

ExxonMobil Global Outlook
Our view to 2050

2023 Sustainability
Report

2024 Advancing
Climate Solutions



Forward-Looking Statement Warning

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

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

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

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

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

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

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

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

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SUPPLEMENTAL INFORMATION FOR NON-GAAP AND OTHER MEASURES

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

ExxonMobil Global Outlook

Our view to

2050

August 2024

ExxonMobil Global Outlook

EXECUTIVE SUMMARY



Our view to

2050

In 2050, the world will be different - vastly different

Modern living standards are made possible by ready, affordable access to energy. For the billions of people without that access even the most basic tasks of life can be extremely challenging. Looking out to 2050, the global population will continue to grow, adding to the demand for energy. Any transition that fails to affordably meet this demand along with the world's ever-evolving needs is simply not just.

**~4 BILLION PEOPLE LIVE BELOW
THE MODERN ENERGY MINIMUM**



(1/2 THE WORLD'S POPULATION)

**1 MILLION
MORE PEOPLE**
every 6 days

Did you know?

The number of people in the world is expected to increase from 8 billion today to nearly 10 billion in 2050. With 2 billion more people on the planet, the world will need new ways to:

Produce more reliable, affordable energy

**Drive global economic growth to raise living standards,
particularly in the developing world**

Further reduce greenhouse gas emissions

The world will be different in 2050, but the need to provide the reliable, affordable energy that drives economic prosperity and better living standards, while reducing greenhouse gas emissions, will remain just as critical as it is today. Achieving this balance will require wind, solar, oil and natural gas, as well as nearly every other form of available energy – because access to energy drives human development and quality of life.

Defining the modern energy minimum

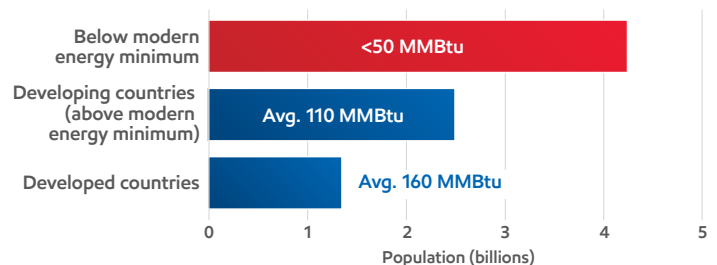
To measure the average quality of life by country, the United Nations created the Human Development Index (HDI). Scores are based on three factors: life expectancy, education, and income.

Using UN HDI data from 2022, we determined that about 4 billion people live below the “**modern energy minimum**.” That’s far below modern standards of living, which require reliable energy for housing, infrastructure, jobs, and mobility.

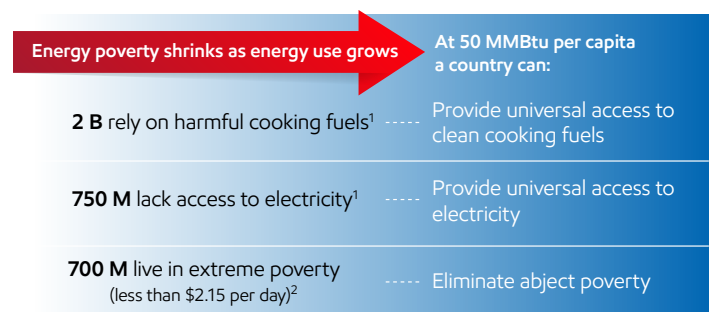
By our analysis, for a country to rise above this threshold, the average energy use per capita would need to be at **least 50 million British thermal units (MMBtu)** per year. Developed countries around the world use, on average, more than three times that amount.

Providing for the basic energy needs is a must to meet the UN’s goal to “**end poverty in all its forms everywhere.**”

Energy consumption per capita (2023)



Meeting the “modern energy minimum” helps break the poverty cycle:



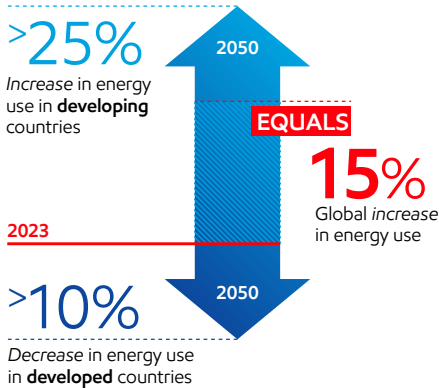
¹ International Energy Agency (IEA) Strategies for Affordable and Fair Clean Energy Transitions May 2024

² World Bank Group Understanding Poverty April 2024

Projection: Carbon emissions will fall even as oil and natural gas remain vital

The world is at a pivotal stage:

It needs to reduce carbon emissions *and* still provide the energy people need.



Lifting nations toward the modern energy minimum will drive a projected 15% increase in total energy use worldwide between now and 2050. Renewables will play an important role. So will oil and natural gas.

Nearly all of this increase enables economic growth in developing countries. By contrast, energy use in developed nations will decline by more than 10% as efficiency improves.

