

**ExxonMobil**

## 2021 Energy & Carbon Summary





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Statements of future events or conditions in this report, including projections, plans to reduce emissions and emissions intensity, sensitivity analyses, expectations, estimates, the development of future technologies, and business plans, are forward-looking statements. Actual future results or conditions, including: demand growth and relative energy mix across sources, economic sections and geographic regions; the impacts of waves of COVID-19; the impact of new technologies; production rates and reserve or resource changes; efficiency gains and cost savings; emission or emission intensity reductions; reductions in flaring; and the results of investments, could differ materially due to, for example, changes in the supply and demand for crude oil, natural gas, and petroleum and petrochemical products and resulting price impacts; the outcome of exploration and development projects; the outcome of research projects and the ability to scale new technologies on a cost-effective basis; changes in law or government policy, including drilling regulations, greenhouse gas regulations, carbon taxes or regulations, and international treaties; the actions of competitors and customers; changes in the rates of population growth, economic development, and migration patterns; trade patterns and the development and enforcement of global, regional and national mandates; military build-ups or conflicts; unexpected technological developments; general economic conditions, including the occurrence and duration of economic recessions; unforeseen technical or operational difficulties; the pace of regional or global recovery from the COVID-19 pandemic and actions taken by governments or consumers resulting from the pandemic; and other factors discussed in this report and in Item 1A of ExxonMobil's most recent Form 10-K and subsequent Form 10-Qs. This document is a shareholder requested publication and is purposefully focused on unknown future events. The statements and analysis in this document represent a good faith effort by the Company to address this request despite significant unknown variables as well as incomplete and, at times, inconsistent market and government policy signals. Energy demand modeling aims to replicate system dynamics of the global energy system, requiring simplifications to limit a great deal of complexity. 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. Third-party scenarios discussed in this report 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. Any reference to ExxonMobil's support of a third-party organization within this document does not constitute or imply an endorsement by ExxonMobil of any or all of the positions or activities of such organization. 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. ExxonMobil refers to new discoveries and acquisitions of discovered resources as "resource additions." 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 [exxonmobil.com](#).

References to "oil" and "gas" include crude, natural gas liquids, bitumen, synthetic oil, and natural gas. The term "project" as used in this publication can refer to a variety of different activities and does not necessarily have the same meaning as in any government payment transparency reports.



**COVER PHOTO:**  
ExxonMobil is committed to producing the energy that is essential to modern life while minimizing environmental impacts.

# Executive summary

ExxonMobil has a long history of responsibly meeting society's evolving need for energy in a reliable and sustainable manner. With a longstanding commitment to investments in technology and the ingenuity of its people, the Company is well positioned to continue to provide the energy that is essential to improving lives around the world, while managing the risks of climate change.

## About the *Energy & Carbon Summary*

The *Energy & Carbon Summary* outlines ExxonMobil's approach to managing climate risks, including Board of Directors oversight, technology investments and actions to reduce greenhouse gas emissions. It highlights the Company's commitment to advancing sustainable, effective solutions that address the world's growing demand for energy and the risks of climate change.

## Positioning for a lower-carbon energy future

Under most third-party scenarios that meet the objectives of the Paris Agreement, oil and natural gas continue to play a significant role for decades in meeting increasing energy demand of a growing and more prosperous global population. ExxonMobil will play an important role in meeting society's need for energy and at the same time is committed to supporting efforts to mitigate the risk of climate change, as reflected in the four pillars of the Company's climate strategy:

- Mitigating emissions in Company operations.
- Providing products to help customers reduce their emissions.
- Developing and deploying scalable technology solutions.
- Proactively engaging on climate-related policy.

## EXXONMOBIL'S CLIMATE STRATEGY



### Mitigating emissions in Company operations

- ExxonMobil's greenhouse gas emissions have declined approximately 5 percent from 2010 to 2019 due to energy efficiency improvements, and reductions in flaring, venting and fugitive emissions.
- At year-end 2020, the Company expected to achieve the emission reduction goals outlined in 2018. These included:
  - 15 percent reduction in methane emissions versus 2016 levels, and
  - 25 percent reduction in flaring versus 2016 levels.
- The Company aims for industry-leading greenhouse gas performance across its businesses by 2030, and recently announced new emission reduction plans for 2025, which are projected to be consistent with the goals of the Paris Agreement.
- The 2025 plans include a 15 to 20 percent reduction in greenhouse gas intensity of upstream operations compared to 2016 levels. This will be supported by a:
  - 40 to 50 percent reduction in methane intensity, and
  - 35 to 45 percent reduction in flaring intensity.
- The Company's upstream operations also plan to align with the World Bank's initiative to eliminate routine flaring by 2030.
- The 2025 emission reduction plans are expected to reduce absolute greenhouse gas emissions by an estimated 30 percent for the Company's upstream business. Similarly, absolute flaring and methane emissions are expected to decrease by 40 to 50 percent. The emission reduction plans cover Scope 1 and Scope 2 emissions from assets operated by the Company.

**EXXONMOBIL'S CLIMATE STRATEGY**, *continued***Providing products to help customers reduce their emissions**

- ExxonMobil is responding to product demand growth by delivering solutions that enable customers to meet product performance requirements while reducing greenhouse gas emissions. These products and solutions include: natural gas, lightweight materials and packaging, and advanced fuels and lubricants.

**Developing and deploying scalable technology solutions**

- Commercially viable technology advances are required to achieve the Paris Agreement objectives. ExxonMobil's sustained investment in research and development is focused on society's highest-emitting sectors of industrial, power generation and commercial transportation, which together account for 80 percent of global CO<sub>2</sub> emissions, and for which the current solution set is insufficient.
- ExxonMobil is working to develop breakthrough solutions in areas such as carbon capture, biofuels, hydrogen and energy-efficient process technology.
- Over the past two decades, ExxonMobil has invested more than \$10 billion to research, develop and deploy lower-emission energy solutions, resulting in highly efficient operations that have eliminated or avoided approximately 480 million tonnes of CO<sub>2</sub> emissions – the equivalent of taking 100 million passenger vehicles off the road for a year.

**Proactively engaging on climate-related policy**

- Recognizing climate change is a global issue that requires collaboration among governments, private companies, consumers and other stakeholders to create meaningful solutions, ExxonMobil has participated in the Intergovernmental Panel on Climate Change (IPCC) since its inception in 1988, is a founding member of the Climate Leadership Council, and is part of the Oil and Gas Climate Initiative.

- The Company continues to engage in efforts to encourage sound and constructive policy solutions that reduce climate-related risks across the economy at the lowest cost to society, such as supporting the regulation of methane from new and existing sources.

**Governance and oversight**

Strong governance is essential to the long-term viability of ExxonMobil's business. Within the Company's robust governance framework, a rigorous risk-management approach is applied to identify and address risks associated with the business. Importantly, the Board of Directors and its various committees are highly engaged and have oversight of risk management, including as it applies to climate. The Board regularly receives updates from internal and third-party experts on climate science and policy, evaluates climate risk in the context of overall enterprise risk, including other operational, strategic and financial risks, and considers the interactions among these factors, which includes in-depth analyses by Board committees.

**Conclusion**

The *2021 Energy & Carbon Summary* contains additional detail on all of the areas described above. It updates and enhances last year's report, and includes a Frequently Asked Questions section as well as metrics, annual Scope 1 and Scope 2 emission data, and a new provision of Scope 3 emissions.

ExxonMobil supports the aims of the 2015 Paris Agreement and efforts to achieve net-zero emissions. The pillars of ExxonMobil's climate strategy, the investments the Company is making in lower-emission technologies, and the actions taken to reduce emissions across its operations are consistent with these global efforts.

ExxonMobil strives to deliver superior results while providing products and services that are essential to the health and welfare of billions of people around the world. The Company is committed to providing reliable and affordable energy to support human progress while advancing effective solutions that address the risks of climate change. ExxonMobil is working to be part of the solution.





## GOVERNANCE

**Strong governance is essential to the long-term viability of ExxonMobil's business.**

Within the Company's robust governance framework, a rigorous risk management approach is applied to identify and address risks associated with its business, including the risks related to climate change.

→ Members of the ExxonMobil Board of Directors visited its Rotterdam, Netherlands, petrochemical complex and learned about the facility from local employees.

## Climate change risk oversight

ExxonMobil's Board of Directors provides oversight of key risks, including strategic; reputational; financial; operational; safety, security, health and environment (SSHE); and legal compliance matters. The Board has a well-established and rigorous enterprise risk framework to oversee risks faced by the Company, including those related to climate change. The Board receives insights on risks and potential mitigations on relevant issues from both Company and external experts.

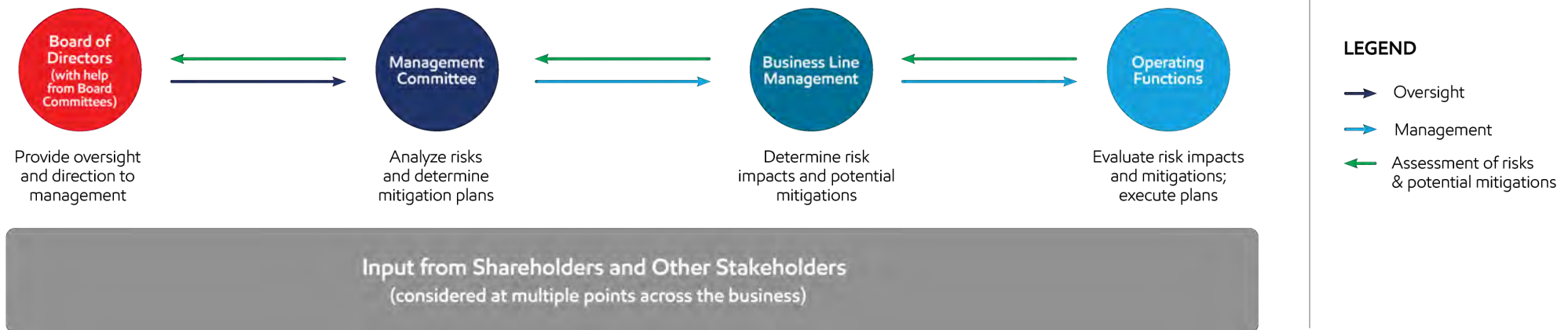
The Board routinely reviews the Corporation's environmental approach and performance. These reviews include briefings with internal and external subject-matter experts on scientific and technical research, public policy positions, emission reduction performance, and new technology developments. They also include at least one session each year where the full Board engages on the latest developments in climate science and policy. In addition, directors engage directly with shareholders to gather insights and share perspectives on issues of importance to the Company, including discussions regarding risks related to climate change.

The Board evaluates climate risks in the context of other operational, market, financial and reputational risks and considers the interactions of these additional factors. The Board is supported by its committees, which take more in-depth reviews of the context and interdependencies in risk evaluation. The role of these committees is described in greater detail on the following page.

Led by the Lead Director, the Board also oversees the Company's response to critical issues. Recently, for example, the independent Lead Director, along with the full board, provided oversight as management guided the Company's response to the COVID-19 pandemic through a series of actions that helped protect its employees, the communities in which it works and people around the world.

Beyond the Board, the Management Committee, including the Chief Executive Officer, provides oversight of strategic risks and participates in briefings to broaden understanding and assess safeguards and mitigation options.

### Enterprise risk framework



## Coordination and support of board committees

As described on the previous page, the Board oversees a broad spectrum of interrelated risks with assistance from its committees. This integrated risk management approach facilitates recognition and oversight of important risk interdependencies more effectively than relying on risk-specific committees. Consideration of climate-related risks is integrated within the activities of the committees.



The Finance and Audit Committees oversee risks associated with financial and accounting matters. The Audit Committee also periodically reviews ExxonMobil's overall risk management approach and structure, which is applied to risks related to climate change, among other business risks.



The Board Affairs Committee oversees matters of corporate governance, including Board evaluation and director refreshment. It also coordinates identification of external experts, including those addressing the energy transition, to provide insights to the Board and sets the criteria for shareholder engagement with directors.



The Compensation Committee reviews executive compensation, which is designed to incentivize executives to maximize long-term shareholder value and requires decision-making that includes careful consideration of current and future risks, such as those related to climate change.



The Public Issues and Contributions Committee (PICC) oversees operational risks such as those relating to safety, security, health, lobbying activities and expenditures, and environmental performance, including actions taken to address climate-related risks.



**HIGHLIGHT:**

## Integrating risk management into executive compensation

Senior executive compensation is determined by the Compensation Committee. The compensation program is designed to incentivize effective management of all operating and financial risks associated with ExxonMobil's business, including risks related to climate change.

Performance shares with long vesting periods and a strong tie to Company performance are among the key design features that support this objective. Executive compensation is designed to support long-term sustainability of Company operations and management of all aspects of risk. Specifically, performance in managing risks related to climate change is recognized in two performance dimensions that are linked to the Company's performance share program: (1) Progress Toward Strategic Objectives, which includes reducing environmental impacts as one of five objectives, and (2) Safety and Operations Integrity, which includes environmental performance in addition to safety and controls. These performance dimensions are shown in the schematic on the left. The executive compensation program requires that these longer-term risks be carefully considered at all levels of the organization, ensuring stewardship beyond the Board and executive level, and is fundamental to success across the Company. Details on the executive compensation program can be found in the annual Proxy Statement.

## Board composition and evaluation

The Board is comprised of independent directors and the CEO. All members of the Audit, Board Affairs, Compensation and PICC committees are independent. Each highly qualified director brings a diverse perspective. The majority have scientific, technical and/or research backgrounds, creating a collective skillset that is well qualified to oversee climate-related issues. In addition, the Board benefits from the experience of a director who is a recognized expert in climate science.

The Board acts as a collective body, representing the interests of all shareholders. While individual directors leverage their experience and knowledge in Board and committee deliberations, Board decisions and perspectives reflect the collective wisdom of the group.

At least annually, the Board and each of the Board committees conduct a robust and thorough evaluation of their performance and effectiveness, as well as potential changes to the committees' charters. The independent Lead Director, as part of the role's recent enhancements, leads the evaluation.

### Board refreshment

The Board prioritizes its refreshment process and values a diverse slate of experienced and qualified Board members with the ability to serve over a period of many years.

ExxonMobil's refreshment process has been successful in identifying diverse, experienced and qualified Board candidates; four of the last eight most recently elected independent directors were female or racial/ethnic minorities. As of April 1, 2020, the average tenure of independent directors up for election in May 2020 was 6.1 years, well below the S&P 500 average of 8.0 years.<sup>(1)</sup>

Qualifications sought for director nominees are documented in the Board's Guidelines for the Selection of Non-Employee Directors available on [exxonmobil.com](http://exxonmobil.com). Important director competencies, built from these qualifications, include experience in risk management and global business leadership, as well as financial and operational experience and scientific, technical or research experience.

Most recently, Joseph Hooley, former Chairman of the Board, President and Chief Executive Officer of State Street Corporation, joined the Board in January 2020 and enhances the Board's investor perspective.



→ The ExxonMobil Board of Directors, as of May 1, 2020. From left: Angela Braly, Kenneth Frazier, Joseph Hooley, Ursula Burns, Samuel Palmisano, Darren Woods, Douglas Oberhelman, Steven Reinemund (since retired), William Weldon, Susan Avery and Steven Kandarian.

**UP CLOSE:****Public Issues and Contributions Committee (PICC)**

The Public Issues and Contributions Committee (PICC) plays an integral role in the Board's oversight of climate-related risks. Like other committees, the PICC is able to work on key issues in greater detail than possible by the full Board.

The PICC is comprised of three independent directors who are appointed by the Board, and reviews and provides guidance on the Corporation's policies, programs and practices on key public issues of significance. It regularly reviews ExxonMobil's safety, security, health and environmental performance, including actions taken to identify and manage risks related to climate change. The broad and diverse set of backgrounds and areas of expertise of the individual PICC members ensures the committee is able to effectively evaluate and inform the Board on dynamic and complex issues.

The PICC, along with other members of the Board, makes annual site visits to operating locations to observe and provide input on operating practices and external engagement. In February 2020, the PICC and other members of the Board and management visited ExxonMobil's integrated manufacturing complex in Beaumont, Texas, which consists of a refinery, chemical plants, and lubricant blending and packaging facilities.

The visit included an overview of chemical and refinery operations, and highlighted the site's manufacturing complexity, reliability and process safety performance. The visit also included a tour of the central control building and operating units and the construction site of a project to increase the capacity to refine light crude oil produced in the United States. During the tour, directors reviewed firsthand the mitigating actions ExxonMobil has taken to address the risks of potential flooding along the Neches River where the refinery is located. Directors also had the opportunity to hear from employees and external guests, including elected officials and local/community leaders.

Through these visits, the PICC and directors review the effectiveness of the Company's risk management process and receive additional insight into how the Operations Integrity Management System (OIMS) helps protect employees, nearby communities, the environment and physical assets. The PICC uses this information, along with reports on safety and environmental activities of the operating functions, to provide recommendations to the full Board.



→ Members of the Board of Directors and senior executives toured the integrated manufacturing complex in Beaumont, Texas, in February 2020 as part of the annual Board trip.





## STRATEGY

## ExxonMobil's business strategies are underpinned by a deep understanding of global energy system fundamentals.

These fundamentals include the scale and variety of energy needs worldwide; capability, practicality and affordability of energy alternatives; greenhouse gas emissions; and government policies. These fundamentals are considered in conjunction with the Company's *Outlook for Energy* to help inform long-term business strategies and investment plans. ExxonMobil is committed to providing reliable and affordable energy to support human progress while implementing and advancing effective solutions to mitigate environmental risks. Actions to address the risks related to climate change, depicted below, position the Company to responsibly meet the growing energy demand of an increasingly prosperous world.



Mitigating emissions in Company operations



Providing products to help customers reduce their emissions



Developing and deploying scalable technology solutions



Proactively engaging on climate-related policy

# Energy supply and demand trends

The *Outlook for Energy* is ExxonMobil's view of energy demand and supply through 2040 and helps inform ExxonMobil's long-term strategies, investment plans and research programs. Given the uncertainty around the near-term impacts of COVID-19 on economic growth, energy demand and energy supply, and lack of precedent, the Company is considering a range of recovery pathways to guide near-term plans. These pathways expect that energy demand will grow beyond 2019 levels post-2022 as COVID-19 impacts phase out and long-term drivers prevail.

