including deciding to join the United Nations Oil and Gas Methane Partnership 2.0.

Our Permian operations make up about 16% of our total methane emissions. By rapidly advancing our plans in the basin, we're reducing emissions and developing solutions that we can refine and deploy in other parts of the world. As of year-end 2022, we have eliminated routine flaring in our Permian operations. With full deployment of our near-continuous monitoring program in the Permian by 2025, we expect our Center for Operations and Methane Emissions Tracking (COMET) to provide real-time monitoring of 700 sites across 1.8 million acres.

Our progress in the Permian Basin guides our projects elsewhere. The pneumatic devices in our industry are, as a category, the largest source of routine methane emissions in our processes. That's why in 2020, we completed the elimination of high-bleed pneumatic devices across our U.S. unconventional production, and we're working to eliminate the rest by 2025. Through actions like these, we're eliminating potential sources of methane emissions while advancing our ability to detect and quantify others.

We know we can't go it alone. Collaboration will be vital as we implement solutions to support society's net-zero future. By working with a wide range of universities, academic consortiums, environmental groups, and more, we're advancing leading-edge research and piloting new technologies to help the industry and our company measure, reduce, and report methane emissions.

Sustaining our commitment to R&D view web module

We determine which research projects to advance based on factors including advantage versus alternatives, ability to scale, alignment with core capabilities and key partners, and probability of commercial success.

We employ thousands of scientists and engineers, including more than 1,500 Ph.D.s. Their work drives our research in new materials, novel low-energy processes, and improved means of CO_2 storage.

Our scientists have written more than 1,000 peer-reviewed publications and received more than 10,000 patents over the past decade. In addition, we collaborate with more than 80 universities around the world, four energy centers, and several U.S. national laboratories. These collaborations have increased knowledge in key areas important to the energy transition, including fugitive methane emissions detection and modeling; optimization techniques to understand CO_2 storage; electrification of processes; lower-emission fuels; and energy systems models.

>1,500

Ph.D.s employed

>1,000

peer-reviewed publications written by our scientists

>10,000

patents over the past decade

>80

university collaborations around the world

Shanghai Technology Center

Investing in lower-emission solutions view web module

We're pursuing more than $20 billion in lower-emission investments from 2022 through 2027, in addition to the approximately $5 billion Denbury acquisition. About 50% of our lower-emission investments are targeted at reducing emissions from operated assets, with the balance going toward reducing the emissions of other companies.

We're focused on customers in the heavy industry, power generation, and commercial transportation sectors. These sectors provide great economic value and generate significant emissions that aren't easy to cut. Together, these sectors account for about 80% of energy-related CO_2 emissions today.

Carbon capture and storage, hydrogen, biofuels, and lithium align with our capabilities and have the potential to make a big difference in these hard-to-decarbonize sectors.

Denbury

Carbon capture and storage

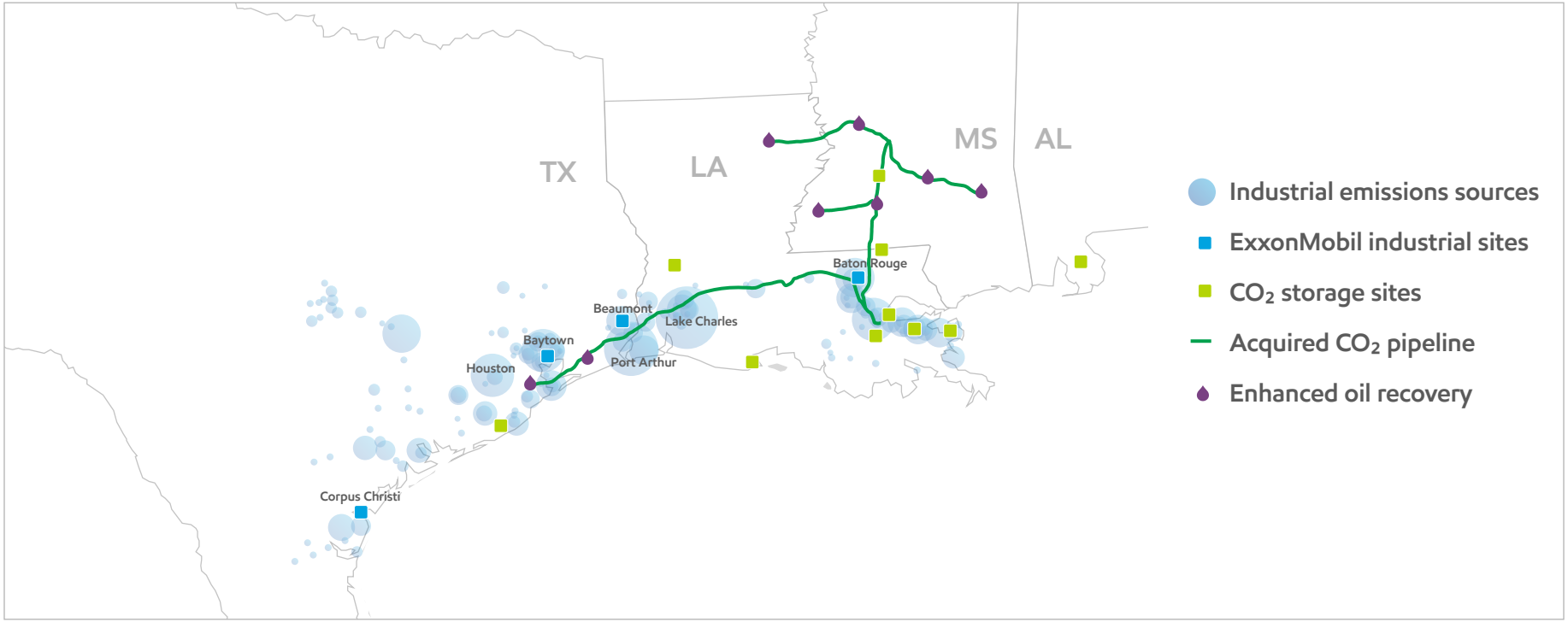
The technology exists today to capture and store CO_2 from emission sources. Global agencies including the International Energy Agency, the U.N. Intergovernmental Panel on Climate Change, and the U.S. Department of Energy have concluded that permanent storage of CO_2 in appropriately selected geological formations is a safe and secure option.[21]

ExxonMobil has cumulatively captured more human-made CO_2 than any other company on the planet, and we're expanding our long-term storage capacity in anticipation of market developments. We have three of the largest third-party contracts to capture, transport, and store CO_2 – advancing projects that will help decarbonize a fertilizer company, an industrial gases company, and a steel company.

The recent acquisition of Denbury expands our capabilities in this area. It provides ExxonMobil with the largest owned and operated network of CO_2 pipelines in the United States, including 900 miles of pipelines near the largest industrial complexes on the Gulf Coast. Combining Denbury's assets and our experience accelerates and expands our ability to help customers reduce their emissions.

Ultimately, we see an opportunity to create a carbon capture and storage business with the capacity to reduce emissions across the Gulf Coast by more than 100 million metric tons per year.[22] This transaction will help us do that at a lower cost and faster pace.

Denbury acquisition creates strong U.S. Gulf Coast CO_2 infrastructure position



Note: All information shown is approximate (e.g., storage / pipeline location) and has potential to change as projects are developed and implemented.

Hydrogen

We also have a long history with hydrogen, a zero-carbon energy source that can be used to reduce emissions in hard-to-decarbonize sectors including steel manufacturing, refining, and heavy-duty trucking, among others.

In Baytown, Texas, we are developing the world's largest low-carbon hydrogen production facility. We are designing it to produce 1 billion cubic feet of hydrogen per day, using a process called "auto-thermal reforming" to separate the hydrogen and carbon atoms. We plan to use carbon capture and storage to sequester the CO_2 emissions. More than 98% of the associated CO_2 emissions produced by the facility – 7 million metric tons per year – are expected to be captured and stored.

Baytown future hydrogen plant

Biofuels

We can also make a real difference with biofuels. Demand for energy-dense, lower-emission fuels is expected to grow rapidly, especially in the aviation, marine, and heavy-duty trucking industries.

This growth creates opportunities to process biofuels and make drop-in replacements for today's fossil fuels. Our Product Solutions business is working to supply approximately 40,000 barrels per day of lower-emission fuel by 2025, with a further goal of 200,000 barrels per day by 2030.

Strathcona biofuels

Lithium

Lithium production is an exciting new business opportunity for us. We're working to apply our upstream and downstream expertise to recover and separate lithium from deep brine reservoirs. Using available technologies, we're working to produce this critical mineral more efficiently and with fewer environmental impacts than traditional hard rock mining – helping to grow a U.S.-based supply for the global battery and electric vehicle markets.[23]

Arkansas lithium

Advocating for sound policy view web module

As we discuss in our Global Outlook, the energy transition is underway, but it is not yet happening at the scale or on the timetable required to achieve society's net-zero ambitions. Three key drivers are needed, and all involve broad collaboration among governments, companies, universities, and others.

First, continued public policy support. Incentives like those in the U.S. Inflation Reduction Act provide a necessary catalyst for companies to begin scaling low-carbon solutions. Permitting reform is needed to accelerate the deployment of these solutions, a step recognized in the European Union's Net-Zero Industry Act. Constructive policy should be stable and transparent so that market participants have sufficient time to adapt to changes. It should also recognize the need to match supply with demand to minimize price spikes that destabilize economies and penalize end-users.

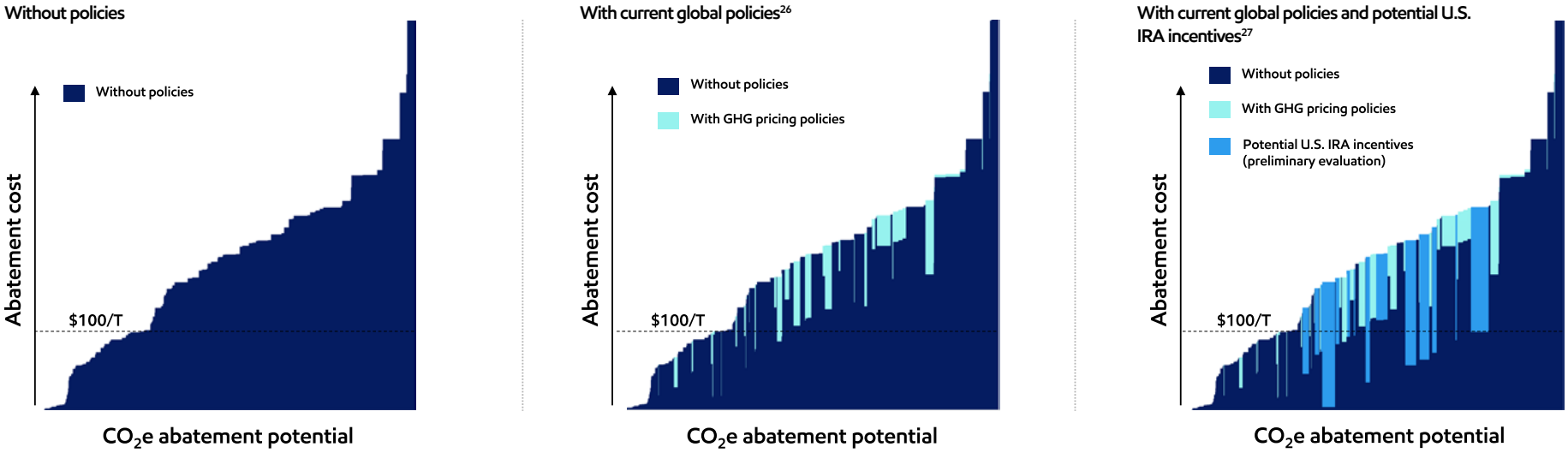
Second, advances in technology. Only three of the more than 50 technologies needed to reach net-zero emissions by 2050 are "on track," according to the International Energy Agency.[24] An approach to technology where governments support further R&D and avoid picking winners and losers through legislation will lead to quicker solutions that are the most cost-efficient.

No single transition pathway can be reasonably predicted, given the wide range of uncertainties. Key unknowns include yet-to-be-developed government policies, market conditions, and advances in technology that may influence the cost, pace, and potential availability of certain pathways. A full complement of technology options should be considered to provide the most economically efficient pathways.

And third, the development of carbon markets. Governments cannot afford to continue paying for emissions reductions indefinitely. Ultimately, to achieve global emission-reduction goals, the world will need to move to widespread adoption of markets that reflect the cost of driving emissions down.

Canada's Clean Fuels Regulations, which went into effect in 2023, offer an example of how governments can establish market-based policies that encourage investment and enable society to accelerate emissions reductions. The regulations set progressive standards for fuels that reduce carbon intensity over time, thereby increasing the incentives for lower-intensity fuels and enabling investments like the Strathcona renewable diesel plant to be operated by our affiliate Imperial Oil.

Potential greenhouse gas abatement options based on ExxonMobil emissions reduction roadmaps supporting our net-zero ambitions[25]



Maintaining strong corporate governance

view web module

Our Board of Directors oversees and provides guidance on our strategy and planning, which includes opportunities and risks related to climate change and the energy transition. Directors engage with experts from inside and outside the company and apply their individual experience and perspective in evaluating the company's capital-allocation priorities, with a focus on growing shareholder value and playing a leading role in a thoughtful energy transition.

The Board, collectively and through its Environment, Safety and Public Policy (ESPP) Committee, regularly engages with senior management on climate matters and our environmental approach and performance. This includes briefings with internal and external subject-matter experts, which can cover elements of scientific and technical research, public policy positions, greenhouse gas emission-reduction reporting and performance, and new technology developments.

In September 2022, we held a Board meeting in the Permian Basin, where our local employees led the directors on tours of our unconventional operations. The tours provided them with critical insights on our progress toward meeting our net-zero goal for this key part of our business.

Ensuring resiliency

view web module

We have continued to assess the resiliency of our business and investment portfolio against a range of future scenarios that are aligned with the goals of the Paris Agreement, including the IEA Net Zero Emissions by 2050 (NZE) scenario.

These resiliency assessments demonstrate that our business is well positioned even in an aggressive decarbonization pathway, driven by the growth potential for chemicals, lower-emission fuels, carbon capture and storage, and hydrogen opportunities, which are critical to achieve society's net-zero ambition.

Updates to the IEA NZE scenario since 2021 have not changed the outcome of our assessment, which highlights resiliency through investment flexibility across options that are both needed and consistent with our core capabilities, including oil and natural gas with lower emission intensity, chemicals, carbon capture and storage, lower-emission fuels, and hydrogen.[28]

For more than 140 years, we have been a leader in innovation, supplying the energy and products people need to live healthy, prosperous lives in the modern world. We are continuing this legacy of innovation by doing our part to provide energy security and evolving our operations in ongoing support of a net-zero future – all while creating long-term shareholder value.

Banyu Urip Indonesia

Footnotes

1. 1940-2022 global society CO_2 emissions estimates based on data from IEA CO_2 Emissions in 2022 Report; includes energy-related combustion and industrial process CO_2 emissions.
2. ExxonMobil Scope 1 and 2 greenhouse gas emission estimates from operated assets compared to 2016 levels. ExxonMobil's reported emissions, reductions, and avoidance performance data are based on a combination of measured and estimated emissions data using reasonable efforts and collection methods. Calculations are based on industry standards and best practices, including guidance from the American Petroleum Institute (API) and Ipieca. There is uncertainty associated with the emissions, reductions, and avoidance performance data due to variation in the processes and operations, the availability of sufficient data, quality of those data, and methodology used for measurement and estimation. Performance data may include rounding. Changes to the performance data may be reported as part of the company's annual publications as new or updated data and/or emission methodologies become available. We are working to continuously improve our performance and methods to detect, measure, and address greenhouse gas emissions. ExxonMobil works with industry, including API and Ipieca, to improve emission factors and methodologies, including measurements and estimates. Scope 1 and 2 emissions and intensity totals are calculated using market based method for Scope 2.
3. ExxonMobil 2030 GHG emission-reduction plans are intensity-based and for Scope 1 and 2 greenhouse gas emissions from operated assets compared to 2016 levels. These plans include actions that are also expected to achieve absolute reduction in corporate-wide greenhouse gas emissions by approximately 20%, compared to 2016 levels. See https://corporate.exxonmobil.com/news/news-releases/2021/1201_exxonmobil-announces-plans-to-2027-doubling-earnings-and-cash-flow-potential-reducing-emissions.
4. Total addressable market based on ExxonMobil analysis of the IPCC's Sixth Assessment Report Scenarios Database hosted by IIASA for carbon capture and storage, wind, solar, hydrogen, nuclear, biofuels, geothermal, and hydropower. Secondary energy demand and prices in 2050 in the Likely Below 2°C scenarios (Category C3) were used, where available, to calculate an estimate of potential market revenue. Carbon capture and storage estimate includes both CCS and direct air capture and used price of carbon for pricing estimate. Biofuels estimate used liquids pricing for pricing estimate. 2020 dollars.
5. Based on Scope 1 and 2 emissions of ExxonMobil operated assets through 2022 (versus 2016). ExxonMobil's reported emissions, reductions, and avoidance performance data are based on a combination of measured and estimated emissions data using reasonable efforts and collection methods. Calculations are based on industry standards and best practices, including guidance from the American Petroleum Institute (API) and Ipieca. There is uncertainty associated with the emissions, reductions, and avoidance performance data due to variation in the processes and operations, the availability of sufficient data, quality of those data, and methodology used for measurement and estimation. Performance data may include rounding. Changes to the performance data may be reported as part of the company's annual publications as new or updated data and/ or emission methodologies become available. We are working to continuously improve our performance and methods to detect, measure, and address greenhouse gas emissions. ExxonMobil works with industry, including API and Ipieca, to improve emission factors and methodologies, including measurements and estimates. Scope 1 and 2 emissions and intensity totals are calculated using market based method for Scope 2.
6. ExxonMobil 2Q 2023 Earnings Release (July 2023): https://d1io3yog0oux5.cloudfront.net/_161f0ad0ee737b82a3ec771e72c07da2/exxonmobil/db/2288/22123/earnings_release/XOM+2Q23+Earnings+Press+Release+Website.pdf.
7. ExxonMobil Press Release (March 2023): https://corporate.exxonmobil.com/news/news-releases/2023/0316_exxonmobil-boosts-fuel-supply-with-2-billion-dollar-beaumont-refinery-expansion.
8. ExxonMobil Press Release (September 2023): https://corporate.exxonmobil.com/news/news-releases/2023/0919_exxonmobil-expands-chemical-production-at-baytown.
9. References to routine flaring herein are consistent with the World Bank's Zero Routine Flaring by 2030 Initiative/Global Gas Flaring Reduction Partnership's principle of routine flaring, and excludes safety and non-routine flaring.
10. ExxonMobil 2Q 2023 Earnings Prepared Remarks: https://d1io3yog0oux5.cloudfront.net/_161f0ad0ee737b82a3ec771e72c07da2/exxonmobil/db/2404/22130/pdf/2Q23+Earnings+-+Preliminary+Prepared+Remarks.pdf.
11. ExxonMobil Press Release (July 2023): https://corporate.exxonmobil.com/news/news-releases/2023/0713_exxonmobil-announces-acquisition-of-denbury.
12. ExxonMobil analysis based on assumptions for U.S. in 2022, including average distance traveled, fuel efficiency, average power grid carbon intensity, electric vehicle charging efficiency, and other factors. Gas-powered cars include light-duty vehicles (cars, light trucks and SUVs).
13. ExxonMobil Press Release (October 2022): https://corporate.exxonmobil.com/news/news-releases/2022/1012_landmark-emissions-reduction-project-in-louisiana-announced.
14. ExxonMobil Press Release (June 2023): https://corporate.exxonmobil.com/news/news-releases/2023/0601_lcs-nucor-agreement.
15. ExxonMobil website: https://lowcarbon.exxonmobil.com/lower-carbon-technology/carbon-capture-and-storage#Newagreement.
16. ExxonMobil 2030 GHG emission-reduction plans are intensity-based and for Scope 1 and 2 greenhouse gas emissions from operated assets compared to 2016 levels. These plans include actions that are also expected to achieve absolute reduction in corporate-wide greenhouse gas emissions by approximately 20%, compared to 2016 levels. See https://corporate.exxonmobil.com/news/news-releases/2021/1201_exxonmobil-announces-plans-to-2027-doubling-earnings-and-cash-flow-potential-reducing-emissions.
17. Based on Scope 1 and 2 emissions of ExxonMobil operated assets through 2022 (versus 2016). ExxonMobil's reported emissions, reductions, and avoidance performance data are based on a combination of measured and estimated emissions data using reasonable efforts and collection methods. Calculations are based on industry standards and best practices, including guidance from the American Petroleum Institute (API) and Ipieca. There is uncertainty associated with the emissions, reductions, and avoidance performance data due to variation in the processes and operations, the availability of sufficient data, quality of those data, and methodology used for measurement and estimation. Performance data may include rounding. Changes to the performance data may be reported as part of the company's annual publications as new or updated data and/ or emission methodologies become available. We are working to continuously improve our performance and methods to detect, measure, and address greenhouse gas emissions. ExxonMobil works with industry, including API and Ipieca, to improve emission factors and methodologies, including measurements and estimates. Scope 1 and 2 emissions and intensity totals are calculated using market based method for Scope 2.
18. Based on ExxonMobil analysis of the BloombergNEF Global Corporate Renewable Power Purchase Agreement Capacity Commitments as of September 2023.
19. ExxonMobil's reported emissions, reductions, and avoidance performance data are based on a combination of measured and estimated emissions data using reasonable efforts and collection methods. Calculations are based on industry standards and best practices, including guidance from the American Petroleum Institute (API) and Ipieca. There is uncertainty associated with the emissions, reductions, and avoidance performance data due to variation in the processes and operations, the availability of sufficient data, quality of those data, and methodology used for measurement and estimation. Performance data may include rounding. Changes to the performance data may be reported as part of the company's annual publications as new or updated data and/or emission methodologies become available. We are working to continuously improve our performance and methods to detect, measure, and address greenhouse gas emissions. ExxonMobil works with industry, including API and Ipieca, to improve emission factors and methodologies, including measurements and estimates.
20. These charts illustrate potential greenhouse gas abatement options for Scope 1 and 2 greenhouse gas emissions. These options are not all-inclusive and are subject to change as a result of a number of factors, including abatement reduction magnitude, implementation timing, abatement cost, portfolio changes, policy developments, technology advancements, and as annual company plans are updated. Includes energy attribute certificates, such as renewable energy certificates (RECs) and guarantees of origin (GOOs). Analysis as of November 2023.
21. NETL Technical Report and User Guide (pg. 11), IPCC Carbon Dioxide Capture and Storage (pg. 14), Special Issue commemorating the 10th year anniversary of the publication of the Intergovernmental Panel on Climate Change Special Report on CO_2 Capture and Storage.
22. Market potential for emission reduction opportunity based on ExxonMobil analysis of CO_2 pipeline routes, current and potential capacity, potential emitters in the U.S. Gulf Coast market, and potential infrastructure upgrades. Subject to additional investment by ExxonMobil, customer commitments, supportive policy, and permitting for carbon capture and storage projects.
23. Expected smaller footprint of lithium mining and expected lower carbon and water impacts: EM analysis of external sources and third party life-cycle analyses. 1) Vulcan Energy, 2022 https://v-er.eu/app/uploads/2023/11/LCA.pdf, Minviro publication. Grant, A., Deak, D., & Pell, R. (2020). 2) The CO2 Impact of the 2020s Battery Quality Lithium Hydroxide Supply Chain-Jade Cove Partners. https://www.jadecove.com/research/liohco2impact. Kelly, J. C., Wang, M., Dai, Q., & Winjobi, O. (2021). 3) Energy, greenhouse gas, and water life cycle analysis of lithium carbonate and lithium hydroxide monohydrate from brine and ore resources and their use in lithium ion battery cathodes and lithium ion batteries. Resources, Conservation and Recycling, 174, 105762.
24. International Energy Agency (2023), Tracking Clean Energy Progress 2023, IEA, Paris https://www.iea.org/reports/tracking-clean-energy-progress-2023, License: CC BY 4.0.
25. Charts illustrate potential GHG abatement options for Scope 1 and 2 greenhouse gas emissions, based on current roadmaps for major operated assets and ExxonMobil analysis. These options are not all-inclusive, may not reflect investment decisions made by the company, and are subject to change as a result of a number of factors, including abatement reduction magnitude, implementation timing, abatement cost, portfolio changes, policy developments, technology advancement, alignment with our partners and other stakeholders, and as annual company plans are updated.
26. ExxonMobil's GHG emissions pricing for 2023-2030 is based on currently stated existing or anticipated policies; pricing for 2030-2050 reflects presumed regional policies for both advanced and emerging economies.
27. Based on preliminary ExxonMobil analysis of U.S. IRA provisions. All assumptions and interpretations of U.S. IRA incentives are subject to change. IRS has yet to publish guidance and regulations to implement the U.S. IRA 45V.
28. International Energy Agency (2021), Net Zero by 2050, IEA, Paris; IEA NZE scenario per World Energy Outlook 2022, IEA, Paris; IEA Net Zero Roadmap: A Global Pathway to Keep the 1.5°C Goal in Reach 2023 Update, IEA, Paris.

Forward-Looking Statement Warning

CAUTIONARY STATEMENT RELEVANT TO FORWARD LOOKING INFORMATION FOR THE PURPOSE OF THE "SAFE HARBOR" PROVISIONS OF THE PRIVATE SECURITIES LITIGATION REFORM ACT OF 1995 AND OTHER IMPORTANT LEGAL DISCLAIMERS

Images or statements of future ambitions, plans, goals, events, projects, projections, opportunities, or conditions in the publications, including plans to reduce, abate, avoid or enable avoidance of emissions or reduce emissions intensity, sensitivity analyses, expectations, estimates, the development of future technologies, business plans, and sustainability efforts are dependent on future market factors, such as customer demand, continued technological progress, policy support and timely rule-making or continuation of government incentives and funding, and represent forward-looking statements. Similarly, emission-reduction roadmaps to drive toward net zero and similar roadmaps for emerging technologies and markets, and water management roadmaps to reduce freshwater intake and/or manage disposal, are forward-looking statements. These statements are not guarantees of future corporate, market or industry performance or outcomes for society and are subject to numerous risks and uncertainties, many of which are beyond our control or are even unknown.