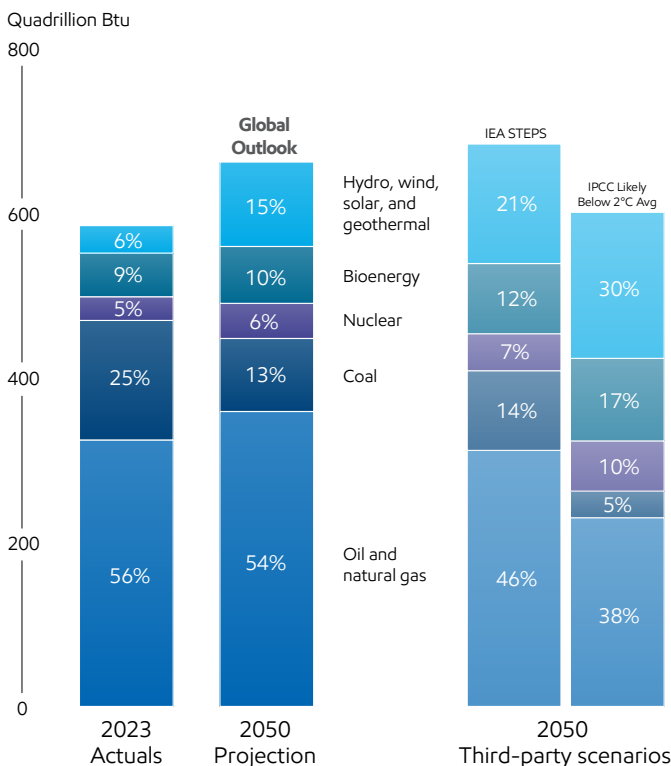


Projection: Even as developing economies grow and consume more energy, global carbon emissions will start to fall for the first time by 2030. In fact, our Outlook sees carbon emissions continuing to decline through 2050.

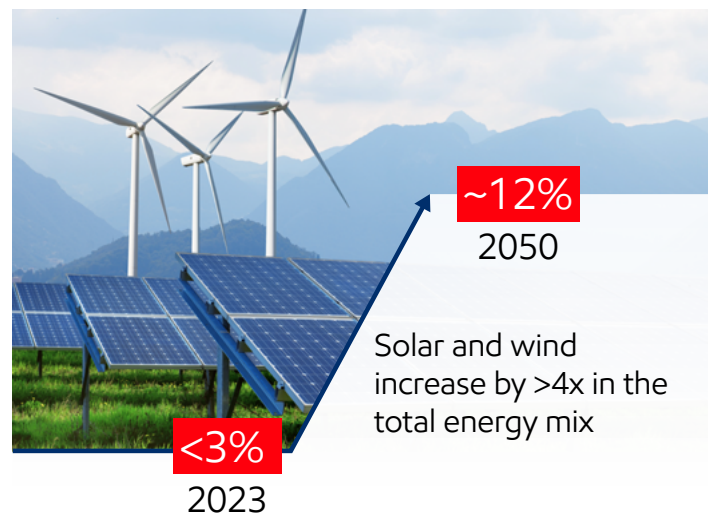
How?

- Greater energy efficiency
- More renewables
- Lower-emission technologies, including carbon capture and storage, hydrogen, and biofuels

Global energy mix



As part of the world's total energy mix, electricity use will grow by 80% by 2050. More broadly, the most significant changes in the **world's total energy mix** between now and then will be:



Coal will continue to be displaced by lower-emission sources, including natural gas, which reduces carbon emissions by up to 60% in electricity generation.

See "How we develop the Global Outlook" section on page 3 for the difference between "projections" and "scenarios."

Projection: Oil and natural gas continue to make up >50% of the world's energy mix in 2050

Sensitivity analysis: If every new car sold in the world in 2035 were electric, oil demand in 2050 would still be 85 million barrels per day. That's the same as it was in 2010.



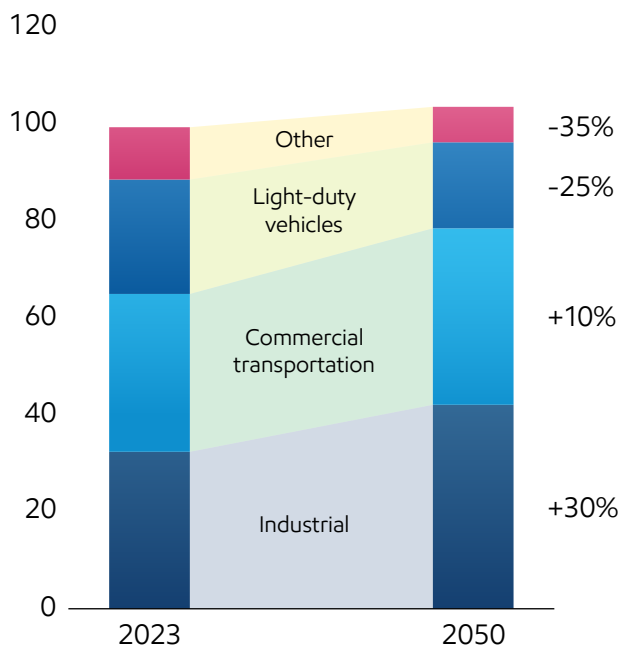
The demand for oil to make gasoline for passenger cars will drop by 2050. What many don't realize is that making gasoline is but one relatively small use for oil.

The large majority of the world's oil is and will be used for industrial processes, such as manufacturing and chemical production, along with heavy-duty transportation like shipping, trucking, and aviation. These services are needed for modern life – and they also fuel future economic growth in the developing world.

The Global Outlook sees a plateau in oil demand beyond 2030, remaining above 100 million barrels per day through 2050.

Projection: Oil demand

Million barrels per day



Yes, changes in the world's overall energy mix are coming. But the Global Outlook and various third-party scenarios are clear – oil and natural gas will remain essential.

How we develop the Global Outlook

Our Global Outlook is our latest view of demand and supply for energy and products through 2050 assuming an aggressive but practical energy transition. It forms the basis for the company's business planning and is scientifically grounded in our deep understanding of long-term market fundamentals. In addition to assessing trends in economic development, technology advances, and consumer behavior, the Outlook seeks to identify potential impacts of climate-related government policies. It is not an endorsement of a particular outcome.