## Energy supports rising prosperity

Access to modern technologies and abundant energy – including oil and natural gas – enables substantial gains in living standards around the world.

Between now and 2040, the world population is expected to grow from 7.5 billion to well over 9 billion, and global gross domestic product (GDP) is expected to nearly double. Billions of people in developing economies are expected to see their incomes grow to levels considered middle class.<sup>(2)</sup>

Given population growth and the linkage between energy use and living standards, energy demand is likely to rise over this same time period. Efficiency gains and a shift in the energy mix – including rising penetration of lower-carbon sources – enable a nearly 45 percent improvement in the carbon intensity of global GDP.

## COVID-19 near-term impact

Government responses to COVID-19, resulting in lockdowns and severe travel restrictions, significantly reduced energy demand in the short term. However, it is widely expected that demand will recover in the years ahead. For example, energy demand in countries that are further along the recovery path, such as China, has started to return to pre-COVID-19 levels.

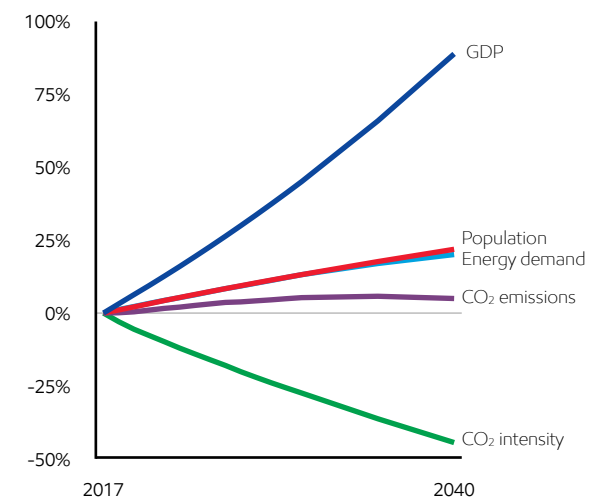
As society recovers and energy demand increases, the following trends are projected by the International Energy Agency (IEA) in its latest publication of the *World Energy Outlook*. This includes the IEA's assessment of the COVID-19 impact, both in its scenario based on stated policies, known as STEPS, as well as its Sustainable Development Scenario (SDS), which limits the rise in global average temperature to well below 2°C:

- Wind and solar (included in Other renewables) are projected to see strong growth.
- Coal's share in the energy mix will likely decrease as the world shifts to lower-emission energy sources.
- Oil and natural gas will continue to play an important role in the world's energy mix (each making up more than 20 percent) as commercial transportation fuel (e.g., trucking, marine) and as feedstock for chemical products, which will continue to see demand growth.

The IEA's 2020 STEPS projects demand for oil and natural gas by 2040, approximately 2 to 3 percent lower than in its pre-COVID-19 2019 STEPS projection. In the IEA's 2020 SDS projection for 2040, oil demand is virtually unchanged and natural gas is estimated 7 percent lower than in the 2019 SDS projection.

## Global fundamentals impact *Outlook for Energy*

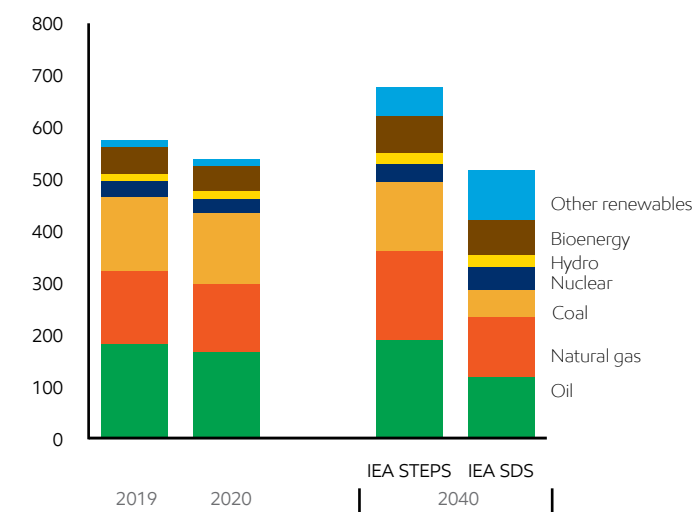
(Percent change)



ExxonMobil 2019 *Outlook for Energy*

## Oil and natural gas remain important

(Quads)



EM analysis; IEA *World Energy Outlook* (WEO) 2020

## Energy supply and demand trends, *continued*

The lockdown measures taken by many authorities in response to COVID-19 resulted in lower greenhouse gas emissions but also had significant economic impacts. The International Labour Organisation estimated that income declined 10.7 percent globally during the first three quarters of 2020 versus 2019, which amounts to US\$3.5 trillion, or 5.5 percent of GDP, affecting middle-income countries and lower-middle-income countries more than upper-middle-income countries.<sup>(3)</sup>

As the world recovers from COVID-19, a focus on addressing environmental risks, including the risks of climate change, while providing accessible and affordable energy for a post-pandemic world remains important. The chart on the upper right illustrates that emission reductions will be needed across all sectors, especially in developing economies.

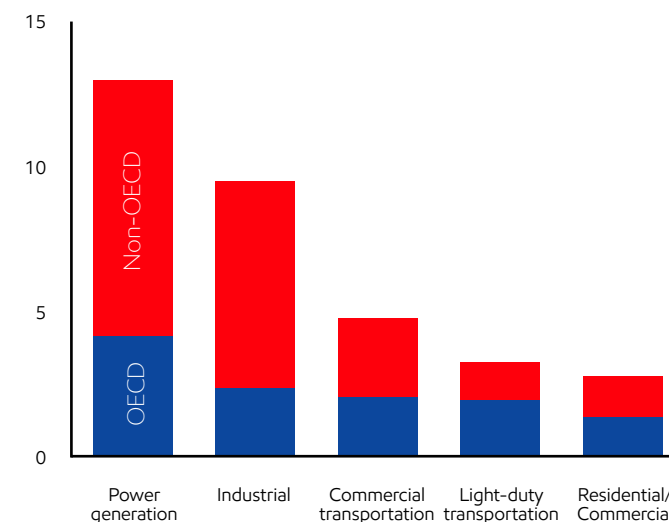
### Addressing the dual challenge

Consistent with third-party assessments, ExxonMobil expects the world to meet, in aggregate, the Nationally Determined Contributions<sup>(4)</sup> of the Paris Agreement pledges by 2030. However, more effort is needed for the world to accelerate progress toward a 2°C pathway.<sup>(5)</sup> Recent announcements by some governments further strengthen this effort. The IEA concludes that the full implementation of recent net-zero pledges by 2050 as well as the Chinese government's 2060 net-zero commitment, would cover around 50 percent of the energy-related CO<sub>2</sub> emission reductions required to move from its STEPS scenario to its well below 2°C scenario or SDS scenario.<sup>(6)</sup>

These net-zero announcements are often based on deployment of existing technologies, even though those governments acknowledge there are scale and cost limitations. Because of these limitations, further technology breakthroughs are expected to play a major role in accelerating progress toward 2°C and net-zero pathways. The IEA in 2020 estimated in its *Tracking Clean Energy Progress* analysis that only six of 46 technologies and sectors assessed are on track to help reach the Paris Agreement climate goal;<sup>(7)</sup> therefore, further efforts will be required. When comparing the emissions of the IEA STEPS scenario with those of the IEA SDS scenario from 2019 to 2040, just over half of the emission reduction effort would be realized by efficiency improvements. Beyond reduced energy demand through efficiency improvements (97 billion tonnes), the chart on the bottom right demonstrates the crucial contribution of the wide range of low-emission technologies needed to reduce energy-related emissions.

### 2017 global energy-related CO<sub>2</sub> emissions by sector

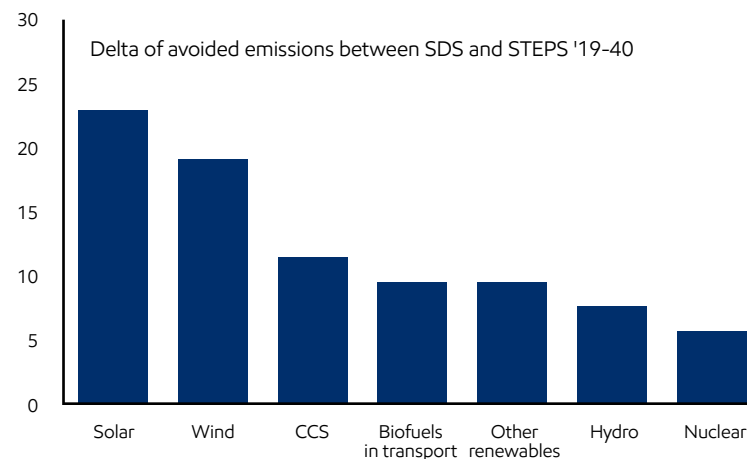
(Billion tonnes)



ExxonMobil 2019 Outlook for Energy

### Technology developments beyond efficiency improvement needed to further reduce emissions

(Billion tonnes)



IEA World Energy Outlook (WEO) 2020



## Considering 2°C scenarios

According to the IEA, a “well below” 2°C pathway implies “comprehensive, systematic, immediate and ubiquitous implementation of strict energy and material efficiency measures.”<sup>(8)</sup> Given a wide range of uncertainties, no single pathway can be reasonably predicted. A key unknown relates to yet-to-be-developed advances in technology and breakthroughs that may influence the cost and potential availability of certain pathways toward a 2°C scenario. Scenarios that employ a full complement of technology options are likely to provide the most economically efficient pathways.

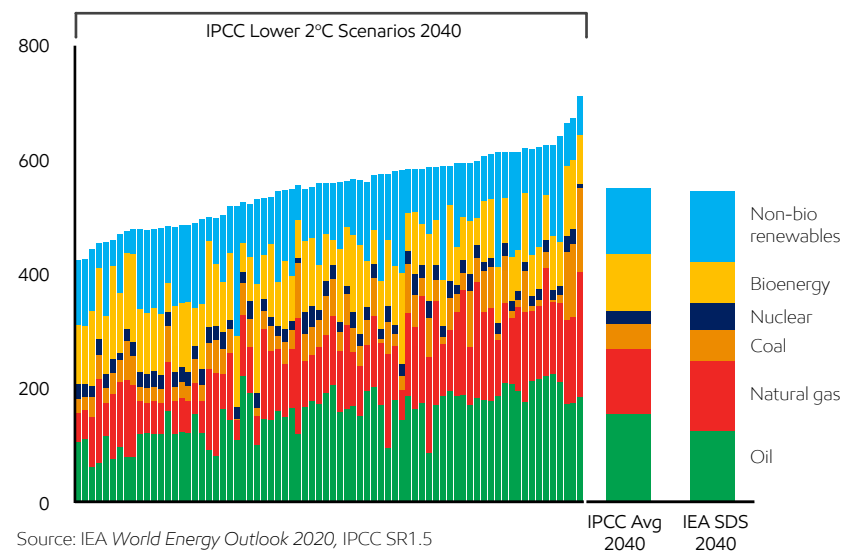
Considerable work has been done in scientific and economic communities to explore potential energy pathways to meet a 2°C target. For example, the Stanford University Energy Modeling Forum 27 (EMF27)<sup>(9)</sup> provided a range of full technology scenarios to meet a 2°C target. In previous publications, ExxonMobil has tested the expected energy mix that could exist under these scenarios. In October 2018, the Intergovernmental Panel on Climate Change (IPCC) published a Special Report on “Global warming of 1.5°C” (IPCC SR1.5)<sup>(10)</sup> and utilized more than 400 emissions pathways with underlying socioeconomic development, energy system transformations and land use change until the end of the century. The IPCC report identified 74 scenarios as “Lower 2°C,” which are pathways limiting peak warming to below 2°C during the entire 21st century with greater than 66 percent likelihood. The chart (upper right) depicts the range of global energy demand in 2040 across these IPCC Lower 2°C scenarios. As the chart illustrates, predicting absolute 2040 energy demand levels in total and by energy type carries a wide range of uncertainty, and particular scenarios are heavily influenced by technology and policy assumptions.

For comparison purposes, the chart also includes energy demand projections in 2040 based on the IEA’s SDS. The IEA specifically notes that its SDS works backward to examine actions needed to achieve the United Nations’ energy-related Sustainable Development Goals, including the objectives of the Paris Agreement.<sup>(11)</sup>

The chart (bottom right) illustrates potential global CO<sub>2</sub> emissions trajectories of the IPCC Lower 2°C scenarios and the IEA’s SDS and STEPS, relative to ExxonMobil’s *Outlook for Energy*. In aggregate, the *Outlook for Energy* projections align with the Nationally Determined Contributions (NDCs<sup>(5)</sup>) submitted by Paris Agreement signatories, which represent each country’s plan to reduce its emissions. The IEA STEPS projects emissions at a comparable level generally in line with the 2030 NDC submissions. The 2020 United Nations Emissions Gap report concluded that the NDCs remain inadequate to meet the Paris Agreement.<sup>(12)</sup> New NDCs have been submitted recently and more are expected in 2021.

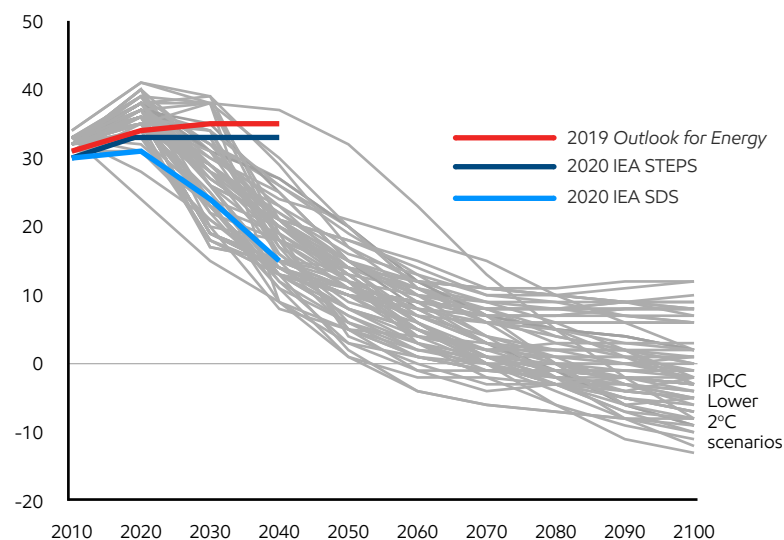
2040 global energy demand mix across IPCC Lower 2°C scenarios

(Exajoules)



Global energy-related CO<sub>2</sub> emissions<sup>(13)</sup>

(Billion tonnes)



# Considering 2°C scenarios, *continued*

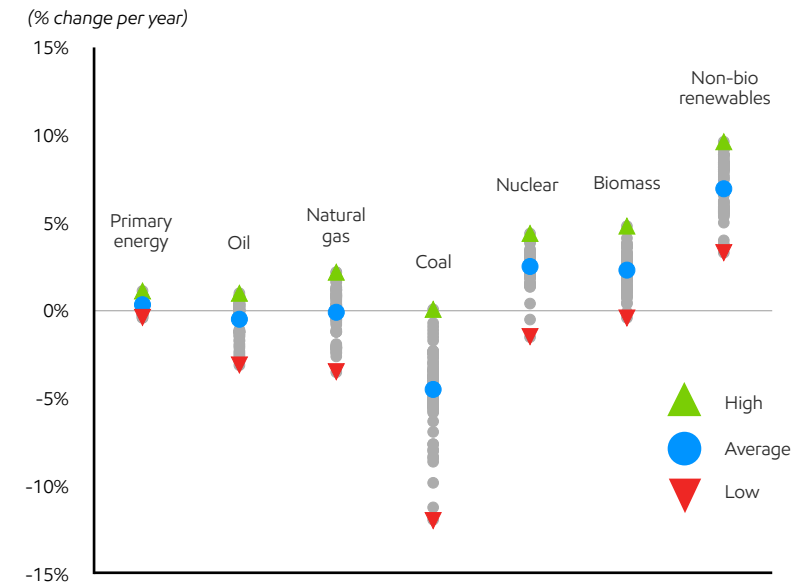
The IPCC Lower 2°C scenarios produce a variety of views on projected global energy demand in total and by specific types of energy. The average of the scenarios’ growth rates per energy source has been used to consider potential impacts on energy demand for this report.<sup>(14)</sup>

Based on this analysis, primary energy demand on a worldwide basis is projected to increase about 0.3 percent per year on average from 2010 to 2040. Expected demand and technologies deployed in 2040 vary by model and energy type (see upper right chart):

- Natural gas demand is expected on average to be similar to 2010, while oil demand is projected on average to decline by about 0.5 percent per year. Together their share of energy demand is projected on average to still be almost 50 percent by 2040.
- Non-bio renewables, such as wind, solar and hydro, are expected to increase on average by almost 7 percent per year, while nuclear power should increase about 2.5 percent per year.
- Coal demand is expected to decline by an average of 4.5 percent per year, representing a roughly 75 percent decrease from 2010 to 2040.
- Bioenergy demand is projected on average to grow at about 2.3 percent per year.
- Carbon capture and storage (CCS) is a key technology to address CO<sub>2</sub> emissions, enabling lower emissions from industrial and power sectors. In the IPCC Lower 2°C scenarios, CCS would need to be deployed to a scale equivalent to about 10 percent of the world's energy demand (table bottom right).