Actual future results, including the achievement of ambitions to reach Scope 1 and 2 net zero from operated assets by 2050, to reach Scope 1 and 2 net zero in Upstream Permian Basin unconventional operated assets by 2030, to eliminate routine flaring in-line with World Bank Zero Routine Flaring, to reach near zero methane emissions from operated assets and other methane initiatives, to meet greenhouse gas emission reduction plans or goals, divestment and start-up plans, and associated project plans; technology advances including in the timing and outcome of projects to capture and store CO2 supply lower-emission fuels, produce hydrogen, produce lithium, obtain data on detection, measurement and quantification of emissions including reporting of that data or updates to previous estimates, and use plastic waste as feedstock for advanced recycling; progress in sustainability focus areas; and reserve or resource changes could vary depending on changes in supply and demand and other market factors affecting future prices of oil, gas, petrochemical or new market products and services; future cash flows; our ability to execute operational objectives on a timely and successful basis; policy and consumer support for emission-reduction and other advanced products and technology; changes in international treaties, laws, regulations and incentives, including those greenhouse gas emissions, plastics, carbon storage and carbon costs; evolving reporting standards for these topics and evolving measurement standards for reported data; trade patterns and the development and enforcement of local, national and regional mandates; unforeseen technical or operational difficulties; the outcome of research efforts and future technology developments, including the ability to scale projects and technologies such as electrification of operations, advanced recycling, CCS, hydrogen production, or direct lithium extraction on a commercially competitive basis; availability of feedstocks for lower-emission fuels, hydrogen, or advanced recycling; changes in the relative energy mix across activities and geographies; the actions of competitors; changes in regional and global economic growth rates and consumer preferences; actions taken by governments and consumers resulting from a pandemic; changes in population growth, economic development or migration patterns; military build-ups, armed conflicts, or terrorism; and other factors discussed in this release and in Item 1A. "Risk Factors" in ExxonMobil's Annual Report on Form 10-K for 2022 and subsequent Quarterly Reports on Forms 10-Q, as well as under the heading "Factors Affecting Future Results" on the Investors page of ExxonMobil's website at www.exxonmobil.com. The Advancing Climate Solutions Report includes 2022 greenhouse gas emissions performance data and Scope 3 Category 11 estimates for full-year 2022 as of March 1, 2023. The greenhouse gas intensity and greenhouse gas emission estimates include Scope 2 market-based emissions. The Sustainability Report, the Advancing Climate Solutions Report, and corresponding Executive Summaries were issued on Jan. 8, 2024. The content and data referenced in these publications focus primarily on our operations from Jan. 1, 2022 – Dec. 31, 2022, unless otherwise indicated. Tables on our "Metrics and data" page were updated on April 26, 2024, to reflect full-year 2023 data. Information regarding some known events or activities in 2023 are also included. No party should place undue reliance on these forward-looking statements, which speak only as of the dates of these publications. All forward-looking statements are based on management's knowledge and reasonable expectations at the time of publication. We do not undertake to provide any further updates or changes to any data or forward-looking statements in these publications. Neither future distribution of this material nor the continued availability of this material in archive form on our website should be deemed to constitute an update or re-affirmation of these figures or statements as of any future date. Any future update will be provided only through a public disclosure indicating that fact.

See "ABOUT THE ADVANCING CLIMATE SOLUTIONS AND SUSTAINABILITY REPORTS" at the end of this document for additional information on these reports and the use of non-GAAP and other financial measures.

ABOUT THE ADVANCING CLIMATE SOLUTIONS AND SUSTAINABILITY REPORTS

The Advancing Climate Solutions Report contains terms used by the TCFD, as well as information about how the disclosures in this report are consistent with the recommendations of the TCFD. In doing so, ExxonMobil is not obligating itself to use any terms in the way defined by the TCFD or any other party, nor is it obligating itself to comply with any specific recommendation of the TCFD or to provide any specific disclosure. For example, with respect to the term "material," individual companies are best suited to determine what information is material, under the long-standing U.S. Supreme Court definition, and whether to include this information in U.S. Securities and Exchange Act filings. In addition, the ISSB is evaluating standards that provide their interpretation of TCFD which may or may not be consistent with the current TCFD recommendations.

These publications have been prepared at shareholders' request or for their convenience and intentionally focused on unknown future events that we have been asked to consider. Forward-looking and other statements regarding environmental and other sustainability efforts and aspirations are not intended to communicate any material investment information under the laws of the United States or represent that these are required disclosures. These publications are not intended to imply that ExxonMobil has access to any significant non-public insights on future events that the reader could not independently research. In addition, historical, current, and forward-looking environmental and other sustainability-related statements may be based on standards for measuring progress that are still developing, internal controls and processes that continue to evolve, and assumptions that are subject to change in the future, including future laws and rulemaking. Forward-looking and other statements regarding environmental and other sustainability efforts and aspirations are for informational purposes only and are not intended as an advertisement for ExxonMobil's equity, debt, businesses, products, or services and the reader is specifically notified that any investor-requested disclosure or future required disclosure is not and should not be construed as an inducement for the reader to purchase any product or services. The statements and analysis in these publications represent a good faith effort by the Company to address these investor requests despite significant unknown variables and, at times, inconsistent market data, government policy signals, and calculation, methodologies, or reporting standards.

Actions needed to advance ExxonMobil's 2030 greenhouse gas emission-reductions plans are incorporated into its medium-term business plans, which are updated annually. The reference case for planning beyond 2030 is based on the Company's Global Outlook research and publication. The Global Outlook is reflective of the existing global policy environment and an assumption of increasing policy stringency and technology improvement to 2050. However, the Global Outlook does not attempt to project the degree of required future policy and technology advancement and deployment for the world, or ExxonMobil, to meet net zero by 2050. As future policies and technology advancements emerge, they will be incorporated into the Global Outlook, and the Company's business plans will be updated as appropriate. References to projects or opportunities may not reflect investment decisions made by the corporation or its affiliates. Individual projects or opportunities may advance based on a number of factors, including availability of supportive policy, permitting, technological advancement for cost-effective abatement, insights from the company planning process, and alignment with our partners and other stakeholders. Capital investment guidance in lower-emission investments is based on our corporate plan; however, actual investment levels will be subject to the availability of the opportunity set, public policy support, other factors, and focused on returns.

Energy demand modeling aims to replicate system dynamics of the global energy system, requiring simplifications. The reference to any scenario or any pathway for an energy transition, including any potential net-zero scenario, does not imply ExxonMobil views any particular scenario as likely to occur. In addition, energy demand scenarios require assumptions on a variety of parameters. As such, the outcome of any given scenario using an energy demand model comes with a high degree of uncertainty. For example, the IEA describes its NZE scenario as extremely challenging, requiring unprecedented innovation, unprecedented international cooperation, and sustained support and participation from consumers, with steeper reductions required each year since the scenario's initial release. Third-party scenarios discussed in these reports reflect the modeling assumptions and outputs of their respective authors, not ExxonMobil, and their use or inclusion herein is not an endorsement by ExxonMobil of their underlying assumptions, likelihood, or probability. Investment decisions are made on the basis of ExxonMobil's separate planning process but may be secondarily tested for robustness or resiliency against different assumptions, including against various scenarios. These reports contain information from third parties. ExxonMobil makes no representation or warranty as to the third-party information. Where necessary, ExxonMobil received permission to cite third-party sources, but the information and data remain under the control and direction of the third parties. ExxonMobil has also provided links in this report to third-party websites for ease of reference. ExxonMobil's use of the third-party content is not an endorsement or adoption of such information.

ExxonMobil reported emissions, including reductions and avoidance performance data, are based on a combination of measured and estimated data. We assess our performance to support continuous improvement throughout the organization using our Environmental Performance Indicator (EPI) process. The reporting guidelines and indicators in the Ipieca, the American Petroleum Institute (API), the International Association of Oil and Gas Producers Sustainability Reporting Guidance for the Oil and Gas Industry (4th edition, 2020, revised February 2023) and key chapters of the GHG Protocol inform the EPI process and the selection of the data reported. Emissions reported are estimates only, and performance data depends on variations in processes and operations, the availability of sufficient data, the quality of those data and methodology used for measurement and estimation. Emissions data is subject to change as methods, data quality, and technology improvements occur, and changes to performance data may be updated. Emissions, reductions, abatements and enabled avoidance estimates for non-ExxonMobil operated facilities are included in the equity data and similarly may be updated as changes in the performance data are reported. ExxonMobil's plans to reduce emissions are good-faith efforts based on current relevant data and methodology, which could be changed or refined. ExxonMobil works to continuously improve its approach to identifying, measuring, and addressing emissions. ExxonMobil actively engages with industry, including API and Ipieca, to improve emission factors and methodologies, including measurements and estimates.

Any reference to ExxonMobil's support of, work with, or collaboration with a third-party organization within these publications do not constitute or imply an endorsement by ExxonMobil of any or all of the positions or activities of such organization. ExxonMobil participates, along with other companies, institutes, universities and other organizations, in various initiatives, campaigns, projects, groups, trade organizations, and other collaborations among industry and through organizations like the United Nations that express various ambitions, aspirations and goals related to climate change, emissions, sustainability, and the energy transition. ExxonMobil's participation or membership in such collaborations is not a promise or guarantee that ExxonMobil's individual ambitions, future performance or policies will align with the collective ambitions of the organizations or the individual ambitions of other participants, all of which are subject to a variety of uncertainties and other factors, many of which may be beyond ExxonMobil's control, including government regulation, availability and cost-effectiveness of technologies, and market forces and other risks and uncertainties. Such third parties' statements of collaborative or individual ambitions and goals frequently diverge from ExxonMobil's own ambitions, plans, goals, and commitments. ExxonMobil will continue to make independent decisions regarding the operation of its business, including its climate-related and sustainability-related ambitions, plans, goals, commitments, and investments. ExxonMobil's future ambitions, goals and commitments reflect ExxonMobil's current plans, and ExxonMobil may unilaterally change them for various reasons, including adoption of new reporting standards or practices, market conditions; changes in its portfolio; and financial, operational, regulatory, reputational, legal and other factors.

References to "resources," "resource base," "recoverable resources" and similar terms refer to the total remaining estimated quantities of oil and natural gas that are expected to be ultimately recoverable. The resource base includes quantities of oil and natural gas classified as proved reserves, as well as quantities that are not yet classified as proved reserves, but that are expected to be ultimately recoverable. The term "resource base" is not intended to correspond to SEC definitions such as "probable" or "possible" reserves. For additional information, see the "Frequently Used Terms" on the Investors page of the Company's website at www.exxonmobil.com under the header "Resources." References to "oil" and "gas" include crude, natural gas liquids, bitumen, synthetic oil, and natural gas. The term "project" as used in these publications can refer to a variety of different activities and does not necessarily have the same meaning as in any government payment transparency reports.

Exxon Mobil Corporation has numerous affiliates, many with names that include ExxonMobil, Exxon, Mobil, Esso, and XTO. For convenience and simplicity, those terms and terms such as "Corporation," "company," "our," "we," and "its" are sometimes used as abbreviated references to one or more specific affiliates or affiliate groups. Abbreviated references describing global or regional operational organizations, and global or regional business lines are also sometimes used for convenience and simplicity. Nothing contained herein is intended to override the corporate separateness of affiliated companies. Exxon Mobil Corporation's goals do not guarantee any action or future performance by its affiliates or Exxon Mobil Corporation's responsibility for those affiliates' actions and future performance, each affiliate of which manages its own affairs. For convenience and simplicity, words like venture, joint venture, partnership, co-venturer and partner are used to indicate business relationships involving common activities and interests, and those words may not indicate precise legal relationships. These publications cover Exxon Mobil Corporation's owned and operated businesses and do not address the performance or operations of our suppliers, contractors or partners unless otherwise noted. In the case of certain joint ventures for which ExxonMobil is the operator, we often exercise influence but not control. Thus, the governance, processes, management and strategy of these joint ventures may differ from those in these reports. At the time of publication, ExxonMobil has completed the acquisition of Denbury Inc. and is in the process of acquiring Pioneer Natural Resources. These reports do not speak of these companies' historic governance, risk management, strategy approaches or emissions performance unless specifically referenced.

SUPPLEMENTAL INFORMATION FOR NON-GAAP AND OTHER MEASURES

The Resiliency section of the Advancing Climate Solutions Report mentions modeled operating cash flow in comparing different businesses over time in a future scenario. Historic operating cash flow is defined as net income, plus depreciation, depletion and amortization for consolidated and equity companies, plus noncash adjustments related to asset retirement obligations plus proceeds from asset sales. The Company's long-term portfolio modeling estimates operating cash flow as revenue or margins less cash expenses, taxes and abandonment expenditures plus proceeds from asset sales before portfolio capital expenditures. The Company believes this measure can be helpful in assessing the resiliency of the business to generate cash from different potential future markets. The performance data presented in the Advancing Climate Solutions Report and Sustainability Report, including on emissions, is not financial data and is not GAAP data.

Low Carbon Solutions

Accelerating the world's paths to net zero and building a compelling new business

Emission-reduction markets have the potential to grow rapidly and reach massive size in a world progressing toward net zero. This provides significant opportunities for our Low Carbon Solutions business, which represents an important and attractive element of the company's plans to profitably grow for many years to come.

Our organization is clear-eyed on the challenges. We also understand the unique and important contributions we can make, and we are embracing the new opportunities.

Our customers, many governments, and others recognize our combination of experience, skills, and capabilities that can meaningfully help reduce the emissions of others.

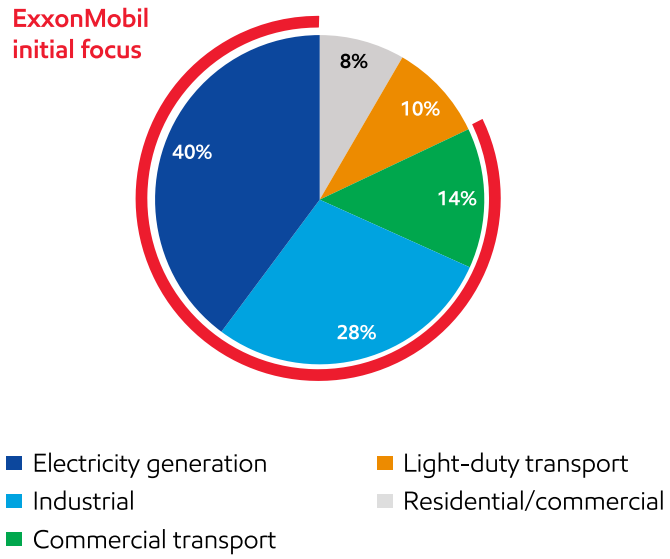
Our strategy is geared toward ensuring strong returns and value growth as the energy transition progresses.

Today the world generates about 34 billion metric tons of energy-related CO_2 emissions per year. Industrial activity, power generation, and commercial transportation together account for 80% of all energy-related CO_2 emissions.[1] And while electric vehicles are important and get a lot of headlines, it's worth noting that these sectors account for about eight times the carbon emissions of passenger vehicles each year. We're focused on these hard-to-decarbonize sectors. They must be tackled for society to reach net zero.

And that's where our capabilities come in.

Energy-related CO_2 emissions by sector, 2021[1]

34 billion metric tons

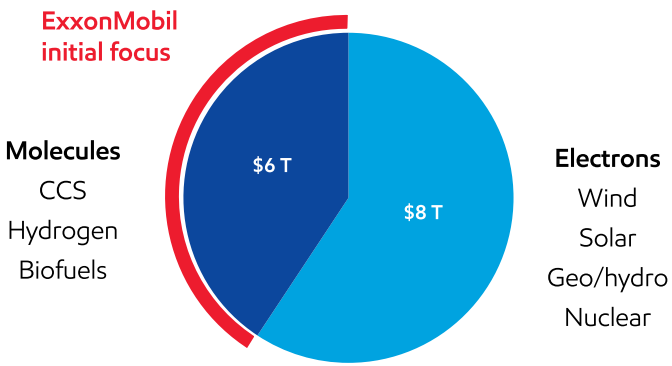


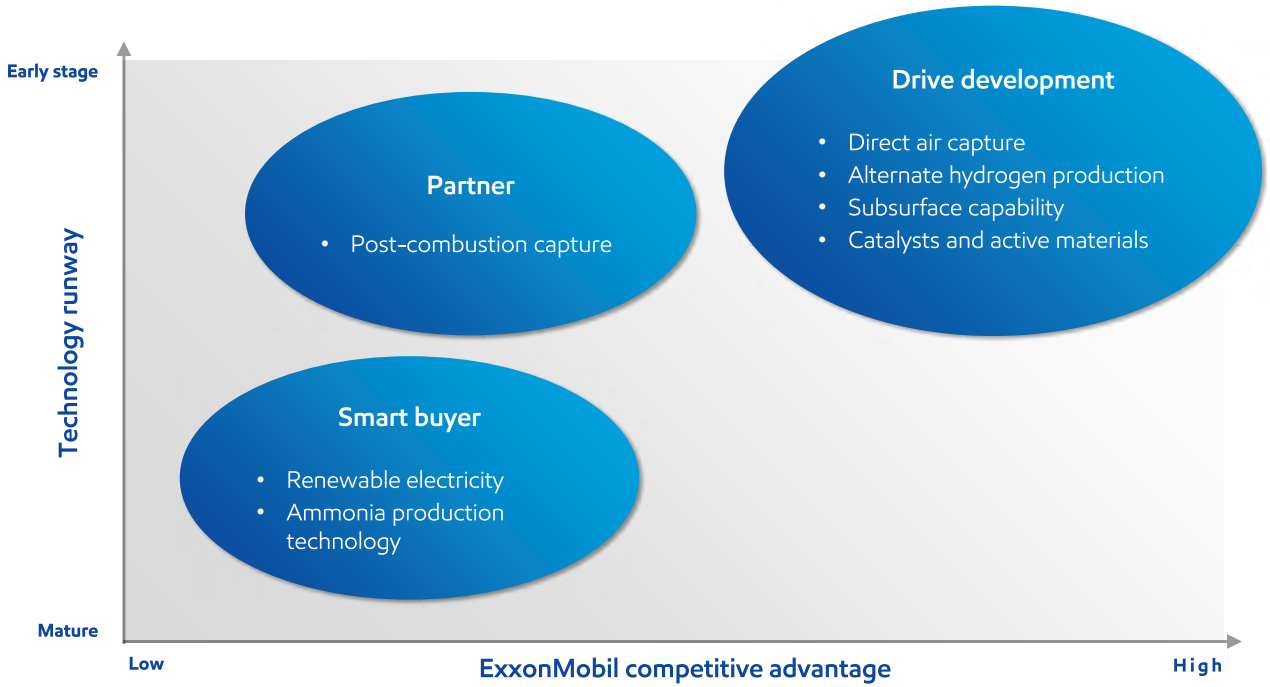
Our company manages **molecules**. It's what we have done for decades, and it's where we're focused today. This work involves technologies for capturing, transporting, and storing molecules; producing hydrogen from other molecules; and sourcing and co-processing lower-carbon-intensity molecules – all of which require the same competitive advantages we've built in our traditional businesses. These markets could exceed $6 trillion globally by 2050.[3]

Government policy plays a key role in building these new markets, especially in the near term.

Most of our activity is focused in the United States, which is being accelerated by incentives in the U.S. Inflation Reduction Act (IRA). We support legislation like the IRA, which provides incentives for companies to be part of the solution. European policy is currently more prescriptive on how emissions must be managed, which limits solutions for the hard-to-decarbonize sectors. At this early stage, supportive policy remains critical to enable emissions reductions, advance technology, and drive scale to improve costs. Ultimately, given the size of the challenge and the costs entailed, a market for emissions reduction will be required to achieve society's net-zero ambition.

Potential size of low-carbon markets, 2050[2]





Technology is already playing a critical role, and it's where we can add real value.

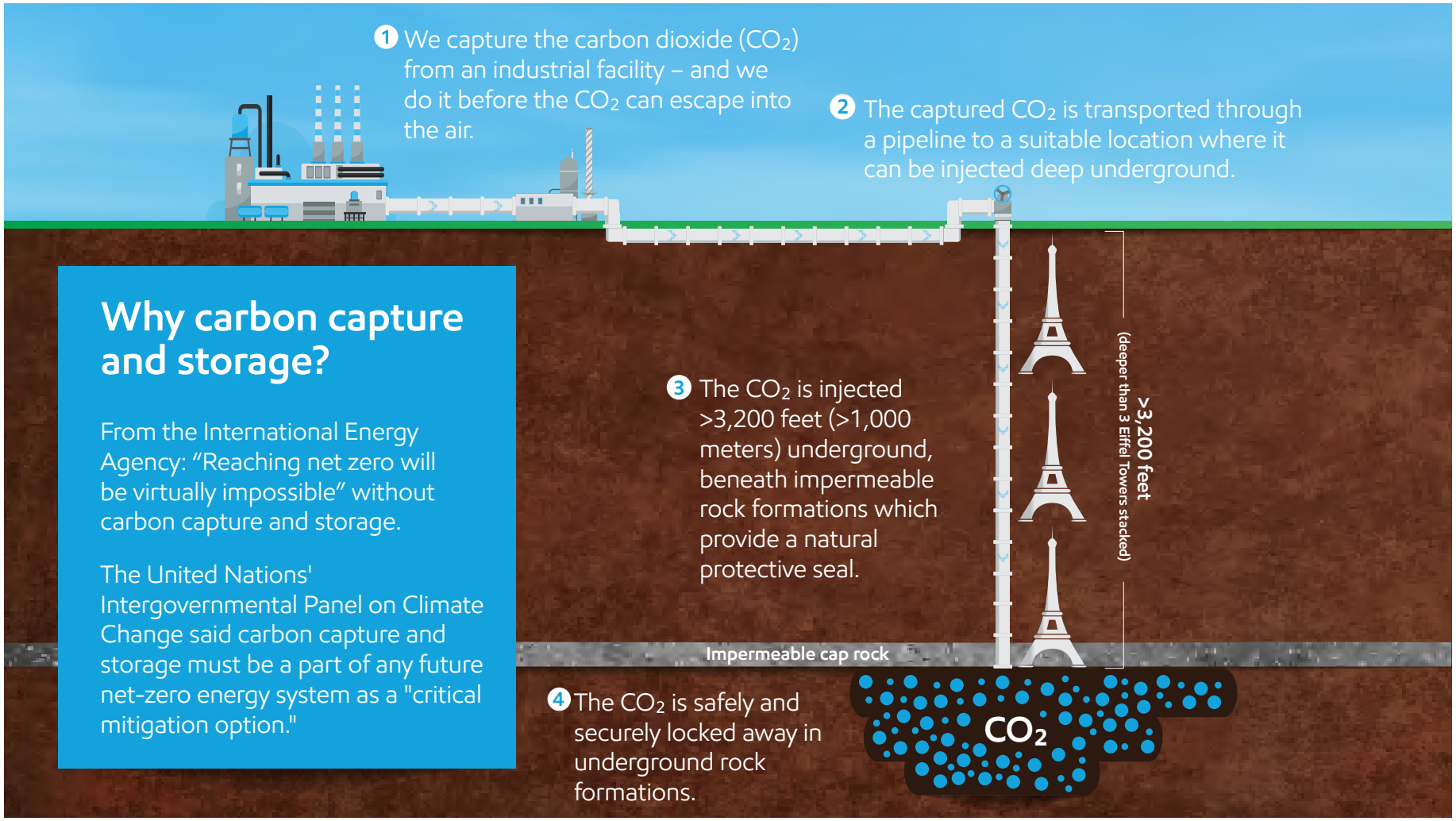
To expand that advantage further, we're tailoring our approach in any given abatement technology as a function of the following:

- First, we're applying resources and driving development in those areas where we think there is an ample technology runway and where we can add value. These are the areas where we're working on the development of new and potentially breakthrough technologies. Examples include direct air capture, alternate methods of hydrogen production, and application of our deep capabilities in the subsurface for carbon storage. And while we're a leader in the technology development in these programs, we're continuing to work with other companies, governments, or academic institutions that bring unique value to the table.
- Second are areas where there is significant runway but where we have less existing advantage. In those areas, we're looking to partner. An example of this is the Mitsubishi Heavy Industries (MHI) post-combustion capture partnership. We're integrating existing MHI technology into our "one-stop-shop" carbon capture, transportation, and storage offering, and we are working on joint technical development with MHI to further advance the technology with the goal of lowering the cost of abatement.
- Third, where technology is mature, and we do not bring a unique competitive advantage, we're looking to purchase or license from established vendors as a smart buyer. Two good examples here are ammonia production and renewable power, which are both well-established technologies with experienced developers.

As we strive to play a leading role in the energy transition, we're pursuing more than $20 billion in lower-emission investments from 2022 through 2027, in addition to the approximately $5 billion Denbury acquisition. About 50% of our lower-emission investments are targeted at reducing emissions from operated assets, with the balance going toward reducing the emissions of other companies.

Carbon capture and storage

ExxonMobil is a global leader in carbon capture and storage



What it is

Carbon capture, transportation, and storage is just what the term implies. Once CO_2 is captured at factories or power plants, we transport and inject it into geologic formations thousands of feet below the earth's surface for safe and secure storage. The injected CO_2 is held in place by thick, impermeable seal rocks.

Carbon capture and storage, on its own or combined with hydrogen production, is one of the few proven technologies that could enable significant CO_2 emission reductions from high-emitting and hard-to-decarbonize sectors. These include power generation, refining, steel, cement, and petrochemicals manufacturing. According to the Center for Climate and Energy Solutions, carbon capture and storage can capture more than 90% of CO_2 emissions from power plants and industrial facilities.[4]

What respected third parties are saying about carbon capture and storage

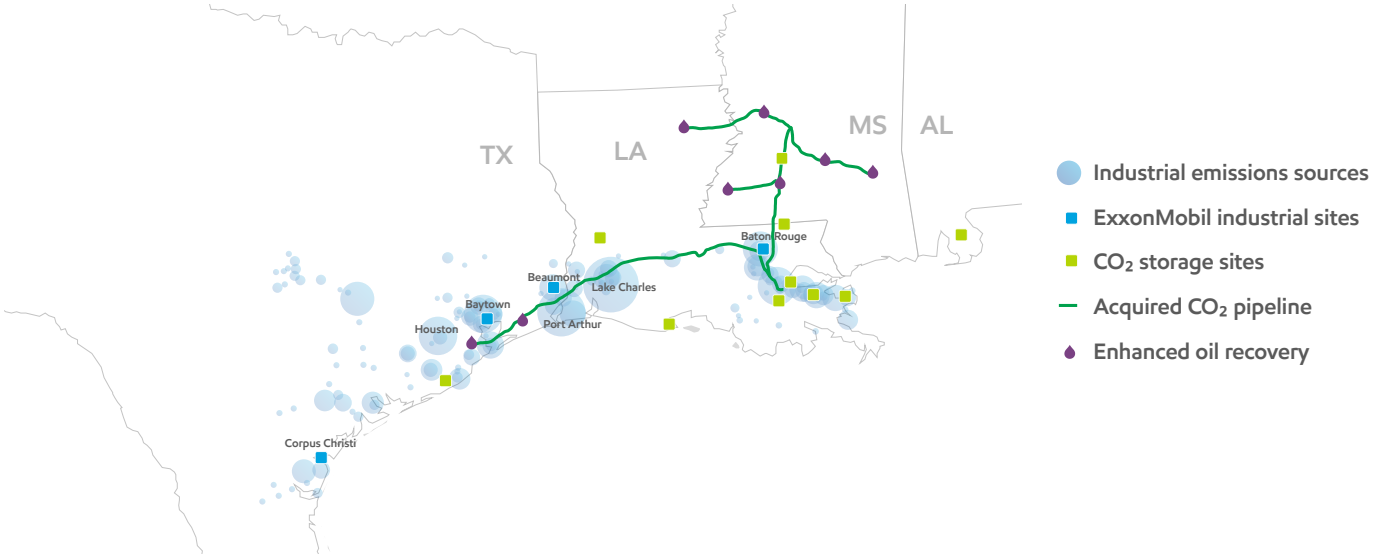
Both the International Energy Agency (IEA) and the United Nations Intergovernmental Panel on Climate Change (IPCC) see carbon capture and storage as key to reaching global emissions goals.