We consider a range of scenarios – including those we view as remote – to help inform strategic thinking. No single pathway can be reasonably predicted, given the wide range of uncertainties. Key unknowns include yet-to-be developed government policies and advances in technology that may influence the cost, pace, and potential availability of certain pathways. What also remains uncertain is how quickly and to what extent businesses and consumers will be willing to pay for deeper carbon reductions in the products and services they use, thereby creating a market that incentivizes an accelerated path to net zero.

Unlike the company's Outlook, which is a projection, many scenarios, such as International Energy Agency's Net Zero Emissions (IEA NZE) by 2050, work backward from a hypothetical outcome to identify the factors needed to achieve that outcome. It is important to note that the IEA acknowledges that society is not on a net-zero pathway.

Global oil and natural gas supplies virtually disappear without continued investment

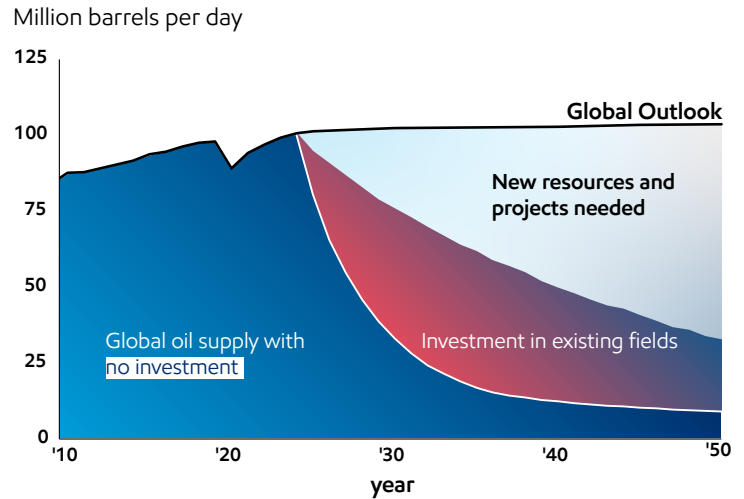
As the world's demand for oil and natural gas remains strong, sustaining investment is more important than ever.

Our Outlook reflects oil production naturally declining at a rate of about 15% per year. That's nearly double the IEA's prior estimates of about 8%.

This increase is the result of the world's shifting energy mix toward "unconventional" sources of oil and natural gas. These are mostly shale and dense rock formations where oil and gas production typically declines faster.

To put it in concrete terms: With no new investment, global oil supplies would fall by more than 15 million barrels per day in the first year alone.

At that rate, by 2030, oil supplies would fall from 100 million barrels per day to less than 30 million – that's 70 million barrels short of what's needed to meet demand every day.

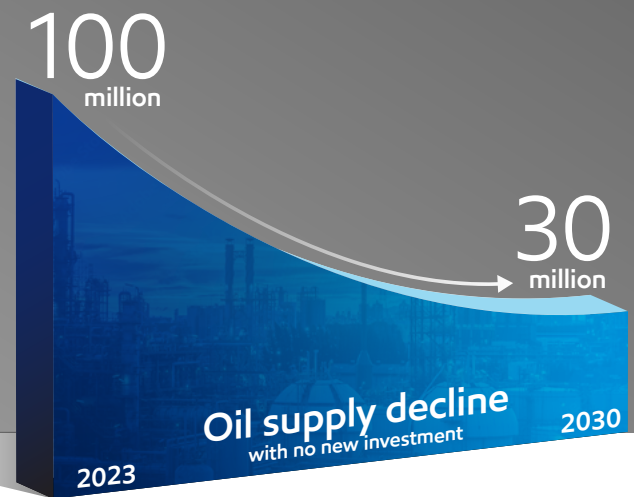


Sensitivity analysis: The economic effects of this kind of supply shock would be dire.

The world would experience severe energy shortages and disruption to daily lives within a year of investment ceasing.

Given price responses to past oil supply shocks, the permanent loss of 15% of oil supply per year could raise oil prices by more than 400%. By comparison, prices rose 200% during the oil price shocks of the 1970s.

Within 10 years, unemployment rates would likely reach 30%. That's higher than during the Great Depression of the 1930s.



Any policy that would "keep it in the ground" is not just.

As this Outlook shows, sustained investment is needed to meet the world's demand for oil and natural gas – even as companies like ExxonMobil invest billions to lower the greenhouse gas emissions associated with its own operations and help other industries lower theirs.

Robust investments in new technology are needed

To improve living standards and get to a lower-emissions future, the world needs to make sustained investments in new technologies to:

- Meet increased demand
- Fuel economic growth – especially in developing countries
- Further reduce global emissions



Rapid growth in wind and solar in the energy mix – a projected fourfold increase by 2050 – will spur the biggest changes to the energy landscape. That’s an important part of the solution.

Commercial transportation and industrial activity alone will account for nearly half of the world’s emissions in 2050. Wind and solar will play a limited role in these sectors.

Reducing emissions in “hard to decarbonize” sectors such as aviation, cement, steel, and others with unique energy needs will require the world to rely on the expansion of biofuels, carbon capture and storage and hydrogen, among other technologies.

To preserve the cost, reliability, and infrastructure advantages of today’s energy system and keep pace with demand, **the world will need to scale up solutions such as:**

H₂ Hydrogen

A fuel that, when combusted, produces only water as a byproduct. One essential way to produce virtually carbon-free hydrogen (with ~98% of CO₂ removed) is to convert natural gas into hydrogen and CO₂ – the hydrogen is used as fuel, while the CO₂ is captured and stored. This method is endorsed as part of the U.S. Inflation Reduction Act.