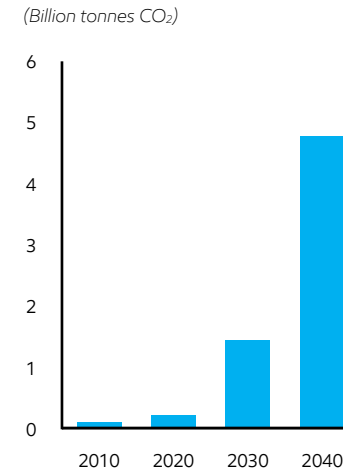
All energy sources remain important through 2040 across all the IPCC Lower 2°C scenarios, though the mix of energy and technology shifts over time. Across these scenarios, a wide range of outcomes can be observed for the various fuel sources (table bottom right). Nevertheless, oil and natural gas remain essential components of the energy mix, even in models with the lowest level of energy demand. Oil demand is projected to decline modestly on average, and much more slowly than its rate of natural decline from existing producing fields. Natural gas demand holds steady due to its many advantages, including lower greenhouse gas emissions. As a result of these growing energy demand trends coupled with natural field decline, substantial new investments are required in both oil and natural gas capacity, even under the IPCC Lower 2°C scenarios that contemplate substantial reductions in greenhouse gas emissions.

Range of growth rates across IPCC Lower 2°C scenarios from 2010 to 2040 (CAGR)



Source: IPCC SR1.5, ExxonMobil analysis

Average need for CCS in IPCC Lower 2°C scenarios



Source: IPCC SR1.5, ExxonMobil analysis

Wide variety of 2040 energy mix in IPCC Lower 2°C scenarios

Share by sources	2040 Average	2040 Range
Oil and natural gas	48%	28-66%
Coal	8%	1-21%
Nuclear	4%	1-7%
Bio	19%	8-36%
Non-bio renewables	21%	8-43%
Percent of total energy deploying CCS	10%	1-19%

Source: IPCC SR1.5, ExxonMobil analysis

# Signposts for the evolving energy landscape

Changes in the relative cost of new technologies compared to existing or alternative energy sources may further increase shifts in the global energy mix. Using Company and third-party sources, ExxonMobil monitors a variety of signposts that may indicate a potential acceleration in shifts to the energy landscape. They include:

- New, more ambitious NDCs, along with broad implementation of significant policy and regulatory initiatives, such as carbon pricing.
- Increasing electrification of energy systems and technology developments that reduce costs and increase reliability of energy storage.
- Development of scalable alternative energy technologies such as advanced biofuels, leading to displacement of gasoline and distillate in the fuels market.
- Advances in CCS technology to lower cost and enable low-carbon hydrogen production.
- Advances in significant new capacity expansions of multiple technologies, as well as the associated financing.

## Use of sensitivity analysis

ExxonMobil uses sensitivity analyses to provide greater perspective on how variations to its *Outlook for Energy* assumptions could affect projected energy supply and demand. The analyses for these sensitivities involve assessing technology advancements and the potential impact on energy supply and demand, resulting in a range of potential low-to-high-demand outcomes for certain energy sources. The projections in the sensitivity analyses do not represent the Company's viewpoint or the likelihood of these alternatives, but can provide context to its analysis.

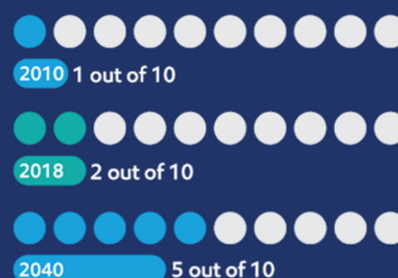
Recent sensitivities included light- and heavy-duty vehicles and natural gas for electricity and power generation, which ExxonMobil has included in its *2019 Outlook for Energy* and *2020 Energy & Carbon Summary*.

## UP CLOSE:

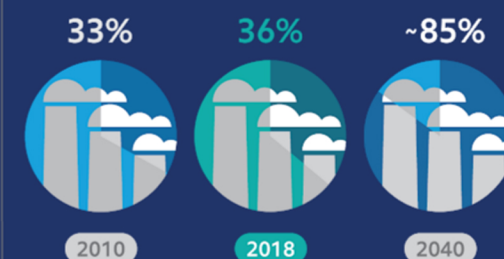
### Indicators for a 2°C pathway

Continued transition of the energy system will provide important indicators on whether society is successfully moving toward a 2°C scenario. The following illustrates the progress made from 2010 to 2018 toward that objective by 2040.

Renewables, nuclear and fossil fuels with CCS rise to ~50% of primary energy demand <sup>(15)</sup>



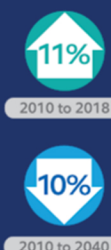
Low-carbon power generation (including CCS) grows to ~85% of total supply <sup>(16)</sup>



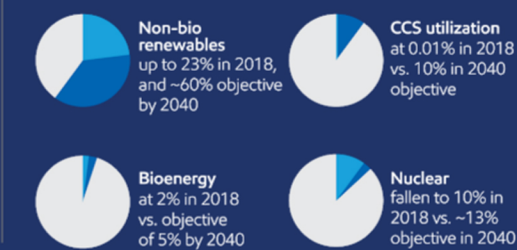
Increased electrification of energy demand <sup>(17)</sup>



Oil demand falls <sup>(18)</sup>



Global electricity generation shifts <sup>(19)</sup>



Summary of demand growth rates	Average of the IPCC Lower 2°C <sup>(19)</sup>	ExxonMobil 2019 Outlook for Energy	IEA World Energy Outlook 2010-2019	Annual reduction carbon intensity/GDP <sup>(20)</sup> (monitoring implementation of Paris Agreement)
Mean annual demand growth rate 2010-2040				
Energy demand	▲ 0.3%	▲ 0.9%	▲ 1.1%	
Oil	▼ (0.5)%	▲ 0.8%	▲ 1.0%	
Natural gas	▼ (0.1)%	▲ 1.4%	▲ 1.9%	
Coal	▼ (4.5)%	▼ (0.2)%	▲ 0.3%	
Nuclear	▲ 2.5%	▲ 1.5%	▲ 0.1%	
Bioenergy	▲ 2.3%	▲ 0.8%	▲ 1.2%	
Non-bio renewables	▲ 6.9%	▲ 4.1%	▲ 5.3%	
				7.7% 2.4%
				Needed to stay within 2°C global carbon budget In 2019

The 2018 progress is based on ExxonMobil 2019 analysis; the 2040 targets are derived from the IPCC Lower 2°C scenarios.



## Potential impact on proved reserves and resources considering 2°C scenarios

Over the coming decades, oil and natural gas will continue to play a critical role in meeting the world's energy demand, even considering the IPCC Lower 2°C scenarios. The following analysis is intended to address the potential impacts to the Company's proved reserves<sup>(21)</sup> and resources<sup>(22)</sup> through 2040 and beyond, considering the average of the IPCC Lower 2°C scenarios' oil and natural gas growth rates.<sup>(23)</sup>

### Proved reserves

Proved reserves are one of the main drivers of intrinsic value of an integrated oil and natural gas company's upstream operations.<sup>(24)</sup> At the end of 2019, ExxonMobil's proved reserves totaled about 22 billion oil-equivalent barrels, comprised of 65 percent oil and 35 percent natural gas. These proved reserves are assessed annually and reported in the Company's annual report on Form 10-K in accordance with rules of the U.S. Securities and Exchange Commission. Based on currently anticipated production schedules, a substantial majority of ExxonMobil's year-end 2019 proved reserves are expected to have been produced by 2040. Since the average of the IPCC Lower 2°C scenarios implies significant use of oil and natural gas through the middle of the century, these reserves face little risk from declining demand.<sup>(25)</sup>

### UP CLOSE:

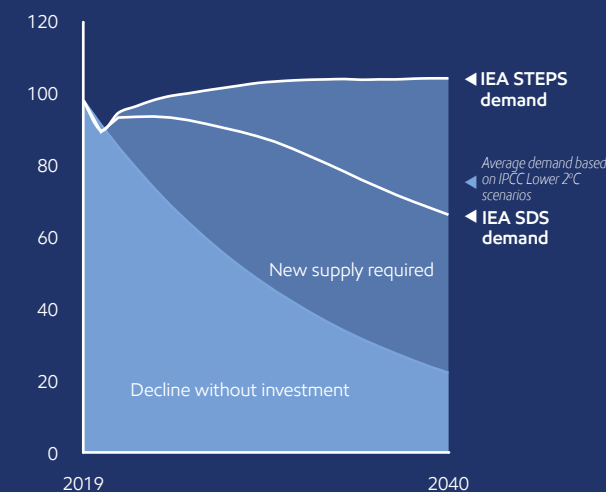
#### Significant investment still needed in 2°C scenarios

Considering the IPCC Lower 2°C scenarios average, global liquids demand is projected to decline from 98 million barrels per day in 2019 to about 75 million barrels per day in 2040. However, without future investment and due to natural field decline, world liquids production would be expected to drop to about 22 million barrels per day in 2040, greatly exceeding the potential demand reduction. Natural gas field decline rates are generally similar to liquids.

With the potential 2040 imbalance (absent future investment), the substantial majority of ExxonMobil's proved reserves that are projected to be produced by 2040 are supported by ample demand, and therefore face little risk related to the average of the IPCC Lower 2°C scenarios. Considering the IEA's SDS (a well below 2°C scenario), the IEA estimated that almost \$12 trillion of investment will be needed for oil and natural gas supply for 2020-2040.<sup>(25)</sup> Additionally, the IEA has reported that current industry investment levels are well below what is needed in these IEA scenarios, indicating a critical need for increased oil and natural gas investment versus 2020 levels.<sup>(26)</sup>

#### Global oil supply estimates

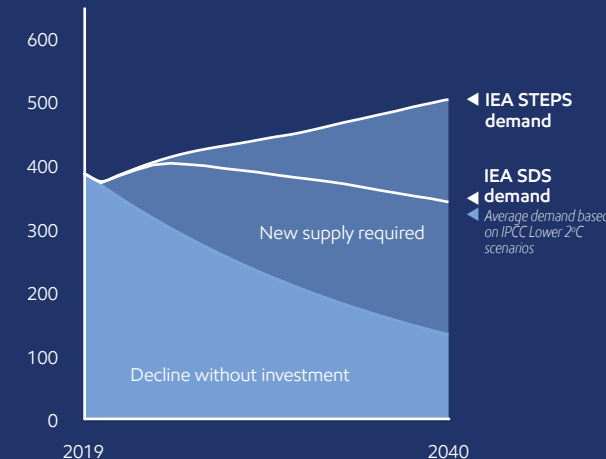
(Million oil-equivalent barrels per day)



Excludes biofuels; Source: IHS, IEA, IPCC SR1.5, EM analyses  
2°C scenarios based on IPCC Lower 2°C scenarios

#### Global natural gas supply estimates

(Billion cubic feet per day)



Source: IHS, IEA, IPCC SR1.5, EM analyses  
2°C scenarios based on IPCC Lower 2°C scenarios

## Potential impact on proved reserves and resources considering 2°C scenarios, *continued*

For the remaining year-end 2019 proved reserves that are projected to be produced beyond 2040, the reserves are generally associated with assets where the majority of development costs are incurred before 2040. 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 emissions and associated costs. In addition, these assets have generally lower risk given the technical knowledge accumulated over many decades of production. Accordingly, the production of these reserves will likely remain economic even considering the average oil and natural gas demand under the IPCC Lower 2°C scenarios.

### Resources

ExxonMobil maintains a large and diverse portfolio of undeveloped resources that provide considerable flexibility to develop new supplies to meet future energy demand and replenish the Company's proved reserves. The Company also continues to enhance the quality of this resource base through successful exploration, acquisitions, divestments, and ongoing development planning and appraisal activities.

Under the IPCC Lower 2°C scenarios, the world will continue to require significant investment in both liquids and natural gas. Based on these scenarios, and assuming ExxonMobil retains its current share of global production,<sup>(27)</sup> the Company would need to replenish its existing proved reserves entirely by 2040 under the IPCC Lower 2°C scenarios average.

For ExxonMobil, the underlying economics of commercializing resources are dependent on a number of factors, including evolving government regulations, that are assessed annually using a dynamic resource development process. The best resource opportunities are advanced and assets with lower potential are monetized or exited. All investments are tested over a wide range of commodity price assumptions and market conditions. Notably, the IEA's estimates of future prices under its 2°C pathway fall within the range used to test investments.<sup>(28)</sup>

### UP CLOSE:

#### Reducing costs using technology to improve competitive position

Trillions of dollars of investment in oil and natural gas will be needed, even in 2°C scenarios. By leveraging high-impact technologies from ExxonMobil's research organization, costs and environmental impacts are reduced, positioning the Company's portfolio to compete successfully.

Examples of technology-enabled cost and environmental footprint reductions:

- Record-setting extended-reach wells in Sakhalin to significantly reduce drilling costs and environmental footprints.
- Full-physics modeling and next-generation completion designs for unconventional developments to reduce drilling and improve recovery.
- Combination of horizontal drilling with hydraulic fracturing to significantly reduce land surface footprint and cost.



→ The Yastrebov drilling rig, Sakhalin Island, Russia.

## Potential impact on proved reserves and resources considering 2°C scenarios, *continued*

In light of the multiple and dynamic factors that influence governments' diverse approaches to regulate resources and decisions by industry to commercialize undeveloped resources, it is not possible to identify which specific assets will ultimately be developed.

However, the Company is confident that the size, diversity and continued upgrading of resources will enable the ongoing replenishment of proved reserves under a range of potential future demand scenarios and regional policy differences. Regional policies that constrain supply in one area could enhance returns in others.

### UP CLOSE:

#### Dynamic resource development planning

This process considers a wide range of variables over time, including as appropriate: the extent and quality of the resource, development concepts, fiscal terms, regulatory requirements, proximity to existing infrastructure, market conditions, enabling technologies, and policy developments, including climate-related policy.

ExxonMobil optimizes resource development plans in line with these variables and prioritizes developments that are competitively advantaged in delivering long-term shareholder value. A rigorous Decision Quality Framework is employed to inform development decisions ranging from developing the resource (which eventually moves to proved reserves), monetizing the resource by selling it to others, or exiting the asset.

With a very large resource base, this process can take decades as technologies are developed, market conditions change and competition evolves. Two examples illustrate this:

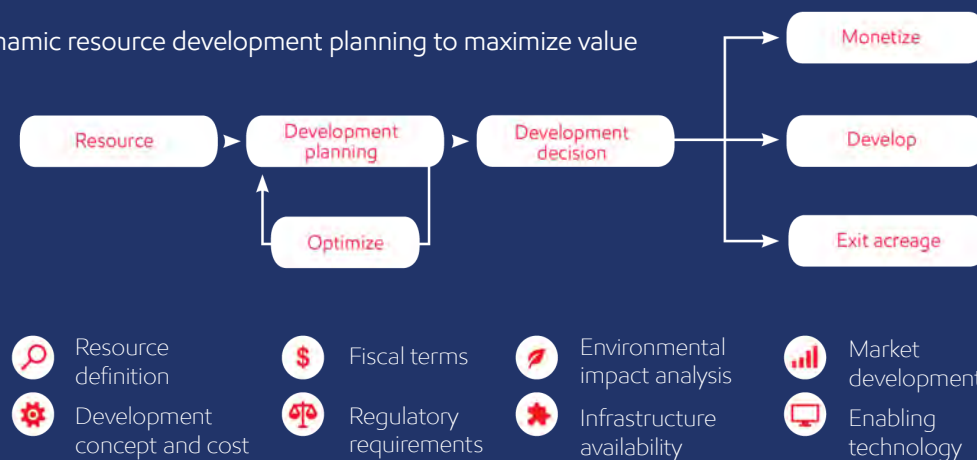
#### LIZA PHASE 1 DEVELOPMENT

The Liza field was discovered in May 2015 offshore Guyana. ExxonMobil's approach to development planning enabled an industry leading start-up in less than five years following discovery.

#### NORWAY SALE

In contrast, the Company monetized its Norway upstream assets through a December 2019 sale. After an evaluation of the Company's portfolio, the asset was divested to enable ExxonMobil to focus on investments with higher long-term strategic value.

#### Dynamic resource development planning to maximize value





# Positioning for a lower-carbon energy future

## Upstream

Oil and natural gas remain important energy sources even across the IPCC Lower 2°C scenarios. Natural gas is expected to play a key role in the projected demand shift from coal to lower-emission fuels for power generation and industrial use.

ExxonMobil is progressing 12 million tonnes per year of low-cost liquefied natural gas (LNG) supply opportunities to meet the growing global demand. This includes potential projects in Papua New Guinea (PNG), Mozambique and in the United States. As one of the largest natural gas producers in the U.S. and a significant producer of LNG around the world, the Company is well positioned to meet the future demand for these resources.

Rising oil demand will be driven by commercial transportation and the chemical industry's use of oil as a feedstock; fuel demand for light-duty vehicles is expected to decrease, reflecting efficiency improvements and growth in alternative fuels.



→ A tanker being loaded with LNG at ExxonMobil's terminal in Papua New Guinea.

# Positioning for a lower-carbon energy future, *continued*

## Downstream

Global demand for commercial transportation fuels, higher-value lube basestock grades, and finished lubricants is expected to grow, while worldwide gasoline demand will likely peak and then begin declining. Over the past several decades, through the application of advantaged technologies, capital redeployment and divestment, ExxonMobil has created a resilient portfolio of manufacturing sites. Portfolio improvement activity included the divestment of 22 of 43 refinery sites since 2000. In addition, competitiveness has been improved by co-locating approximately 80 percent of refining capacity with chemical or lube basestock manufacturing. ExxonMobil's average refinery throughput is 75 percent larger than industry providing economies of scale for lower cost transportation fuel production. The Company invests in advantaged, integrated assets with proprietary process and catalyst technology to improve the yield of high-value products consistent with demand trends. This continuous high-grading of the portfolio has positioned the Company's downstream business to remain competitive across a wide range of future scenarios (see top chart).