The IEA NZE report concludes that more than 7.6 billion metric tons per year of CO_2 will need to be captured and stored by 2050 to reach a net-zero future. By comparison, the world's current capture capacity is about 40 million metric tons of CO_2 per year.[5] The agency has also said "reaching net zero will be virtually impossible" without carbon capture and storage.[6]

The IPCC estimates that the cost of achieving a 2°C outcome would more than double without carbon capture and storage.[7]

We identify opportunities with concentrated streams of CO_2 near sites with safe and secure storage space, and where we can use existing infrastructure to gain scale to offer economical solutions to customers.

Denbury acquisition creates strong U.S. Gulf Coast CO_2 infrastructure position



Note: All information shown is approximate (e.g., storage / pipeline location) and has potential to change as projects are developed and implemented.

Leading now

With more than 30 years of experience in carbon capture, we lead the industry in the successful deployment of this technology at scale. We are continuing to develop and expand our capacity for storing CO_2 on a long-term basis.

On the U.S. Gulf Coast, we're building carbon capture and storage infrastructure that will allow industrial customers to work with us to significantly reduce their emissions. We expect the first of our Gulf Coast projects to be operational as soon as 2026.

Because carbon capture and storage projects require geologic space, we continue to add suitable acreage both onshore and offshore, for this use. Building on our long record of successful collaborations with host governments around the world, we are also negotiating to gain access to nationally owned acreage that holds potential for CO_2 storage. We also continue working with the local jurisdictions on the appropriate permitting to sequester CO_2, which will be essential to the success of these projects.

Another vital element of establishing a successful business is building a customer base. And in this area, we're making great progress with customers that include a major fertilizer company, an industrial gas producer, and a leading steel manufacturer:

- **CF Industries**, a leading global manufacturer of hydrogen and nitrogen products, signed the largest of its kind commercial agreement with us to capture and permanently store up to 2 million metric tons of CO_2 emissions annually from its manufacturing complex in Louisiana. The project supports Louisiana's objective of net-zero CO_2 emissions by 2050.
- **Linde**, one of the world's leading industrial gases and engineering companies, entered into a long-term commercial agreement with us in which ExxonMobil will capture, transport, and permanently store up to 2.2 million metric tons of CO_2 each year from Linde's new clean hydrogen production facility in Beaumont, Texas.
- **Nucor Corp.**, North America's largest steel and steel products producer, entered into a long-term commercial agreement with us, in which ExxonMobil will capture, transport, and store up to 800,000 metric tons of CO_2 per year from Nucor's manufacturing site in Convent, Louisiana.

Working to grow our leadership in carbon capture and storage

CF Industries		Linde		Nucor		Capture
2	+	**2.2**	+	**0.8**	=	**5**
million metric tons of CO_2 per year		million metric tons of CO_2 per year		million metric tons of CO_2 per year		million metric tons of CO_2 per year

equivalent to replacing nearly 2-million gasoline-powered cars with electric vehicles[8]

Our acquisition of Denbury Inc. supports these major projects and opens opportunities for many others along the U.S. Gulf Coast and in other locations.

The acquisition provides ExxonMobil with the largest owned and operated network of CO_2 pipelines in the United States. Combining Denbury's assets and experience with our capabilities significantly expands our ability to profitably help customers reduce their emissions.

Of Denbury's 1,300 miles of CO_2 pipeline, roughly 70% is in the Gulf Coast states of Louisiana, Texas, and Mississippi — one of the largest U.S. markets for CO_2 reduction and home to some of ExxonMobil's largest integrated refining and chemical sites. Denbury also brings strategically located CO_2 storage sites in this region.

We believe these synergies will drive strong growth and returns for our shareholders. A cost-efficient transportation and storage system accelerates carbon capture and storage deployment for both ExxonMobil and our third-party customers. It supports multiple low-carbon businesses – including carbon capture and storage, hydrogen, ammonia, and biofuels.

Ultimately, we continue to see potential, working with others in the industry, to create a carbon capture and storage business with the capacity to reduce emissions across the Gulf Coast by more than 100 million metric tons per year.[9] This transaction is part of our efforts to do that at a lower cost and faster pace.

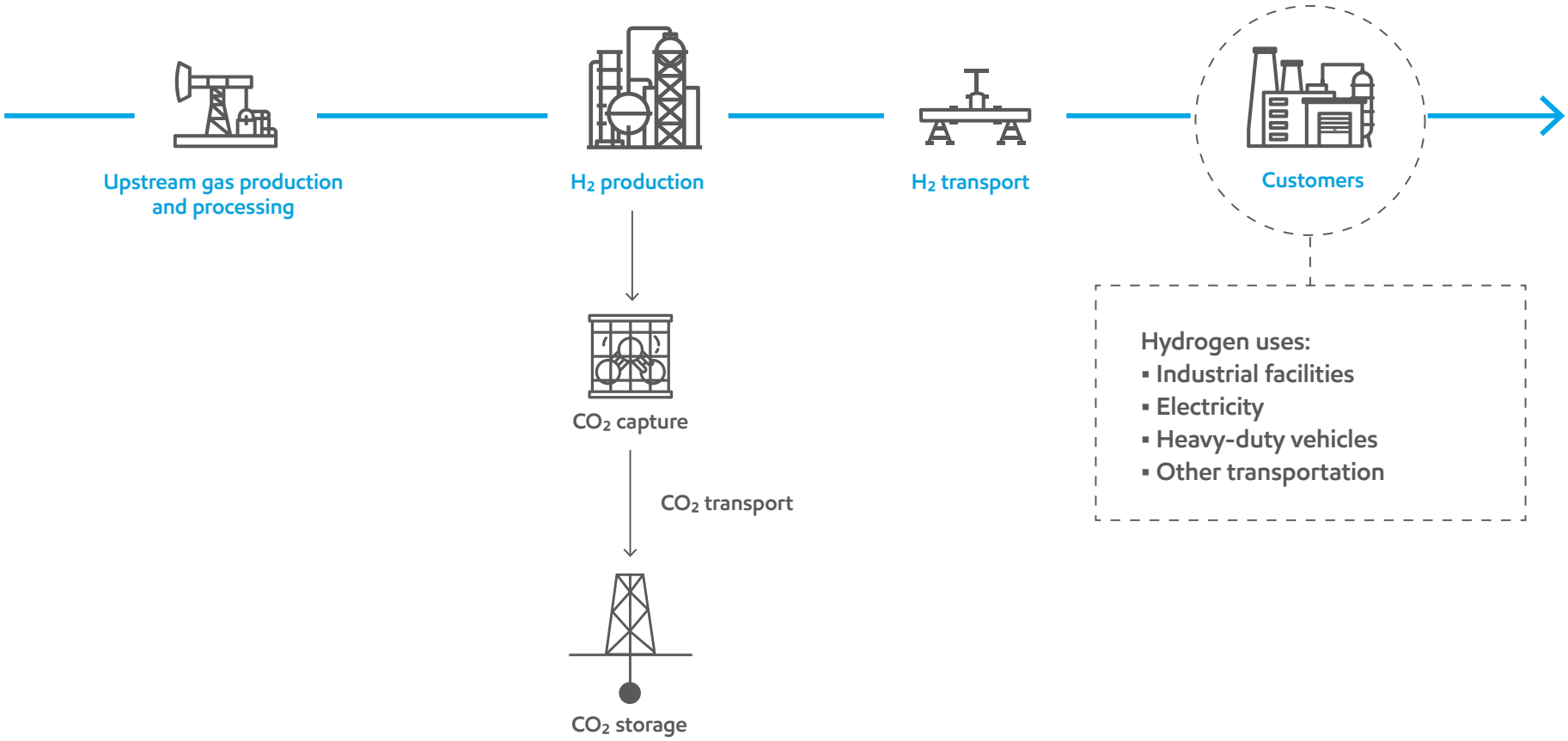
What's next

- **Improving capture:** We continue to research processes, compounds, and materials to capture carbon more efficiently. These innovations include a new metal organic framework[10] that is highly selective to CO_2, as well as advanced amines that provide enhanced efficiency and stability.[11]
- **Developing materials:** We are working closely with suppliers and logistics partners to develop new designs for offshore transport, while we partner with a wide range of experts on materials integrity for pipeline transport and storage of CO_2.
- **Studying storage:** We are working with leading universities and other research organizations to improve modeling of geologic storage,[12] including seal characterization for containment assessment, as well as optimal long-term monitoring of stored CO_2. Our research and experimental efforts are advancing knowledge in areas such as monitoring requirements and effective storage capacity.

Hydrogen

What it is

Hydrogen is a zero-carbon energy source that can generate the high temperatures needed to produce steel, cement, and refining and chemical products without carbon dioxide emissions. This means it could serve as an affordable and reliable source of energy for hard-to-decarbonize industrial processes.



Leading now

Just as we have a long history with carbon capture and storage, we have deep and broad experience with hydrogen as well. We use hydrogen in just about every one of our refining and chemical plants, and we're looking to expand that.

Baytown future hydrogen plant

In Baytown, Texas, we are developing the world's largest low-carbon hydrogen production facility. It's being designed to produce 1 billion standard cubic feet of hydrogen per day, which is equivalent to the energy needed to power 1.5 million homes.[13] This single project would represent nearly 10% of the Biden administration's goal as reflected in the U.S. National Clean Hydrogen Strategy and Roadmap.[14] We expect to capture more than 98% of the CO_2, or about 7 million metric tons per year, associated with producing this hydrogen. The new plant could supply Gulf Coast industrial customers, as well as our own facilities in the Baytown area, with clean-burning hydrogen fuel for process operations. In addition, tapping into our certified lower-emission natural gas from the Permian Basin should further lower carbon intensity that will be very difficult for others to match. Front-end engineering is underway. Startup is expected as soon as 2028.

What's next

- **Studying technology advances and transport**
  We are participating in cross-industry initiatives to identify the technology advancements and government policies required to deploy low-carbon hydrogen at scale. For example, natural gas transmission infrastructure has the potential to be used for hydrogen transport. Our membership in the U.S. HyBlend consortium will help address the technical barriers of blending hydrogen into natural gas pipeline systems.[15] In addition to working with industry organizations to develop hydrogen transportation standards, we're working with the U.S. Department of Energy to advance understanding of the challenges and opportunities involved.

- **Energy initiative**
  We are working with the MIT Energy Initiative[16] to develop a new carbon life-cycle tool that measures the end-to-end carbon emissions from different technologies, including blue hydrogen. This tool can help inform policymakers as they consider legislation to incentivize investments in technologies that are needed to lower societal emissions in an affordable and practical way.

Lower-emission fuels

What they are

These fuels generate less emissions over their life cycle than the traditional fuels they replace. They include biofuels made from renewable sources like plants and waste biomass and synthetics made from hydrogen and captured carbon dioxide. Lower-emission fuels have the high energy density required to move heavy trucks. Renewable diesel can reduce carbon emissions by up to 70% compared to conventional diesel.[17] Demand for these fuels is expected to grow rapidly, driven by the aviation, marine, and heavy-duty trucking industries. Our Global Outlook projects almost 9 million oil-equivalent barrels per day of these fuels by 2050, more than four times 2021 levels.

Our Product Solutions business is focused on growing lower-emission fuels by leveraging current technology and infrastructure, while our Low Carbon Solutions business is focused on innovation in the next generation of low-emission fuels which are supported by our other low-carbon businesses like carbon capture and storage.

We're exploring opportunities to combine biomass-based fuel production with carbon capture and storage, enabling very low- or negative-carbon intensity fuel production. We're also looking at how we can efficiently transform natural gas into methanol-based fuels. Our existing capability to convert methanol to multiple end-use fuels, such as marine and jet fuel, could enable a range of low- to zero-emissions fuels. Low-emission fuels can utilize existing distribution infrastructure, further enabling their cost-effective deployment.

Leading now

- **Strathcona, Canada**: We are ramping up renewable fuel production at our Imperial Oil refinery near Edmonton, where we're building the technology and infrastructure to provide renewable diesel to several industries in western Canada. When completed in 2025, the facility is expected to be the largest of its kind in Canada, with capacity of 20,000 barrels a day.
- **Singapore**: We leveraged our integrated refining and petrochemical complex in Singapore and our logistics network in 2022 to deliver the first cargo of certified sustainable aviation fuel (SAF) to Changi Airport as part of a one-year pilot.[18]

What's next

- **Maritime goals**: ExxonMobil supports the International Maritime Organization's (IMO) ambition to reduce total annual GHG emissions from international shipping to reach net-zero by or around 2050. We are working to help our customers determine their best route toward meeting the IMO's GHG emission-reduction goals. As part of this initiative, we are supplying ExxonMobil bio marine fuel oil blends at our Singapore and Amsterdam-Rotterdam-Antwerp bunkering hubs.
- **Testing with Toyota**: ExxonMobil is exploring innovative fuel blends with the potential to reduce emissions from road transportation by up to 75% versus conventional fuels available today. In a test we conducted with Toyota Motor Corp. in 2023, our fuels under development proved compatible with today's vehicles and existing infrastructure. Fuels that work with current networks will reduce or eliminate the need to build new pipelines and tanks, accelerating and lowering the cost of deployment.
- **Co-processing**: We are conducting co-processing trials in our facilities using proprietary technology to produce lower-emission fuels, including sustainable aviation fuels. We are evaluating how to deploy our capacity to co-process 100,000 barrels per day of lower-emission fuels to markets where supportive policy exists. The ability to process biofeed and conventional feedstock together through an existing fluid catalytic cracker or hydrotreater will allow for faster, lower-cost delivery of these fuels to customers compared to construction of new facilities requiring large capital investments.
- **Fats to fuel**: We are evaluating opportunities to lower life-cycle emissions through conversion of bio-based feedstocks for diesel production. With the processes ExxonMobil has developed and our proprietary dewaxing catalyst, we can convert waste fats or vegetable oils into renewable fuels with less byproduct formation and hydrogen consumption than other methods. With an additional step, and provided we can obtain ample feedstocks, we could use this same process to make sustainable aviation fuels.
- **New jet fuel technology**: We recently announced a new technology that can produce jet fuel using renewable methanol as the feedstock.[19] This methanol has a lower carbon intensity and can be made through either gasification of biofeeds, such as wood waste, or captured CO_2 and H_2 made by electrolysis of water using renewable electricity. The lower-emission methanol can be converted into sustainable aviation fuel using our innovative technology. We expect this process will provide a higher yield of jet fuel than other techniques for the same feedstock, with the potential to be used to make other fuels or chemicals.

Lithium

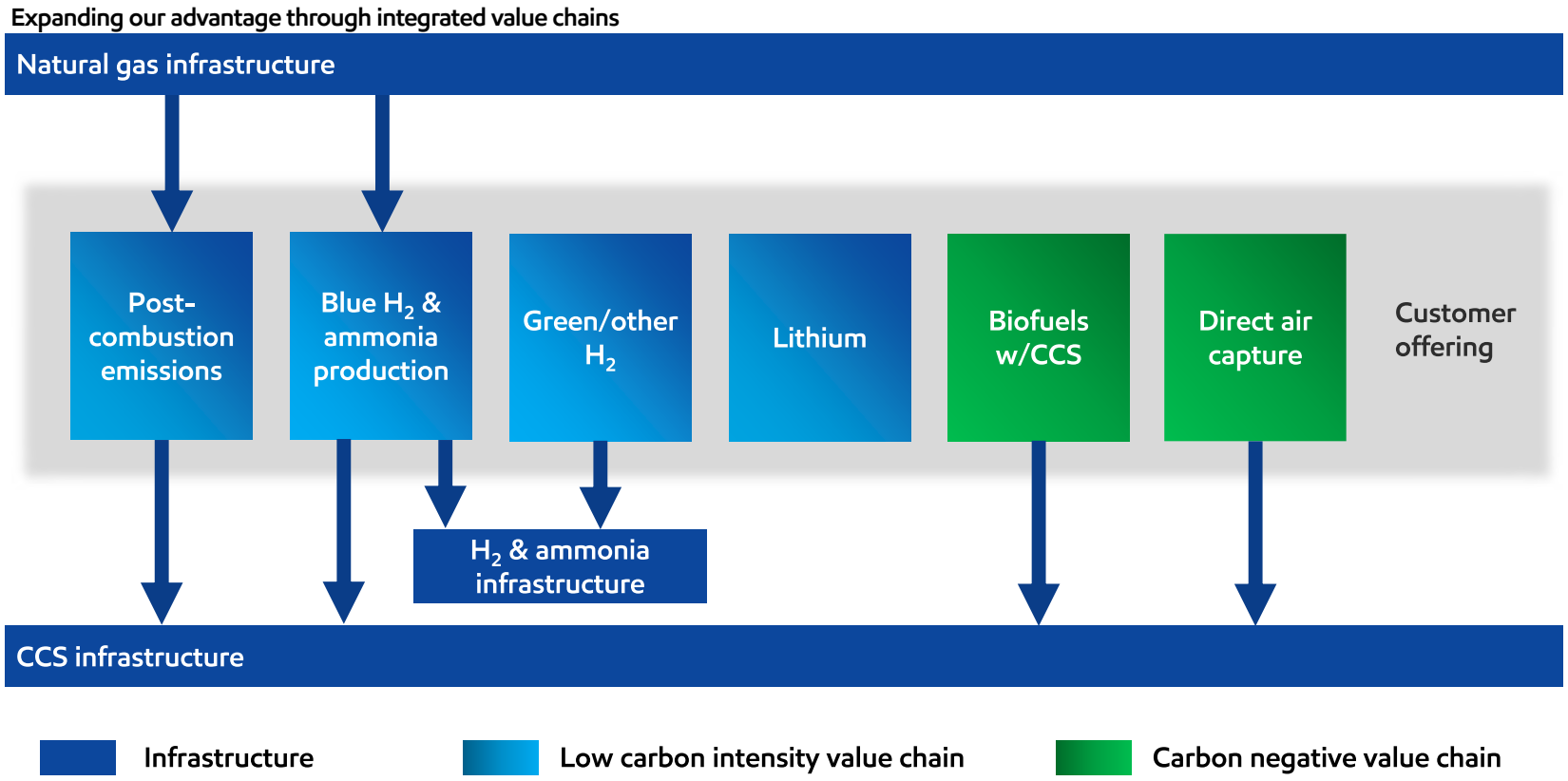
What it is

Lithium is used for the batteries in electric vehicles and portable electronic devices. Batteries account for 80% of global lithium use. Global consumption of lithium was 134,000 tons in 2022, up 41% from 2021, according to the U.S. Geological Survey.[20] The International Energy Agency expects demand to keep rising, potentially reaching over 1 million tons by 2040.[21]

Leading now

In November, we announced plans to produce lithium carbonate for use in EV battery manufacturing by employing direct lithium extraction (DLE) technology in southern Arkansas. By separating the lithium from deep brine reservoirs using available technologies, we're working to produce this critical mineral more efficiently and with fewer environmental impacts than traditional hard rock mining. Our existing skills in subsurface exploration, drilling, refining, and chemicals will allow us to bring meaningful scale to this technology and provide auto battery manufacturers with a more reliable, lower-carbon lithium supply option.[22]

Other solutions



Carbon capture and storage, hydrogen, lower-emission fuels, and lithium are far from the only emission-reduction opportunities in the world. We are always looking for opportunities that fit our strengths and leverage our current capabilities and businesses.

For example, many of our natural gas and LNG customers have significant post-combustion emissions that they'd like to abate. We offer a "one-stop shop" for CO_2 capture, transportation, and storage that will enable these customers to reduce their emissions.

We're working to accelerate the world's paths to net zero. We're building on our technology, scale, project execution, and integration advantages to establish a compelling new business. We're leading now with real-world projects moving into execution, and a pipeline of future opportunities. We believe this new business complements our existing businesses and will underpin the corporation's future growth and returns for decades to come.

Footnotes

1. ExxonMobil 2023 Global Outlook.
2. Total addressable market based on ExxonMobil analysis of the IPCC's Sixth Assessment Report Scenarios Database hosted by IIASA for carbon capture and storage, wind, solar, hydrogen, nuclear, biofuels, geothermal, and hydropower. Secondary energy demand and prices in 2050 in the Likely Below 2°C scenarios (Category C3) were used, where available, to calculate an estimate of potential market revenue. Carbon capture and storage estimate includes both CCS and direct air capture and used price of carbon for pricing estimate. Biofuels estimate used liquids pricing for pricing estimate. 2020 dollars.
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4. Center for Climate and Energy Solutions, https://www.c2es.org/content/carbon-capture/.
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8. ExxonMobil analysis based on assumptions for U.S. in 2022, including average distance traveled, fuel efficiency, average power grid carbon intensity, electric vehicle charging efficiency, and other factors. Gas-powered cars include light-duty vehicles (cars, light trucks and SUVs).
9. Market potential for emission reduction opportunity based on ExxonMobil analysis of CO_2 pipeline routes, current and potential capacity, potential emitters in the U.S. Gulf Coast market, and potential infrastructure upgrades. Subject to additional investment by ExxonMobil, customer commitments, supportive policy, and permitting for carbon capture and storage projects.
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14. U.S. National Clean Hydrogen Strategy and Roadmap: https://www.hydrogen.energy.gov/docs/hydrogenprogramlibraries/pdfs/us-national-clean-hydrogen-strategy-roadmap.pdf.
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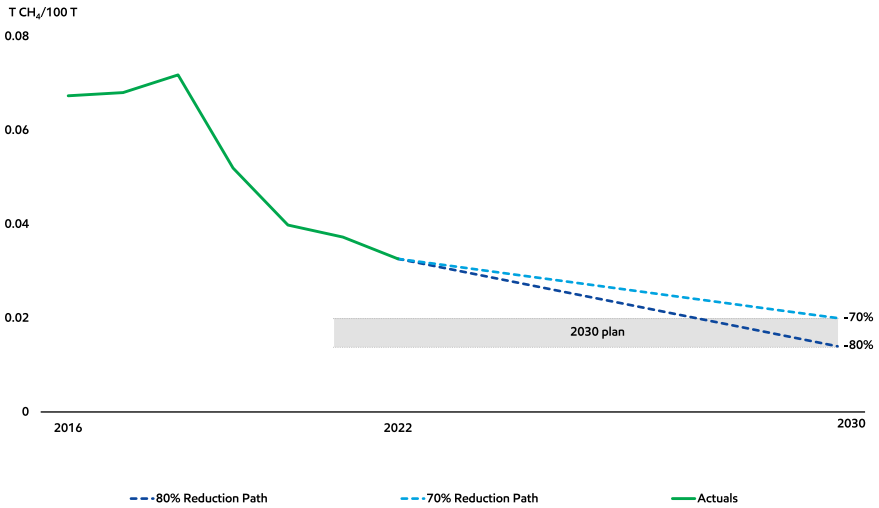
Methane

Driving reductions in methane emissions

Highlighting our progress

What we've done	What we're doing
▪ Cut operated methane emissions intensity in half since 2016	▪ On plan to reduce methane intensity versus 2016 across all operated assets 70%-80% by 2030[1]
▪ Eliminated routine flaring in Permian Basin operated assets	▪ On track to achieve zero routine flaring across all operated upstream assets by 2030, consistent with World Bank Zero Flaring Initiative[2]
▪ Eliminated "high-bleed" pneumatic devices in our U.S. operated unconventional assets	▪ On track to eliminate natural gas-driven pneumatic devices by 2025 in our key U.S. unconventional operated assets
▪ In 2022 alone, we surveyed 2.3 million components with optical gas imaging cameras and 1.3 million components with aerial flyovers	▪ Expanding continuous monitoring program in the Permian to cover ~700 unconventional production sites by 2025
▪ Progressed collaborations including deciding to join the U.N. Oil and Gas Methane Partnership (OGMP) 2.0	▪ Partnering with Scepter to launch 2 monitoring satellites in 2025 with a plan to have 24 in place over the next three years
▪ Launched our Center for Operations and Methane Emissions Tracking (COMET) in 2022 to provide near-continuous real-time monitoring	

Reducing corporate-wide methane emissions intensity



Methane: The other greenhouse gas

Methane is a deceptively simple molecule.

With just one carbon and four hydrogen atoms, it's the principal component in natural gas. Methane has the high energy density needed to make natural gas a reliable and flexible energy source that is already helping to meaningfully reduce carbon emissions around the world and will continue to be critical in achieving a lower-emission future. Our Global Outlook forecasts natural gas to make up more than 25% of the global energy mix in 2050.

Here are a few reasons why natural gas is such a great option:

- Choosing natural gas-fired electricity generation to replace older, inefficient coal plants can reduce greenhouse gas emissions by up to 60%, while producing fewer air pollutants.
- Natural gas resources are geographically and geologically diverse and abundant; natural gas is reliable and versatile for everything from power to transportation to home use.
- Natural gas is a reliable source for the required backup power generation when the wind isn't blowing enough to turn wind turbines and the sun isn't shining to fuel solar panels.

But, as with any form of energy, there are tradeoffs. For natural gas, in addition to CO_2, it's the issue of fugitive methane – or put simply, methane that is leaked to the atmosphere, where it is a potent greenhouse gas. It exists for a short time when compared to CO_2, but with a higher global warming potential. In fact, on a 100-year timespan, each kilogram of methane equals about 30 kilograms of CO_2.[3]

That's why it's important for us to keep methane contained and managed in our operations – in our pipeline networks, in our storage tanks, and in our processing equipment.

Managing methane is good business. Fewer methane leaks also means more product to sell.

Methane at ExxonMobil

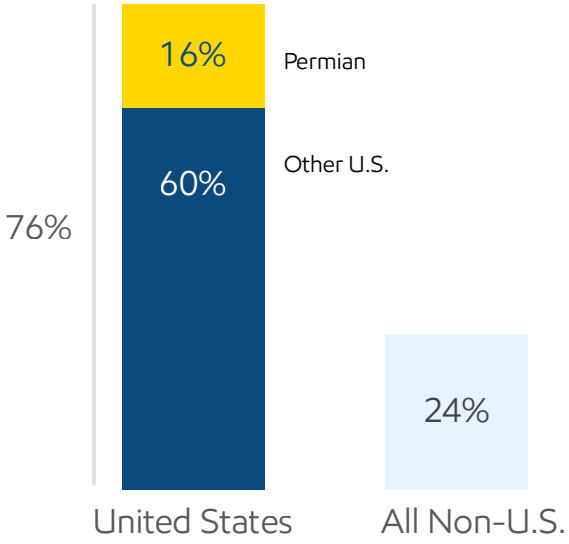
Methane emissions in our industry come from four primary sources:

- **Flaring** is the burning of excess natural gas for safety or other reasons, resulting in CO_2 emissions.
- **Venting** is when pneumatic devices, storage tanks, dehydration units, and other components of our operations sometimes release excess methane from our equipment to the atmosphere to reduce pressure and help ensure personnel safety.
- **Fugitive emissions** that occur when we experience unintentional leaks from our equipment.
- **Combustion slip** is uncombusted methane left over in the exhaust of natural gas fired engines used to power operations.