CO₂ Carbon capture and storage

A proven and safe technology that reduces emissions from manufacturing and power generation. CO₂ emissions are captured, transported by pipeline to suitable geologic formations, and permanently stored deep underground. This technology has been endorsed by the U.S. EPA, the European Union, and the United Nations.

Biofuels

A lower-emission alternative to fossil fuels that is particularly useful in commercial transportation. Growing the plants that are used to make biofuels can help offset the CO₂ produced when biofuels are combusted, resulting in fewer greenhouse gas emissions when used in place of diesel fuel.

What is needed to get to net zero?

“To get serious, three things are needed: supportive public policy, significant technology advancements, and a smooth transition from government subsidies to market-based mechanisms.”

- Darren Woods, ExxonMobil Chairman and CEO



Governments, companies, universities, and others need to work together to achieve a transition that increases the supply of energy for everyone while steadily and thoughtfully reducing emissions.

Given the need to do more and do it faster at a lower cost, progress will need to occur in parallel, supported by durable policies that are focused on:

- **More transparency** to give the market more lead time to adapt to changes.
- **Outcomes** to keep the market focused on the best technologies to reduce the most emissions at the lowest price. Collaboration is key to finding the right application of technology to lower emissions in specific industries. That’s why we believe governments should create a level field in which all technologies can compete without fear or favor so that the best choices emerge.

The right policy framework can speed up action by the private sector. Examples include:

- **The U.S. Inflation Reduction Act** which focuses on an outcome of carbon intensity and does not pick winners and losers
- **Canada’s Clean Fuel Regulations** allows for co-processing of biofuels to achieve a lower-carbon intensity outcome

Where no market exists and initial costs are high, incentives make sense to get things started. But government incentives cannot – and should not – be in place forever. To get to net zero, markets must be developed to encourage reduced emissions.

Five key takeaways of our Global Outlook

There has been enormous progress, yet more work is needed.

When considering the world’s energy future, keep these truths in mind:

1. All energy types will remain in the mix.
2. Renewables will grow the fastest.
3. Coal will decline the most.
4. Under any credible scenario, oil and natural gas remain essential.
5. Lower-carbon technology needs policy support to grow rapidly but ultimately must be supported by market forces.

This Executive Summary of the Global Outlook includes Exxon Mobil Corporation's internal estimates of both historical levels and projections of challenging topics such as energy demand, supply, and trends through 2050 based upon internal data and analyses as well as publicly available information from many external sources including the International Energy Agency. Separate from ExxonMobil's analysis, we discuss a number of third-party scenarios such as the Intergovernmental Panel on Climate Change Likely Below 2°C and the International Energy Agency scenarios. Third-party scenarios discussed in this report reflect the modeling assumptions and outputs of their respective authors, not ExxonMobil, and their use and inclusion herein is not an endorsement by ExxonMobil of their results, likelihood or probability. Work on the Outlook and report was conducted during 2023 and 2024. The report contains forward looking statements, including projections, targets, expectations, estimates and assumptions of future behaviors. Actual future conditions and results (including energy demand, energy supply, the growth of energy demand and supply, the impact of new technologies, the relative mix of energy across sources, economic sectors and geographic regions, imports and exports of energy, emissions and plans to reduce emissions) could differ materially due to changes in economic conditions, the ability to scale new technologies on a cost-effective basis, unexpected technological developments, the development of new supply sources, changes in law or government policy, political events, demographic changes and migration patterns, trade patterns, the development and enforcement of global, regional or national mandates, changes in consumer preferences, and other factors discussed herein and under the heading "Factors Affecting Future Results" in the Investors section of our website at www.exxonmobil.com. The Outlook was published in August 2024. ExxonMobil assumes no duty to update these statements or materials as of any future date, and neither future distribution of this material nor the continued availability of this material in archive form on our website should be deemed to constitute an update or re-affirmation of this material as of any future date. This material is not to be used or reproduced without the permission of Exxon Mobil Corporation. All rights reserved.

Global Outlook:

Executive summary

Energy demand drivers

Energy transition progress



Global Outlook

Energy demand drivers

- Affordable and reliable energy fuels economic development and modern living standards.
- Large energy disparity still exists between developed and developing countries.
- Growing energy consumption supports economic expansion, enabling longer, more productive lives for the growing global population.