## Chemical

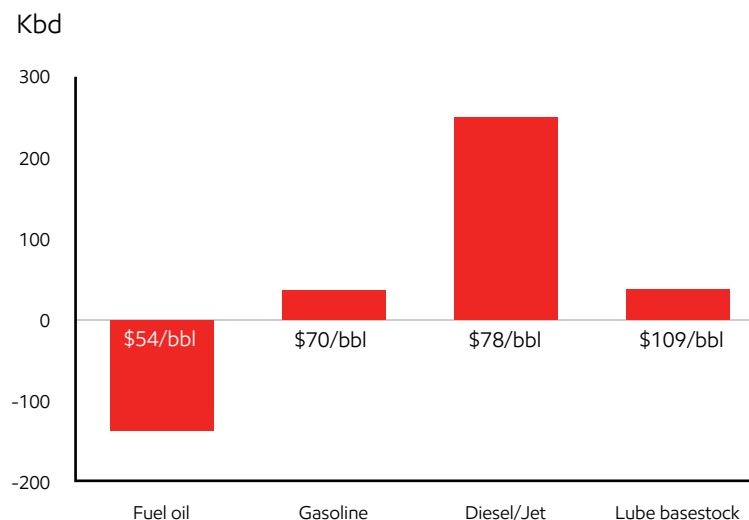
Worldwide demand for chemicals is expected to rise by approximately 45 percent by 2030, underpinned by global population growth, an expanding middle class and demand for increased living standards. These factors, together with a recognition of the lower greenhouse gas emissions of plastics versus alternatives,<sup>(29)</sup> correspond to an increase in demand for a variety of everyday products, from food packaging to appliances, vehicle parts to clothing. Many of ExxonMobil's chemical products help customers reduce their greenhouse gas emissions by making cars lighter and more fuel efficient, improving recyclability and extending products' shelf life, therefore, reducing waste. Due to robust growing demand, the Company's investment strategy is targeted at high-value sectors with approximately 70 percent of new planned capacity additions focused on its performance products (see bottom chart).

## Potential new areas of investment

In addition to major capital investments in base business lines, the Company is also investing in significant research and development (R&D) programs that will create potential opportunities to enhance and expand its portfolio. These programs are discussed further in the sections ahead and include R&D efforts in CCS, hydrogen, advanced biofuels and energy-efficient manufacturing.

## ExxonMobil's downstream product shift

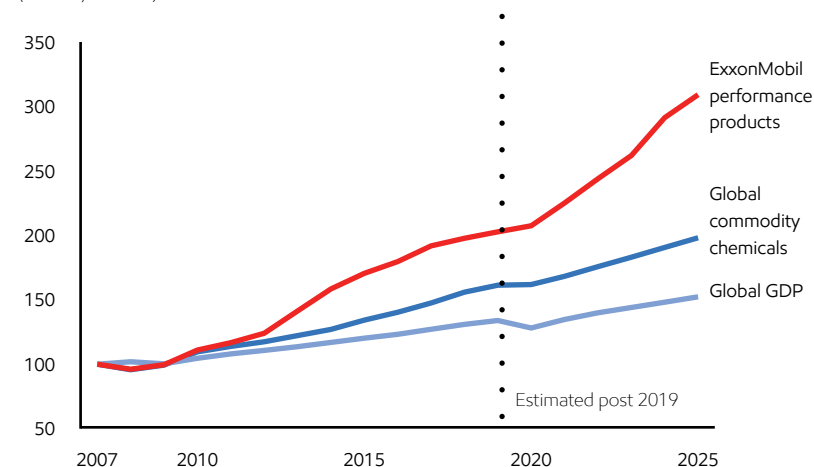
(2027 vs. 2017)



All columns reflect 2019 prices: Platts, Argus and IHS

## Performance product sales growth

(volume, indexed)



Source: ExxonMobil 2019 Outlook for Energy, IHS Markit, ExxonMobil analysis



## Developing and deploying scalable technology solutions

ExxonMobil's sustained investment in R&D plays an important role in positioning the Company to develop next generation solutions and progress breakthroughs in areas such as carbon capture, biofuels and energy-efficient process technology. These solutions are critical to addressing the risks of climate change, and have the potential to be used across multiple sectors including the power, industrial and long-distance heavy-duty transportation sectors.

A variety of disciplines in science and engineering are needed to provide affordable and scalable energy. ExxonMobil employs 20,000 scientists and engineers, including more than 2,000 Ph.D.s, who have a wide range of capabilities. The Company's scientists have authored more than 1,000 peer-reviewed publications and been awarded more than 10,000 patents over the past decade. ExxonMobil's patent portfolio is overseen by management to ensure an efficient and effective process is utilized to steward intellectual property.

ExxonMobil collaborates around the world with over 80 universities, five energy centers, and U.S. national laboratories to advance emerging energy technologies. In 2019, the Company formed a research partnership with the U.S. Department of Energy and is working with the National Renewable Energy Laboratory and the National Energy Technology Laboratory to accelerate development of areas such as carbon capture and biofuels technologies. In addition, ExxonMobil became the first energy company to join the IBM Quantum Network to explore the future potential for quantum computing to solve real-world energy problems faster or more efficiently than classical computing.

ExxonMobil has worked with companies such as FuelCell Energy to facilitate development and deployment of lower-cost carbon capture technologies, and with biological experts at Synthetic Genomics Inc. (SGI) to develop renewable fuels. The Company's strengths in science and engineering across the innovation pipeline, combined with extensive collaborations, provide a unique position to progress energy solutions from lab to scale.

The Company actively monitors emerging and impactful technologies, including solar, wind, nuclear and natural sinks, which are a natural means of removing carbon from the atmosphere. Much of this is undertaken through academic collaborations, which help inform and identify potential future opportunities.

ExxonMobil has demonstrated its commitment to R&D through various price cycles and delivered a number of energy innovations. While deployment at scale takes time, the Company is confident it will be at the forefront of many future innovations to meet growing demand for energy with lower emissions.

### CORE R&D CAPABILITIES

BIOLOGY DATA SCIENCE  
CLIMATE SCIENCE PRODUCT TECHNOLOGY  
GEOSCIENCE EMERGING TECHNOLOGY  
ENGINEERING CHEMISTRY ENERGY MODELING  
MATERIAL SCIENCE PHYSICS MATHEMATICS  
PROCESS TECHNOLOGY

### AWARDS



33

MEMBERS OF NATIONAL  
ACADEMIES OF SCIENCE  
AND ENGINEERING



29

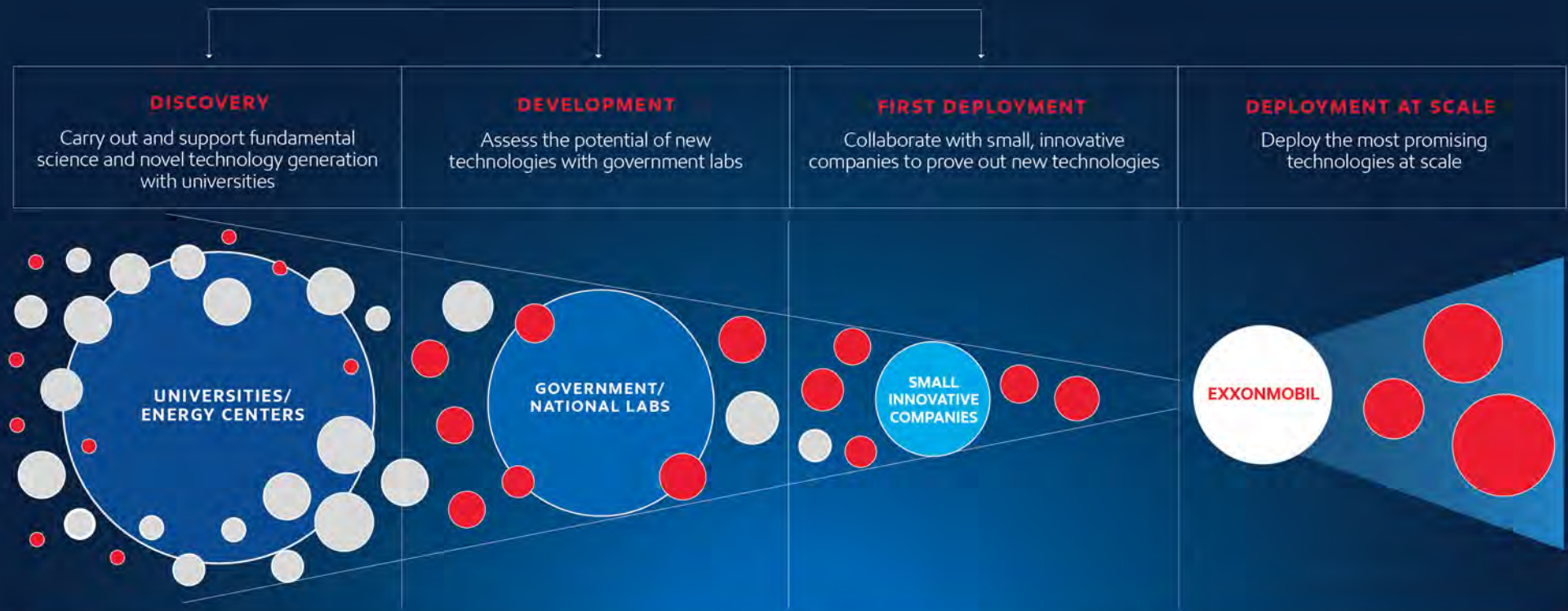
FELLOWS OF AMERICAN  
ASSOCIATION FOR THE  
ADVANCEMENT OF SCIENCE



## EXXONMOBIL COLLABORATIONS

### ExxonMobil

Innovates with organizations across the technology pipeline to bring science to scale



#### CCS CASE STUDY

Proof of concept for CO<sub>2</sub> capture and sequestration technologies



Demonstration of emerging CO<sub>2</sub> capture technologies at small scale



First demonstration and deployment of fuel cell based CO<sub>2</sub> capture technology



#### BIOFUELS CASE STUDY

New routes to improve fuel yields from algae and cellulosic biomass



Advancement of both algae and cellulosic technology options



First demonstration and deployment of advanced biofuels technologies



ExxonMobil integrates technology and world-class project management to deploy the most promising technologies at scale.



## Carbon capture and storage

Carbon capture and storage (CCS) is the process of capturing CO<sub>2</sub> that would have otherwise been emitted to the atmosphere from industrial facilities and power plants, transporting the captured CO<sub>2</sub> to a carefully selected storage site and then injecting the CO<sub>2</sub> into deep geologic formations for safe, secure and permanent storage. Direct air capture uses advanced materials to capture CO<sub>2</sub> from the atmosphere so that it can be stored in geological formations.

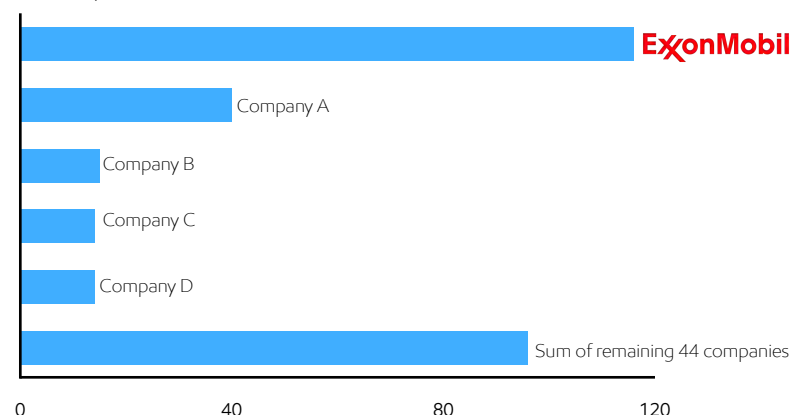
CCS is one of the most important low-carbon technologies required to achieve societal climate goals at the lowest cost. The Intergovernmental Panel on Climate Change (IPCC) estimated in its Fifth Assessment Report that the cost of achieving a 2°C outcome would increase by 138 percent if CCS were not included in the set of decarbonization solutions.<sup>(30)</sup> CCS is generally recognized as one of the only technologies that can enable negative emissions, via bio-energy with CCS (BECCS) or direct air capture methods. In many low-carbon transition scenarios, negative emissions technologies are needed to reduce atmospheric CO<sub>2</sub> concentration. CCS is also one of the only technologies that could enable some industry sectors to decarbonize, including the refining, chemicals, concrete and steel sectors. This could be achieved by directly capturing CO<sub>2</sub> emissions from these industrial sources or by using CCS in conjunction with hydrogen production to provide decarbonized fuel to these processes. See pages 15 and 16 for more information on the role of CCS under the IPCC Lower 2°C scenarios.

ExxonMobil is a global leader in CCS and has more than 30 years of experience developing and deploying CCS technologies. The Company has equity share of about one-fifth of the world's CO<sub>2</sub> capture capacity,<sup>(31)</sup> and has projects operating in the United States, Australia and Qatar. ExxonMobil's annual carbon capture capacity is about 9 million tonnes, the equivalent emissions of approximately 2 million passenger vehicles per year. Since CCS began in the early 1970s, ExxonMobil has cumulatively captured more CO<sub>2</sub> than any other company, accounting for approximately 40 percent of all the anthropogenic CO<sub>2</sub> that has ever been captured.<sup>(32)</sup> The Company is working to expand capacity and is evaluating multiple opportunities that have the potential to be commercially attractive through the convergence of supportive policy and technology.

In the Netherlands, ExxonMobil is working to advance both the Port of Rotterdam CO<sub>2</sub> Transportation Hub and Offshore Storage (PORTHOS) project and the H-Vision study in the Rotterdam industrial area. With potential support from the European and Dutch governments, the initiatives could position ExxonMobil's Rotterdam refinery as an attractive location for a hydrogen project with CCS and for pilot testing ExxonMobil's carbonate fuel cell technology. The Company is also researching more cost-effective approaches for deployment of direct air capture at scale (see page 26).

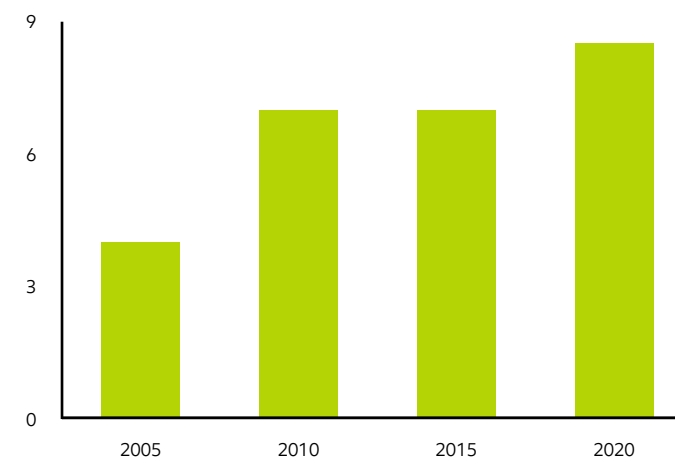
Cumulative CO<sub>2</sub> capture volume since 1970<sup>(31)</sup>

(Million tonnes)



ExxonMobil carbon capture capacity

(Equity; CO<sub>2</sub>-equivalent emissions million tonnes per year)



## Carbon capture and storage, *continued*

In Belgium, ExxonMobil is part of a consortium at the Port of Antwerp, Europe's largest integrated energy and chemicals cluster, that is evaluating the feasibility of a cross-border collaboration to build CCS capacity and infrastructure. The Company is also progressing a potential expansion at its capture facility in LaBarge, Wyoming.

In addition, ExxonMobil supports multiple leading organizations that are working to accelerate CCS. Through its membership in the Oil & Gas Climate Initiative (OGCI), ExxonMobil is progressing the carbon capture, utilization and storage (CCUS) Kick-Starter initiative to support large-scale commercial deployment of CCS via multiple low-carbon industrial hubs. ExxonMobil is also sharing its CCS expertise through participation in the Zero Emissions Platform (ZEP), which advises the European Union on the deployment of CCUS under the Commission's Strategic Energy Technologies Plan. The ZEP was founded in 2005 and is a coalition of stakeholders united in the support for CCS as a key technology for addressing climate change.

As noted in last year's *Energy & Carbon Summary*, ExxonMobil contributed to the National Petroleum Council's report on at-scale deployment of CCS. The Council's policy, regulatory and legal recommendations set out a road map for accelerating the deployment of CCS investment in the United States. Alongside the Energy Advance Center and other organizations advocating for CCS policy, ExxonMobil worked throughout 2020 to advance many of the Council's recommendations, including seeking important clarifications to the Internal Revenue Code Section tax credit that is critical to promoting new CCS investment.

While focused on deploying existing technology in the near term where supportive policy exists, ExxonMobil also recognizes the longer-term need for new technologies to lower the cost of deployment. In 2019, the Company extended its relationship with FuelCell Energy to further develop carbonate fuel cell system technology for the purpose of capturing CO<sub>2</sub> from power plants and industrial facilities. The research by ExxonMobil and FuelCell Energy indicates this technology has the potential to capture CO<sub>2</sub> much more efficiently than conventional technologies, while at the same time producing hydrogen and electricity. To further progress this technology, ExxonMobil is working to prove this technology at scale through a demonstration unit at its Rotterdam refinery mentioned on page 24.



→ [FuelCell Energy reports](#) its 14.9MW fuel cell platform in Bridgeport, Connecticut, has provided clean and reliable power since 2013.

## Carbon capture and storage, *continued*

The Company is also working with TDA Research in Golden, Colorado, to co-develop a new carbon capture adsorption process. The technology has the potential to offer several advantages over conventional approaches by reducing energy-intensive process steps. The technology has been tested at the National Carbon Capture Center (U.S. Department of Energy-sponsored research facility), and achieved up to 90 percent CO<sub>2</sub> capture from flue gas.<sup>(33)</sup> Together with the University of California, Berkeley and the Lawrence Berkeley National Laboratory (LBNL), ExxonMobil published joint research in the peer-reviewed journal *Science* on the discovery of another new technology that could potentially capture more than 90 percent of CO<sub>2</sub> and could prove up to six times more effective than conventional approaches.<sup>(34)</sup>

In addition, the Company is exploring the potential to capture CO<sub>2</sub> directly from the air. When combined with geologic storage of CO<sub>2</sub>, direct air capture could provide a path to negative emissions. In 2020, ExxonMobil extended a joint development agreement with Global Thermostat to further explore the process fundamentals and potential pathways to large-scale deployment of direct air capture technology. While more research and development is still required, direct air capture could have a significant role to play in global decarbonization efforts.