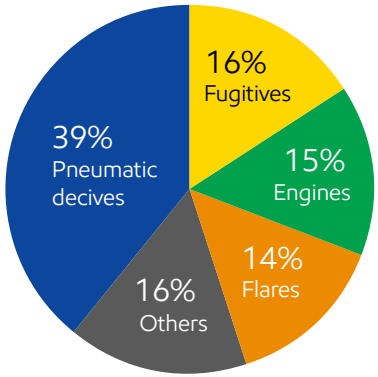
As reported in our data table, methane emissions at ExxonMobil were approximately 140,000 metric tons CH_4 in 2022, about 4% of our total Scope 1 emissions on an operated basis. The charts below illustrate where we have our biggest opportunities to tackle the methane challenge and provide greater transparency into the sources of methane emissions from our upstream operations, which comprise 96% of our methane emissions.

ExxonMobil methane emissions[4]

By location



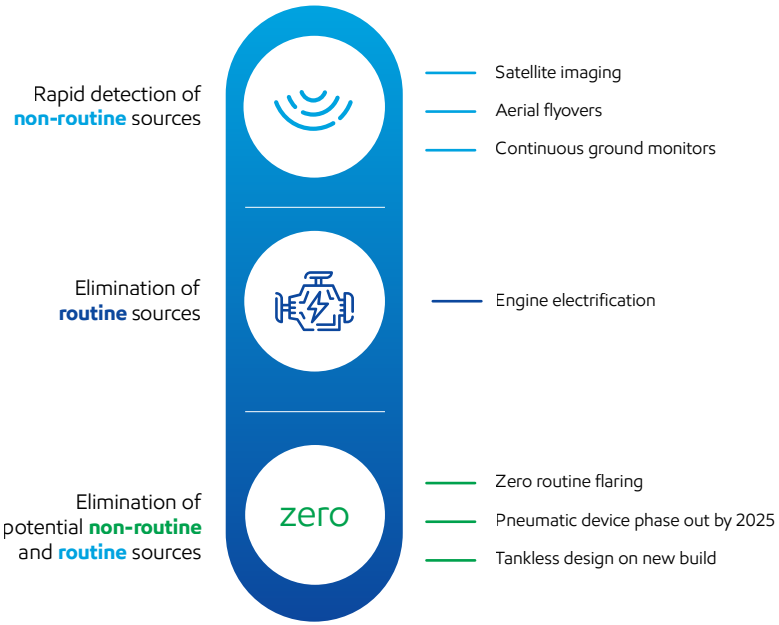
By source



The methane challenge

Methane is odorless and colorless. When leaked, there are only a small number of methane molecules relative to the volume of surrounding air. A gust of wind can easily disperse those molecules, obscuring the source. Our assets are often in remote locations with extreme weather conditions, making detection a challenge.

Finding methane leaks in those environments, across vast acreage, is not simple. Methane emissions are not concentrated at certain points or at certain times in our operations. Leaks can be short in duration, low in volume, infrequent in occurrence, and therefore harder to identify.



Aiming for zero

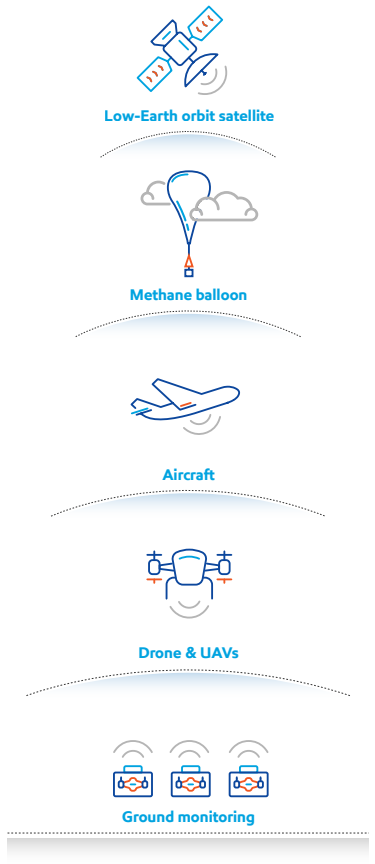
In March 2022, ExxonMobil joined others in our industry to launch the Aiming for Zero Methane Emissions Initiative. Our efforts support the goals of the Global Methane Pledge and the U.S. Methane Emissions Reduction Plan – as well as ExxonMobil's 2050 net-zero ambition.

We're implementing a multilayered approach that includes leading-edge technology to **monitor**, **measure**, and **mitigate** methane emissions.

Monitoring and detection

In our ongoing efforts to target and eliminate methane emissions, we continue to develop and deploy enhanced technologies for rapid detection, mitigation, and quantification of sources of methane at our operated assets.

On the ground, in the air, and in space, the technology and processes we use to identify non-routine methane emissions provide us with a wide range of data points to inform and continuously improve our mitigation efforts. At this time, we're advancing detection technologies in nine countries at operated assets that we estimate account for more than 80% of our methane emissions.



Methods of detection

Method	Technologies	Detection thresholds*	Considerations	ExxonMobil sites**
Manual detection	▪ Handheld devices ▪ Portable detectors	Less than 1 kg/hr	Advantages: Precise location of emissions, using services already available in some locations Limitations: Labor intensive, periodic, and subject to human error. Does not provide quantification. No access to difficult-to-reach locations.	▪ Permian Basin, U.S. ▪ Eagle Ford, U.S. ▪ Bakken, U.S. ▪ Appalachian Basin, U.S. ▪ Haynesville, U.S. ▪ LaBarge, U.S. ▪ Guyana FPSO ▪ Hebron, Canada ▪ Kearl Oil Sands, Canada ▪ Cold Lake, Canada ▪ Normal Wells, Canada ▪ Malaysia ▪ Nigeria† ▪ Angola†
Facility-scale, near-continuous monitoring	▪ Fixed cameras ▪ On-the-ground sensors	25 kg/hr – less than 1 kg/hr	Advantages: Stationary monitoring, offering potential 24/7 coverage of an individual site, including duration of leaks. Limitations: Requires precise weather data for quantification. Additional research and innovation still needed to make this technology scalable.	▪ Permian Basin, U.S. ▪ Freestone, U.S.
Facility-scale, periodic monitoring	▪ Drones ▪ Mobile labs	Less than 1kg/hr	Advantages: Can cover multiple sites in their entirety, including areas unreachable by handheld devices. Limitations: Requires individual site visits. Airspace regulations may restrict drone use. Monitoring is not continuous.	▪ Permian Basin, U.S. ▪ Freestone, U.S.
Aerial detection	▪ Airplanes ▪ High-altitude platforms (i.e., balloons)	50 kg/hr – less than 3 kg/hr	Advantages: Can cover hundreds of sites per day, often using existing technology. Limitations: Additional detection often needed to identify sources within facilities.	▪ Permian Basin, U.S. ▪ Eagle Ford, U.S. ▪ Bakken, U.S. ▪ Appalachian Basin, U.S. ▪ Haynesville, U.S. ▪ Germany† ▪ Australia†
Satellite detection	▪ Low-earth orbit networks	25,000 kg/hr – 100 kg/hr	Advantages: Global, near-continuous coverage. Potentially lower cost. Limitations: High detection thresholds and sensitivity to environmental conditions.	▪ Permian Basin, U.S. ▪ Cold Lake, Canada

*Detection thresholds vary depending on human and environmental factors, including weather and wind conditions.
**Includes sites where these technologies have been piloted or deployed.
†Planning stages.

The technology to detect and quantify methane emissions continues to improve through collaboration and innovation supported by constructive government policy. While the current industry and regulatory approach on the ground is focused on manual leak detection, we're continuing to invest to develop and deploy technologies to increase the efficiency, precision, and coverage of our detection abilities.

For example, Project Astra is a collaboration of universities, environmental groups, and industry partners that is developing an innovative sensor network to continuously monitor methane emissions across large areas of Texas. This high-frequency monitoring system will give us the tools for quick leak detection and repair at specific locations, lowering costs and improving efficiency. After the completion of the first phase of the project in early 2023, the Department of Energy approved additional funding to extend Project Astra basin-wide.

Advances in facility-scale, near-continuous monitoring like this will enable sensitive, specific detection of methane emissions over time. Periodic monitoring using airplanes or drones can further expand coverage on land to dozens of onshore sites per day, depending on local conditions and logistics.

In the air, the moment-in-time observations provided by airplane surveys continue to be a valuable source of data, but we're going higher to enhance detection across larger areas on a more continuous basis.

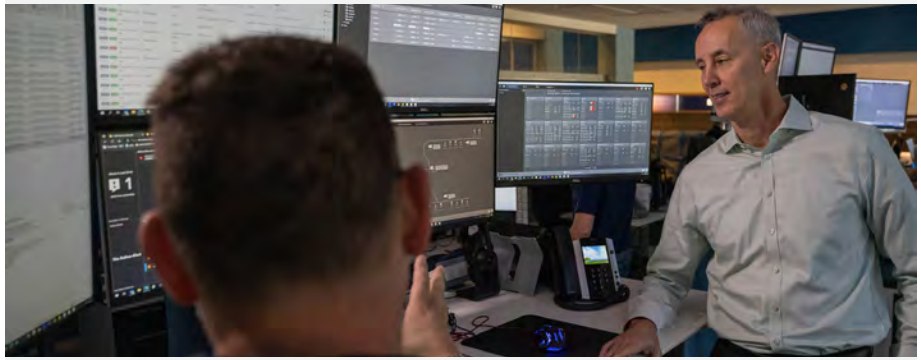
In 2023, we achieved an important milestone in our collaboration with Scepter, using a high-altitude balloon to test advanced imaging technology and proprietary data processing platforms to detect methane emissions across a large operating area in the Permian Basin. The data collected is the first of its kind, representing the first real-world demonstration of the potential for continuous methane monitoring over a broad region.

Finally, on the frontier of global emissions detection, we're venturing into space. We're working with Scepter and Amazon Web Services to develop satellite-based technology to design and optimize satellite placement and coverage, initially focused on capturing methane emissions data from our operations in the Permian Basin. Scepter anticipates increasing coverage with more than 24 satellites over three years, forming a large constellation network capable of monitoring oil and natural gas operations around the world.

COMET: Bringing it all together in real time

Your home smoke detector serves an important purpose. When the alarm sounds you know that it has sensed a problem, whether it's smoke or just a low battery, you know that you need to respond. Our Center for Operations and Methane Emissions Tracking (COMET) operates on the same simple principle, scaled to cover massive acreages with diverse sources of data.

Launched in 2022, COMET is a $20 million investment to centralize, continuously monitor and analyze methane emissions data from sources across our operations in the Permian Basin for rapid detection and mitigation. When fully deployed at all 700 operated sites across 1.8 million acres in the Permian, COMET will ultimately provide near-continuous, real-time monitoring in the region. With opportunities to expand outside the Permian Basin, COMET is a potential game changer for ExxonMobil and the industry.



Our methane-reduction roadmap in the Permian Basin

Back in 2021, we became the first company to announce plans to achieve net zero by 2030 for Scope 1 and 2 greenhouse gas emissions from unconventional operated assets in the U.S. Permian Basin. Reducing methane emissions is a key part of that plan.

To date, we have focused largely on improving detection and response times to potential leaks, an effort that has led us to be recognized as an industry leader by the Environmental Defense Fund in its three-year direct measurement study in the Permian Basin.[5] Currently, remote operators receive automated alerts when an event is detected, analyze the data, and dispatch crews.

In the years ahead, we are focused on expanding these continuous monitoring and response capabilities, as well as automating the collection and analysis of data through integrated operations support centers like COMET to advance quantification of methane and analysis of trends over time.

Measurement and reporting

We have reported our methane emissions publicly every year since 2014. This is an important part of our transparency efforts, and it enables us to work with academia, peers in our industry, and other stakeholders to continuously improve our shared understanding of methane emissions.

The data we report is based on internationally recognized methodologies and compiled each year by determining emissions by source at each operated asset across our company. With formal and informal guidance from frameworks like Veritas and the Oil and Gas Methane Partnership, our emissions data reporting improves each year, even as we've already begun the work of reducing the emissions themselves.

Methane is measured through interconnected processes. Snapshots of methane concentrations in the atmosphere provide, as described above, one input. Considering local weather patterns, the size and shape of an observed methane plume, and other environmental factors helps us model the rate and volume of the emissions. This process guides our timely mitigation efforts by identifying large or unexpected sources of methane.

Understanding emission factors

Emission factors, consistent with regulatory reporting requirements and established by reputable third parties, help us to further understand our methane emissions. This standardized practice helps us to credibly estimate emissions, covering common sources across our business.

What are emission factors? Emission factors add to observational and other data to provide an estimate for average methane emissions. Classes of equipment, types of activities, or other variables are multiplied by the relevant emission factor to provide a credible estimate for our emissions inventory. Derived from sources like the American Petroleum Institute and the U.S. EPA Greenhouse Gas Reporting Program, emissions factors help oil and natural gas companies track methane emissions in a consistent way. As direct measurement and detection technologies evolve, emission factors are expected to be used less industry-wide.

We have long been a leader in advocating for strong measurement, reporting, and verification standards. Combined with the ongoing innovations in monitoring and detection, improvements in measuring and quantifying methane emissions are leading to a deeper understanding of emission sources and mitigation actions. We are focused on emissions mitigation and the transition to observation-based emission quantification of potential non-routine sources.

Mitigating methane emissions

Our detection and quantification work continues to improve the accuracy of the methane volumes and intensity we report each year – and helps us assess the scale of the methane challenge and the effectiveness of the work we're already doing. The framework we've established and shared has enabled the development of consistent and comparable data which, along with growing field measurements, guide our mitigation efforts.

The Methane Guiding Principles includes ExxonMobil's framework as a resource for regulators in their Methane Policy toolkit, with potential applications across the natural gas value chain. We are proud of this thought leadership and our contribution to this challenge.

To lower our methane intensity, we are evolving the designs of our facilities, continuously improving our operations processes and protocols, and pursuing advanced technologies to meet the needs of our customers with fewer emissions.

Flaring is perhaps our most visible source of methane emissions because the flame can be seen by the naked eye. In 2022, flaring comprised about 14% of our operated methane emissions. It occurs as a safety measure when the volume of gas exceeds the capacity of our facilities. When these needs are anticipated and planned, we call that "routine flaring," and we are working to eliminate this process from our operations.

We have committed to eliminate routine flaring in line with the World Bank Zero Routine Flaring Initiative in our operated assets by 2030 – something we achieved in our operated Permian Basin unconventional assets at the end of 2022. In addition to installing and upgrading our equipment, we continue to optimize our operations to eliminate routine flaring in the remaining locations.

Ongoing enhancements – large and small, complex and simple, proven and leading edge – are further accelerating our efforts to remove, reduce, or avoid methane emissions.

In some cases, we're doing more with less, such as when we modify designs to eliminate components like pneumatic devices. In other circumstances, we're simply doing the same things, but better. For example, we continue to improve the seals on centrifugal compressors and expand gas collection systems.

To put it succinctly, we take an approach where every feasible option is on the table as we explore and develop solutions to rapidly, safely, and reliably mitigate methane emissions.

Replacing pneumatic devices

Pneumatic control devices have been used in the oil and natural gas industry for more than a century to operate valves that control liquid levels, pressure, temperature, and other process variables. By using natural gas from the production site, these devices safely and reliably perform their tasks in a wide range of extreme conditions around the world.

They also emit methane. Each time a pneumatic device is used, a small amount of methane is vented. Multiply this by the number of devices at each site, and it can add up. More than a third of our total methane emissions come from pneumatic devices, which is why we have eliminated "high-bleed" devices across our U.S. unconventional operated assets that vent methane at a higher rate and have made replacement of the rest a priority.

Unfortunately, there's no one-size-fits-all solution to this challenge. In some cases, when reliable electricity is available, it's as simple as installing an air compressor or a mechanical valve. In other cases, it means looking outside our industry, collaborating with others to enhance existing controllers and other technologies to mitigate or eliminate emissions. It can even mean using existing equipment in new ways, such as substituting nitrogen, which is an inert gas with no global warming potential, for operations instead of natural gas.

And the benefits extend beyond the individual piece of equipment. When retrofitting our existing assets, we often replace the infrastructure, which improves reliability and often further reduces opportunities for leaks and fugitive emissions.

Looking ahead, we're continuing to conduct trials to test emerging solutions, deploy the most promising ones, and share what we learn with others to advance the shared ambition of near-zero methane emissions.

Certified natural gas

As part of our methane management efforts, we continue to expand the volume of natural gas production that is independently certified by the nonprofit MiQ. The certification from MiQ verifies that our natural gas is produced with lower methane intensity, which helps us meet customer demand for energy produced with lower emissions, and it also helps us identify areas for improvement.

Over the course of 2022, our most recent year of full data, we increased our Permian Basin MiQ certified natural gas volume to approximately 700 million cubic feet per day produced from our facilities in Poker Lake, New Mexico. We have also successfully recertified our Appalachia facilities which produce approximately 300 million cubic feet per day. We are working to expand certification in other unconventional operated assets.

Advocacy and collaboration

The energy industry is collaborative by nature. We work with industry partners and regulators around the world to advocate for strong and consistent measurement, reporting, and verification standards – and we collaborate with universities, industry groups, and others to advance the technologies and fundamental science related to methane emissions.

Supporting sound policy

The model regulatory framework we published in 2020, and have shared broadly, provides a blueprint for industry-wide regulation, urging stakeholders, policy makers, and governments to develop comprehensive rules for methane emissions.

We work with the U.S. Environmental Protection Agency, the Bureau of Land Management, the Pipeline and Hazardous Materials Safety Administration, and others to encourage practical and effective regulation of methane emissions. In the United States alone, there are half a dozen agencies currently conducting important work on methane rulemaking, which, if not well coordinated, could lead to overlapping and potentially conflicting regulations. This is why we're focused on consistent regulation that incentivizes technology deployment and builds upon the industry-wide voluntary efforts that have been highly successful.

Our model framework for industry-wide methane regulations underpins our advocacy efforts, and in recent years, the commentary and guidance we've offered regulators includes:

- Comment letters to the U.S. EPA in November 2019, January 2022, and February 2023 related to new source performance standards.
- A joint comment letter about continuous monitoring to the U.S. EPA, co-signed with five other companies in the energy, power, and aviation industries.
- Our comment letter to the Pipeline and Hazardous Materials Safety Administration on their proposed rules for leak detection.
- Testimony at the U.S. EPA Methane Detection Technology Workshop.

Teaming up to tackle methane emissions

We know we can't go it alone. Collaboration will be vital as we implement solutions to support society's net-zero future, and by working with a wide range of universities, academic consortiums, environmental groups, and more, we're advancing leading-edge research and piloting new technologies to help the industry and our company measure, reduce, and report methane emissions.

Among others, we're members of (*ExxonMobil is a founding member):

- **Collaboratory to Advance Methane Science***: A research collaboration with energy leaders to explore, discover, and quantify methane emissions, and develop solutions to reduce them.
- **Stanford Natural Gas Initiative***: A collaboration of more than 40 research groups from multiple disciplines working with industry partners and others to maximize the social, economic, and environmental benefits of natural gas.
- **Project Astra***: A partnership to monitor emissions across the Permian Basin with a first-of-its-kind sensor network, led by The University of Texas at Austin and bringing us together with the Environmental Defense Fund, Chevron, Pioneer Natural Resources Company, and GTI Energy, a research organization focused on energy solutions.
- **Veritas**: GTI Energy's Methane Emissions Measurement and Verification Initiative, pursuing credible, comparable methane emissions measurement and accelerating actions that reduce methane emissions.
- **Project Falcon***: An industry partner study that aims to determine the best way to deploy fixed sensors for continuous methane monitoring at individual facilities.
- **The Environmental Partnership***: A collaboration among U.S. oil and natural gas companies of all sizes to take action on environmental performance, transfer knowledge, and foster collaboration among stakeholders.
- **World Bank Global Gas Flaring Reduction Partnership***: A multi-donor trust fund composed of governments, companies, and multilateral organizations committed to ending routine gas flaring at production sites across the world.
- **Methane Guiding Principles***: A partnership of more than 50 companies and organizations to enable action in industry and government to reduce methane emissions from the natural gas supply chain.

Sharing knowledge and insight

Throughout our journey, we're sharing what we learned through peer-reviewed publications either co-authored by ExxonMobil or funded in part by the company. Since 2016, more than 23 articles have been published in academic and trade journals. Topics covered include tiered leak detection and repair programs, global to point-source methane emissions quantification, next-generation imaging, satellite capabilities, region-specific life-cycle greenhouse gas emissions of oil and natural gas, and much more.

Our work has been shared in technical briefings at venues like the American Geophysical Union and European Geophysical Union annual meetings, the American Petroleum Institute's Environmental Partnership meetings, and Stanford University's Methane Emissions Technology Alliance.

We've made significant progress, having cut our operated methane emissions in half since 2016, and we're not finished. By 2030, our methane-reduction plans include a 70%-80% reduction in corporate-wide methane intensity across our operated assets, and we are working to eliminate routine flaring in our global operated upstream assets in line with the World Bank Zero Routine Flaring Initiative. These efforts support the goals of the Global Methane Pledge and the U.S. Methane Emissions Reduction Plan, as well as our own 2050 net-zero ambitions.

Footnotes

1. ExxonMobil's 2030 GHG emission reduction plans: https://corporate.exxonmobil.com/news/news-releases/2021/1201_exxonmobil-announces-plans-to-2027-doubling-earnings-and-cash-flow-potential-reducing-emissions. ExxonMobil's 2030 plans are expected to result in a 20%-30% reduction in corporate-wide greenhouse gas intensity, including reductions of 40%-50% in upstream intensity, 70%-80% in corporate-wide methane intensity, and 60%-70% in corporate-wide flaring intensity. Based on Scope 1 and 2 emissions of ExxonMobil operated assets (versus 2016). ExxonMobil's reported emissions, reductions, and avoidance performance data are based on a combination of measured and estimated emissions data using reasonable efforts and collection methods. Calculations are based on industry standards and best practices, including guidance from the American Petroleum Institute (API) and Ipieca. There is uncertainty associated with emissions, reductions, and avoidance performance data due to variation in processes and operations, the availability of sufficient data, quality of those data, and methodology used for measurement and estimation. Performance data may include rounding. Changes to performance data may be reported as part of the company's annual publications as new or updated data and/or emission methodologies become available. We are working to continuously improve our performance and methods to detect, measure, and address greenhouse gas emissions.
2. References to routine flaring herein are consistent with the World Bank's Zero Routine Flaring by 2030 Initiative/Global Gas Flaring Reduction Partnership's principle of routine flaring and excludes safety and non-routine flaring.
3. IPCC AR6 Report, Chapter 7: The Earth's Energy Budget, Climate Feedbacks and Climate Sensitivity (Table 7.15): https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Chapter07.pdf.
4. ExxonMobil methane emissions estimates as of year-end 2022.
5. https://blogs.edf.org/energyexchange/wp-content/blogs.dir/38/files/2022/11/PermianMAPFinalReport.pdf.

Positioning for a lower-emission future

Our strategic priorities

We remain focused on five strategic priorities to create sustainable solutions that improve quality of life and meet society's evolving needs. Our vision is to lead industry in innovations that advance modern living and a net-zero future.

- **Leading performance**
  Industry leader in operating and financial performance.
- **Essential partner**
  Value through win-win solutions for our customers, partners, and broader stakeholders.
- **Advantaged portfolio**
  Portfolio of assets and products outperform competition and grow value in a lower-emission future.
- **Innovative solutions**
  New products, technologies, and approaches to accelerate large-scale deployment of solutions essential to modern life and lower emissions.
- **Meaningful development**
  Diverse and engaged organization with unrivaled opportunities for personal and professional growth doing impactful work to meet society's needs.

We plan to play a leading role in the energy transition as we retain investment flexibility across a portfolio of evolving opportunities to maximize shareholder returns.

Positioning for a lower-emission future

We have evolved our operating model, enabling efficiencies that better leverage the scale of an increasingly integrated company. At the same time, we have centralized many of the skills and capabilities required by our business, allowing us to improve allocation of critical resources; drive continuous improvement, including detection and measurement of emissions; and grow value. This serves us well in a variety of future scenarios, irrespective of the pace of the energy transition.

Core businesses

- Upstream strengthens energy security by expanding access to reliable and affordable supply while focusing on achieving industry-leading emissions intensity.
- Product Solutions is the world's largest downstream and chemical company developing high-value innovative products needed by modern society.
- Low Carbon Solutions helps to lower society's greenhouse gas emissions by providing solutions in growing markets for carbon capture and storage, hydrogen, and biofuels. It also supports reducing emissions from our major operations and products.

Evolving our model to strengthen competitiveness

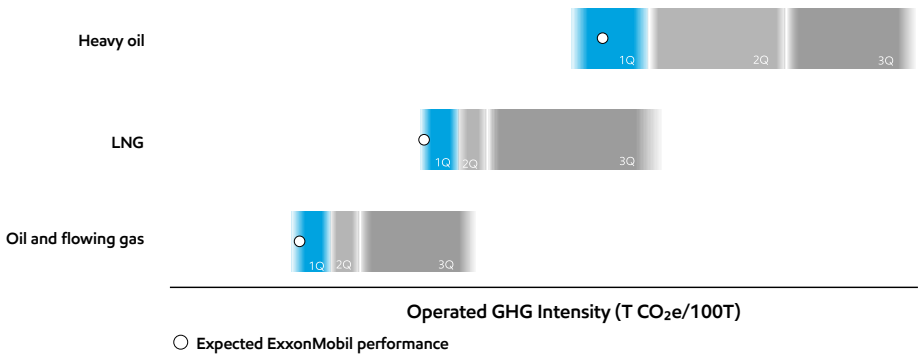
Realizing full set of corporate competitive advantages.

Upstream

We are well positioned to help meet the need for oil and natural gas through the next decade and beyond, delivering value by reducing structural costs, growing high-value production at low cost of supply, and improving emissions intensity.[1] As part of our net-zero ambition, we have identified more than 100 potential modifications to reduce emissions across all upstream operated assets including energy efficiency measures and equipment upgrades. Examples include carbon capture and storage at operations in the United States, Australia, and Canada; electrification of compressors and heaters in our Permian operations; and replacement of pneumatic devices with electrical or mechanical devices to eliminate fugitive emissions in natural gas operations. These examples, as shown in the chart below, demonstrate our capacity to lead industry as a responsible operator and are expected to deliver first-quartile Scope 1 and 2 emissions intensity performance by 2030 for each asset class when benchmarked against other operators based upon available data.[2]

2030 Upstream GHG intensity[3]

By asset class and benchmarking quartile (Q)



Unconventional operations

We have set a goal to be net zero in Scope 1 and 2 greenhouse gas emissions by 2030 for our Permian Basin unconventional operated assets. The enhancements in our unconventional operations include electrification, improving processes, and using electricity from renewables and other lower-emission sources. In 2022, we eliminated routine flaring in our Permian Basin operated assets in line with the World Bank's Zero Routine Flaring Initiative.[4] Further, we achieved the top certification for methane emissions management at our Poker Lake, New Mexico, facilities from independent validator MiQ.