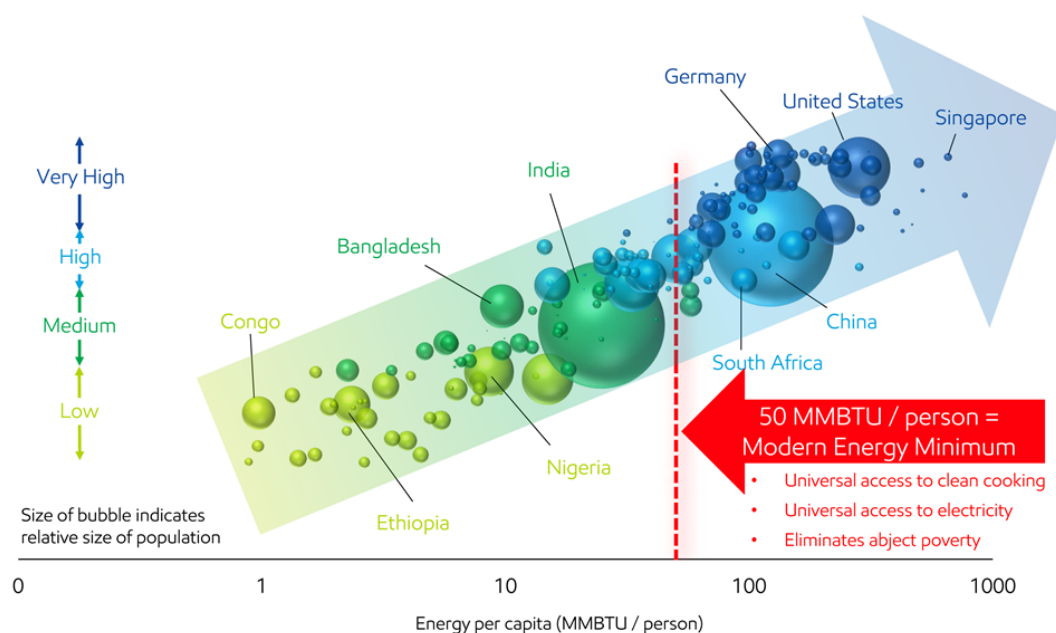
Report

2 min read • Aug. 26, 2024

More than 4 billion people live below modern standards for life expectancy, education, and income

U.N. Human Development Index

2022 Index



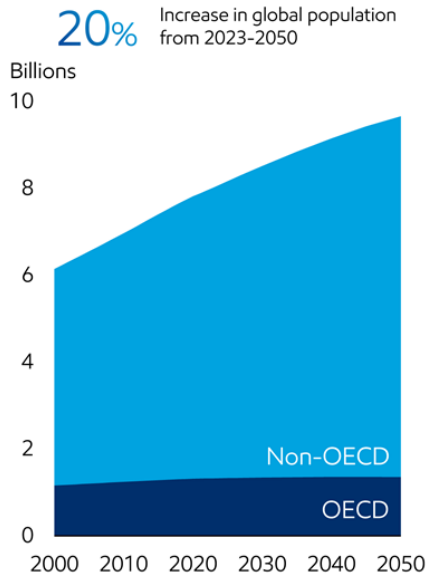
Source (see reference list): U.N. Human Development Reports, EIA, ExxonMobil analysis

Energy improves quality of life.

- Rising energy use fuels higher incomes that enable people to own homes, purchase labor-saving appliances, travel, and obtain needed medical services.
- The United Nations Human Development Index is a measure of average quality of life by country, based on life expectancy, education, and income.
- Consumption of 50 million British thermal units (MMBTU) per person is the threshold needed to materially move the human development indicators;

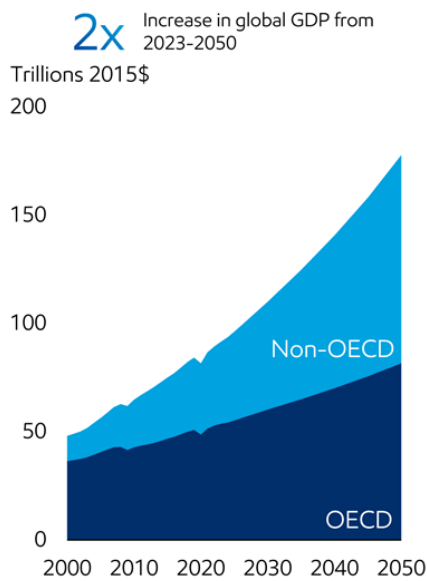
however, today, more than 4 billion people live in countries below the “modern energy minimum.”

Population



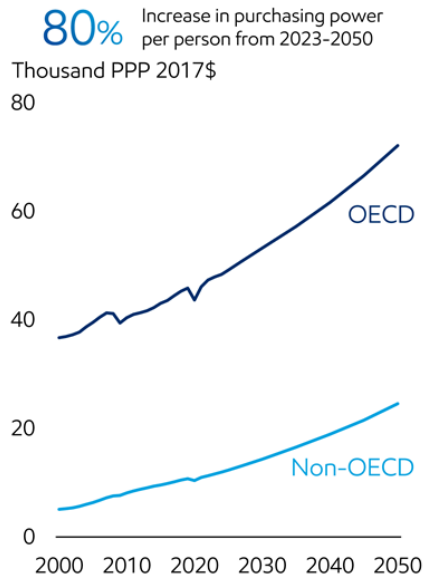
OECD: Organization for Economic Cooperation and Development, a group of more affluent democracies with market-based economies that promotes economic growth.

GDP



OECD: Organization for Economic Cooperation and Development, a group of more affluent democracies with market-based economies that promotes economic growth.

Purchasing power per person



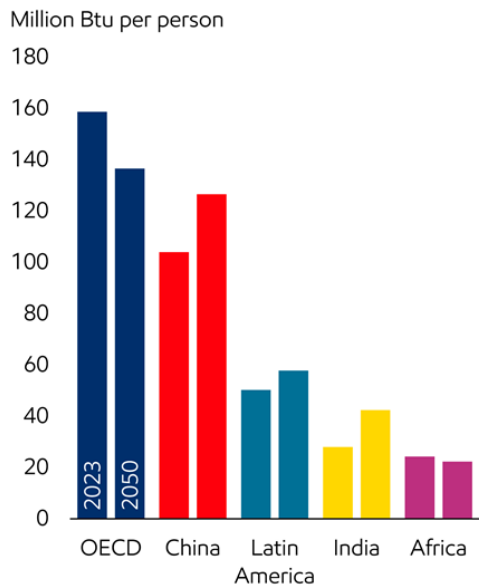
OECD: Organization for Economic Cooperation and Development, a group of more affluent democracies with market-based economies that promotes economic growth.