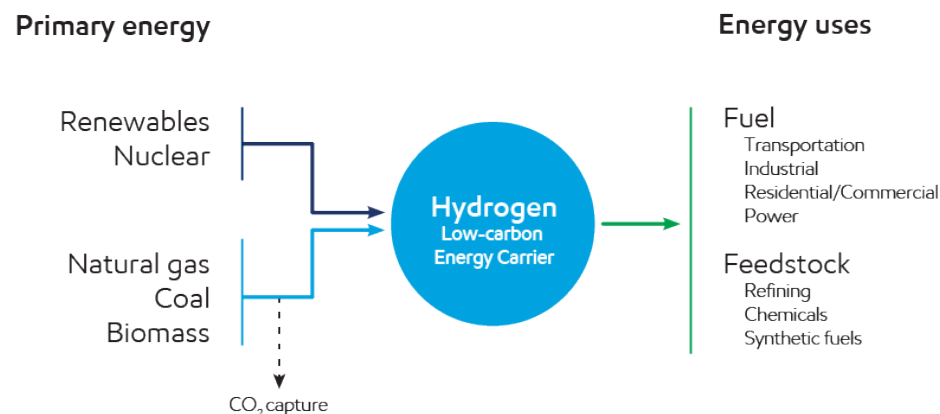
### Low-carbon hydrogen

Hydrogen (H<sub>2</sub>), as a low-carbon energy carrier, has received a great deal of attention recently. ExxonMobil expects future policies to incentivize low-carbon H<sub>2</sub> for a variety of clean energy applications. Low-carbon H<sub>2</sub> can be produced from low-carbon electricity via electrolysis of water, natural gas reforming coupled with CCS, or by other processes. Hydrogen can be useful in hard-to-decarbonize sectors, such as fuel for heavy-duty trucks and to produce high temperature industrial heat for steel, refining and chemical industries.<sup>(35)</sup> Low-carbon H<sub>2</sub> from natural gas with CCS has cost and scale advantages compared to H<sub>2</sub> from electrolysis in the near and medium term.<sup>(36-37)</sup> As a world leader in both natural gas production and CCS, ExxonMobil is well positioned to play an important role in this potential area of the energy transition.



→ Global Thermostat direct air capture pilot unit.

### Low-carbon hydrogen in the energy system





## Advanced biofuels

Heavy-duty transportation (trucking, aviation and marine) requires fuels with a high energy density that liquid hydrocarbons provide. The need for an energy-dense fuel could make certain alternatives, such as battery power, poorly suited for this sector. Biofuels, such as those derived from algae, have the potential to be a scalable solution and deliver the required energy density in a liquid form that could reduce greenhouse gas emissions by more than 50 percent compared to today's heavy-duty transportation fuels.<sup>(38)</sup> ExxonMobil continues to progress research to transform algae and cellulosic biomass into liquid fuels (biofuels) for the transportation sector.

Together with Synthetic Genomics Inc., ExxonMobil has improved strains of algae that use CO<sub>2</sub> and sunlight to produce energy-rich bio-oil, which can then potentially be processed at existing refineries, similar to crude oil, into renewable fuels. A key focus is developing novel genetic tools to overcome inherent inefficiencies in photosynthesis and improve bio-oil production. Needed biology modifications to the algae continue to be progressed, and the project team has demonstrated increased production in outdoor algae ponds.

Through key collaborations, ExxonMobil has also made significant progress that has more than doubled the yield of biodiesel from a variety of cellulosic sugars. Work with the national labs and academic institutions is helping to address the most challenging issues of scale for cellulosic biofuels and the Company continues to evaluate a wide range of options in this space.

ExxonMobil recently signed an agreement with Global Clean Energy Holdings to purchase 2.5 million barrels of renewable diesel per year for five years, starting in 2022. The renewable diesel will be sourced from a refinery acquired by Global Clean Energy that is being repurposed to produce renewable diesel. In addition, the Company has completed a sea trial of ExxonMobil's first bio-based marine fuel, which can provide up to approximately 40 percent CO<sub>2</sub> emissions reduction compared to conventional marine fuels.



→ Process development to first deployment at Synthetic Genomics Inc. CAAF (California Advanced Algal Facility), in Calipatria, California.



# Energy-efficient manufacturing

## Taking the emissions out of manufacturing

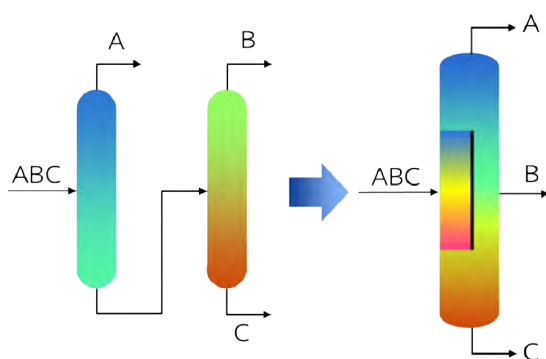
The manufacturing sector of the economy – which produces fuel, plastic, steel, cement, textiles and other building blocks of modern life – accounts for about one-third of the world's energy-related CO<sub>2</sub> emissions.

Demand for industrial products is expected to grow as economies expand and standards of living rise in the developing world. To meet this demand, the world will need manufacturing solutions that are more energy- and greenhouse gas-efficient than those currently available (see page 13). Since 2000, ExxonMobil has reduced and avoided more than 320 million tonnes of its emissions through its energy efficiency and cogeneration projects and continues to target research in equipment design, advanced separations, catalysis and process configurations as part of broader efforts to develop energy-efficient manufacturing.

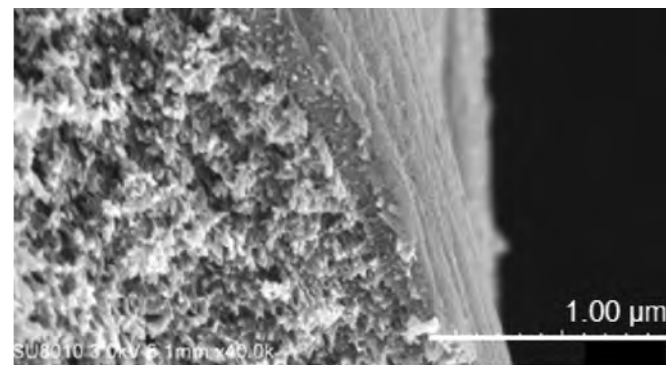
## Energy-efficient manufacturing efforts

*Rethinking equipment design:* New equipment design may provide a step-change reduction in energy use even in traditional separation processes like distillation. For instance, use of divided wall columns – a concept discovered and developed by ExxonMobil – can combine a series of distillation towers into one, thereby providing significant energy and capital cost savings. Energy savings on the order of 50 percent were demonstrated at ExxonMobil's Fawley Refinery in the U.K.<sup>(39)</sup>

*Reimagining separations:* ExxonMobil scientists and researchers from Georgia Institute of Technology and Imperial College London are working together on membrane technologies that could reduce carbon dioxide emissions and lower the energy required in refining thermal (distillation) processes. Research results published in the peer-reviewed journal *Science*<sup>(40)</sup> demonstrate the potential for non-thermal fractionation of light crude oil through a combination of class- and size-based "sorting" of molecules. Initial prototypes have shown that with gasoline and jet fuel they are twice as effective as the most selective commercial membranes in use today.



→ Concept of divided wall columns is applied to provide energy and capital savings by combining a series of distillation towers into one, as demonstrated at the Fawley Refinery xylene tower in the U.K. (picture shown above).



→ Depiction of the surface of a molecular membrane. Membranes could enable the transition from high-energy to low-energy processes.

# Life cycle analysis

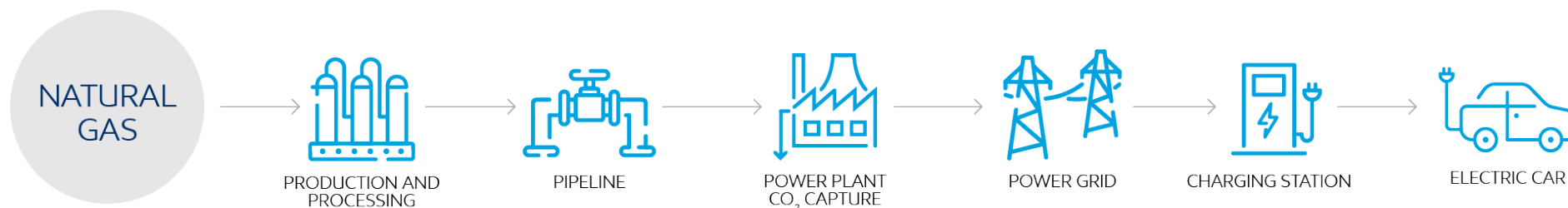
Life cycle analysis (LCA) is the preferred scientific method to estimate the environmental impact of energy processes and products. It is important to include all emissions across the life cycle of each option when comparing different energy technologies. Every step that emits any type of greenhouse gas must be included to properly estimate the total emissions footprint. This includes emissions associated with production of the resource, conversion and transportation steps, and lastly, consumption of the fuel by the end user (e.g., in a vehicle or in a power plant).

ExxonMobil has been working with the MIT Energy Initiative to develop a new LCA tool that covers pathways of multiple technologies representing the majority of greenhouse gas emissions. This tool, called the Sustainable Energy System Analysis Modeling Environment (SESAME<sup>(41)</sup>), is based on well-referenced peer-reviewed sources in the public domain and can 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 have meaningful impact, greenhouse gas mitigation technologies must also be cost-effective. The use of techno-economic analysis (TEA) helps determine the most impactful and cost-effective ways to meet global energy needs while reducing greenhouse gas emissions. TEA also helps to transparently inform policy development.

TEA is currently being added to the SESAME model. Once completed, SESAME will compare both the emissions and costs of energy technologies across all sectors in a system-wide setting. It will be publicly available as a transparent and open-source web tool designed for both experts and general users.

## LCA example



→ Pictorial example of one pathway included in the SESAME tool: natural gas production and power generation to the end use in an electric vehicle.



## Proactively engaging on climate-related policy

ExxonMobil engages on policy directly, through trade associations and focused industry collaboration efforts, such as the Oil & Gas Climate Initiative. Policy solutions to address climate change should be balanced, recognizing the increasing global demand for affordable energy, which is vital to addressing global poverty, education, health and energy security. Access to modern energy is closely correlated to increased life expectancy, reduced poverty and malnutrition, and higher levels of childhood education.

Given this dual challenge, the Company encourages sound policy solutions that reduce climate-related risks across the economy at the lowest societal cost. Company policy positions are clear and transparent, and [lobbying efforts](#)<sup>(42)</sup> are consistent with these positions.

ExxonMobil has monitored developments in science over the last four decades and surveys the evolving scientific literature. ExxonMobil's engagement with the scientific and policy community on climate science has been ongoing and collaborative. The Company's scientists, engineers and other experts have participated on such efforts for decades, including the IPCC since its inception in 1988, and have co-authored chapters of IPCC scientific reports. The Company's public policy experts have contributed to the development of sound policy solutions at national and international levels.

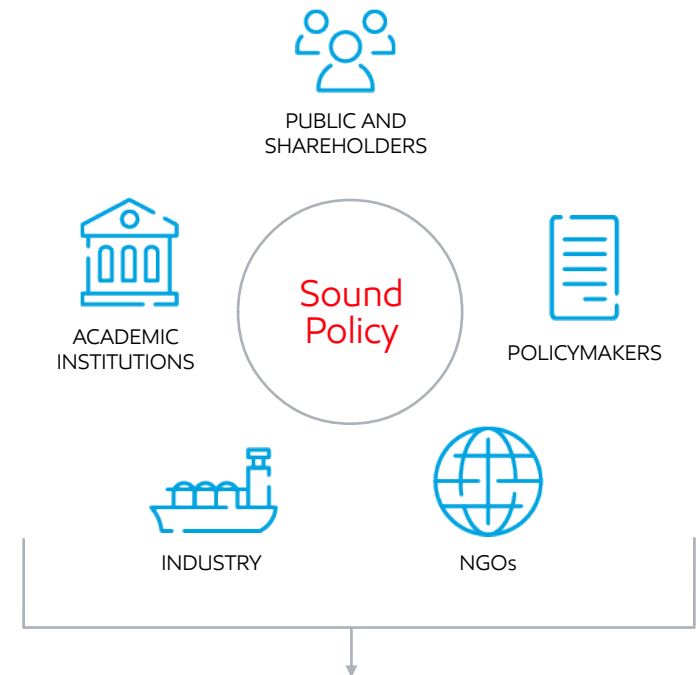
The Company actively engages on policy at the domestic and global level to inform business planning and to assist policymakers seeking expertise about energy markets and technology. ExxonMobil has supported the Paris Agreement since its adoption, and offers to assist policymakers addressing the gaps between the policies called for under current Nationally Determined Contributions and the ultimate goals of the Paris Agreement as part of the 26th United Nations Climate Change Conference in 2021.

For more than a decade, ExxonMobil has supported an economy-wide price on CO<sub>2</sub> emissions as an efficient policy mechanism to address greenhouse gas emissions. ExxonMobil is a founding member of the Climate Leadership Council (CLC), which calls for regulatory simplification and the adoption of a carbon fee. According to the CLC, the Council's bipartisan plan could cut U.S. CO<sub>2</sub> emissions in half by 2035, as compared to 2005 levels.<sup>(43)</sup>

In addition, ExxonMobil provides financial support for Americans for Carbon Dividends, a national education and advocacy campaign promoting the policy pillars of the CLC.

ExxonMobil is also part of the Oil and Gas Climate Initiative (OGCI), a voluntary effort representing 12 of the world's largest oil and natural gas producers working collaboratively to mitigate the risks of climate change. OGCI is a CEO-led organization focused on developing practical solutions in areas including carbon capture and storage, methane emissions reductions, and energy and transportation efficiency.

### Attributes of sound policy



- Promote global participation
- Let market prices drive the selection of solutions
- Ensure a uniform and predictable cost of GHG emissions across the economy
- Minimize complexity and administrative costs
- Maximize transparency
- Provide flexibility for future adjustments to react to developments in technology, climate science and policy



## Providing products to help customers reduce their emissions

Over the next few decades, population and income growth, and an unprecedented expansion of the global middle class, are expected to create new demand for energy and hydrocarbon-based products, even under 2°C scenarios. ExxonMobil is responding to this growth in product demand by delivering solutions that enable customers to reduce their emissions and improve energy efficiency.



### NATURAL GAS

Natural gas is a versatile, abundant and lower-emission fuel. The use of natural gas in power generation plays an important role in reducing global emissions. When considering life cycle emissions, natural gas emits up to 60 percent lower greenhouse gases and produces significantly fewer air pollutants than coal for power generation. Many national and state governments have recognized the contributions natural gas can make to reducing greenhouse gas emissions and have included transitioning to natural gas in their carbon-reduction programs.<sup>(44-45)</sup> In fact, the power sector's switch from coal to natural gas is one of the main reasons why U.S. emissions have declined more than any other country since 2000.<sup>(46)</sup>

Natural gas also provides a reliable source of power to supplement renewable energy when wind or solar power is not available. LNG enables transportation of natural gas from supply centers to customers safely and cost-effectively. ExxonMobil is one of the largest natural gas producers in the world and a leader in LNG.



### LIGHTWEIGHT MATERIALS & PACKAGING

Demand for auto parts, housing materials, electronics and other products made from petrochemicals continues to grow. ExxonMobil produces weight-reducing materials for automobiles, resulting in an estimated 7 percent fuel economy improvement for every 10 percent reduction in vehicle weight. ExxonMobil's butyl rubber helps tires retain air pressure and thus can improve fuel efficiency by up to 2 percent and can increase electric vehicle range by up to 7 percent. Santoprene TPV, a high-performance elastomer, enables up to 45 percent weight reduction versus thermoset rubber. ExxonMobil also provides lightweight packaging materials for consumer goods reducing transport-related energy use and greenhouse gas emissions. Advanced packaging also helps extend the shelf life of fresh food by days or even weeks, improving safety and reducing food waste and emissions from agricultural processes. Many recent technology breakthroughs, such as battery-powered electric vehicles, would not be possible without lightweight materials, including those developed by ExxonMobil.



### ADVANCED FUELS & LUBRICANTS

ExxonMobil's high-performance synthetic lubricants and premium fuels deliver improved vehicle efficiency and improved gas mileage, which can help customers reduce their emissions. The Company's synthetic lubricants require less frequent replacement than conventional motor oils. Mobil 1™ Advanced Fuel Economy synthetic motor oil can improve fuel economy compared to other motor oils. SpectraSyn HiVis and LoVis PAO underpin the Company's synthetic lubricant oils that can deliver up to 2 percent better fuel economy and longer lubricant change intervals. Premium fuels such as Synergy™ gasoline and diesel also help consumers improve gas mileage. By improving engine efficiency and fuel economy, these products can help reduce greenhouse gas emissions compared to conventional lubricants and fuels. ExxonMobil is progressing several multibillion-dollar refinery expansion projects to supply the growing demand for these advanced products.





## Mitigating emissions in Company operations

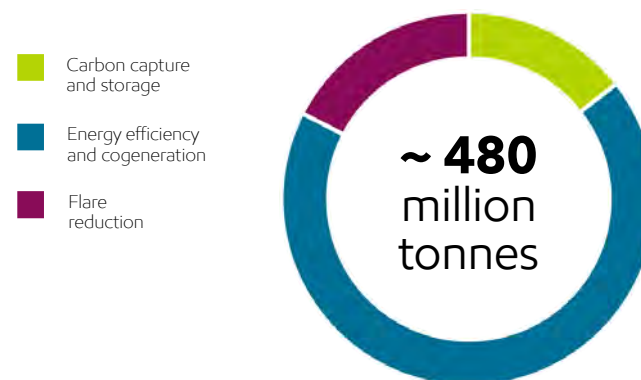
ExxonMobil has a robust set of processes to improve energy efficiency and mitigate emissions, including programs focused on reducing methane emissions, flaring and venting. These processes include, where appropriate, setting tailored objectives at the business, site and equipment level, and then stewarding progress toward meeting those objectives. This rigorous approach is effective to promote efficiencies and reduce greenhouse gas emissions in operations while striving to achieve industry-leading performance.