Liquefied natural gas (LNG)

ExxonMobil is progressing development of approximately 13 million metric tons per year of high-efficiency liquefaction capacity to meet expected global demand growth for LNG. This includes diverse projects in the United States, Papua New Guinea, Mozambique, and Qatar. ExxonMobil operated assets are expected to be among industry's lowest in greenhouse gas intensity.[5]

Deepwater

ExxonMobil's deepwater oil and gas developments are being designed to support our 2030 greenhouse gas emission-reduction plans.

Prosperity joins the Liza Unity as two of the world's first FPSOs to be awarded the SUSTAIN-1 notation by the American Bureau of Shipping in recognition of the sustainability of its design, documentation and operational procedures.

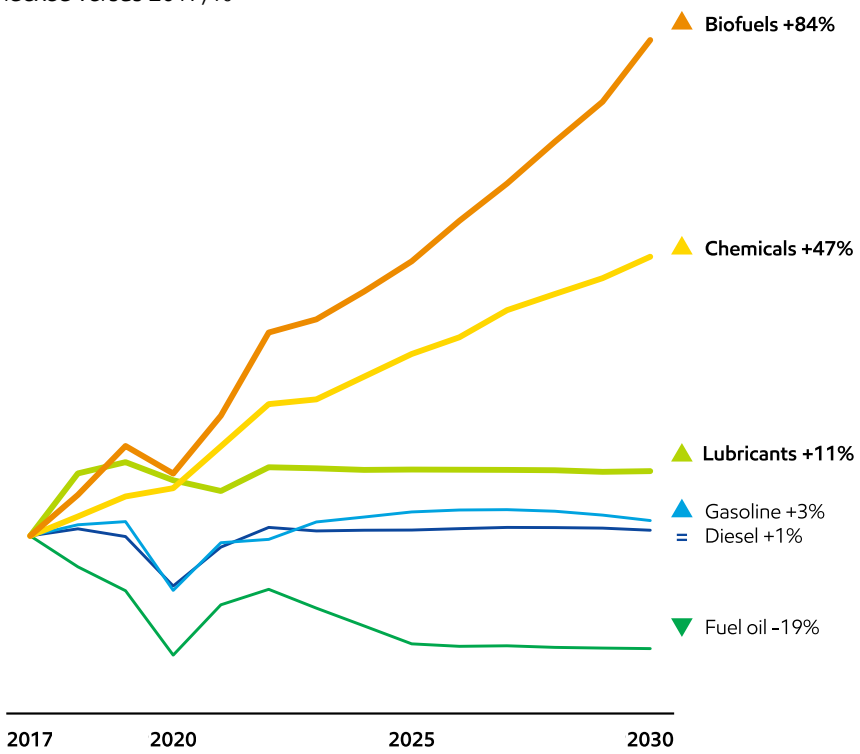
Product Solutions

Our Product Solutions business plays a critical role in providing products that are needed for modern life. Our customers want high-value products with lower life-cycle greenhouse gas emissions, which requires product innovation and emissions intensity reductions in our manufacturing processes.

Our refining and chemicals businesses each operate assets that are among the lowest in industry for greenhouse gas intensity.[6] Through 2030, we expect to more than offset emissions from new operated facilities needed to meet growing demand. Our emission-reduction plans consider fuel switching to hydrogen; carbon capture and storage projects in Houston, Rotterdam, Fife, and Antwerp; renewable power purchase agreements; energy efficiency projects; and conversions of select refineries to terminals.

Global demand growth[7]

Indexed versus 2017, %



Energy products

Demand for conventional fuels is expected to peak this decade and then begin to decline, while demand for energy-dense, lower-emission fuels is expected to grow rapidly, driven by hard-to-decarbonize transportation sectors such as aviation, marine, and heavy-duty trucking.

Around 85% of our manufacturing capacity is co-located in large, integrated sites that have the flexibility to shift product yield to best meet society's evolving needs. As demand for conventional road transport fuels declines, select assets can be repurposed to manufacture high-value products including chemicals, lubricants, and lower-emission fuels.

We continue to improve our portfolio, focusing investments on those major assets in locations with sound comprehensive carbon policy. Our investments in North America, China, and Singapore will help meet the growing demand for products with lower life-cycle emissions, and the flexibility of our sites will allow us to change as society's needs evolve.

Chemical products

Global chemical demand is expected to grow faster than the global economy,[8] driven by demand for products like cell phones and medical supplies, as well as products necessary to preserve food and improve hygiene. Demand for performance chemicals, including our performance polyethylene and polypropylene, is expected to remain strong and resilient through the energy transition. These products support customers' efficiency and greenhouse gas emission-reduction needs. To further support our customers, we continue to grow the supply of performance chemicals through large, competitively advantaged investments such as:

- The Gulf Coast Growth Venture, which started up at the end of 2021, ahead of schedule and under budget. The operation includes a 1.8 million-metric-ton-per-year ethane steam cracker, two polyethylene units capable of producing up to 1.3 million metric tons per year, and a monoethylene glycol unit with a capacity of 1.1 million metric tons per year.
- The Baton Rouge, Louisiana, performance polypropylene project, which started up in fourth quarter 2022, expanded our production capacity along the Gulf Coast by 450,000 metric tons per year.
- The Baytown, Texas, chemical expansion, started up in 2023, will have the capacity to produce about 400,000 metric tons of Vistamaxx™ polymers per year and about 350,000 metric tons of Elevexx™ linear alpha olefins per year.
- The chemical complex in Guangdong province, China, which is currently under construction, includes performance polyethylene lines, differentiated performance polypropylene lines, and a flexible feed steam cracker with a capacity of about 1.6 million metric tons per year.

Key plan activities to grow high-value products[9]

Major expansions

Performance chemicals – Guangdong, China

Lubricants and chemicals – Singapore

Biofuels

Renewable diesel – Strathcona, Canada

Bio co-processing – Sarnia & Nanticoke, Canada

Advanced recycling

Baton Rouge, Louisiana

Baytown, Texas

Beaumont, Texas

Joliet, Illinois

Sarnia, Canada

Antwerp, Belgium

Gravenchon, France

Rotterdam, Netherlands

Singapore

Other

U.S. Gulf Coast refinery reconfigurations

China lubricants expansion

India lubricant manufacturing plant

Specialty products

Demand for lubricants is expected to remain strong and grow in the industrial, aviation, and marine sectors. Our Singapore Resid Upgrade Project will upgrade bottom-of-the-barrel products into higher-value lubricant basestocks and cleaner fuels. This investment will position us to better meet demand growth in Asia, while displacing higher carbon-intensity products in the marketplace.

Helping customers reduce their emissions

Our competitive advantages of scale, integration, and proprietary technology provide customers with products that improve efficiency, avoid greenhouse gas emissions associated with alternative products, and serve a range of applications, including health and safety, packaging, transportation, and industrial.

Innovative solutions to improve modern life

- Plastic packaging has 54% lower life-cycle greenhouse gas emissions versus alternatives.[10]
- Exceed™ XP enables up to 30% thinner plastic packaging versus conventional plastics for equivalent performance.[11]
- Certified circular polymers[12] offer equivalent performance of virgin plastics.

Total vehicle product solutions improve transportation efficiency

- Plastics enable lighter vehicles and 6%-8% fuel efficiency improvement for every 10% reduction in vehicle weight.[13]
- Butyl rubber improves air retention in tires, which can increase electric vehicle range by up to 7%.[14]
- Mobil 1 ESP X2 0W-20 engine oil helps provide up to 4% fuel economy improvement.[15]
- Renewable diesel can reduce carbon emissions by up to 70% compared to conventional diesel.[16]
- Marine biofuel can reduce carbon emissions by up to 30% compared to conventional marine fuel.[17]

Reliable solutions for industrial efficiency

- Mobil DTE 10 Excel Series provides up to 6% improvement in hydraulic pump efficiency.[18]
- Mobil SHC™ 600 Series provides up to 3.6% energy efficiency gain.[19]
- Mobil SHC™ Gear WT helps reduce oil consumption and maintenance costs through extended oil life and drain intervals.[20]

Footnotes

1. ExxonMobil operated facilities; excludes startup phase of major new facilities. Projected emission intensity includes Scope 1 and 2 emissions of ExxonMobil operated assets as compared to available benchmark. Reduction estimates provided herein have a high degree of uncertainty, and are subject to change based on potential future conditions. 2030 first quartile projection based on comparison of available peer performance data, publicly available announcements, third-party sources (Rystad for oil and flowing gas, COSIA for heavy oil, Phillip Townsend and Associates Inc. for LNG), and ExxonMobil analysis.
2. Ibid.
3. Ibid.
4. References to routine flaring herein are consistent with the World Bank's Zero Routine Flaring Initiative/Global Gas Flaring Reduction Partnership's (GGFRP) principle of routine flaring and excludes safety and non-routine flaring.
5. First quartile operated performance based on Phillip Townsend and Associates Inc. industry benchmarking analysis for operating year 2021.
6. Based on Scope 1 and 2 emissions of ExxonMobil operated assets. Refining performance results based on ExxonMobil analysis of 2020 Solomon Associates' proprietary Carbon Emissions Index; Chemicals performance results based on ExxonMobil analysis of key competitors' publicly available information, annual data (2016-2022).
7. Total demand through 2030 – ExxonMobil 2023 Global Outlook. Chemicals based on ExxonMobil 2023 Global Outlook for Energy chemical feedstock projected demand excluding direct ethane from Upstream operations.
8. Global economy - ExxonMobil's 2023 Global Outlook; Chemicals growth - IHS Markit Report, Global (Polyethylene, Polypropylene, and Paraxylene), 2023 edition: Fall 2023 update.
9. May not reflect final investment decisions made by the company. Individual opportunities may advance based on a number of factors, including availability of supportive policy, technology for cost-effective abatement, and alignment with our partners and other stakeholders. The company may refer to these opportunities as projects in external disclosures at various stages throughout their progression.
10. April 2018 report of Franklin Associates on Life Cycle Impacts of Plastic Packaging Compared to Substitutes (April 2018 Franklin Associates Report); U.S. packaging market; alternatives include steel, aluminum, glass, paper-based packaging, fiber-based textiles, and wood (Table 4-14). Source: https://www.americanchemistry.com/better-policy-regulation/plastics/resources/life-cycle-impacts-of-plastic-packaging-compared-to-substitutes-in-the-united-states-and-canada-theoretical-substitution-analysis.
11. Based on performance of specific ExxonMobil Exceed™ XP grades versus conventional polyethylene in flexible packaging applications.
12. Certifications through the International Sustainability and Carbon Certification (ISCC) PLUS process. For more information, please visit https://www.exxonmobilchemical.com/en/exxonmobil-chemical/sustainability/advanced-recycling-technology/mass-balance-attribution.
13. Department of Energy statements at https://www.energy.gov/eere/vehicles/lightweight-materials-cars-and-trucks.
14. Based on ExxonMobil analysis: https://www.exxonmobilchemical.com/en/resources/library/library-detail/91254/properly_inflated_tires_affect_energy_consumption_en.
15. Based on ExxonMobil analysis when compared to conventional mineral oils: https://www.mobil.com/en-be/passenger-vehicle-lube/pds/eu-xx-mobil-1-esp-x2-0w-20.
16. Based on ExxonMobil analysis using Argonne National Labs' GREET2022 model and published fuel carbon intensity from California LCFS regulations. Argonne National Laboratory GREET model: https://greet.anl.gov/, California Air Resources Board Low Carbon Fuel Standard Regulation: https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard/lcfs-regulation.
17. Based on ExxonMobil analysis using Argonne National Labs' GREET2022 model versus conventional fuel oil. Argonne National Laboratory GREET model: https://greet.anl.gov/ Performance dependent on blend rates and bio components used.
18. Based on ExxonMobil analysis; performance profile at https://www.mobil.com/en-us/industrial/pds/gl-xx-mobil-dte-10-excel-series.
19. Based on ExxonMobil analysis; performance profile at https://www.mobil.com/en-us/industrial/pds/gl-xx-mobil-shc-600-series.
20. Based on ExxonMobil analysis; performance profile at https://www.mobil.com/en-us/industrial/pds/gl-xx-mobilshc-gear-320-wt.

Emission-reduction plans and progress

Progress toward net zero by 2050

With advancements in technology and the support of clear and consistent government policies, we aim to achieve net-zero Scope 1 and 2 greenhouse gas emissions in our operated assets by 2050.

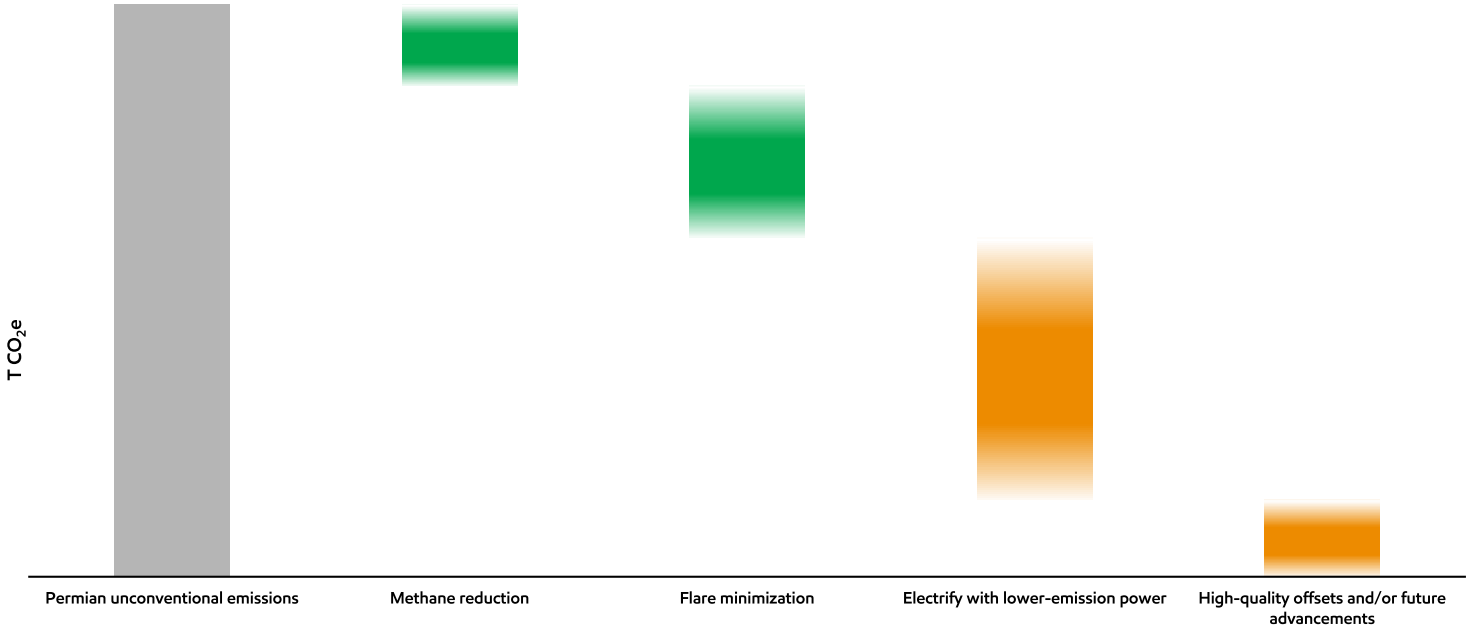
Our net-zero ambition is backed by a comprehensive approach centered on detailed emission-reduction roadmaps. We completed these roadmaps in 2022 and continue to update them to reflect technology and policy, and to account for the many potential pathways and the pace of the energy transition.

We are using this approach in our Permian Basin unconventional operations, where we are on track to achieve our industry-leading plans to reach net-zero Scope 1 and 2 emissions by 2030.

Our progress on the roadmap includes:

- Electrifying operations: Our first 23 electrical compressors are online and we deployed an electric frac unit in 2023.
- Lower-carbon power: In 2023, we signed long-term agreements to enable over 475 megawatts of wind capacity for our assets in Texas and New Mexico. We also conducted behind-the-meter solar evaluation.
- Upgrading equipment: We have replaced all the pneumatic devices in our Permian unconventional operations, more than 6,000 in total.
- Deploying technology: We further expanded our methane detection and mitigation technology, eliminated routine flaring, and upgraded equipment.

Potential GHG abatement options for ExxonMobil Permian unconventional operated assets supporting 2030 net-zero plan[1]



2030 greenhouse gas emission-reduction plans[2]

We are working to continuously improve our performance, methods to detect and address methane emissions, and our measurement of emissions, with the aim to lower our emissions in support of our greenhouse gas emissions plans.

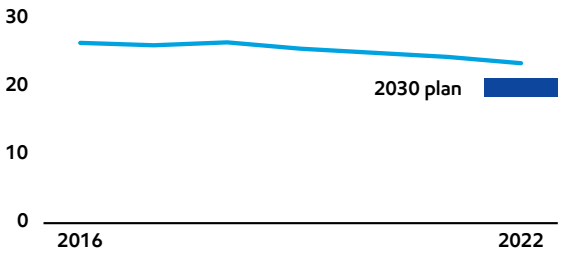
Our 2030 plans are expected to result in a 20%-30% reduction in corporate-wide greenhouse gas intensity, including reductions of 40%-50% in upstream intensity, 70%-80% in corporate-wide methane intensity and 60%-70% in corporate-wide flaring intensity. These plans apply to Scope 1 and 2 greenhouse gas emissions from our operated assets versus 2016 levels.

Our actions to reduce emissions through 2030 include:

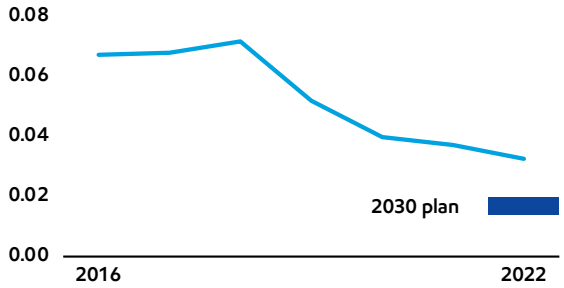
- Achieving net-zero Scope 1 and 2 greenhouse gas emissions in our Permian Basin unconventional operated assets.
- Deploying carbon capture and storage, hydrogen, and lower-emission fuels in our operations.
- Further reducing methane emissions at operated assets in alignment with the Global Methane Pledge and the Aiming for Zero Methane Emissions Initiative developed by the Oil and Gas Climate Initiative. To do this, we're deploying best practices and advanced technologies, including satellite, aerial, and ground-sensor networks.
- Further reducing flaring in upstream operations to meet the World Bank Zero Routine Flaring Initiative, which mitigates methane and greenhouse gas emissions.
- Integrating energy sources with lower emissions into our facilities, for example through long-term renewable power purchase agreements and equipment electrification.
- Improving energy efficiency in our businesses by adapting operational and maintenance processes, such as improving furnace performance.
- Substituting blue hydrogen for natural gas to reduce emissions from our manufacturing operations.
- Deploying innovative solutions to further reduce greenhouse gas emissions with future advancements in technology and supportive policies.

Progress toward 2030 greenhouse gas emission-reduction plans[3,4]

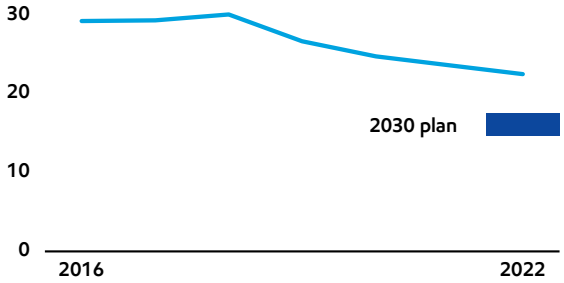
Corporate-wide operated GHG emissions intensity
(T CO_2e/100 T)
2022 year-end actual



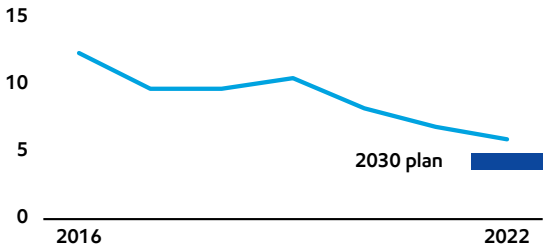
Corporate-wide operated methane emissions intensity
(T CH_4/100 T)
2022 year-end actual



Upstream operated GHG emissions intensity
(T CO_2e/100 T)
2022 year-end actual



Corporate-wide operated hydrocarbon flaring intensity
(m^3/T)
2022 year-end actual

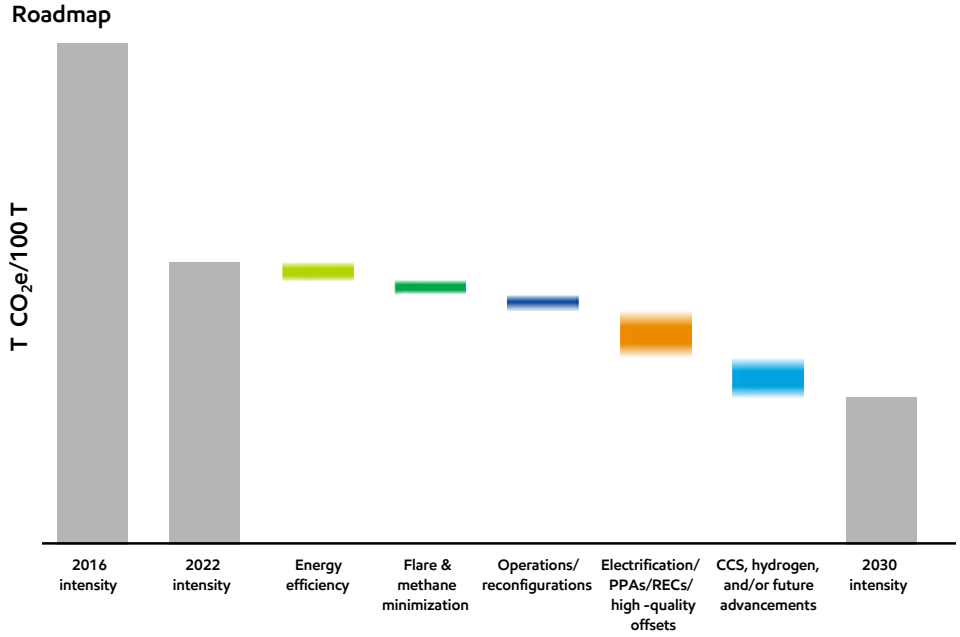


Approach to greenhouse gas emissions reductions in business planning

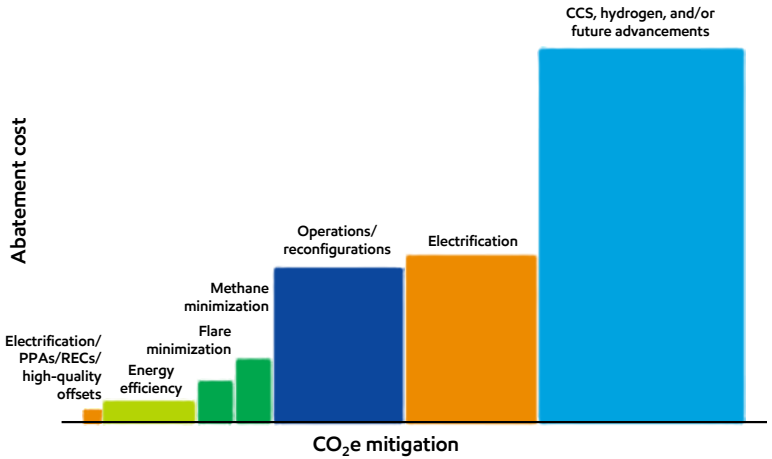
We incorporate actions needed to advance our 2030 emission-reduction objectives into our medium-term business plans, which we update annually. The reference case for planning beyond 2030, including impairment assessments and future planned development activities, is based on our Global Outlook. The Outlook considers the existing global policy environment, announced policy changes, technology advances, consumer preferences and the historical precedents for each of these areas. It does not attempt to project the degree of future policy, technology advancement, or deployment necessary for the world or ExxonMobil to meet net zero by 2050. As additional policies are implemented and technology advances beyond our estimates, we incorporate those changes into the Outlook and update our business plans accordingly as part of our annual planning cycle.

Potential GHG abatement options for ExxonMobil operated assets supporting 2030 GHG emission-reduction plans[5]

Roadmap



Abatement curve



Higher-cost options reflects the need for additional policy and continued advocacy.

Footnotes

1. These charts illustrate potential greenhouse gas abatement options for Scope 1 and 2 greenhouse gas emissions. These options are not all-inclusive and are subject to change as a result of a number of factors, including abatement reduction magnitude, implementation timing, abatement cost, portfolio changes, policy developments, technology advancements, and as annual company plans are updated. Includes energy attribute certificates, such as renewable energy certificates (RECs) and guarantees of origin (GOOs).
2. ExxonMobil's 2030 GHG emission reduction plans, https://corporate.exxonmobil.com/news/news-releases/2021/1201_exxonmobil-announces-plans-to-2027-doubling-earnings-and-cash-flow-potential-reducing-emissions.
3. Ibid.
4. Based on Scope 1 and 2 emissions of ExxonMobil operated assets through 2022 (versus 2016). ExxonMobil's reported emissions, reductions, and avoidance performance data are based on a combination of measured and estimated emissions data using reasonable efforts and collection methods. Calculations are based on industry standards and best practices, including guidance from the American Petroleum Institute (API) and Ipieca. There is uncertainty associated with the emissions, reductions, and avoidance performance data due to variation in the processes and operations, the availability of sufficient data, quality of those data, and methodology used for measurement and estimation. Performance data may include rounding. Changes to the performance data may be reported as part of the company's annual publications as new or updated data and/or emission methodologies become available. We are working to continuously improve our performance and methods to detect, measure and address greenhouse gas emissions. ExxonMobil works with industry, including API and Ipieca, to improve emission factors and methodologies, including measurements, and estimates.
5. These charts illustrate potential greenhouse gas abatement options for Scope 1 and 2 greenhouse gas emissions. These options are not all-inclusive and are subject to change as a result of a number of factors, including abatement reduction magnitude, implementation timing, abatement cost, portfolio changes, policy developments, technology advancements, and as annual company plans are updated. Includes energy attribute certificates, such as renewable energy certificates (RECs) and guarantees of origin (GOOs).

Resiliency

Testing resiliency under the IEA NZE scenario[1,2]

We have used the assumptions in the IEA NZE scenario to test the resiliency of our current portfolio even though the IEA acknowledges that society is not on the IEA NZE pathway.