By 2050, population is expected to grow by nearly 2 billion people as GDP doubles.

- Developing countries' income doubles to \$25,000 but remains well below developed-country levels.

Energy per capita

↑ ↓ Efficiency gains in developed nations partially offset rising use in developing countries



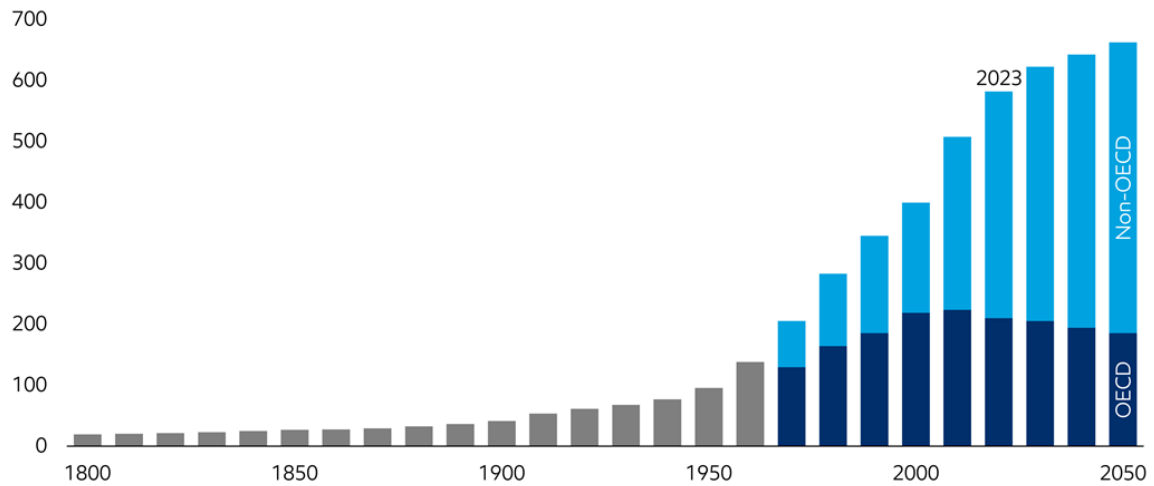
Energy use per person grows in developing countries, driven by economic expansion.

- Developed countries continue to see efficiency gains, which enables continued economic growth with less energy.

Global energy demand to grow 15% by 2050

Global energy demand

Quadrillion Btu



Source (see reference list): Smil, Energy Transitions (1900-1960), 2024 ExxonMobil Global Outlook (1970-2050)

Population and economic growth drive global energy demand to increase by 15%.

- >10% reduction in energy demand in developed countries from efficiency gains is offset by >25% increase in energy demand in developing countries.

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Global Outlook

Energy transition progress

- By 2030, carbon emissions are projected to fall for the first time as economic activity expands.
- Hard-to-decarbonize commercial transportation and industrial activity will account for nearly half of the world's emissions in 2050.
- Reducing emissions to achieve a below 2°C pathway will require supportive policy, technology innovation, and market incentives to drive faster deployment of all available solutions.

Report

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2050 insights

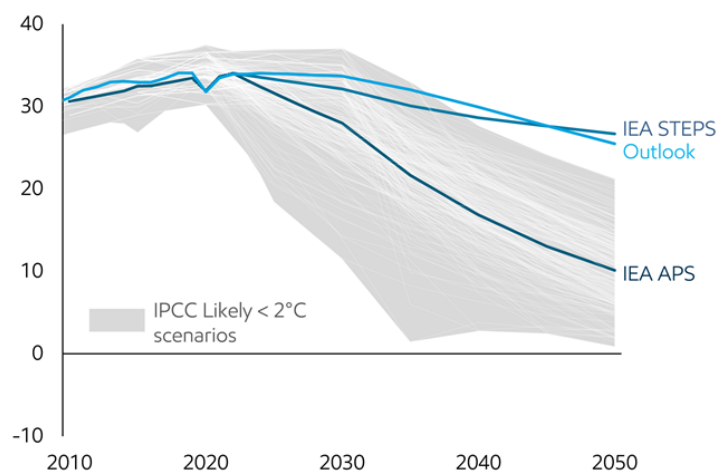
- By 2030, carbon emissions are projected to fall for the first time, while economic activity and prosperity continue to expand, driven by greater energy efficiency, increased renewables, and lower-emission technologies.
- But more progress is needed as the world is not yet on track for the Paris Agreement. Reducing emissions to achieve a below 2°C pathway will require supportive policy, technology innovation, and market incentives to drive faster deployment of all available solutions.
- Hard-to-decarbonize commercial transportation and industrial activity will account for nearly half of the world's emissions in 2050. Abatement in these

sectors will require technologies such as carbon capture and storage, hydrogen, and biofuels.

- Efficiency will play an essential role in reducing the carbon intensity of the global economy.

Global energy-related emissions

CO₂ Billion metric tons



Source (see reference list): 2023 IEA World Energy Outlook; IPCC: AR6 Scenarios Database hosted by International Institute for Applied Systems Analysis (IIASA) release 1.0 average.

IPCC C3: "Likely Below 2°C" scenarios.

Emissions do not contain industry process emissions or land use and natural sinks.