ExxonMobil's greenhouse gas emissions have declined approximately 5 percent (see bottom right chart) from 2010 to 2019. The greenhouse gas emissions from the base facilities that were in operations in 2010 have decreased more than 25 percent (approximately 32 million tonnes), primarily due to portfolio optimization, energy efficiency improvements, and reductions in flaring, venting and fugitive emissions. Meanwhile, the greenhouse gas emissions from acquisitions, expansions, new developments and facilities (shown as growth projects) increased approximately 5 percent in 2019 compared to 2018.

The greenhouse gas emissions from the electricity used in ExxonMobil's operations represents more than 10 percent of net equity greenhouse gas emissions, and therefore, using energy more efficiently is a powerful tool to reduce emissions. An effective way to increase efficiency is through cogeneration, a process that simultaneously produces electricity while capturing useful heat or steam for industrial uses. ExxonMobil has interest in approximately 5,400 megawatts of cogeneration capacity in more than 100 installations around the world and is continuing to pursue additional economic cogeneration opportunities. In late 2020, a cogeneration unit began operating at the Strathcona refinery in Canada. It produces approximately 41 megawatts of power and is estimated to reduce greenhouse gas emissions by approximately 112,000 tonnes per year versus separate steam and power generation – the equivalent to taking nearly 24,000 vehicles off the road.

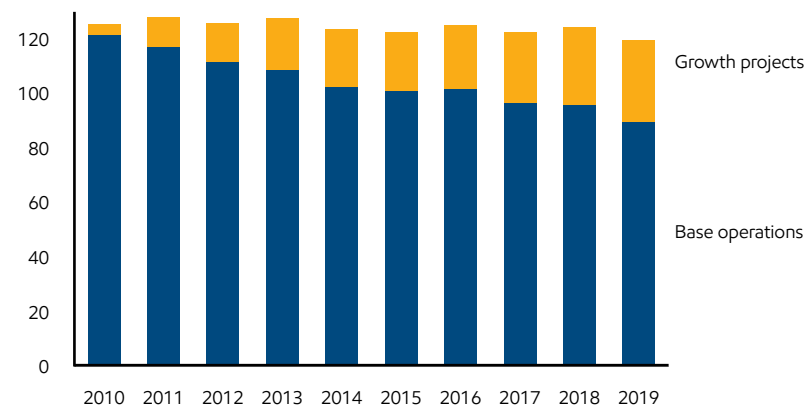
ExxonMobil estimated Scope 1 greenhouse gas emissions reduced and avoided<sup>(47)</sup>

(Net equity, CO<sub>2</sub>-equivalent emissions cumulative since 2000, millions tonnes)



ExxonMobil estimated Scope 1 & 2 greenhouse gas emissions<sup>(47)</sup>

(Net equity, CO<sub>2</sub>-equivalent emissions, million tonnes)





#### METRICS & TARGETS

**ExxonMobil has established programs to drive improvements in energy efficiency and mitigate greenhouse gas emissions.**

These programs are supported by key performance metrics to identify and prioritize opportunities to deliver results.

## Progressing further greenhouse gas reductions; meeting 2020 goals

By the end of 2020, ExxonMobil expects to deliver on its goal to significantly reduce methane emissions and flaring versus 2016 levels. The Company's goals included a 15 percent reduction in methane and a 25 percent reduction in flaring. Both are expected to be achieved through targeted improvements at facilities in the United States, Equatorial Guinea, Angola and Nigeria, eliminating approximately 4 million tonnes of CO<sub>2</sub> equivalent emissions (CO<sub>2</sub>e).

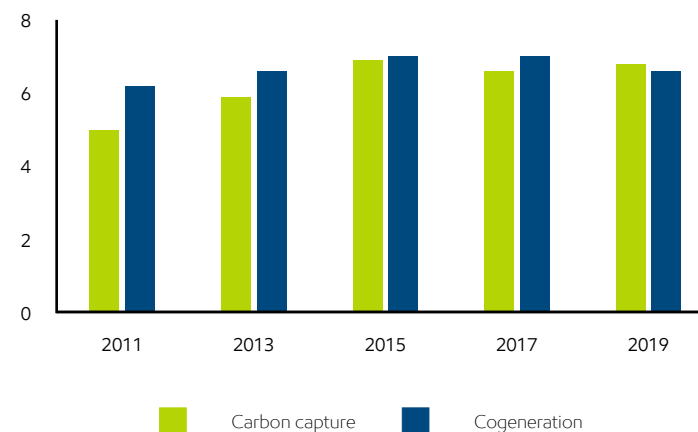
New CCS deployment captured an additional 500,000 tonnes of CO<sub>2</sub>e in Australia and Qatar in 2019. Through the Company's energy management systems, including the application of cogeneration, about 1 million tonnes of CO<sub>2</sub>e were avoided through year-end 2019.

In 2018, ExxonMobil announced two 12-year agreements with Lincoln Clean Energy for the purchase of 500 MWs of wind and solar electricity. Sage Draw, the operator of the wind facility, began generating power to the electricity grid in Texas (ERCOT) in December of 2019. The solar plant is expected to start up in early 2021. Both plants are expected to avoid approximately 800,000 tonnes of CO<sub>2</sub> per year by replacing 70 percent of power purchased by the Company from the ERCOT grid with carbon-free power. Additional power purchase agreements are being evaluated around the world.

Since 2000, ExxonMobil has invested over \$10 billion in projects to research, develop and deploy lower-emission energy solutions. ExxonMobil also continues to expand collaborative efforts with other companies and academic institutions. See pages 22 to 29 for more information on these collaborations.

### Greenhouse gas emissions avoided from carbon capture and from cogeneration<sup>(38)</sup>

(Net equity, CO<sub>2</sub>-equivalent emissions  
million tonnes per year)



→ ExxonMobil has interests in more than 100 cogeneration facilities around the world, with the latest unit recently completed at Imperial's Strathcona refinery in Alberta, Canada.

**UP CLOSE:****Taking actions to reduce methane emissions**

ExxonMobil is committed to reducing methane emissions in its operations, as well as advancing technology and policy to make progress across the industry in a cost-effective manner.

**Operations**

ExxonMobil implemented a program across its U.S. unconventional production to reduce methane emissions from new and existing sources by:

- Enhancing leak detection and repair surveys.
- Phasing out high-bleed pneumatic devices.
- Monitoring liquid unloadings to avoid unplanned releases.
- Improving facility designs.
- Furthering training programs for operations management, superintendents, foremen, facility engineering personnel and those involved in leak inspections.

In addition, the Company continues to mature and operationalize research and technology developments in these areas. For example, emerging aircraft leak detection is now part of routine monitoring campaigns. Continuous monitoring approaches are also under development.

Since initiating its voluntary methane reduction program, the Company has conducted nearly 23,000 leak surveys on more than 5.2 million components at more than 9,500 production sites. High-bleed pneumatic devices have been eliminated across U.S. unconventional production as of 2020. As a result of these actions, U.S. unconventional methane emissions have been reduced by nearly 18 percent as of 2019, compared to 2016, which is equivalent to about 33,000 tonnes.

**UNCONVENTIONAL PRODUCTION  
PROGRESS****~18%****METHANE REDUCTION ACROSS U.S.  
UNCONVENTIONAL PRODUCTION AS OF 2019****~100%****HIGH-BLEED PNEUMATIC DEVICES PHASED  
OUT ACROSS U.S. UNCONVENTIONAL  
PRODUCTION AS OF 2020****Advocacy**

ExxonMobil respects and supports society's ambition to achieve net-zero emissions by 2050, and continues to advocate for policies that promote cost-effective solutions to address the risks of climate change. In this regard, ExxonMobil submitted a letter to the U.S. Environmental Protection Agency rulemaking docket indicating support for reasonable, cost-effective regulations to manage methane emissions from new and existing sources. ExxonMobil submitted a similar statement to the European Commission as it was developing a methane strategy for the European Union. The Company also published a model framework for industry-wide methane regulations and urged stakeholders, policymakers and governments to develop comprehensive, enhanced rules to reduce emissions in all phases of production and across the full natural gas value chain.

In addition, ExxonMobil was a founding member, and remains highly involved in the [Methane Guiding Principles](#)<sup>(48)</sup> – an international multi-stakeholder initiative now comprising more than 20 companies and 15 supporting organizations that work together to address methane emissions across the full natural gas value chain. Under the Methane Guiding Principles, ExxonMobil is a primary sponsor of the IEA's [Methane Tracker](#)<sup>(49)</sup> a web-based information portal that provides information on global emissions, mitigation measures, and regulatory approaches. The Company also participates in the Methane Guiding Principles' non-operated joint venture and policy-related work streams.



**UP CLOSE:****Taking actions to reduce methane emissions, *continued***

ExxonMobil supports strong measurement, reporting and verification standards as part of a broad suite of regulations to address oil and natural gas related methane emissions. To that end, the Company is actively engaged with organizations such as the Oil and Gas Climate Initiative, the Collaboratory for Advancing Methane Science, the Environmental Partnership, and the Methane Guiding Principles, mentioned on the previous page, to continue to improve the accuracy and transparency of how industry approaches methane emissions measurement, reporting and verification. ExxonMobil participates in the recently formed International Association of Oil & Gas Producers/IPIECA/OGCI Task Force for Recommended Practices for Methane Emission Detection & Quantification Technologies.

ExxonMobil is also working with trade associations to encourage consensus on the need to develop policy positions and/or best practices on methane emissions inventory and management, as well as technology and innovation, most recently for example, with the American Exploration & Production Council (AXPC), the Natural Gas Supply Association (NGSA) and the Argentinean Institute for Oil and Gas (Instituto Argentino del Petróleo y del Gas, IAPG).

**Research and technology**

Reducing methane emissions in oil and natural gas operations is an important way to reduce global greenhouse gas emissions. Advances in technology can help detect and identify the sources, and improve the ability to respond quickly.

ExxonMobil is working to find new and better ways to monitor and reduce methane emissions through a new collaboration, known as Project Astra, involving universities, environmental groups and other industry partners. Together, the partners are working to develop an innovative sensor network in Texas that continuously monitors methane emissions across large areas to enable quick and efficient detection and repair of leaks. This high-frequency monitoring system will enable operators to more efficiently direct resources to a specific location and could provide a more affordable, efficient solution to reduce methane emissions.

In addition, the Company is testing novel analytical systems that can be deployed in helicopters, airplanes and drones to detect fugitive emissions. The Company is also exploring the use of satellite surveillance where data can be regularly updated each time satellites orbit the earth. These technology investments complement the Company's voluntary methane management program that includes structured leak detection and repair protocols, prioritized replacement of high-bleed pneumatic devices, and infrastructure enhancements.

**IN SPACE**

Emissions can be detected by satellite surveillance technology. The data can be updated each time the satellite orbits the earth.

**IN THE AIR**

Using helicopters and airplanes, ExxonMobil is trialing four different airborne technologies fitted with methane sensors to detect and quantify emissions. *Photo courtesy of Scientific Aviation.*

**ON THE GROUND**

ExxonMobil is also testing a ground-based leak detection system that combines research in sensing technology, plume modeling and data analytics to identify leaks for repair.



## ExxonMobil's greenhouse gas emission reduction plans

The Company recently announced plans to further reduce greenhouse gas emissions in its operations by 2025, compared to 2016 levels, while aiming for industry-leading greenhouse gas performance across its businesses by 2030. The 2025 plans include a 15 to 20 percent reduction in greenhouse gas intensity of upstream operations. The reductions will be supported by a 40 to 50 percent reduction in methane intensity; and a 35 to 45 percent reduction in flaring intensity. The Company also plans to eliminate routine flaring by 2030 in upstream operations, as defined by the World Bank.

The 2025 emission reduction plans include actions that are expected to reduce absolute greenhouse gas emissions by an estimated 30 percent for the Company's upstream business. Similarly, absolute flaring and methane emissions are expected to decrease by 40 to 50 percent. ExxonMobil's emission reduction plans cover Scope 1 and Scope 2 emissions from assets operated by the Company.

Actions will include deploying industry-leading best practices such as increased leak detection and repair, the application of advanced technologies to improve inspections, and improved facility designs including the phase out of high-bleed pneumatic devices. See page 36 for more information.

ExxonMobil's emission reduction plans will leverage the continued application of operational efficiencies, ongoing development and deployment of lower-emission technologies, such as carbon capture, and through additional purchases of renewable electricity for its operations.



→ ExxonMobil is working to find new and better ways to monitor and reduce methane emissions, including in its Permian operations.

# Greenhouse gas emissions performance data

ExxonMobil assesses its performance to support continual improvements throughout the organization. Since 2011, performance data include unconventional operations information. In 2014, the Company started reporting data over a 10-year period to demonstrate trends over time as part of a commitment to transparency. The reporting guidelines and indicators of International Petroleum Industry Environmental Conservation Association, the International Oil and Gas Producers Association and the American Petroleum Institute Oil and Gas Industry Guidance on Voluntary Sustainability Reporting (2015) informed what data are included in the performance table.



## Managing the risks of climate change<sup>(50)</sup>

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
<sup>(51)</sup> Greenhouse gas emissions, absolute (net equity, CO <sub>2</sub> -equivalent emissions), millions of tonnes	126	128	126	127	124	122	125	123	124	120
<sup>(52)</sup> Direct (excluding emissions from exported power and heat)	117	119	118	119	116	114	117	115	116	111
<sup>(53)</sup> Emissions associated with imported power	9	9	8	8	8	8	8	8	8	9
CO <sub>2</sub> (excluding emissions from exported power and heat)	122	124	120	119	116	115	117	116	117	114
Methane (CO <sub>2</sub> -equivalent)	3	3	5	7	7	6	7	7	7	6
Other gases (CO <sub>2</sub> -equivalent)	1	1	1	1	1	1	1	<1	<1	<1
Emissions from exported power and heat	13	15	15	16	8	4	3	3	3	3
<sup>(51)</sup> Greenhouse gas emissions, normalized (net equity, CO <sub>2</sub> -equivalent emissions), tonnes per 100 tonnes of throughput or production										
Upstream	20.5	20.7	22.3	23.2	24.0	25.7	26.3	26.3	26.8	25.4
Downstream	20.8	20.0	19.6	19.7	19.2	18.9	19.4	18.6	18.6	19.1
Chemical	57.9	57.2	56.3	57.9	54.5	54.8	53.9	54.2	55	52.8
By-region Greenhouse gas emissions (net equity, CO <sub>2</sub> -equivalent emissions), millions of tonnes										
Africa/Europe/Middle East	45	45	44	44	43	44	45	43	42	37
Americas	64	66	68	70	66	65	64	64	63	66
Asia Pacific	17	17	14	13	15	13	16	16	19	17
By-division Greenhouse gas emissions (net equity, CO <sub>2</sub> -equivalent emissions), millions of tonnes										
Upstream	50	54	56	58	56	56	59	58	58	55
Downstream	55	54	51	49	47	45	45	43	42	42
Chemical	21	20	19	20	21	21	21	22	24	23
Carbon dioxide – captured for storage, millions of tonnes	4.8	5.0	4.8	5.9	6.9	6.9	6.3	6.6	7.0	6.8
Energy use (billion gigajoules)	1.5	1.5	1.5	1.4	1.4	1.5	1.5	1.4	1.5	1.5
Upstream (gigajoules per tonnes production)	2.0	2.0	2.0	2.1	2.3	2.4	2.4	2.5	2.5	2.5
Refining (gigajoules per tonnes throughput)	3.0	3.0	3.0	3.0	2.9	2.9	2.9	2.9	3.0	3.0
Chemical (gigajoules per tonnes product)	9.5	11.4	12.0	10.9	10.7	10.9	10.6	10.5	10.0	10.0
<sup>(54)</sup> Hydrocarbon flaring (worldwide activities), million standard cubic feet per day	380	430	380	390	470	570	530	410	410	430
<sup>(55)</sup> Cogeneration capacity in which ExxonMobil has interest, gigawatts	4.9	5.0	5.2	5.3	5.5	5.5	5.3	5.4	5.4	5.4





#### RISK MANAGEMENT

ExxonMobil utilizes a risk management framework based on decades of experience to identify, manage and address risks associated with its business.



# ExxonMobil's approach to risk management

ExxonMobil's corporate risk framework provides a structured, comprehensive approach to identify, prioritize and manage risks across the Company. It is designed to drive consistency across risk type, and monitor key risks, including risks related to climate change. The framework includes five elements: (1) a way to organize and aggregate risks (illustrated at the right); (2) robust risk identification practices; (3) a prioritization method; (4) an inventory of systems and processes to manage risk; and (5) risk governance.

ExxonMobil's approach to risk governance includes clearly defined roles and responsibilities for managing each type of risk, utilizing a multilayered approach. This approach includes a definition of the responsibilities of risk owners, functional experts and independent verifiers. Each risk type is managed and supported by functional organizations that 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, as described on pages 5 to 10, are a key part of risk governance.

Managing long-term risks associated with climate change is an integral part of managing strategic risks at ExxonMobil. A core element of the Company's management of strategic risks is the work underpinning the *Outlook for Energy*. As described in the previous sections of this report, the *Outlook* reflects a long-term, data-driven approach to promote a deeper understanding of global trends and projections related to population and economic growth, energy demand and supply options, as well as assessments of key uncertainties and potential impacts of alternative assumptions. Uncertainties include changes in economic growth, the evolution of energy demand and supply, emerging and disruptive technologies, and policy goals and actions. The *Outlook* informs business strategies, assumptions and processes for evaluating investment opportunities. Managing risk associated with climate change is an integral part of that work, helping to ground choices related to long-term strategies and individual investments.

ExxonMobil enterprise risk framework considers climate-related risks

Risk type	Examples of potential risks that could be impacted by climate change, energy transition or extreme weather
1 Strategic	Supply/demand, disruptive technology, geopolitical, government changes and capital allocation
2 Reputational	Industry reputation, corporate reputation
3 Financial	Price volatility, foreign exchange fluctuations, customers' credit risk, insurance
4 Operational	Geological risk, project risk, product quality and brand, talent, supplier, operations disruption
5 Safety, Security, Health & Environment	Process safety, well control events, environmental incidents
6 Compliance & Litigation	Litigation risks, regulatory compliance

**UP CLOSE:****Resiliency: Protection of assets, the community and the environment**

ExxonMobil has extensive experience operating in a wide range of challenging physical environments around the world. The Company's long history of managing diverse operational designs, construction and operating conditions provides it with a solid foundation to address risks associated with unique physical environments. The Company assesses risks posed by weather and other natural elements, and designs its facilities and operations in consideration of these risks.