Our testing methodology uses IEA's assumptions

We modeled a hypothetical business and investment portfolio based on the IEA NZE scenario and used a respected third party to conduct an independent audit and confirm the integrity of our model. The analysis included existing operations and future opportunities across our businesses in oil, natural gas, fuels, lubricants, chemicals, lower-emission fuels, hydrogen, and carbon capture and storage. We used IEA NZE assumptions relevant to these business areas to inform demand and pricing in our model:

- Oil prices decline to $24 per barrel by 2050; natural gas prices decline to $2-$4.60 per million British thermal units depending on region (both in real terms, 2019 USD).
- Oil and natural gas demand declines from 53% of total primary energy in 2020 to 19% by 2050.
- Chemicals demand increases by 30% from 2020 to 2050, with 80% of production leveraging carbon capture and storage or hydrogen technology integration.
- Carbon prices increase to $250 per metric ton in advanced economies, $200 per metric ton in China, Russia, Brazil, and South Africa, and $55 per metric ton in other emerging markets and developing economies (real terms, 2019 USD).
- Carbon capture and storage volumes expand rapidly from 40 million metric tons in 2020 to 7.6 billion metric tons in 2050, supported by a range of measures to increase investment.
- Lower-emission fuels, in which the IEA includes liquid biofuels, biogas and biomethane, and hydrogen-based fuels, increase from 1% of global final energy demand in 2020 to 20% in 2050.
- Hydrogen production increases by a factor of six, from 87 million metric tons in 2020 to 528 million metric tons in 2050.

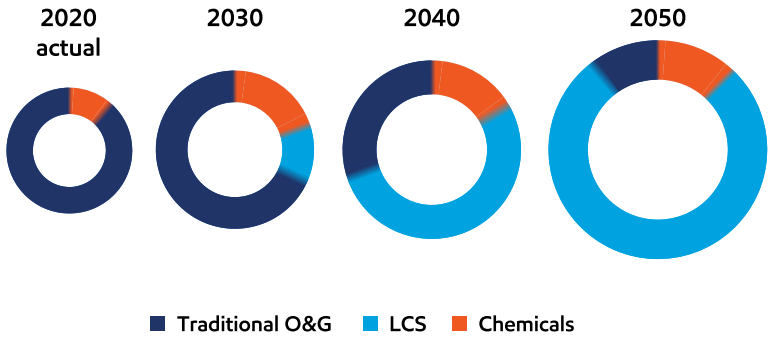
We developed additional assumptions consistent with the IEA NZE narrative as needed to estimate the performance of our portfolio. To use the IEA NZE price assumptions, we assumed that current prices decline to conform to IEA published prices by 2025 and that the path is linear between the price assumptions that IEA provided by decade thereafter. The IEA NZE scenario did not provide assumed margins for refining and chemical businesses. Therefore, for refining, we assumed margins decline to the lowest level needed to incentivize production required to meet IEA NZE oil demand. For chemicals, we modeled margins consistent with history, at a level sufficient to support the investment necessary to meet chemicals demand growth per the IEA NZE; the margins decline over time, partially offset by inflation.[3] For our Low Carbon Solutions business, we used IEA NZE demand assumptions and assumed the business investments attract reasonable returns based on our historical averages for similar business lines and products. Our modeling assumes that the resulting market position for existing and new areas as a percentage of demand under IEA NZE is in line with our current market positions in existing businesses. We assumed investment to abate estimated greenhouse gas emissions from our businesses by 2050. Annual inflation was set to 2.5%. We also assumed total capital expenditures through 2050 starting with our 2020 trailing five-year average and moving forward on a real basis, which is sufficient investment to maintain market share. On this basis, the results further support the growth in cash flow from our Low Carbon Solutions business under the IEA NZE scenario. Our competitors and peers have different portfolios, strategies, markets, and regulatory realities that lend themselves to different approaches and may lead to different results that are not necessarily comparable across companies, especially for those who anticipate a production decrease or an exit from the oil and natural gas business as part of their plans.

Outcomes of our testing

The chart illustrates potential changes to our business portfolio through 2050 from the modeling. It demonstrates that, under the IEA NZE assumptions, we have flexibility to continue to grow cash flows over time through reduced investments in oil and natural gas and increased investments in value-accretive projects in chemicals, carbon capture and storage, lower-emission fuels, and hydrogen. We disclose estimated operating cash flows over time, broken out by traditional oil and gas, chemicals, and Low Carbon Solutions to address enterprise resiliency questions. We believe this is an industry-leading disclosure because it provides a clearer view of the resiliency and enterprise value of our portfolio, expertise, and opportunities than hypothetical noncash accounting measures dependent on asset-specific assumptions not provided by the IEA NZE.

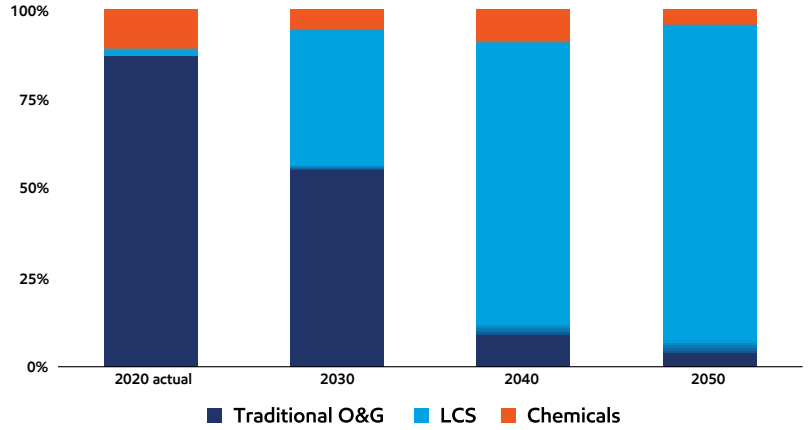
Operating cash flow modeled under IEA NZE 2050 scenario[4]

Trailing 5-year averages (nominal $)



Capital expenditures modeled under IEA NZE 2050 scenario[5]

Trailing 5-year averages



Our modeling illustrates a number of considerations for our business in an IEA NZE scenario. Through 2030, the upstream portfolio would further focus on resources with competitive cost while accelerating options to improve greenhouse gas emissions intensity. Assets with shorter production cycles, such as unconventional developments in the Permian, and a lower cost of supply, like deepwater production in Guyana, would continue to attract capital and generate competitive returns.

The energy transition creates opportunities for our existing assets, which could provide additional business optionality. If the IEA NZE scenario's long-term decline in oil and natural gas demand and pricing were to materialize, we would respond by ceasing oil and gas exploration in new basins along with reduced spending on new developments. Longer-term, through 2050 in this scenario, this potentially reduced investment would result in lower overall production as natural depletion outpaces investment in new volumes, with a continued portfolio focus on cost-efficient assets with low greenhouse gas emissions intensity. Existing oil and natural gas production assets would be optimized and operated as long as economically justified, consistent with IEA NZE assumptions, which project that global production of approximately 24 million barrels of oil and 170 billion cubic feet of natural gas per day would still be needed to meet demand in 2050.

In our Product Solutions portfolio, as production of traditional refined products declines through 2030 under the IEA NZE scenario, manufacturing sites would be reconfigured to shift production to meet the demand for non-combusted products like lubricants, basestocks, and chemicals, as well as to meet growth in lower-emission fuels and provide additional optionality for these assets in the energy transition. Current examples include investments and partnerships to increase renewable diesel production and transport, such as at our Strathcona refinery in Canada or Slagen facility in Norway.

Demand growth for chemical products, many of which generate lower life-cycle emissions relative to available alternatives, would be supported by value-accretive investments in our chemicals business. Examples include expansions currently underway in the U.S. Gulf Coast and Singapore, and at our China chemical complex. Longer-term through 2050, we would continue to optimize and potentially expand our integrated sites with flexibility to produce lower-emission fuels and chemicals while reducing their operational emissions. Additional integration with carbon capture and storage and/or fuel switching with hydrogen technology would further accelerate lowering greenhouse gas emissions intensity, with less advantaged sites potentially closed or converted to terminals.

Under IEA NZE, significant growth potential exists in the Low Carbon Solutions portfolio in lower-emission fuels, carbon capture and storage, and hydrogen. Our core capabilities and advantages, including subsurface expertise, scaling major projects, existing assets including infrastructure, and our people, would continue to position us to effectively compete. Throughout the modeled period, the increasing IEA NZE carbon price would support accelerating attractive investments that would increase cash flow in Low Carbon Solutions, offsetting reduced investment in traditional oil, natural gas, and fuels refining. Through 2030, we would focus on scaling lower-emission fuels options to meet the expected growing demand.

We would also pursue investments like the Baytown blue hydrogen project, acquisition of geologic storage to sequester CO_2, and participation in new potential industrial clusters that would advance new and existing infrastructure opportunities and position us as a partner of choice. Longer-term through 2050, the carbon price and demand for decarbonization options would continue to grow rapidly in the scenario, leading to a significant shift in our capital spend to further scale carbon capture and storage and hydrogen.

Third-party independent audit of ExxonMobil's modeling of IEA NZE

After an extensive search, we enlisted an independent third party, Wood Mackenzie Inc., to audit our portfolio model. The objectives of the audit were to confirm the integrity of the calculations and overall model functionality and to validate that the model accurately reflected the IEA NZE's assumption inputs, ensuring the output is a reasonable expression of the portfolio mix as defined by the model inputs.

The Wood Mackenzie audit included testing and confirming the integrity of the ExxonMobil Portfolio Model, including evaluation of each business under the IEA NZE. They also confirmed that the IEA NZE assumptions are accurately reflected in the portfolio model. Specifically, Wood Mackenzie validated the following:

- The IEA Net Zero assumptions are accurately reflected in the model.
- Model calculations are correct.
- There are no data translation errors.
- The output is a reasonable representation of portfolio mix as defined by model inputs.

As a global research and consultancy business with 50 years of experience, Wood Mackenzie partners with organizations to provide quality data, analytics, and insights used to power the natural resources industry.[6] To view the 2022 Wood Mackenzie independent audit statement, click here.[7]

Considering IEA NZE by 2050 scenario updates

The IEA NZE by 2050 scenario is back-cast, meaning that the outcome of net-zero CO_2 emissions in 2050 is fixed, with the scenario working backward to present one view of supply, demand, geopolitical, technology and market assumptions to achieve this set objective. While hypothetical, this type of rationale may be of use to consider the significant challenges present in an aggressive scenario. We directly leveraged the assumptions made by the IEA in their NZE scenario to assess our business and investment portfolio, with the outcome demonstrating our resiliency. Since the initial release in 2021, the IEA has continued to make updates to their NZE scenario.[8]

The IEA also continues to share updates on energy-related CO_2 emission levels[9] as well as the critical technologies[10] and clean energy investments[11] assumed necessary. These publications highlight that multiple key areas are not progressing as assumed in the NZE scenario. With these key areas lagging, updates to the back-cast NZE scenario must address an increased total amount of emissions reduction in a shorter time period to achieve the set 2050 net-zero objective.

Fundamentally, an update that increases improvements needed while shortening the time allowed means that each iteration of the NZE's methodology leads to assumptions that increase the importance of lower-carbon solutions. These NZE scenario updates have not changed the outcome of our assessment, which highlights resiliency through investment flexibility across options that are both needed and consistent with our core capabilities, including lower emissions-intensity oil and natural gas, chemicals, carbon capture and storage, lower-emission fuels, and hydrogen.

The differences that remain apparent between current progress in lowering emissions and the aspirational assumptions outlined by the NZE scenario updates point to further need for society to advance supportive policies, effective carbon markets, and technology solutions to enable progress. We are doing our part, building an entire Low Carbon Solutions business dedicated to reducing emissions – both our own and others – and spending billions of dollars on solutions that have a real, sustainable impact.

Assessing potential impacts

The following is intended to address the potential impacts through 2050 to our proved reserves, resources, evaluation of asset impairments, and other measures, considering the discussed scenarios' ranges of oil and natural gas demand.[12]

In assessing various aspects of resiliency, we believe taking a portfolio approach is the most appropriate way for ExxonMobil to provide transparency in our analysis of the potential impacts of any energy transition scenario, including the IEA NZE. Additionally, as an integrated company with assets around the world, we have seen that economic events and trends may have a negative effect on one asset and an offsetting positive effect on others, with a minimal net effect on the full portfolio. When individual subsurface and energy system assets are analyzed in isolation from the full portfolio, the analysis is vulnerable to misinterpretation of the interplay among assets in the market and the optionality that assets may have in a specific region in the energy transition. This may provide a misleading picture of our resiliency and enterprise value. While one group of assets may perform below expectations for a period of time, other assets may perform above expectations – such is the nature of this cyclical industry. Numerous examples have occurred over time, with Russia's invasion of Ukraine providing a recent example of the value of our diversified portfolio. While we experienced a loss of value from the expropriation of our Russian assets, the international sanctions contributed to a rise in global commodity prices, increasing the value of many of our other Upstream assets. We believe an analysis that fails to account for these details could both misrepresent the value of the portfolio and miss important macro factors such as energy reliability and security. We do not believe this approach provides meaningful disclosure to investors.

We believe the energy transition is likely to unfold at an uncertain pace with variation in technology and policy by region. The individual assets in our portfolio respond differently to economic signals, technology evolution, commodity prices, regional differences, government policies, and many other variables. Even where global benchmark prices are given, local prices, including differentials, are influenced by external factors that cannot be reliably predicted. Third-party scenarios offer some assumptions related to these variables; however, determining impacts by individual asset requires additional forecasts, projections, and cost estimates that cannot be reasonably predicted. Publicly providing individual asset modeling for remote scenarios risks conveying a false level of precision.

To further support our portfolio approach, we believe using the IEA NZE in a hypothetical individual asset impairment analysis is inconsistent with the principles outlined under U.S. GAAP, which specifies that impairment analyses should be based on assumptions that are "reasonable in relation to" our planning basis. Our planning basis is our Global Outlook, which is a projection of supply and demand through 2050. The assumptions in the IEA NZE significantly vary from our Outlook, and the IEA has acknowledged that its NZE is an extremely aggressive scenario, and that society is not currently on this pathway. Providing detailed asset-specific public disclosure regarding remaining useful lives, retirement costs, and potential proved reserves changes in an IEA NZE scenario could imply a higher degree of certainty or accuracy than exists. In addition, as the energy transition progresses, disclosing this type of detailed asset-level information could provide a competitively sensitive roadmap of how we might make adjustments in our portfolio. For these reasons, we do not provide hypothetical, individual asset accounting analysis using the IEA NZE. We believe looking at the evolution of our portfolio operating cash flows, which reflect how investment decisions may change under the IEA NZE, provides a better demonstration of our resiliency and enterprise value with less potential to confuse our stakeholders.

Use of sensitivity analysis

Sensitivity analysis provides greater perspective on how variations to our Outlook assumptions could affect projected energy supply and demand. Analyzing these sensitivities involves evaluating possible technology advancements and their potential impact on energy supply and demand. This results in a range of potential low- to high-demand outcomes for certain energy sources. The projections yielded by sensitivity analysis do not represent our viewpoint or the likelihood of these alternatives, but can provide context.

Proved reserves

Proved reserves are assessed each year and reported in our annual report on Form 10-K in accordance with rules of the U.S. Securities and Exchange Commission. Based on 2022 production schedules, a substantial majority of our year-end 2022 proved reserves are expected to have been produced by 2050. For the remaining year-end 2022 proved reserves that are projected to be produced beyond 2050, the reserves are generally associated with assets where the majority of development costs are incurred before 2050. While these proved reserves may be subject to more stringent climate-related policies in the future, technology advancements and targeted investments could mitigate production-related greenhouse gas emissions and associated costs. In addition, these mature assets generally have a lower risk profile given the experience and technical knowledge accumulated over many decades of production.

Resources

We maintain a large and diverse portfolio of undeveloped resources that provide flexibility to develop new supplies to meet future demand. We work to enhance the quality of this resource base through successful exploration, application of new technology, acquisitions, divestments, and ongoing development planning and appraisal activities.

The underlying economics of commercializing resources depend on a number of factors that are assessed annually. Decisions can range from developing the resource (which eventually moves to proved reserves), monetizing the resource by selling it to others, or exiting the resource. All investments are tested over a wide range of commodity price assumptions and market conditions. In scenarios like the IEA NZE, higher-cost assets could become disadvantaged without active portfolio management.

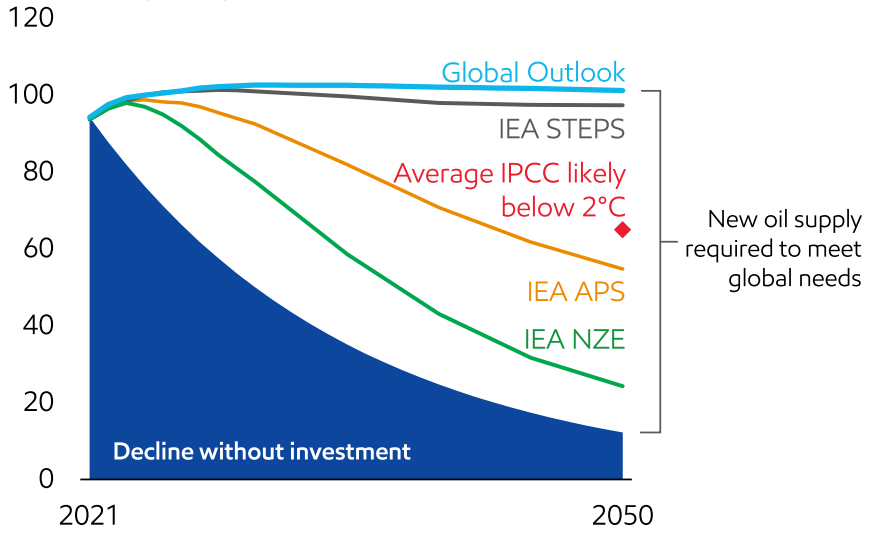
In light of the multiple and dynamic factors that influence governments' diverse approaches to regulating resources and industry's decisions to commercialize undeveloped resources, it is not possible to identify which specific assets will ultimately be developed. For example, regional policies that constrain supply in one area could enhance returns in others. Alternatively, geopolitical conflict affecting resources in one region could advantage resources in another, making diverse long-lived assets a hedge against instability. Ultimately, we are confident in our ability to apply high-impact technologies to position our portfolio to compete successfully in a broad range of scenarios.

Significant investment still needed under Likely Below 2°C and IEA NZE scenarios[13]

In the IPCC Likely Below 2°C scenarios, average global oil demand is projected to decline from approximately 90 million barrels per day in 2021 to about 65 million in 2050. The IEA NZE scenario projects about 24 million barrels per day of demand in 2050. Without future investment, world oil production would be expected to drop to about 12 million barrels per day due to natural field decline. In the IEA NZE scenario, additional investment of approximately $8 trillion through 2050 will be required in oil and natural gas to meet the world's energy demand.[14] Even under IEA NZE, new discoveries will be needed to support energy security and reliable supply in the face of geopolitical uncertainty.

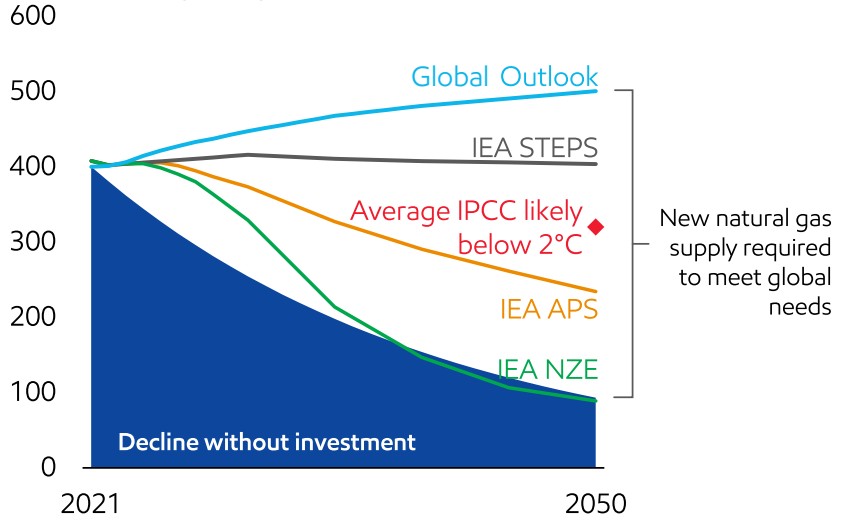
Global oil supply and demand

Million barrels per day



Global gas supply and demand

Billion cubic feet per day

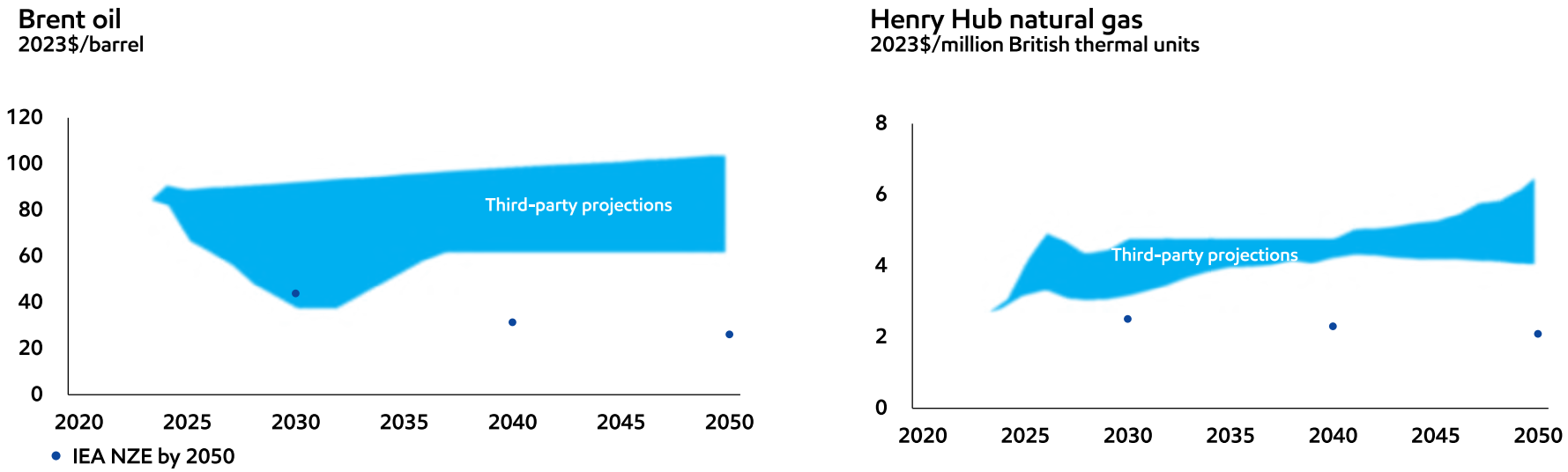


The supply gap to 2050

Significant investment would be needed to meet even the rapidly declining demand for oil and gas envisioned in the IEA's Net Zero Emissions by 2050 scenario. In 2050, IEA STEPS projects a price of $83 per barrel and a U.S. natural gas price of $4.3 per million British thermal units (prices in 2022 U.S. dollars).

Our Outlook estimates energy-related CO_2 emissions in 2050 to have dropped by almost 25% versus 2021 to 25 billion metric tons per year – approximately 5% lower than IEA STEPS. Our Outlook projects higher future demand for oil and natural gas, partially based on a larger share of global economic growth coming from emerging economies, as they improve access to energy vital for human development. The Outlook also reflects higher growth of carbon capture and storage and low-carbon hydrogen based on our insights into these technologies, which are critical solutions for net-zero pathways.

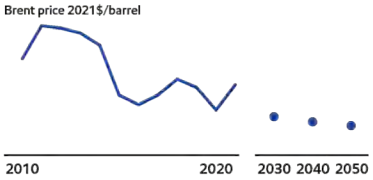
Third-party price projections versus IEA NZE price[15]



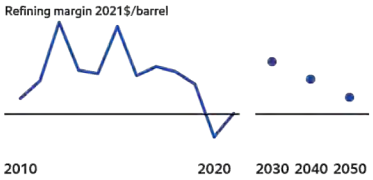
The company's projections for prices are proprietary. Our Global Outlook forms the basis of our business planning and is used for commercial decisions and economic evaluations. Our near-term prices are informed by market conditions. For mid- to longer-term, our prices are in the range of third-party projections published by reputable organizations with significant industry expertise. The pricing is also well within historical bands.[16]

Footnotes

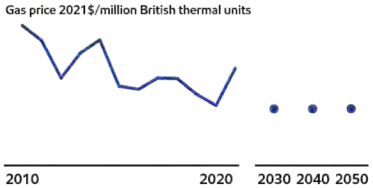
1. The Use of Scenario Analysis in Disclosure of Climate-related Risks and Opportunities – TCFD Knowledge https://www.tcfdhub.org/scenario-analysis/.
2. The statements and figures contained in this section are hypothetical in nature, do not constitute a forecast of future company performance and are based on assumptions from International Energy Agency (2021), Net Zero by 2050, IEA, Paris.
3. Forward price and margin assumptions used in IEA NZE modeling; historical values provided for context.



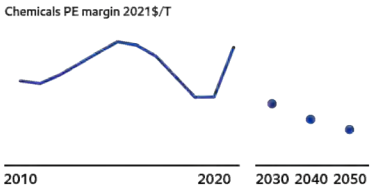
Source: historical – Platts Dated Brent; forward – IEA NZE by 2050 (2021)



Source: historical – Platts and ExxonMobil analysis, based on industry average Opex and ExxonMobil historical capacity; forward – ExxonMobil analysis incorporating IEA NZE by 2050 (2021) demand



Source: historical – Settled NYMEX Henry Hub; forward – IEA NZE by 2050 (2021)



Source: historical – IHS Markit, Platts and company estimates based on ExxonMobil capacity; forward – EM analysis incorporating IEA NZE by 2050 (2021) demand

4. ExxonMobil analysis, IEA NZE by 2050 (2021). Supplemental information for non-GAAP and other measures. This chart mentions modeled operating cash flow in comparing different businesses over time in a future scenario. Historic operating cash flow is defined as net income, plus depreciation, depletion and amortization for consolidated and equity companies, plus noncash adjustments related to asset retirement obligations plus proceeds from asset sales. The Company's long-term portfolio modeling estimates operating cash flow as revenue or margins less cash expenses, taxes and abandonment expenditures plus proceeds from asset sales before portfolio capital expenditures. The Company believes this measure can be helpful in assessing the resiliency of the business to generate cash from different potential future markets. The performance data presented in the publication and its associated supplement, including on emissions, is not financial data and is not GAAP data.
5. ExxonMobil analysis, IEA NZE by 2050 (2021).
6. Wood Mackenzie, https://www.woodmac.com/about/our-story/.
7. Note: 2022 opinion letter references page numbers from the 2023 Advancing Climate Solutions Progress Report.
8. International Energy Agency (2021), Net Zero by 2050, IEA, Paris; IEA NZE scenario per World Energy Outlook 2022, IEA, Paris; IEA Net Zero Roadmap: A Global Pathway to Keep the 1.5°C Goal in Reach 2023 Update, IEA, Paris.
9. "Global energy-related CO_2 emissions grew by 0.9% or 321 Mt in 2022, reaching a new high of over 36.8 Gt." - CO_2 Emissions in 2022 – Analysis - IEA.
10. "Of the over 50 components tracked, in the 2023 edition 3 are evaluated as fully "On track"" (vs. NZE scenario) - https://www.iea.org/reports/tracking-clean-energy-progress-2023.
11. "Scaling up clean investment is the key task for the sustainable and secure transformation of the energy sector" - https://www.iea.org/data-and-statistics/charts/historical-investment-in-energy-benchmarked-against-needs-in-iea-scenarios-in-2030.
12. For the purposes of this report, "proved reserves" means estimated year-end 2022 proved oil and gas reserves for consolidated subsidiaries and equity companies which was reported in the Corporation's 2022 Annual Report on Form 10-K. Proved oil and gas reserves are determined in accordance with Securities and Exchange Commission (SEC) requirements. Proved reserves are those quantities of oil and gas which, by analysis of geoscience and engineering data, can be estimated with reasonable certainty to be economically producible under existing economic and operating conditions and government regulations. Proved reserves are determined using the average of first-of-month oil and natural gas prices during the reporting year. For the purposes of this disclosure, resources are total remaining estimated quantities of discovered oil and gas that are expected to be ultimately recoverable. The resource base includes proved reserves and quantities of oil and gas that are not yet classified as proved reserves.
13. IEA World Energy Outlook 2023, ExxonMobil analysis, ExxonMobil 2023 Global Outlook, IPCC Sixth Assessment Report, Likely Below 2°C scenarios refers to Category C3.
14. ExxonMobil analysis based on IEA World Energy Outlook 2023, Figure 3.22.
15. IEA NZE by 2050 (2021), Third-party oil price projection range includes:
    a. FACTS Global Energy Group – Forecast of Crude Oil Prices and Differentials. (October 2023); Global Oil Market Outlook (July 2023).
    b. Wood Mackenzie – Macro Oils Investment Horizon Outlook (October 2023).
    c. Rystad Energy – UCube (October 2023).
    d. S&P Global Commodity Insights – Energy Price Portal (October 2023). North American Crude Oil Markets Short-Term Outlook (October 2023). Global Fundamentals Crude Oil Markets Price Long-Term Outlook: 3Q2023 (September 2023).
    e. U.S. Energy Information Administration – Short-Term Energy Outlook (October 2023). Annual Energy Outlook (March 2023).