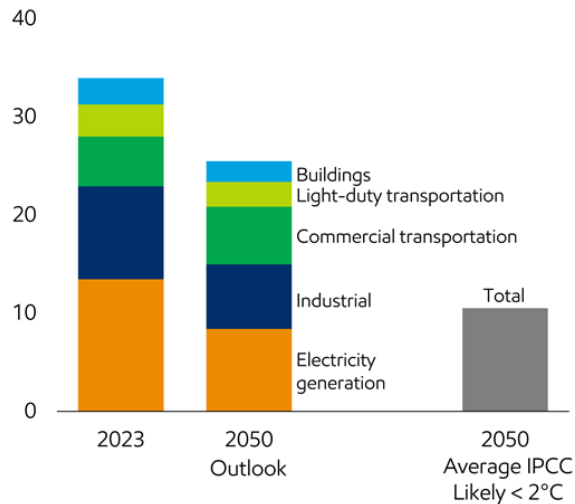
Different assumptions about how the world will continue to evolve produce dramatically different paths to 2050.

- Projections such as the Global Outlook start with current factors including public policy and commercially available technology, and then evaluate how they might change over time.

- In contrast, scenarios such as the IPCC Likely Below 2°C start with a hypothetical outcome and work backward to identify the factors that need to occur to achieve that outcome.

Energy-related emissions

CO₂ Billion metric tons



Source (see reference list): IPCC: AR6 Scenarios Database hosted by International Institute for Applied Systems Analysis (IIASA) release 1.0 average.

IPCC C3: "Likely Below 2°C" scenarios; ExxonMobil analysis.

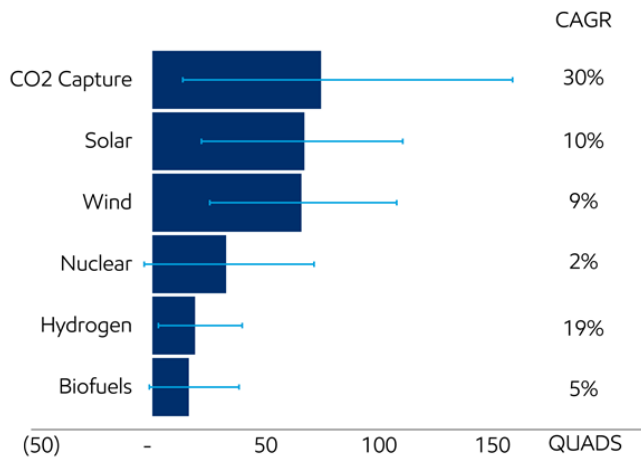
Emissions do not contain industry process emissions or land use and natural sinks.

By 2050, energy related emissions are projected to decline by 25%, but more is needed to achieve a below 2°C pathway.

- Commercial transportation and industrial activity account for nearly half of the world's emissions in 2050.

- A rapid scaling of emerging technologies such as carbon capture and storage, along with continued deployment of solar and other renewables will be required.

Growth of lower-carbon solutions between 2020 and 2050 in IPCC Likely Below 2°C scenarios



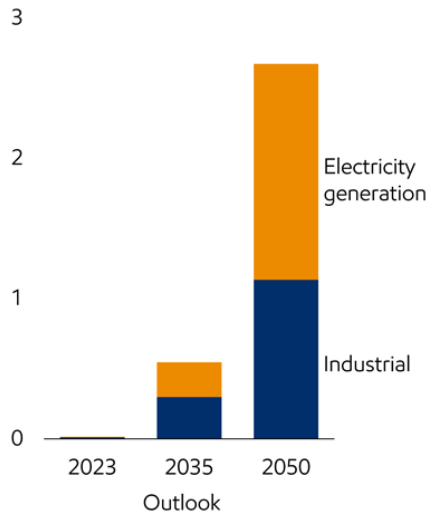
Source (see reference list): IPCC Sixth Assessment Report, ExxonMobil analysis; Uncertainty bars represent 10th percentile to 90th percentile scenario.

All lower-emission solutions grow between 2020 and 2050 in IPCC Likely Below 2°C scenarios. None of the IPCC pathways rely on only one or two solutions,

reiterating that “all of the above” is required to achieve a below 2°C pathway.

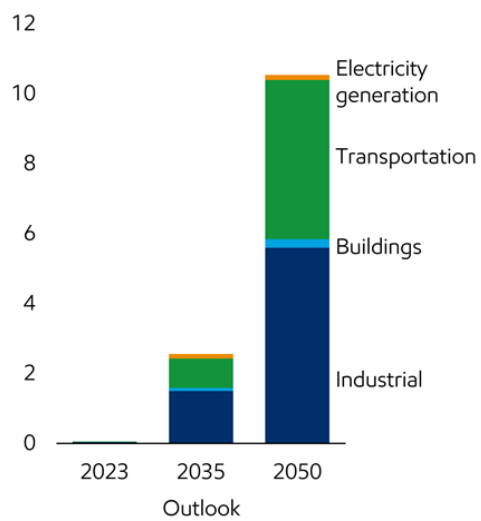
Carbon capture and storage

CO₂ Billion metric tons per year



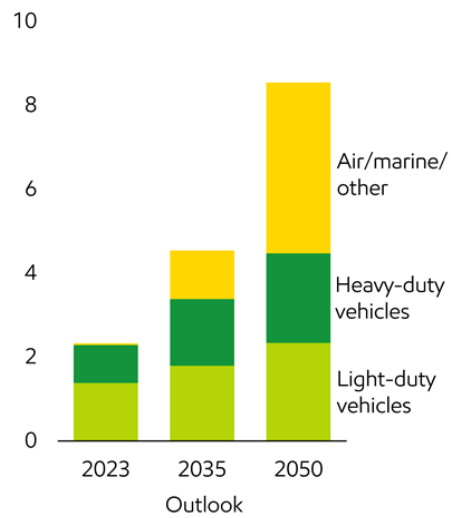
Hydrogen-based fuel use

Quadrillion Btu



Biofuels use

Million barrels per day of oil equivalent



Carbon capture and storage, hydrogen, and biofuels are essential solutions for hard-to-decarbonize sectors.