ExxonMobil's diverse portfolio requires it to work in remote and challenging environments, including flood-prone areas. Using a rigorous and comprehensive scientific assessment process and the highest quality data from measurements and advanced computer modeling, the full range of potential environmental, socioeconomic and health risks associated with potential operations are considered before pursuing a new development. Public consultation is also undertaken through community meetings and other outreach mechanisms, and the Company works with regulators to share information and maintain alignment. In doing so, a comprehensive understanding of potential impacts is developed and the information is used to implement measures to avoid environmental, socioeconomic and health risks, reduce them to acceptable levels, or remedy the impacts.

When considering physical environmental risks, including risks for production, refining and petrochemical facilities, the type and location of current and planned facilities are evaluated. As an example, offshore facilities could be impacted by changes in wave and wind intensity as well as by changes in ice floe patterns, while onshore facilities could be vulnerable to sea level rise, changes in storm surge, flooding, changes in wind and seismic activity, or geo-technical considerations. Environmental assessments are conducted in advance to ensure that protective measures and procedures are in place prior to building and start-up of the facilities.

ExxonMobil's scientists and engineers are considered industry experts across a variety of relevant 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 ExxonMobil's standards and procedures and industry practices such as the American Society of Civil Engineers' *Climate-Resilient Infrastructure Adaptive Design and Risk Management Manual of Practice*.

Industry standards such as ASCE 7,<sup>(56)</sup> Minimum Design Loads and Associated Criteria for Buildings and Other Structures, are used along with historical experience and additional factors to cover a range of uncertainties. After construction of a facility, the Company monitors and manages ongoing facility integrity, through periodic checks of key aspects of the structures.

For example, the Gulf Coast Growth Venture (GCGV), a new petrochemical manufacturing facility near Corpus Christi, Texas, is compliant with both San Patricio County and national standards (ASCE 7). Storm water handling, which is a risk factor associated with GCGV, includes basins that have been designed to retain excess storm water 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 have held hundreds of outreach meetings with local organizations, chambers, government agencies, civic groups and neighborhoods and have addressed all comments and concerns raised during the permitting process. Additional information on the TCEQ permitting process can be found on its website.<sup>(57)</sup>

ExxonMobil's comprehensive approach and established systems enable management of a wide variety of possible outcomes, including risks associated with climate change.



→ Design standards provide for resiliency and environmental protection.



→ Proactive monitoring and surveillance to protect the environment.



→ Supporting recovery efforts in communities.

**UP CLOSE:****Local Emergency Planning Committee**

Once facilities are in operation, the Company maintains disaster preparedness, response and business continuity plans. Detailed, well-practiced and continuously improved emergency response plans are tailored to each facility to help ExxonMobil 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 such events. 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.

Under the U.S. Emergency Planning and Community Right-to-Know Act of 1986, local emergency planning committees must develop an emergency response plan, review it annually, and provide information to citizens about chemicals in the community. These plans are developed by the committees with stakeholder participation.

Each of the Company's U.S. manufacturing facilities is involved with local emergency planning committees in the communities where they are located. Site personnel attend regular meetings and events alongside local emergency services providers, elected officials, public health officials, community groups, and industry representatives. Each committee posts information on a public website for accessibility.

The following are recent examples that demonstrate the power of this engagement:

- **Baton Rouge, LA:** ExxonMobil worked with the city of Baton Rouge, through relationships built in the area planning committees, to enable fuel truck deliveries during events requiring safety curfews, and ensure a steady supply of fuel to support critical infrastructure.<sup>(58)</sup>
- **Baytown, TX:** ExxonMobil's Baytown Complex sponsored a shelter-in-place awareness campaign, intended to enhance communications, equip residents, and engage local residents and officials on the importance of having a shelter-in-place community plan in the event of an emergency.<sup>(59)</sup>
- **Beaumont, TX:** Officials at ExxonMobil's integrated petrochemical complex developed shelter-in-place guidance to help strengthen the connection between industry and community emergency responders.<sup>(60)</sup>



→ ExxonMobil's integrated complex in Baton Rouge works closely with city and community leaders to develop emergency response plans.

## Scope 3 emissions

ExxonMobil has publicly reported the Company's Scope 1 and Scope 2 greenhouse gas emissions data for many years. The 2025 emission reduction plans are based on Scope 1 and Scope 2 emissions and are projected to be consistent with the goals of the Paris Agreement.

Reporting Scope 1 emissions data (direct greenhouse gas emissions from Company operations) provides useful insight into the efficiency and emission-reduction performance of the Company's operations, portfolio of products, business sectors served and resource type.

Reporting Scope 2 emissions data (indirect greenhouse gas emissions from energy purchased by the Company) highlights the Company's choice of energy sources, primarily purchases of electricity to power its operations.

Noting that stakeholders have expressed growing interest in Scope 3 data, the Company is providing Scope 3 information in the table to the right and plans to do so on an annual basis. Scope 3 includes the indirect emissions resulting from the consumption and use of the Company's products.

Because Scope 1 and Scope 2 emissions are within the direct control of a company, the criteria for identifying and reporting them is well established, transparent and consistent across industries. Reporting Scope 3 emissions, however, is less certain and less consistent because it includes the indirect emissions resulting from the consumption and use of a company's products occurring outside of its control. Evaluating a company's Scope 3 emissions and comparing them to other companies can be challenging due to inconsistent reporting methodologies, as well as potential duplication, inconsistencies and inaccuracies that may occur when reporting emissions that are the result of activities from assets not owned or controlled by the reporting organization. The International Petroleum Industry Environmental Conservation Association (IPIECA) acknowledges these issues.<sup>(61)</sup>

Furthermore, Scope 3 emissions do not provide meaningful insight into the Company's emission-reduction performance and could be misleading in some respects. For example, increased natural gas sales by ExxonMobil that reduce the amount of coal burned for power generation would result in an overall reduction of global emissions but would increase Scope 3 emissions reported by the Company.

Ultimately, changes in society's energy use coupled with the development and deployment of affordable lower-emission technologies will be required to drive meaningful Scope 3 emissions reductions.

To do its part and support society's ambition of net-zero emissions by 2050, ExxonMobil is committed to continuing to invest in new technologies that can potentially reduce emissions at scale. As highlighted throughout this report, the Company is focusing its competencies on developing breakthrough technology that could reduce emissions from the three sectors that emit 80 percent of all energy-related greenhouse gas emissions: power generation, industrial processes and commercial transportation. The Company is also partnering with governments, academia and industry to research and commercialize biofuels, direct air capture, and lower the cost of carbon capture and storage.

ExxonMobil's focus and commitment to supporting the goals of the Paris Agreement are further detailed in the forward-looking emission-reduction plans described in the Metrics and Targets section.

Estimated Scope 3 emissions from the use of ExxonMobil's crude and natural gas production for the year ending Dec. 31, 2019 as provided under IPIECA's Category 11 were 570 million tonnes.

Note: The table below provides ExxonMobil's Scope 3 estimates associated with the use of its 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. ExxonMobil's Scope 3 estimates represent three approaches for accounting and are not meant to be aggregated as this would lead to duplicative accounting.

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

### ExxonMobil 2019 Scope 3 estimates

(Million tonnes CO<sub>2</sub>-equivalent)

IPIECA Category 11 Scope 3 potential estimates		Upstream production	Refining throughput	Petroleum product sales
Natural gas production	190	570	630	730
Crude production	380			

Notes: Applied CO<sub>2</sub> 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.



## Frequently asked questions

### How are ExxonMobil's operations and investments aligned with the Paris Agreement?

ExxonMobil supports the goals of the Paris Agreement,<sup>(5)</sup> an agreement among national governments to reduce carbon emissions from their economies. The Company's *Outlook for Energy*, which informs its business strategy and investments, projects future energy supply and demand, and aligns in aggregate with the Nationally Determined Contributions (NDCs) submitted by Paris Agreement signatories, which outline each country's plans to reduce its emissions. ExxonMobil's greenhouse gas emission reduction plans announced in 2020 are projected to be consistent with the goals of the Paris Agreement.

The Company's strategy focuses on the dual challenge of meeting the growing demand for energy to support economic development around the world while minimizing environmental impacts and the risks of climate change. ExxonMobil believes it has an important role to play in helping reduce climate risks through its commitment to manage operational emissions, produce cleaner, more advanced products, conduct fundamental research into new technology solutions, and engage in climate policy discussions.

Over the past two decades, ExxonMobil has invested more than \$10 billion to research, develop and deploy lower-emission energy solutions. These solutions have resulted in highly efficient operations that have eliminated or avoided approximately 480 million tonnes of CO<sub>2</sub> emissions. The Company continues to deploy its competencies in breakthrough technology development to pursue advances in the high-emission sectors where current technologies are insufficient to achieve deep reductions. These sectors – power generation, commercial transportation and industrial – represent about 80 percent of current energy-related CO<sub>2</sub> emissions and are projected to increase with population growth and economic development. Further advances in these areas are critical to reducing emissions and would make a meaningful contribution to achieving the goals of the Paris Agreement.

As governments around the world implement policies to meet their respective emission-reduction goals, demand for more carbon-intensive energy products will be reduced.

However, even under 2°C scenarios, a growing and increasingly prosperous global population will increase energy demand and still require significant investment in new supplies of oil and natural gas. The IEA's Sustainable Development Scenario (SDS) estimates the world will still need 66 million barrels of oil per day in 2040.<sup>(62)</sup> However, without further investment, the impact of depletion would result in oil production of just 22 million barrels of oil per day in 2040.<sup>(63)</sup> The IEA estimates \$12 trillion of additional oil and natural gas investment is needed to meet the oil and natural gas demand in the SDS.

Noting the Paris Agreement did not contemplate voluntary commitments from individual companies, and that advancing the goals of Paris can occur in a number of ways (including replacing more emission-intensive activities with less intensive activities), ExxonMobil's announced greenhouse gas plans are projected to be consistent with the goals of the Paris Agreement. For example, planned reductions in upstream emissions through 2025 would be consistent with the goals of a 2-degree pathway (which envisions a global emissions reduction of about 10 percent in 2025 versus 2016<sup>(64)</sup>).

## Frequently asked questions, *continued*

### **Does ExxonMobil have to reduce its production to align with the Paris Agreement?**

The Paris Agreement does not contemplate or require individual companies to decrease production to align with the goal of maintaining global temperature rise to below 2°C. The structure of the agreement recognizes that energy-related emissions are driven by society's demand for energy – not its supply. Improved efficiency, effective government policies and informed consumer choices are more effective measures to address demand.

With respect to energy supply, production reductions by individual companies would have no impact on demand or consumption of energy, and would simply result in production shifting from one producer to another. In addition, shifting of production would not necessarily reduce the amount of greenhouse gases produced and, in some cases, the opposite could be true. The transfer of production from well-run, highly efficient operators to less-efficient producers, for example, could actually increase emissions associated with the production of oil and natural gas, and finished products. Society benefits when the most efficient operators lead energy development efforts.

ExxonMobil has a long history of industry-leading operational performance. For example, the Company's refining operations have consistently ranked in the top quartile for energy efficiency in the key refining industry benchmark survey by Solomon Associates.<sup>(65)</sup> In ExxonMobil's chemical business, advanced efficiency technologies and techniques have reduced net equity greenhouse gas emissions intensity by nearly 9 percent between 2013 and 2019.

In addition, as of 2019 the Company reported a nearly 20 percent reduction in methane emissions in its U.S. unconventional production through a series of industry-leading best practices such as equipment upgrading and enhanced use of technology to improve inspections. ExxonMobil expects to exceed its goal to reduce company-wide methane emissions by 15 percent and flaring by 25 percent by year-end 2020.

Recently, ExxonMobil announced plans to reduce the intensity of operated upstream greenhouse gas emissions by 15 to 20 percent by 2025, compared to 2016 levels. This will be supported by a 40 to 50 percent decrease in methane intensity, and a 35 to 45 percent decrease in flaring intensity across its global operations, as well as other measures. The Company's upstream operations also plan to align with the World Bank's initiative to eliminate routine flaring by 2030.

The plan is projected to be consistent with the goals of the Paris Agreement and will drive meaningful near-term emission reductions as the Company works toward industry-leading greenhouse gas performance across its business lines.

ExxonMobil's emission reduction plans cover Scope 1 and Scope 2 emissions from assets operated by the Company. The plans will leverage the continued application of operational efficiencies and ongoing development and deployment of lower-emission technologies such as carbon capture and storage.

While the Company's voluntary efforts are important, they capture only a fraction of industry's overall methane emissions, which is why ExxonMobil works with policymakers to improve effectiveness of regulations so that all of industry participates to maximize the benefits to society.

## Frequently asked questions, *continued*

### **What is ExxonMobil doing to prepare for a lower-carbon future while meeting energy needs of a growing population?**

ExxonMobil plays a critical role in providing the energy that supports economic growth and improves the quality of life for people around the world. Major forecasts project energy demand to increase as the global population rises to well over 9 billion by 2040 from 7.5 billion today, and because of growing prosperity and an expanding middle class.<sup>(2)</sup>

Even under 2°C and net-zero scenarios, meeting this increase in energy demand will require significant investment in new supplies of oil and natural gas, generally consistent with ExxonMobil's investment levels. This is mainly due to the significant natural decline rates associated with oil and natural gas production. At the same time, there is a need to pursue further emission-reduction efforts and technologies in support of the goals of the Paris Agreement.

The Company supports market-based approaches to reduce emissions, including further cost-effective regulation of methane and an economy-wide price on carbon. ExxonMobil believes market-based policies that place a uniform, predictable cost on carbon will drive emission reductions at the lowest cost to society while supporting technology innovation and deployment.

Technology innovation is critical because the current solution set is insufficient to reduce emissions to targeted levels at an acceptable cost to society. According to the IEA, only six of 46 important technologies and sectors are on track to help society reach the Paris Agreement goals.<sup>(7)</sup> Meeting these goals will require large-scale deployment of new technologies in key areas – power generation, commercial transportation and industrial processes – where emissions are most significant and forecast to increase.

Near-term actions the Company is taking to prepare for a lower-carbon future, include:

- Expanding supplies of cleaner-burning natural gas.
- Improving energy efficiency in operations.
- Operating and investing in carbon capture and storage.
- Reducing flaring and methane emissions from operations.
- Developing products, such as premium lubricants, light-weight plastics, and special tire liners to help consumers improve efficiency and reduce emissions.
- Advocating for effective climate policy to address the risks of climate change at the lowest societal cost.

Longer-term efforts include:

- Progressing advanced biofuels from algae and agricultural waste for commercial transportation and petrochemicals.
- Researching breakthroughs to improve commerciality of carbon capture and storage technology for power generation and industrial applications.
- Developing new and efficient technologies that reduce emissions in refining and chemical facilities.

More information can be found in the Strategy section of this *2021 Energy & Carbon Summary*.

## Frequently asked questions, *continued*

### How is ExxonMobil supporting society's desire to achieve net-zero emissions and 2°C?

ExxonMobil has supported the Paris Agreement from its adoption. The Company also continues to support U.S. government participation in the framework. ExxonMobil's *Outlook for Energy* aligns in aggregate with the current Nationally Determined Contributions (NDCs) submitted by Paris Agreement signatories, which represent each country's plan to address its greenhouse gas emissions. ExxonMobil bases its business strategy and investments on its work underpinning the *Outlook*, which assumes progress in technologies, infrastructure and government policies to meet the NDCs. New NDCs have been submitted recently and more are expected in 2021.

The IPCC assessed available pathways and found 74 pathways that limit global warming to below 2°C (IPCC Lower 2°C).<sup>(10)</sup> In those pathways, global net anthropogenic emissions of CO<sub>2</sub> fell on average more than 20 percent from 2010 levels by 2030, reaching net zero around 2070.<sup>(66)</sup> At the time at which net emissions reach net zero, any remaining emissions would need to be balanced by removing CO<sub>2</sub> from the atmosphere.

A challenge for society is how to transition to a net-zero world, while providing for a growing population with growing energy needs.

The IPCC pathways that lead to net zero and limit warming to less than 2°C show important trends, including increase in renewables (wind and solar), decrease in coal, increase in use of carbon dioxide removal (CDR), increase in carbon capture, and focused efforts to reduce other greenhouse gases and aerosols that cause warming. The IEA's net-zero emissions by 2050 scenario, a net-zero analysis through 2030, also reached similar conclusions on needed CO<sub>2</sub> reductions through deployment of all key technologies.

ExxonMobil continues to help meet global oil and natural gas demand, which is projected to continue even in a rapid net-zero transition, while working to reduce the Company's emissions of greenhouse gases. The Company also plays an important role in helping to improve technology that would be useful in net-zero pathways including biofuels, carbon capture, direct air capture, reduction of methane including advanced measurement and monitoring, and technology to enable low greenhouse gas energy such as hydrogen.

The pathways that lead to net zero involve a transition of all major regions of the world and across all sectors of the economy. ExxonMobil continues to proactively collaborate with governments and organizations to advance policy and technology development in support of net zero. The Company recognizes and continues to support the important work of the UNFCCC to achieve global participation through the Paris Agreement. The Company also works with major trade associations and industry groups including the Oil and Gas Climate Initiative and International Petroleum Industry Environmental Conservation Association to advance emission reduction policies and best practices and to develop and deploy lower emission technology. The oil and natural gas sector along with other sectors and governments all have an important role to play in the energy transition.



## Frequently asked questions, *continued*

### **Why isn't ExxonMobil investing in existing renewable energy sources like wind and solar?**

Although wind and solar will play an important role in the transition to lower-carbon energy sources, new technology advances are required to reduce emissions to levels outlined in 2°C scenarios. ExxonMobil is undertaking research and development where the need is greatest. The Company is focused on areas where it can make a unique and significant contribution, and where it has deep scientific competencies. In this way, ExxonMobil can make the most meaningful and expedient contribution to society's efforts to manage the risks of climate change.