    Third-party gas price projection range includes:
    a. Rystad Energy – UCube (October 2023).
    b. Wood Mackenzie – Global Gas Investment Horizon Outlook (October 2023).
    c. S&P Global Commody Insights – Energy Price Portal (October 2023). North American Natural Gas Short-Term Outlook (October 2023). North American Gas Long-Term Outlook (August 2023).
    d. U.S. Energy Information Administration – Short-Term Energy Outlook (October 2023). Annual Energy Outlook (March 2023).
16. For example, from 2010 to 2022, annual Brent crude prices ranged from $112 a barrel to $42 a barrel. For the same period, annual Henry Hub natural gas price ranged between $6.45/mmbtu and $2.03/mmbtu. Source: U.S. EIA Brent and Henry Hub Annual Spot Price; May 3, 2023 (nominal dollars). U.S. EIA Brent and Henry Hub Annual Spot Price; May 3, 2023 (nominal dollars).

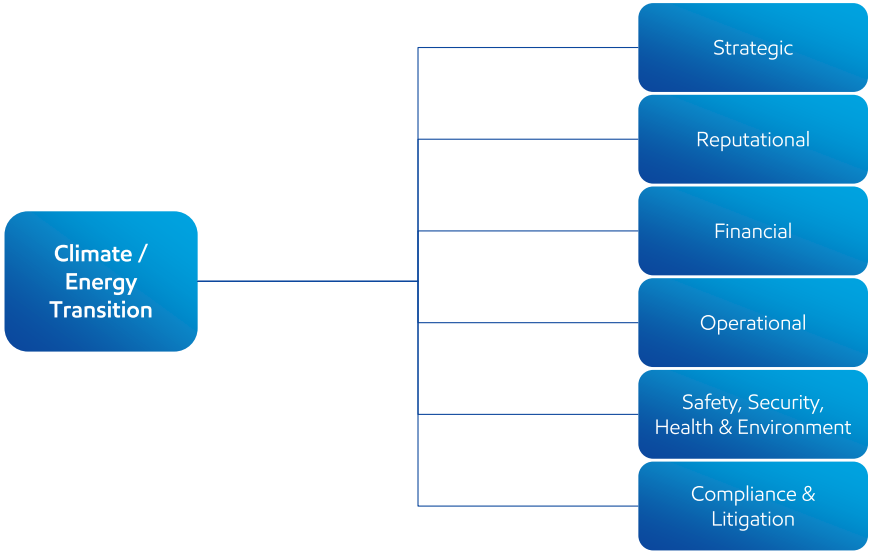
Risk management

Our risk management approach

Our Enterprise Risk Management Framework provides a comprehensive and structured approach to identify, prioritize, understand, and manage ExxonMobil's most important risks. It is designed to drive consistency across risk types and support monitoring key risks. For more details on the risks we consider and manage, refer to Item 1A. Risk Factors in the 10-K.

Examples of potential risks

Managing long-term risks associated with climate change and the energy transition is a key part of managing a broad spectrum of interrelated risks.



Our enterprise risk framework includes five elements:

1. A way to organize and aggregate risks.
2. Robust risk identification practices.
3. A prioritization method.
4. Systems and processes to manage risk.
5. Risk governance to support oversight.

Our approach to risk governance is multilayered and includes clearly defined roles and responsibilities for managing each type of risk. It includes a definition of the responsibilities of risk owners, functional experts, and independent verifiers. Each risk type is managed and supported by organizations that actively execute risk management processes and are responsible for specifying corporate requirements and processes. Each of these processes includes the critical elements of leadership, people, risk identification and management, and continuous improvement. Oversight responsibilities by the Management Committee and the Board and its committees are a key part of risk governance. Our Management Committee consists of our Chief Executive Officer, our Chief Financial Officer, and our two Senior Vice Presidents.

Protection of assets, the community, and the environment

We have extensive experience operating in a wide range of challenging physical environments around the world.

Effective risk management requires the ongoing assessment and mitigation of potential impacts to our people, our assets, the community, and the environments in which we operate. Before pursuing a new development, we use data and advanced computer modeling to assess the full range of potential environmental, socioeconomic and health risks associated with potential construction and operations. We also consult with communities through public meetings and other outreach, and we work with regulators to share information and seek necessary approvals. This process gives us a comprehensive understanding of possible impacts, which we use to implement measures to avoid, reduce, or remedy environmental, socioeconomic, and health risks or impacts.

When considering physical environmental risks, we evaluate the type and location of facilities and investments. As an example, changes in patterns of waves, wind, or ice floes can affect offshore facilities. Onshore facilities could be vulnerable to sea level rise, changes in storm surge, flooding, changes in wind and seismic activity, or geo-technical considerations. We conduct environmental assessments before building and operating facilities to ensure that protective measures and procedures are in place.

Hebron

The Hebron platform is located off the coast of eastern Canada in 92 meters of water. The platform is a reinforced concrete gravity-based structure designed to withstand sea ice, icebergs, and meteorological and oceanographic conditions. Hebron was engineered and wave-tank tested for storms so extreme they may occur only once every 10,000 years. On Nov. 14, 2018, the Grand Banks saw its largest storm in 30 years, estimated as a 100-year return period event. Following temporary shutdown of all Grand Banks platforms, Hebron was up and running within a week without any major issues.

Our scientists and engineers are industry experts across a variety of disciplines. Through their active participation and leadership in industry groups, they advise and gather insights to inform and improve industry standards which, in turn, are adopted to enhance our standards and procedures. We follow industry practices such as the American Society of Civil Engineers' Climate Resilient Infrastructure: Adaptive Design and Risk Management manual of practice.[1]

Industry standards, including American Society of Civil Engineers (ASCE 7)[2] Minimum Design Loads and Associated Criteria for Buildings and Other Structures, are also used along with professional experience to cover a range of uncertainties. After construction of a facility, we monitor and manage ongoing facility integrity through periodic checks of key aspects of the structures.

Gulf Coast Growth Venture

The Gulf Coast Growth Venture, a petrochemical manufacturing facility near Corpus Christi, Texas, is compliant with both San Patricio County and national standards (ASCE 7). Stormwater handling is a risk factor associated with the facility, so the design includes basins to retain excess stormwater to supplement the capacity of the municipal water system. The design, construction, and operations of petrochemical facilities are highly regulated by the Texas Commission on Environmental Quality.

Company representatives held hundreds of outreach meetings with local organizations, chambers, government agencies, civic groups, and neighborhoods and have addressed comments and concerns raised during the permitting process. More information on the Texas Commission on Environmental Quality permitting process can be found on its website.[3]

Once facilities are in operation, we maintain disaster preparedness, response, and business continuity plans. Detailed, well-practiced, and continuously improved emergency response plans are tailored to each facility to help us prepare for unplanned events, including extreme weather. Periodic emergency drills are conducted with appropriate government agencies and community coalitions to help heighten readiness and minimize the impacts of an event. Strategic emergency support groups are established around the world to develop and practice emergency response strategies and assist field responders. Regardless of the size or complexity of any potential incident, each ExxonMobil facility and business unit has access to readily available trained responders, including regional response teams, to provide rapid tactical support.

Footnotes

1. American Society of Civil Engineers Climate- Resilient Infrastructure: Adaptive Design and Risk Management, https://doi.org/10.1061/9780784415191.
2. American Society of Civil Engineers (ASCE 7) Minimum Design Loads and Associated Criteria for Buildings and Other Structures, https://doi.org/10.1061/9780784415788.
3. Texas Commission on Environmental Quality permits and registration, https://www.tceq.texas.gov/permitting/business_permitting.html.

Research and development

Our unique and sustained approach to R&D

We take a fundamental approach to our research, which seeks to identify and progress new technologies that, once proven, could be deployed at a commercial scale by market participants.

As we work to advance carbon capture and storage, hydrogen and lower-emission fuels opportunities, we are also investing in research and development aimed at next-generation, lower-emission solutions. We determine which research projects to advance based on factors including advantage versus alternatives, the ability to scale, alignment with core capabilities and key partners, and the probability of commercial success.

Thousands of scientists and engineers, including more than 1,500 Ph.D.s, work at ExxonMobil. In R&D, they are exploring areas such as new catalytic and separation materials, novel low-energy process development and scale-up, advanced performance materials, and improved means of CO_2 storage. Our scientists have written more than 1,000 peer-reviewed publications and received more than 10,000 patents over the past decade. In addition, we collaborate with more than 80 universities around the world, four energy centers, and several U.S. national laboratories. These collaborations have increased knowledge in key areas important to the energy transition: fugitive methane emissions detection and modeling; optimization techniques to understand CO_2 storage; electrification of processes; lower-emission fuels; and energy systems models.

We also monitor emerging lower-emission technologies for future research opportunities and to improve understanding of likely energy transition pathways. Our research and development approach focuses on areas that align with our businesses.

Core R&D capabilities

- Engineering
- Process & scale-up
- Production technology
- Geoscience
- Emerging technology
- Modeling & data science
- Energy modeling
- Biology
- Catalysis
- Chemistry
- Physics
- Materials science

Energy center collaborations

Stanford | ENERGY Strategic Energy Alliance

SINGAPORE ENERGY CONSORTIUM

The University of Texas at Austin Energy Institute

MITei MIT Energy Initiative

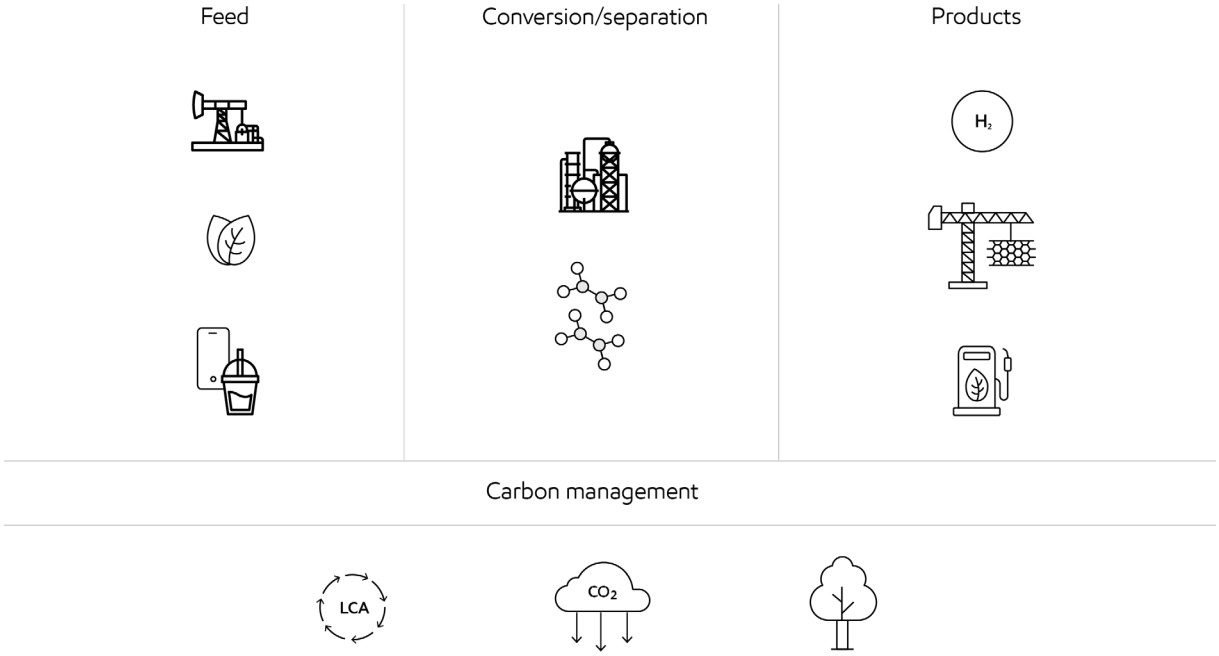
National labs

NATIONAL ENERGY TECHNOLOGY LABORATORY

NREL NATIONAL RENEWABLE ENERGY LABORATORY

INL Idaho National Laboratory

Innovating across our value chain



Feed

Biomass – We are working to expand the range of options for biofuels feedstocks, ranging from vegetable oils to wood wastes, cover crops, and more. These have potential application at our biofuels facilities, such as our Strathcona renewable diesel plant and future advanced biofuel deployments.

Plastic waste – We focus on plastics that are difficult to recycle mechanically, allowing us to use a wider range of mixed and soiled plastic waste to make valuable raw materials safely, reliably, and economically at scale.

Methane detection – We are testing and deploying innovative technology on the ground, in the sky, and even in space to identify and mitigate fugitive emissions in our natural gas value chain, which supports the production of low-carbon hydrogen.

Conversion/separation

New catalysts – Our catalysts have applications in performance materials and lower-emission fuels, including renewable fuels. For example, our dewaxing catalyst provides higher yield with less hydrogen consumption while improving the diesel flow at low temperatures.

Low-energy separations – Reducing the energy needed to sort molecules (i.e., isolate hydrocarbons for use in the refining or chemical process) can dramatically reduce emissions in our manufacturing. Our scientists are building off years of research with university partners to identify ways to improve the scalability of this technology.[1,2]

GHG abatement and energy efficiency – As part of our GHG roadmaps, we are working across our sites to apply modeling that can drive efficiencies, support future deployment of carbon capture in our operations, explore opportunities for electrification and heat recovery, and pursue the full range of large and small optimizations that may lower emissions.

Products

Hydrogen – We are developing improved, lower-cost technology for production of low-carbon hydrogen at scale. We are also working with leading combustion equipment manufacturers on burners to enable industrial fuel switching to hydrogen while controlling NOx emissions. In addition, we are working with the U.S. Department of Energy and industry organizations to evaluate safe and cost-effective hydrogen transport, which could enable us to grow the supply of hydrogen for a wide range of end users.[3]

Performance materials – We are developing and deploying new thermosets, thermoplastics, fillers, and lubricants to enable improved performance while using less materials and reducing energy use for products used in society. For example, our Proxxima™ thermoset resin system, based on Nobel Prize-winning technology, provides stepout advantages in a range of applications including wind turbine blades, concrete reinforcement, and automotive applications. We are also studying additional opportunities for materials in the energy transition.

Lower-emission fuels – Our continuing research in advanced biofuels could lead to improved longer-term solutions by converting lower-value, bio-based feedstock into renewable fuels. For example, we have identified a new pathway for the production of sustainable aviation fuel (SAF) from renewable methanol, which can produce jet fuel with high selectivity and lead to reduced GHG emissions. In addition, we are leading the industry through a technical evaluation of this pathway to certify its use in aircraft.

Carbon management

Post-combustion carbon capture – ExxonMobil and Mitsubishi Heavy Industries (MHI) have entered a strategic alliance to deploy MHI's leading CO_2 capture technology as part of ExxonMobil's end-to-end carbon capture and storage solution for industrial customers. The alliance also leverages our combined core capabilities in engineering and science to advance the carbon capture technology for improved performance and lower overall cost of CO_2 capture.

With our partner FuelCell Energy, we are progressing the development of a next-generation carbonate fuel cell technology for CO_2 capture from industrial point sources. A project is planned at our Rotterdam refinery to validate fuel cell performance and lower cost of CO_2 avoidance in an industrial deployment. We are developing commercialization options as part of our Low Carbon Solutions portfolio.

Direct air capture (DAC) – We believe there is potential for direct air capture to play an important role in reducing greenhouse gas emissions, and ExxonMobil plans to play a lead role in accelerating the development of cost competitive and scalable DAC technology with our in-house expertise and select partners. We are planning for a prototype demonstration of our DAC platform in early 2024. Our goal is to produce a low-cost commercial platform at scale, in line with the improvements we expect to realize through rapid learning cycles.

Carbon storage – To support the required scale-up of global geologic CO_2 storage, we continue to build on our experience and develop improvements such as rapid modeling tools. One such example is our support for Stanford University to develop a machine learning framework for CO_2 storage modeling.[4] Approaches like this have the potential to enable real-time modeling. Another area is our collaboration with the University of Texas at Austin, the National Energy Technology Laboratory, and Brooklyn College and the Benjamin Levich Institute at City College, both part of City University of New York, where our laboratory simulations indicate that the pore-scale sealing of caprocks is maintained under geological CO_2 storage conditions.

Nature-based solutions – We continue to evaluate the potential opportunities to remove carbon from the atmosphere, including prairies, grassland, and other nature-based options.

Life-cycle assessment – The Sustainable Energy System Analysis Modeling Environment (SESAME) tool we have been developing with the MIT Energy Initiative can perform full life-cycle assessments for more than 1,000 technology pathways, from primary energy sources to final products or services.[5]

Footnotes

1. K. Thompson, R. Mathias, D. Kim, J. Kim, N. Rangnekar, J. Johnson, S. Hoy, I. Bechis, A. Tarzia, K. Jelfs, B. McCool, A. Livingston, R. Lively, M. Finn, N-Aryl-linked spirocyclic polymers for membrane separations of complex hydrocarbon mixtures, Science 369 (6501) (2020) 310-315.
2. Siyao Li, Ruijiao Dong, Valentina-Elena Musteata, Jihoon Kim, Neel D. Rangnekar, J. R. Johnson, Bennett D. Marshall, Stefan Chisca, Jia Xu, Scott Hoy, Benjamin A. McCool, Suzana P. Nunes, Zhiwei Jiang, Andrew G. Livingston, Hydrophobic polyamide nanofilms provide rapid transport for crude oil separation, Science 377 (6614) (2022) 1555-1561.
3. HyBlend Project to Accelerate Potential for Blending Hydrogen in Natural Gas Pipelines, https://www.nrel.gov/news/program/2020/hyblend-project-to-acceleratepotential-for-blending-hydrogen-in-natural-gas-pipelines.html; HyBlend: Pipeline CRADA Materials R&D, https://www.hydrogen.energy.gov/docs/hydrogenprogramlibraries/pdfs/review22/in035_san_marchi_2022_o-pdf.pdf.
4. Gege Wen, Zongyi Li, Kamyar Azizzadenesheli, Anima Anandkumar, Sally M Benson, Real-time high-resolution CO_2 geological storage prediction using nested Fourier neural operators, Energy & Environmental Science 16 (2023) 1732-1741.
5. E. Gencer, S. Torkamani, I. Miller, T. Wu, F. O'Sullivan, Sustainable energy system analysis modeling environment: analyzing life-cycle emissions of the energy transition, Applied Energy 277 (2020) 115550.

Advocating for essential policy support

We recognize the important role that supportive government policies play in the development and deployment of lower-emission technologies, including those that are part of our Low Carbon Solutions business.

Clear and consistent policies, along with advancements in technology, can act as an accelerator for lower-emission alternatives, which is why we actively participate in climate-related policy engagements around the world, including our work with the IPCC.

We focus on practical policy solutions that consider both sides of the "and" equation: rising global demand for affordable, reliable energy, and scalable development of technologies with lower greenhouse gas emissions.

Understanding life-cycle emissions to better inform policy decisions

We have been working with the MIT Energy Initiative to develop a new life-cycle approach tool that covers pathways of multiple technologies representing most sources of greenhouse gas emissions. This tool, called the Sustainable Energy System Analysis Modeling Environment (SESAME),[1] is based on well-referenced, peer-reviewed public sources. It will evolve to perform full life-cycle analyses for more than 1,000 technology pathways, from primary energy sources to final products or services including those from the power, transportation, industrial, and residential sectors. To date, a series of SESAME-related publications in peer-reviewed journals have been released exploring areas such as the U.S. electric power systems.[2,3,4]

For example, a coordinated and transparent economy-wide price on carbon such as a carbon tax would enable all technologies to compete and cost-effectively lower carbon emissions intensity by focusing on reducing emissions per unit of energy while delivering meaningful emission reductions. Broad adoption of an economy-wide price on carbon could also help spur the development of global carbon markets as envisioned in Article 6 of the Paris Agreement.

In the absence of economy-wide carbon pricing, well-designed sector-based policy options, along with technology advancements, could also be an effective way to reduce emissions. We support the approaches outlined below, which help address greenhouse gas emissions in hard-to-decarbonize sectors of the economy, including manufacturing, transportation, and power generation.

Manufacturing

To reduce industrial emissions in the manufacturing sector, our focus is on both carbon capture and storage and hydrogen. To drive investment and deploy these technologies at the pace and scale needed for a net-zero future, governments must establish durable regulatory and legal frameworks as well as incentives similar to those available for more established lower-emission technologies such as solar and wind. The U.S. Inflation Reduction Act (IRA), enacted in 2022, provides some of the government support described in this document. The IRA leverages a life-cycle assessment approach as the method for assessing the greenhouse gas emissions of low-carbon hydrogen and transportation fuels, and it defines the value of corresponding credits by the emissions intensity achieved on a life-cycle basis.

We support a policy and regulatory framework for carbon capture and storage that would:

- Sustain long-term government support for research and development.
- Provide standards to ensure safe and secure CO_2 storage.
- Allow for fit-for-purpose CO_2 injection well design standards.
- Provide legal certainty for geologic storage ownership.
- Ensure a streamlined permitting process for carbon capture and storage facilities.
- Provide access to CO_2 storage capacity owned or controlled by governments.
- Allow for high-quality offsets generated from carbon capture and storage, low-carbon, and carbon-removal projects.

We are participating in several studies, including the National Petroleum Council's report on low-carbon hydrogen, to assess emissions during hydrogen production and transportation as well as the benefits of hydrogen on a full life-cycle intensity basis versus alternatives.

Transportation

A holistic low-carbon transport policy that combines a market-based, technology-neutral fuel standard with a life-cycle vehicle CO_2 emission standard could drive emission reductions across the entire vehicle fleet.

We advocate for a carbon intensity-based fuel standard approach that can be extended to the aviation and marine sectors. We are a lead participant in developing the American Petroleum Institute's policy framework that includes actions to reduce life-cycle emissions in the U.S. transportation sector.

Power generation

A technology-neutral clean-energy standard or carbon-intensity standard could reduce CO_2 emissions in the electricity sector by setting targets based on carbon intensity and incentivizing necessary infrastructure and lower-emission options. These include natural gas, renewables, and bioenergy, as well as negative-emission technologies like carbon capture and storage and direct air capture.

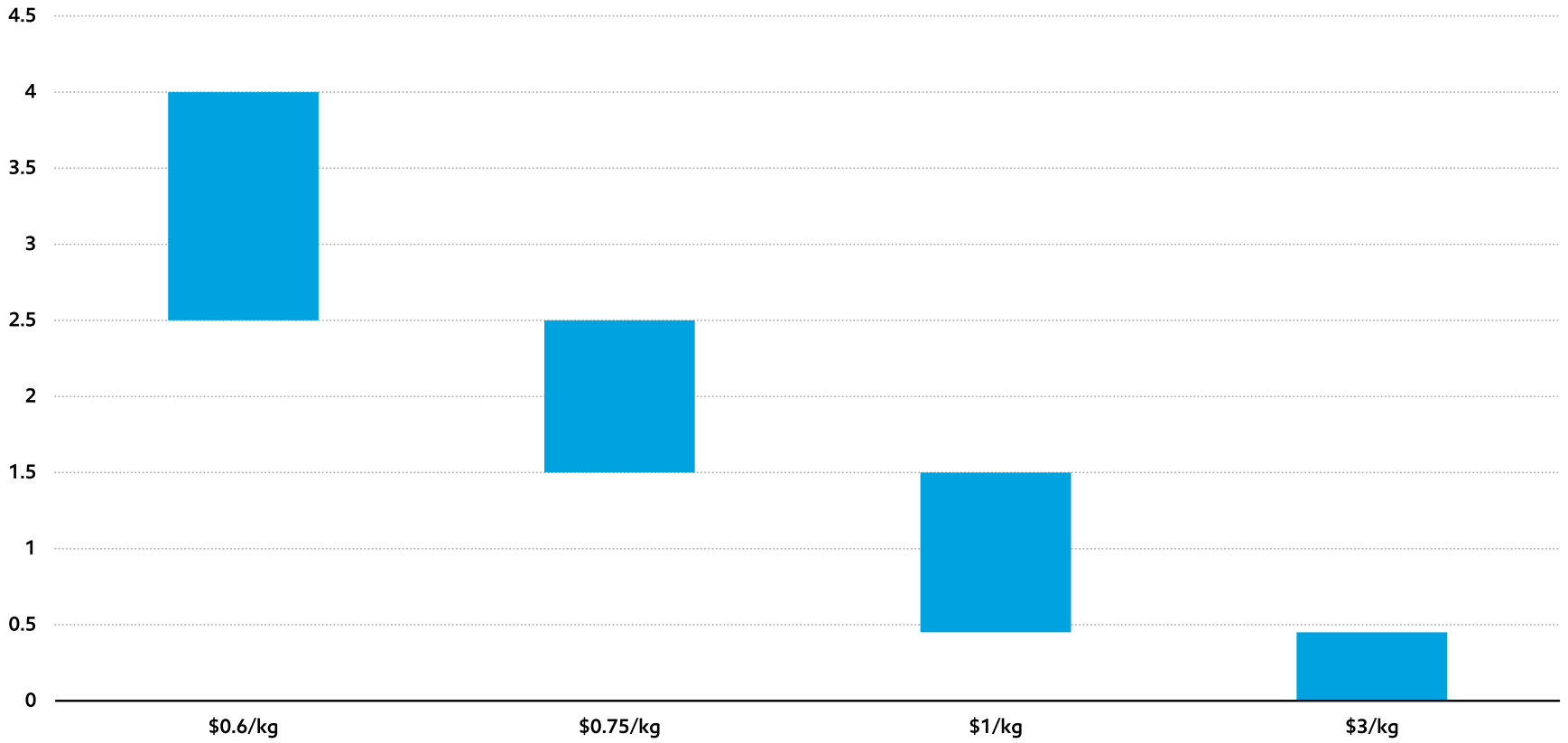
We participated in the U.S. Chamber of Commerce's development of policy principles to underpin a U.S. clean energy standard for the electricity sector. We continue to support engagement with the U.S. government on this issue.