The Company's technology development program focuses on three distinct high-emitting sectors where there are currently limited viable solutions for broad deployment: commercial transportation, power generation and industrial processes. These sectors represent about 80 percent of current energy-related CO<sub>2</sub> emissions and are projected to increase with population growth and economic development.

In transportation, ExxonMobil is making progress in the development of advanced algae and cellulosic liquid biofuels. Because of their energy density, liquid fuel solutions are currently needed for commercial transportation where battery capacity is an issue for heavy loads and long distances.

In power generation and for industrial processes, the Company is working to make carbon capture and storage technology more economic, to potentially enable wider deployment. ExxonMobil currently has about 20 percent of the world's total carbon capture capacity.

In the industrial sector, ExxonMobil is developing new processes for refining and chemical facilities to reduce energy use through advanced separations processes, catalysts and process configurations.

Further progress in these areas is critical to reducing emissions and would make a meaningful contribution to achieving the goals of the Paris Agreement.

It should also be noted that ExxonMobil was one of the top purchasers in 2018 of renewable energy, including wind and solar, to support its operations.

# The *Energy & Carbon Summary* is aligned with the core elements of the TCFD framework

ExxonMobil's *Energy & Carbon Summary* is aligned with the core elements of the framework developed by the Financial Stability Board's Task Force on Climate-related Financial Disclosures (TCFD), designed to encourage the informed conversation society needs on these important issues.

TCFD core elements and recommended disclosures	ExxonMobil disclosures
<b>Governance</b> <ul style="list-style-type: none"> <li>a. Describe the Board's oversight of climate-related risks and opportunities.</li> <li>b. Describe management's role in assessing and managing risks and opportunities.</li> </ul>	<p>Pages 5-10, 39-40</p> <p>Pages 5-10, 39-40</p>
<b>Strategy</b> <ul style="list-style-type: none"> <li>a. Describe the climate-related risks and opportunities the organization has identified over the short, medium and long term.</li> <li>b. Describe the impact of climate-related risks and opportunities on the organization's businesses, strategy and financial planning.</li> <li>c. Describe the resilience of the organization's strategy, taking into consideration different climate-related scenarios, including a 2°C or lower scenario.</li> </ul>	<p>Pages 11-32</p> <p>Pages 11-32</p> <p>Pages 11-32</p>
<b>Metrics &amp; targets</b> <ul style="list-style-type: none"> <li>a. Disclose the metrics used by the organization to assess climate-related risks and opportunities in line with its strategy and risk management process.</li> <li>b. Disclose Scope 1, Scope 2 and, if appropriate, Scope 3 GHG emissions, and the related risks.</li> <li>c. Describe the targets used by the organization to manage climate-related risks and opportunities and performance against targets.</li> </ul>	<p>Pages 33-38</p> <p>Pages 33-38, 43</p> <p>Pages 33-38</p>
<b>Risk management</b> <ul style="list-style-type: none"> <li>a. Describe the organization's processes for identifying and assessing climate-related risks.</li> <li>b. Describe the organization's processes for managing climate-related risks.</li> <li>c. Describe how processes for identifying, assessing and managing climate-related risks are integrated into the organization's overall risk management.</li> </ul>	<p>Pages 39-40</p> <p>Pages 39-42</p> <p>Pages 39-42</p>

# Disclosures

ExxonMobil is committed to providing its shareholders with disclosures that impart meaningful insights about its business, including how it manages climate-related risks. This report, along with the rest of its comprehensive set of disclosures relating to climate-related matters, follow the framework established by IPIECA, including IPIECA's Climate Change Reporting Framework.<sup>(67)</sup> This year's report is also aligned with the core elements of the TCFD framework. IPIECA members represent a significant portion of the world's oil and natural gas production, including state oil companies, and the organization is the industry's principal channel of communication with the United Nations. A broad and global membership enables a reporting framework that is tailored to the petroleum industry and facilitates better comparisons of member companies on a more consistent and standardized basis.

Web links to other various climate-related disclosures are highlighted below:

- **Sustainability Report** ([exxonmobil.com/sustainabilityreport](https://www.exxonmobil.com/sustainabilityreport))
- **Outlook for Energy** ([exxonmobil.com/energyoutlook](https://www.exxonmobil.com/energyoutlook))
- **Technology** ([exxonmobil.com/technology](https://www.exxonmobil.com/technology))
- **Enhanced Methane Emissions Reduction Program** ([exxonmobil.com/methanereduction](https://www.exxonmobil.com/methanereduction))
- **Climate-related materials** ([exxonmobil.com/climate](https://www.exxonmobil.com/climate))
- **SEC Form 10-K** ([exxonmobil.com/secfilings](https://www.exxonmobil.com/secfilings))
- **Executive Compensation materials contained in current year proxy statement** ([exxonmobil.com/proxymaterials](https://www.exxonmobil.com/proxymaterials))

Existing policy frameworks (including the Paris NDCs), financial flows, and the availability of cost-effective technologies indicate that society is not currently on a 2°C pathway. Should society choose to more aggressively pursue a 2°C pathway, the Company will be positioned to contribute through its engagement on policy, development of needed technologies, improved operations and customer solutions.

## Footnotes

(1) Spencer Stuart (2019). 2019 U.S. Spencer Stuart Board Index, page 5.

[https://www.spencerstuart.com/-/media/2019/ssbi-2019/us\\_board\\_index\\_2019.pdf](https://www.spencerstuart.com/-/media/2019/ssbi-2019/us_board_index_2019.pdf)

(2) BROOKINGS INSTITUTION, There are many definitions of "middle class" - here's ours, Richard V. Reeves and Katherine Guyot Tuesday, September 4, 2018, accessed December 2020.

<https://www.brookings.edu/blog/up-front/2018/09/04/there-are-many-definitions-of-middle-class-heres-ours/>

(3) International Labour Organization, ILO Monitor: COVID-19 and the world of work. Sixth edition, Updated estimates and analysis, 23 September 2020, accessed December 2020.

[https://www.ilo.org/wcmsp5/groups/public/@dgreports/@dcomm/documents/briefingnote/wcms\\_755910.pdf](https://www.ilo.org/wcmsp5/groups/public/@dgreports/@dcomm/documents/briefingnote/wcms_755910.pdf)

(4) Article 4 paragraph 2 of the Paris Agreement.

[https://unfccc.int/files/meetings/paris\\_nov\\_2015/application/pdf/paris\\_agreement\\_english\\_.pdf](https://unfccc.int/files/meetings/paris_nov_2015/application/pdf/paris_agreement_english_.pdf)

(5) Reference is made to the first set of NDC submissions made in 2015; new or updated NDCs are anticipated, but not included as part of this analysis as only a few countries have updated their NDCs at this time. Additional NDC submissions are anticipated ahead of the 26th United Nations Climate Change Conference in 2021.

(6) IEA, 2020. Achieving net zero emissions, C. McGlade, D. Crow, 19 November, 2020, accessed December 2020.

<https://iea.blob.core.windows.net/assets/4b4be30b-bb86-4a3c-982f-5b49e3380917/WEOWeek-Gettingtonetzero.pdf>

(7) IEA, 2020. Uneven progress on clean energy technologies faces further pressure from the Covid-19 crisis, 5 June 2020, accessed December 2020.

<https://www.iea.org/news/uneven-progress-on-clean-energy-technologies-faces-further-pressure-from-the-covid-19-crisis>

(8) IEA, 2017. Chapter 2 of Perspectives for the energy transition - investment needs for a low-carbon energy system, p57.

(9) "EMF was established at Stanford in 1976 to bring together leading experts and decision makers from government, industry, universities, and other research organizations to study important energy and environmental issues. For each study, the Forum organizes a working group to develop the study design, analyze and compare each model's results and discuss key conclusions." <https://emf.stanford.edu/about>

EMF is supported by grants from the U.S. Department of Energy, the U.S. Environmental Protection Agency as well as industry affiliates including ExxonMobil.

<https://emf.stanford.edu/industry-affiliates>

(10) IPCC, 2018: Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [V. Masson-Delmotte, P. Zhai, H. O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J. B. R. Matthews, Y. Chen, X. Zhou, M. I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, T. Waterfield (eds.)]. In Press.

(11) IEA, World Energy Outlook 2020, p. 87. The IEA SDS was not assessed by the IPCC as part of the suite of 74 "Lower 2°C" scenarios. According to the IEA "the SDS would provide a 50% probability of limiting the temperature rise to less than 1.65 °C, in line with the Paris Agreement objective of 'holding the increase in the global average temperature to well below 2°C'."

(12) UNEP, Emissions Gap Report 2020 Key Messages, accessed December 2020.

<https://wedocs.unep.org/xmlui/bitstream/handle/20.500.11822/34461/EGR20KM.pdf>

(13) The emissions charted from ExxonMobil 2019 Outlook for Energy, 2020 IEA STEPS and 2020 IEA SDS do not contain industry process emissions. Land use and natural sinks are also excluded.

(14) The IPCC Lower 2°C scenarios produce a variety of views on the potential impacts on global energy demand in total and by specific types of energy, with a range of possible growth rates for each type of energy as illustrated in this report. Since it is impossible to know which elements, if any, of these models are correct given the inherent uncertainty in energy demand modeling, an average of all 74 scenarios was used to approximate growth rates for various energy types as a means to estimate trends to 2040 indicative of hypothetical 2°C pathways.

(15) Based on the average of the IPCC Lower 2°C scenarios referenced in this report, the combination of renewables, nuclear and fossil fuels using CCS is estimated in these scenarios to increase significantly as a percentage of total primary energy demand, rising from over 10 percent in 2010 to roughly 50 percent in 2040.

(16) Electricity delivered from fossil fuels without CCS as a percentage of total electricity delivered decreases from 68 percent to 14 percent on average from 2010 to 2040 under the IPCC Lower 2°C scenarios. Share of electricity from non-bio renewables (e.g., wind, solar, hydro) increases from less than 20 percent to 60 percent. Share of electricity generation utilizing CCS increases to about 10 percent.

(17) Total electricity delivered as a percentage of total final energy demand increases from 18 percent to 34 percent on average across the IPCC Lower 2°C scenarios referenced in this report.

(18) Under the IPCC Lower 2°C scenarios, the average annual growth rate for oil demand is projected to be -0.5 percent from 2010 to 2040, which implies a decrease in absolute level of demand in 2040 by approximately 10 percent relative to 2010 levels, which is near 2000 levels. Oil demand has increased about 11 percent since 2010, hence it would require a demand decrease of about 20 percent to reach the same 2040 level relative to today's demand.



## Footnotes

(19) Based on average global demand trends under IPCC Lower 2°C scenarios.

(20) PwC: Net Zero Economy Index 2020: The Pivotal Decade. <https://www.pwc.co.uk/services/sustainability-climate-change/insights/net-zero-economy-index.html>

(21) For the purposes of this report, proved reserves are year-end 2019 proved oil and gas reserves for consolidated subsidiaries and equity companies as reported in the Corporation's 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.

(22) For the purposes of this disclosure, resources are total remaining estimated quantities of discovered quantities of 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.

(23) To estimate global demand in 2040 for oil and natural gas, the average of the IPCC Lower 2°C scenarios' growth rates for oil and natural gas covering the period 2010–2040 have been applied to standard baseline estimates of oil and natural gas demand in 2010. In addition, the IEA STEPS and SDS scenarios for oil demand and natural gas demand were added.

(24) IHS, 2017: Climate-Related Financial Risk and the Oil and Gas Sector, page 23.

(25) IEA, World Energy Outlook 2020 Annex 5, investment data.

(26) IEA, Energy Investment Report, p. 15.

(27) Hypothetical cumulative production determined by proportioning ExxonMobil's 2019 average daily production (Form 10-K, page 9) and 2019 average daily global oil and gas production to estimated 2040 average daily production (assuming ExxonMobil's current market share and 100 percent proved reserves replacement to maintain its proved reserves consistent with its production ratio at the end of 2019) and implied oil and gas demand from the IPCC Lower 2°C scenarios average. Assumed linear decline of estimated average daily production through 2040.

(28) IEA, World Energy Outlook 2020, table 2.2. Fossil fuel prices by scenario.

(29) Lower overall greenhouse gas emissions of plastics over alternatives is over the full life cycle of the plastic. American Chemistry Council (ACC), 2018. Life cycle impacts of plastic packaging compared to substitutes in the United States and Canada, theoretical substitution analysis. Prepared by Franklin Associates for ACC.

<https://plastics.americanchemistry.com/Reports-and-Publications/LCA-of-Plastic-Packaging-Compared-to-Substitutes.pdf>

(30) Edenhofer, O. et al (2014) Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. [https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc\\_wg3\\_ar5\\_full.pdf](https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_full.pdf)

(31) Global CCS capacity: Global CCS Institute, Global Status of CCS 2020, page 19. ExxonMobil CCS capacity: ExxonMobil estimates.

(32) Global CCS Institute. Data updated as of April 2020 and based on cumulative anthropogenic carbon dioxide capture volume. Anthropogenic CO<sub>2</sub>, for the purposes of this calculation, means CO<sub>2</sub> that without carbon capture and storage would have been emitted to the atmosphere, including, but not limited to: reservoir CO<sub>2</sub> from gas fields; CO<sub>2</sub> emitted during production and CO<sub>2</sub> emitted during combustion. It does not include natural CO<sub>2</sub> produced solely for enhanced oil recovery.

(33) TDA Research, Pilot unit testing at NCCC of sorbent based CO<sub>2</sub> capture project, October 2020. [https://netl.doe.gov/sites/default/files/netl-file/20VPRCC\\_Elliott.pdf](https://netl.doe.gov/sites/default/files/netl-file/20VPRCC_Elliott.pdf)

(34) E. Kim, R. Siegelman, H. Jiang, A. Forse, J.-H. Lee, J. Martell, P. Milner, J. Falkowski, J. Neaton, J. Reimer, S. Weston, J. Long, Cooperative carbon capture and steam regeneration with tetraamine-appended metal-organic frameworks, *Science* 369 (6502) (2020) 392–396.

(35) IEA, World Energy Outlook 2020, p. 122.

(36) Goldman Sachs, Carbonomics: The Rise of Clean Hydrogen, July 2020.

(37) IEA, The Future of Hydrogen – Seizing today's opportunities, June 2019.

(38) ExxonMobil estimates.

(39) B. Slade, B. Stober, D. Simpson, Dividing wall column revamp optimises mixed xylenes production, *ICHEME, Symposium Series No. 152*, (2006).

(40) 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.

## Footnotes

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(42) <https://corporate.exxonmobil.com/Company/Policy/Political-contributions-and-lobbying>

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(44) IEA, The Role of Gas in Today's Energy Transitions, July 2019.  
<https://www.iea.org/reports/the-role-of-gas-in-todays-energy-transitions>

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<https://www.nytimes.com/interactive/2020/10/28/climate/how-electricity-generation-changed-in-your-state-election.html>

(46) IEA, Global CO<sub>2</sub> emissions in 2019, February 2020.

(47) Calculations are based on the guidance provided in API's Compendium of Greenhouse Gas Emission Estimation Methodologies for the Oil and Gas Industry and IPIECA's Petroleum Industry Guidelines for Reporting Greenhouse Gas Emissions. Greenhouse gas emissions are reported on a net equity basis for business operations, demonstrating a share of emissions from any facility or operation in which ExxonMobil holds a financial interest, with the share reflecting the equity interest.

480 million tonnes of CO<sub>2</sub> emissions is equivalent to approximately 104 million passenger vehicles driven for one year according to the the U.S. EPA greenhouse gas equivalences calculator <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>

(48) <https://methaneguidingprinciples.org>

(49) <https://www.iea.org/reports/methane-tracker-2020>

(50) ExxonMobil-operated emission estimates are based on a combination of measured and estimated emissions data using best available information. Calculations are based on industry standards and best practices, including guidance from the American Petroleum Institute (API) and IPIECA. The uncertainty associated with the emission estimates depends on variation in the processes and operations, the availability of sufficient data, the quality of those data and methodology used for measurement and estimation. Changes to the estimates may be reported as updated data and/or emission methodologies become available. ExxonMobil works with industry, including API and IPIECA, to improve emission factors and methodologies. Emission estimates from non-ExxonMobil operated facilities are included in the equity data. The data includes XTO Energy performance beginning in 2011.

(51) The net equity greenhouse gas emissions metric was introduced in 2011 as a replacement for the direct equity greenhouse gas metric. Information has been restated back to 2009 according to the new metric. The net equity greenhouse gas metric includes direct and imported greenhouse gas emissions and excludes emissions from exports (including

Hong Kong Power through mid-2014). ExxonMobil reports greenhouse gas emissions on a net equity basis for all business operations, reflecting its percent ownership in an asset.

(52) The addition of direct emissions and emissions associated with exported power and heat is equivalent to World Resources Institute (WRI) Scope 1.

(53) These emissions are equivalent to WRI Scope 2.

(54) Flaring increased in 2019 due to start-up of growth projects in the Upstream and as a result of implementing measures to comply with new regulatory requirements in Downstream and Chemical manufacturing. We anticipate meeting our 2020 flaring reduction target.

(55) Cumulative figure.

(56) ASCE 7 is an American Society of Civil Engineers standard for *Minimum Design Loads and Associated Criteria for Buildings and Other Structures* that "describes the means for determining dead, live, soil, flood, tsunami, snow, rain, atmospheric ice, earthquake, and wind loads, and their combinations for general structure design."

(57) [https://www.tceq.texas.gov/permitting/business\\_permitting.html](https://www.tceq.texas.gov/permitting/business_permitting.html)

(58) <https://corporate.exxonmobil.com/Locations/United-States/Baton-Rouge-area-operations-overview>

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(61) IPIECA/API, 2016. Estimating petroleum industry value chain (Scope 3) greenhouse gas emissions - Overview of methodologies

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(63) IEA, ExxonMobil analysis.

(64) ExxonMobil analysis

(65) Solomon Associates. Solomon Associates fuels and lubes refining data available for even years only.

(66) ExxonMobil analysis of IPCC 74 Lower 2°C scenarios.

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