As part of our participation in policy discussions, we engage through trade associations and industry collaborations, including the Oil and Gas Climate Initiative. We are also actively engaged in the development of studies and reports designed to better inform policy decisions. For example, we have leadership roles on two National Petroleum Council reports, one focusing on hydrogen and the other on natural gas.

We use various communication channels including this report, press releases, ExxonMobil.com, and the Exxchange advocacy portal to clearly and transparently articulate our climate-related policy positions. These positions inform and provide the basis for our lobbying and advocacy efforts.

U.S. Inflation Reduction Act 45V credit by GHG intensity[5]

Well-to-Gate GHG Intensity, kg CO_2eq/kg H_2



Our international affiliates are also engaged in climate-related policy developments and initiatives. For example, our Imperial Oil affiliate in Canada will work alongside our partners, the Government of Canada, and the Government of Alberta toward the goal of achieving net-zero GHG emissions from oil sands operations by 2050,[6] collectively reducing an estimated 68 Mt/CO_2e per year.[7]

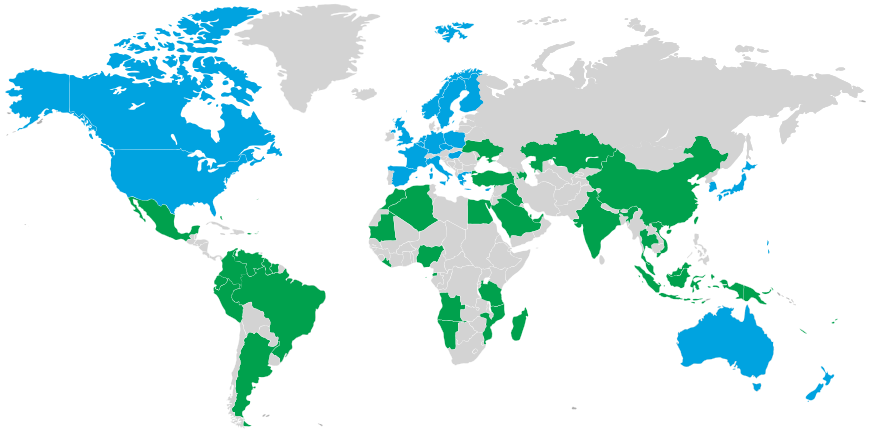
Policy impact

Our Global Outlook seeks to identify potential impacts of climate-related policies by using various assumptions and tools, including applications of a proxy cost of carbon, to estimate potential impacts on global energy demand.

Separately, we use proprietary greenhouse gas pricing where we operate and invest. Where policy provides greenhouse gas pricing, we align with and apply such greenhouse gas pricing to evaluate investment opportunities and estimate operating costs, where appropriate, for specific greenhouse gas emissions sources. International accords and underlying regional and national regulations covering greenhouse gas emissions continue to evolve with uncertain timing, outcome, and potential business impact. Where greenhouse gas pricing policy currently does not exist, we assume a price informed by the Global Outlook proxy cost of carbon.

Greenhouse gas emissions pricing where ExxonMobil operates or invests[8,9]

The greenhouse gas pricing we use for planning is similar to ranges provided by the third parties referenced below.



($/metric ton CO_2 - 2023$ Real)	World Bank Carbon prices	EM GHG Emissions Prices	IEA WEO STEPS CO_2 prices	
		2023-2050	2030	2050
Advanced economies	4-96	4-150	<136	<162
Emerging economies	1-13	2-100	<29	<55

Ranges provided for jurisdictions where ExxonMobil operates or invests.

ExxonMobil's GHG emissions pricing for 2023-2030 is based on currently stated existing or anticipated policies; pricing for 2030-2050 reflects presumed regional policies for both advanced and emerging economies.

ExxonMobil's GHG emissions pricing is in 2023 USD and has not been adjusted for future inflation.

For 2023 and 2024, we have not applied GHG emission prices to our operations or investments in countries where there is no existing GHG emission price. We do apply anticipated prices within the range identified in the table in those countries beginning in 2025.

ExxonMobil's GHG emissions prices include CO_2 and other GHGs (e.g., methane), where appropriate.

Footnotes

1. E. Gencer, S. Torkamani, I. Miller, T. Wu, F. O'Sullivan, Sustainable energy system analysis modeling environment: analyzing life-cycle emissions of the energy transition, Applied Energy 277 (2020) 115550. https://sesame.mit.edu/.
2. E. Kasseris, N. Goteti, S. Kumari, B. Clinton, S. Engelkemier, S. Torkamani, T. Akau, E. Gencer, Highlighting and overcoming data barriers: creating open data for retrospective analysis of US electric power systems by consolidating publicly available sources, Environmental Research Communications 2 (2020) 115001.
3. I. Miller, E. Gencer, H. Vogelbaum, P. Brown, S. Torkamani, F. O'Sullivan, Parametric modeling of life-cycle greenhouse gas emissions from photovoltaic power, Applied Energy 238 (2019) 760-774.
4. I. Miller, M. Arbabzadeh, E. Gencer, Hourly power grid variations, electric vehicle charging patterns, and operating emissions, Environmental Science & technology 2020, 54, 16071-16085.
5. H.R.5376 – Inflation Reduction Act of 2022, SEC. 45V. Credit for production of clean hydrogen.
6. Scope 1 and 2.
7. 2023 Imperial Oil Advancing Climate Solutions Report: https://www.imperialoil.ca/-/media/imperial/files/publications-and-reports/advancing-climate-solutions-report.pdf.
8. World Bank: State and Trends of Carbon Pricing 2023, https://openknowledge.worldbank.org/entities/publication/58f2a409-9bb7-4ee6-899d-be47835c838f. Reference World Bank ranges are consistent with existing carbon pricing for those jurisdictions as of March 31, 2023.
9. IEA World Energy Outlook 2023. IEA ranges have been adjusted for 2023$ Real.

Portfolio life-cycle emissions

All credible third-party net-zero carbon emissions scenarios reflect the critical role oil and natural gas play in growing modern economies and improving quality of life. While these scenarios may differ in the speed at which these forms of energy will be displaced, all agree that oil and natural gas and the products produced from them will remain essential for decades to come.

It is also clear that the combustion of oil and gas generates CO_2 emissions that pose a risk in the form of climate change. These emissions, generated across a global energy system built over the last century for trillions of dollars, must be reduced. At the same time, we must continue to meet society's critical need for affordable energy by investing trillions of dollars more in capacity to help more than a billion people escape poverty. Addressing both requires serious thought, an objective assessment of the challenges, and actionable plans, anchored in reality.

We need to develop solutions that address the problem – emissions – while continuing to meet societal needs. All solutions should be on the table. Viable solutions must be affordable, reliable, and available at scale – to span the globe. We need a measurement system that objectively evaluates the amount of emission reduced and the associated cost. To do this, society will require sound policy (the U.S. Inflation Reduction Act, with a focus on carbon intensity, was a good start) that supports the growth of efficient emission-reduction solutions. Equally important, but far less discussed, is the imperative for an effective method to account for emissions. This is critical to understand how to affordably meet society's growing energy needs while efficiently reducing emissions.

Regrettably, there is no existing, comprehensive carbon "accounting system" for greenhouse gas emissions. The current, widely used proxy is the GHG Protocol, which divides absolute emissions into different categories (Scope 1, 2 and 3). When applied to a company, the emissions calculated for each category are:

- Scope 1 emissions, the direct result of a company's operations.
- Scope 2 emissions, associated with a company's third-party purchases of electricity, steam, heat and cooling (e.g., emissions from a power company).
- Scope 3 emissions, all indirect emissions (not included in Scope 2) that occur in the value chain of the reporting company, including both upstream and downstream emissions.

Designed decades ago, the Protocol was intended to draw attention to not just direct emissions but indirect emissions, creating more transparency to the full scope of societal activities that would need to be addressed to tackle climate change. However, it is far less effective at assessing a company's emissions efficiency or comparing the emission intensity of alternatives. Using the Protocol to understand how societal activities generate emissions at a macro level is appropriate and useful; using anything other than Scope 1 emissions as an assessment tool to measure and manage company or sector-wide emissions is flawed with the potential for significant, unintended consequences.

The most obvious shortcoming of the GHG Protocol is the double-counting of emissions. ExxonMobil's Scope 2 emissions are the power company's Scope 1; our Scope 3 emissions are the consumer's Scope 1; our Scope 1 are a factory's Scope 2; and so on. There is no viable method of quantifying emissions and the impact of reduction steps when the same emissions are counted repeatedly. Making a company responsible for reductions, with targets, outside of Scope 1 emissions, distorts accountability and undermines the incentive for each responsible party to act. When everybody is responsible, nobody is responsible.

A particularly flawed application of the Protocol is holding suppliers accountable for their customers' choices and their resulting absolute emissions (Scope 3). It disincentivizes supply but does not change demand. When responsible producers stop supplying product, the remaining demand is met by other producers, potentially less responsibly. Production and emissions are not reduced, just moved.

Case study: Does it matter which company makes the gasoline you buy? Company A is an experienced, large, publicly traded company with a focus on emissions reporting and transparency. Company B is in the same business as Company A but is in a location where it is not subject to the same standards. If Company A is forced to reduce supply to meet absolute Scope 3 emission reduction targets, that demand will be met by Company B, with the resulting emissions required to meet demand being higher.

Case study: What happens when demand is not met? Prices go up. This was demonstrated when Russia shut off gas supply to Europe. Fuel switching was another outcome as Europe burned more coal, resulting in higher emissions compared to natural gas.

Since the GHG Protocol is an absolute measure, it can't be used to compare alternatives to determine the least emission-intensive option for meeting demand or an established need. Large producers will have large emissions even if they make a product with fewer emissions than a smaller producer making a lower volume of the same product. The trade-offs between alternative products that meet the same need with different levels of emissions also can't be assessed. Without a relative measure of emissions intensity, it isn't possible to identify and promote the most responsible energy producers, the lowest-emission products, and the most effective technologies in efficiently reducing emissions. Setting targets for absolute reductions without understanding the relative emissions intensity will disincentivize the most responsible and efficient producers and the lowest-emission products from growing – benefiting less efficient producers and products.

Because the GHG Protocol does not allow for relative assessments, it doesn't account for the avoided emissions associated with a product from one value chain or company (e.g., liquefied natural gas) replacing a product with higher emissions from an alternative value chain or company (e.g., coal). Replacing coal with liquefied natural gas (LNG) in power generation results in up to 60% reduction in CO_2 emissions.[1] However, a company producing LNG used to replace coal is penalized for its additional production and emissions, despite the significant overall emission benefits from the reduced use of coal. As a result, there is no incentive for a company to produce an energy product meaningfully lower in emissions when its emission performance is evaluated using the GHG Protocol – an unintended consequence resulting from the misuse of the Protocol.

In addition, the Protocol does not recognize third-party abated emissions. It does not give credit for a company's activities to help another company reduce its emissions. For example, ExxonMobil's calculated emissions under the Protocol will go up as we grow a carbon capture and storage business to eliminate a far greater amount of emissions from hard-to-decarbonize industrial companies. Measuring a company's effort to reduce societal emissions using the GHG Protocol will disincentivize necessary investments to help third parties reduce emissions at scale.

The issues highlighted above are a result of using an established metric, the GHG Protocol, to measure the right thing (emissions reductions) in the wrong way (assessments and targets on absolute Scope 2 and 3 emissions). Doing this penalizes companies like ExxonMobil for their size and their efforts to help others reduce their emissions through services and products like carbon capture, plastics, biofuels, and LNG. An effective assessment of the most responsible operator, with the lowest emission intensity, producing products that lower society's overall emissions is critically important to achieving significant reductions while continuing to meet society's critical needs.

To do this, we need a carbon measurement and accounting system, along with an assessment approach, that encourages the right actions. It should allow comparisons of alternatives at a company level (e.g., the emissions generated by two of companies of different sizes, making the same product) and at a product level (e.g., alternative products meeting the same need). It should also incentivize the least emission-intense companies to invest to meet society's growing need for affordable energy, with lower emissions.

A shift to carbon intensity (the emissions associated with a fixed volume of production) enables a fair comparison of the emissions efficiency of companies making the same product – irrespective of their size. It will incentivize companies to reduce emissions by growing lower emissions-intensive products to replace higher-emission alternatives. Finally, it allows comparison of different products that meet the same need to help ensure that higher-emission products are replaced with equally viable, lower-emission alternatives (e.g., coal vs. LNG).

To be effective, the system must account for the emissions associated with the development, deployment, use, and disposal of a product, commonly referred to as a Life Cycle Approach (LCA). An LCA is the only way to ensure a comprehensive accounting for the emissions associated with fulfilling society's needs. It allows for fully informed decisions when establishing policies and making choices because it accounts for **all** the relevant emissions. For instance, when comparing gasoline-powered engines to electric vehicles (EVs), it is important to account not just for tailpipe emissions but also for emissions associated with generating the electricity or producing the gasoline. A serious approach to addressing the threat of climate change must be grounded in an objective methodology focused on assessing and eliminating **all** emissions – not just those associated with oil and gas – and continuing to meet society's needs. We must do both.

LCA will help with this:

- There is no double-counting – emissions that are associated with making and using a product are only accounted for once along the value chain.
- There are no distortions in accountability – activities establish emissions, participation in the activities establishes accountability.
- There are opportunities for informed trade-offs – comprehensive accounting across the life of each alternative fully informs decision making.
- It recognizes societal needs – allowing comparisons between the available alternatives to meet established demands and critical needs.

A problem as serious as climate change requires objective thinking and problem-solving centered on data and facts, using tools, methodologies, and accounting that are equally objective and just as serious. Today, that doesn't exist, as policies and solutions being pursued lack a comprehensive analysis that factors in all relevant challenges. As a result, desired outcomes are not achieved, results are often regressive, and progress is slow. That is not good enough. It is time to get real and do the math. The world deserves better.

Footnote

1. Based on ExxonMobil analysis for power plant use including EIA U.S. electricity net generation and resulting CO_2 emissions: https://www.eia.gov/tools/faqs/faq.php?id=74&t=11. Reductions may vary based on regional differences and other variables.

Metrics and data

Greenhouse gas emissions performance data

We assess our performance to support continuous improvement throughout the organization using our Environmental Performance Indicator (EPI) process. The reporting guidelines and indicators in the Ipieca, the American Petroleum Institute (API), the International Association of Oil and Gas Producers Sustainability Reporting Guidance for the Oil and Gas Industry (4th edition, 2020, revised February 2023), and key chapters of the GHG Protocol inform the EPI and the selection of the data included in this performance table. The following data table is based upon IPCC AR6.[1,2]

Indicator	Units	2016	2019	2020	2021	2022	2023
Operated Basis							
GREENHOUSE GAS							
GHG emission intensity (Scope 1 + Scope 2)*	(metric tons CO_2e per 100 metric tons of throughput or production)	26.4	25.6	25.0	24.4	23.4	23.3
Upstream*	(metric tons CO_2e per 100 metric tons of production)	29.3	26.7	24.8	23.6	22.5	22.2
Downstream	(metric tons CO_2e per 100 metric tons of throughput)	20.0	19.8	20.2	20.2	19.4	19.2
Chemical	(metric tons CO_2e per 100 metric tons of production)	52.6	52.6	51.2	48.9	47.9	49.4
GHG emissions (Scope 1 + Scope 2)	(million metric tons CO_2e)	117	109	102	103	100	98
Upstream	(million metric tons CO_2e)	53	47	44	43	40	38
Downstream	(million metric tons CO_2e)	46	42	40	41	41	41
Chemical	(million metric tons CO_2e)	19	19	19	19	19	20
Scope 1 GHG emissions[3]	(million metric tons CO_2e)	109	101	95	97	96	92
CO_2	(million metric tons CO_2)	99	94	90	92	92	88
CH_4	(million metric tons CO_2e)	9	7	5	5	4	3
Other gases	(million metric tons CO_2e)	<1	<1	<1	<1	<1	<1
CO_2 Biogenic	(million metric tons CO_2)	<0.1	<0.1	<0.1	<0.1	<0.1	0.2
Scope 2 GHG emissions (location-based)[4]	(million metric tons CO_2e)	8	8	7	7	7	7
Scope 2 GHG emissions (market-based)[5]	(million metric tons CO_2e)	8	8	7	7	4	6
Energy attribute certificates (RECs, GOOs)	(million metric tons CO_2e)	0	<1	<1	1	3	1
Net GHG (Excludes exported power and heat)[6]	(million metric tons CO_2e)	114	106	100	101	98	96
GHG Emissions from exported power and heat	(million metric tons CO_2e)	3	2	2	2	2	2
CO_2 - captured for storage[7]	(million metric tons CO_2)	6	6	6	6	6	6
METHANE							
Methane (CH_4) Intensity*	(metric tons CH4 per 100 metric tons of throughput or production)	0.07	0.05	0.04	0.04	0.03	0.02
Methane (CH_4)	(million metric tons CH_4)	0.30	0.22	0.16	0.16	0.14	0.10

Indicator	Units	2016	2019	2020	2021	2022	2023
Operated Basis (continued)							
FLARING							
Hydrocarbon flaring Intensity*	(m^3 per metric tons of throughput/production)	12	10	8	7	6	5
Hydrocarbon flaring	(million standard cubic feet per day)	530	430	320	280	250	220
Africa/Europe/Middle East	(million standard cubic feet per day)	400	230	170	170	130	120
Americas	(million standard cubic feet per day)	70	160	120	80	80	70
Asia Pacific	(million standard cubic feet per day)	60	40	30	30	30	30
Scope 1 - Greenhouse gas emissions from flaring	(million metric tons CO_2e)	16	12	10	8	7	6
ENERGY							
Energy use	(billion gigajoules)	1.5	1.5	1.5	1.5	1.5	1.4
Upstream Energy Intensity	(gigajoules per metric tons production)	2.4	2.5	2.5	2.4	2.1	2.2
Downstream Energy Intensity	(gigajoules per metric tons throughput)	2.9	3.1	3.3	3.4	3.3	3.1
Chemical Energy Intensity	(gigajoules per metric tons product)	10.3	10.2	11.3	10.0	11.1	10.5
Equity Basis							
GREENHOUSE GAS							
GHG emissions intensity (Scope 1 + Scope 2)	(metric tons CO_2e per 100 metric tons of throughput or production)	26.0	25.8	25.7	25.5	24.2	24.0
Upstream	(metric tons CO_2e per 100 metric tons production)	26.6	25.7	24.9	24.6	22.9	22.4
Downstream	(metric tons CO_2e per 100 metric tons of throughput)	20.2	19.8	20.3	20.6	19.9	19.6
Chemical	(metric tons CO_2e per 100 metric tons production)	54.7	55.4	54.7	51.8	50.8	53.1
GHG emissions (Scope 1 + Scope 2)	(million metric tons CO_2e)	129	123	115	118	113	111
Upstream	(million metric tons CO_2e)	59	56	52	52	49	46
Downstream	(million metric tons CO_2e)	47	43	40	42	42	42
Chemical	(million metric tons CO_2e)	22	24	23	23	23	23
Scope 1 GHG Emissions[3]	(million metric tons CO_2e)	120	114	108	111	109	104
CO_2	(million metric tons CO_2)	111	107	102	105	104	101
CH_4	(million metric tons CO_2e)	9	7	6	5	5	3
Other gases	(million metric tons CO_2e)	<1	<1	<1	<1	<1	<1
CO_2 Biogenic	(million metric tons CO_2)	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Scope 2 GHG emissions (location-based)[4]	(million metric tons CO_2e)	8	8	8	8	7	7
Scope 2 GHG emissions (market-based)[5]	(million metric tons CO_2e)	8	8	7	7	4	7
Energy attribute certificates (RECs, GOOs)	(million metric tons CO_2e)	0	<1	<1	1	3	1
Net GHG (Excludes exported power and heat)[6]	(million metric tons CO_2e)	125	120	112	115	110	108
GHG Emissions from exported power and heat	(million metric tons CO_2e)	3	3	3	3	3	3
CO_2 - captured for storage[7]	(million metric tons CO_2)	6	7	7	7	7	7
METHANE							
Methane (CH_4) intensity	(metric tons CH_4 per 100 metric tons of throughput or production)	0.06	0.05	0.04	0.04	0.03	0.02
Methane (CH_4)	(million metric tons CH_4)	0.29	0.24	0.19	0.18	0.15	0.11

Lloyd's Register Quality Assurance has provided their independent limited level of assurance that the 2022 ExxonMobil greenhouse gas emissions inventory meets ISO 14064-3 expectations. LRQA Independent Assurance Statement

*ExxonMobil announced greenhouse gas emission-reduction plans[8] compared to 2016 levels.

FOOTNOTES FOR GREENHOUSE GAS EMISSIONS PERFORMANCE DATA:

1. Based on Scope 1 and 2 emissions of ExxonMobil operated assets through 2023 (versus 2016). ExxonMobil's reported emissions, reductions, and avoidance performance data are based on a combination of measured and estimated emissions data using reasonable efforts and collection methods. Calculations are based on industry standards and best practices, including guidance from the American Petroleum Institute (API) and Ipieca. There is uncertainty associated with the emissions, reductions, and avoidance performance data due to variation in the processes and operations, the availability of sufficient data, quality of those data, and methodology used for measurement and estimation. Performance data may include rounding. Changes to the performance data may be reported as part of the company's annual publications as new or updated data and/or emission methodologies become available. We are working to continuously improve our performance and methods to detect, measure and address greenhouse gas emissions. ExxonMobil works with industry, including API and Ipieca, to improve emission factors and methodologies, including measurements, and estimates. Scope 1 and 2 emissions and intensity totals are calculated using market based method for Scope 2.
2. IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2391 pp. doi:10.1017/9781009157896.
3. Scope 1 (direct emissions) include emissions from exported power and heat.
4. Includes indirect emissions from imported electricity, heat, steam, and cooling.
5. Includes indirect emissions from imported electricity, heat, steam, and cooling; incorporates the purchase of energy attribute certificates (renewable energy certificates, guarantees of origin).
6. The net GHG metric includes Scope 1 GHG emissions and Scope 2 GHG emissions (market-based), excluding emissions from exported power and heat.
7. Mass of CO_2 that was captured for applications such as geologic sequestration, acid gas injection, enhanced oil and gas recovery, including capturing CO_2 for third parties or customers.
8. ExxonMobil 2030 GHG emission-reduction plans are intensity-based and for Scope 1 and 2 greenhouse gas emissions from operated assets compared to 2016 levels. These plans include actions that are also expected to achieve absolute reduction in corporate-wide greenhouse gas emissions by approximately 20%, compared to 2016 levels. See https://corporate.exxonmobil.com/news/news-releases/2021/1201_exxonmobil-announces-plans-to-2027-doubling-earnings-and-cash-flow-potential-reducing-emissions.

Portfolio life-cycle emissions intensity

We are pursuing third-party carbon emissions reductions of more than 50 million metric tons per year by 2030

We see the opportunity to help other essential industries and customers achieve their goals to lower emissions. Estimates of greenhouse gas emissions are on a life-cycle basis and include avoided and abated emissions from hydrogen, lower-emission fuels, and carbon capture and storage.

For example, customers could avoid up to 25 million metric tons per year of their greenhouse gas emissions if all of ExxonMobil's projected 2030 supply to the market of lower-emission fuels displaces conventional fuel refined from crude oil. This calculation is an ExxonMobil analysis illustrating the general benefits of lower-emission fuels based on estimated fuel carbon intensity from various third-party sources (such as Argonne National Labs' GREET model) as compared against its conventional fuel alternate on a life-cycle basis. The calculation is an estimate that represents a range of potential outcomes based on certain assumptions. Estimates are based on the potential implementation of projects or opportunities that are at various stages of maturity.

Individual projects or opportunities may advance to a final investment decision by the company based on a number of factors, including availability of supportive policy and permitting, technology and infrastructure for cost-effective abatement, and alignment with our partners and other stakeholders. Actual avoided and abated emissions may differ.

For more information on the potential impact of our investments see our Corporate Plan Update.

Using an LCA approach and applying it to ExxonMobil's business plans through 2030, we expect an 11% reduction in full life-cycle emissions intensity, the result of which is expected to be an estimated 10% reduction in full life-cycle absolute emissions. These are in comparison to 2016 levels.*

*A life-cycle approach was used to develop our proprietary portfolio life-cycle intensity model, which estimates elements of Scope 1, 2, and 3 greenhouse gas emissions for our Upstream, Product Solutions, and Low Carbon Solutions businesses. The estimated figures are based on our projected 2023 corporate plan volumes for 2030. The portfolio life-cycle emissions intensity calculation is based upon the emissions associated with the mass of products delivered to the market.

Scope 3 emissions

The table below provides Scope 3 estimates associated with the use of our natural gas and crude production in alignment with Category 11 of Ipieca's methodology, which contemplates accounting for products at the point of extraction, processing, or sales. Scope 3 estimates represent three approaches for accounting and are not meant to be aggregated, as this would lead to duplicative accounting.

Estimated Scope 3 emissions from the use of ExxonMobil's crude and natural gas production for the year ending Dec. 31, 2023, as provided under Ipieca's Category 11 were 540 million metric tons.

For example, for completeness, the Scope 3 estimates associated with the combustion of the crude processed, produced, or sold from our refineries are provided; however, to avoid duplicative accounting, these Scope 3 estimates are not included in our Scope 3 Category 11 total, since the associated Scope 3 emissions would have been reported by the producer of those crudes.

Applied CO_2 emission factors were obtained from EPA or derived from API calculations; where applicable, emission factors for specific fuel products were applied. Non-fuels products are not combusted by the end user and therefore are not included in these Scope 3 estimates. Ipieca's Scope 3 methodology includes 15 categories of activities along each product's value chain. Due to lack of third-party data, Scope 3 emissions for categories other than Category 11 could not be estimated. Scope 3 guidelines are based on the GHG Protocol.

ExxonMobil 2023 Scope 3 estimates

(Million metric tons CO_2-equivalent)

Ipieca Category 11 Scope 3 potential estimates		Upstream production	Refining throughput	Petroleum product sales
Natural gas production	150	540	640	730
Crude production	390			

We do not set Scope 3 targets. As we discuss in the Life Cycle Approach module, using the GHG Protocol to understand how societal activities drive emissions is appropriate and useful; using it to measure and manage company or sector-wide emissions is flawed and counterproductive. It also ignores growing energy demand, enabling no comparison of alternative ways to meet that demand.

To meet a net-zero goal, it is essential that companies fully understand their net emissions and have a means of comparing themselves against others in their industry. Most importantly, the approach needs to equip and incentivize companies to make investments that will reduce their emissions – not simply encourage companies to back away from meeting society's needs and pass portions of their carbon footprint to someone else.