- Unlike personal transportation, electrification is ill-suited for commercial transport, such as long-haul trucks or aviation. Similarly, industrial

applications require intense heat and hydrocarbon-based feedstocks that cannot be solely met with electrification.

Signposts this decade for the evolving energy transition

	'19 – '22 Avg ¹	'23 Act ¹	Annual deployment over 2020-2030 ¹				IPCC Likely Below 2°C ²
			'24 Global Outlook ²	IEA STEPS ²	IEA APS ²	IEA NZE ²	
Efficiency (energy per capita)	~0 %	~0%	-0.1% (2019-2030)	-0.2% (2019-2030)	-0.7% (2019-2030)	-1.6% (2019-2030)	-0.7%
Solar ³ (GW - utility)	95	245	195	215	255	295	300
Wind ³ (GW)	85	100	105	135	170	200	120
CCS ⁴ (1.3 MTA equivalent)	<1	<1	13	6	34	84	65
Nuclear ³ (GW)	-1	-1	5	7	8	13	20
Biofuels in transportation (KBDOE growth)	55	260	140	98	248	323	105
Hydrogen ⁴ (MTOE) Excluding feedstocks, NH3	<1	<1	1.3	1.0	4.0	13	2.4

1. History is average of '19 – '22; actuals and history based on IEA history file and ExxonMobil 2024 Global Outlook unless otherwise noted; efficiency trends start in '19 to avoid the low COVID year as the start point

2. Source: ExxonMobil 2024 Global Outlook, IEA World Energy Outlook 2023, IPCC Sixth Assessment Report

3. Solar is utility solar; IEA solar projections converted to utility only based on STEPS, APS, and NZE forecast total solar, applying average proportion of commercial scale solar from IEA Renewables 2022 Report (figure 1.5; historical data and accelerated case); Solar history from IEA '23 Renewables report, IEA '23 World Energy Outlook, and BNEF solar tracker; Wind history from IEA '23 Renewables report, IEA '23 World Energy Outlook and BNEF wind tracker; Wind and Solar deployment calculated from TWh based on fixed capacity factor of 35% and 17%, respectively, where capacity is not stated; Nuclear based on average net deployment from IAEA PRIS database, IEA '23 World Energy Outlook and ExxonMobil 2024 Global Outlook, based on an 85% capacity factor

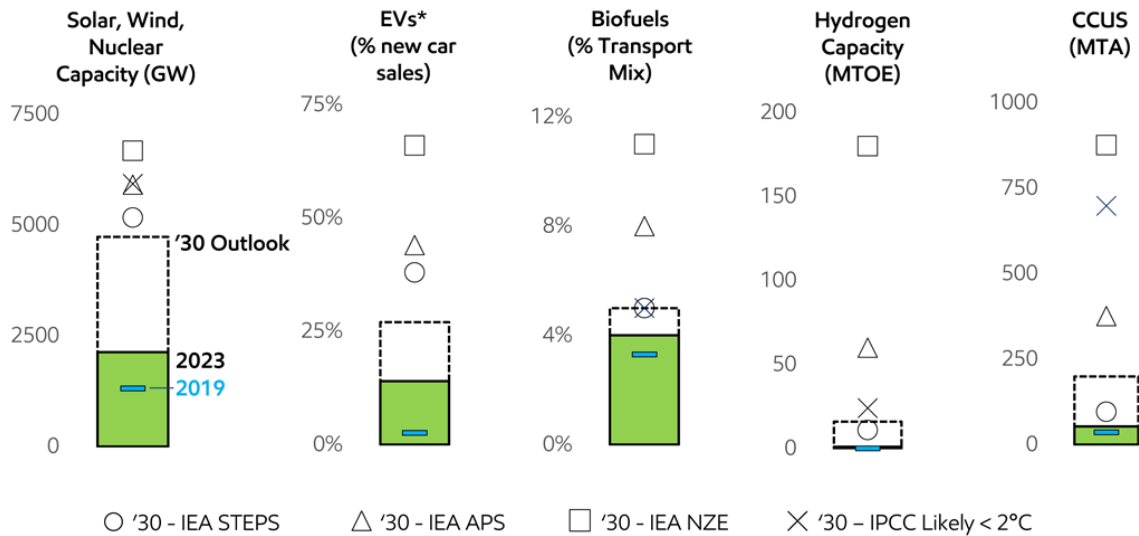
4. H2 and CCUS history from Wood Mackenzie project database (see reference list)

While progress is being made, deployment this decade is not yet on track to achieve a below 2°C pathway.

- Deployment trends this decade provide essential insights on an energy transition.

- Hydrogen and carbon capture and storage need to rapidly deploy to achieve 2030 government pledges.

Reducing emissions requires ALL viable technology



○ '30 - IEA STEPS △ '30 - IEA APS □ '30 - IEA NZE × '30 - IPCC Likely < 2°C
 Source (see reference list): 2023 IEA World Energy Outlook; IPCC: AR6 Scenarios Database hosted by International Institute for Applied Systems Analysis (IIASA) release 1.0 average.
 IPCC C3: "Likely Below 2°C" scenarios.

*EVs includes light duty battery electric, plug-in hybrid, and fuel cell electric vehicles.

Scenarios agree*: reducing emissions will require deployment of ALL available technologies.

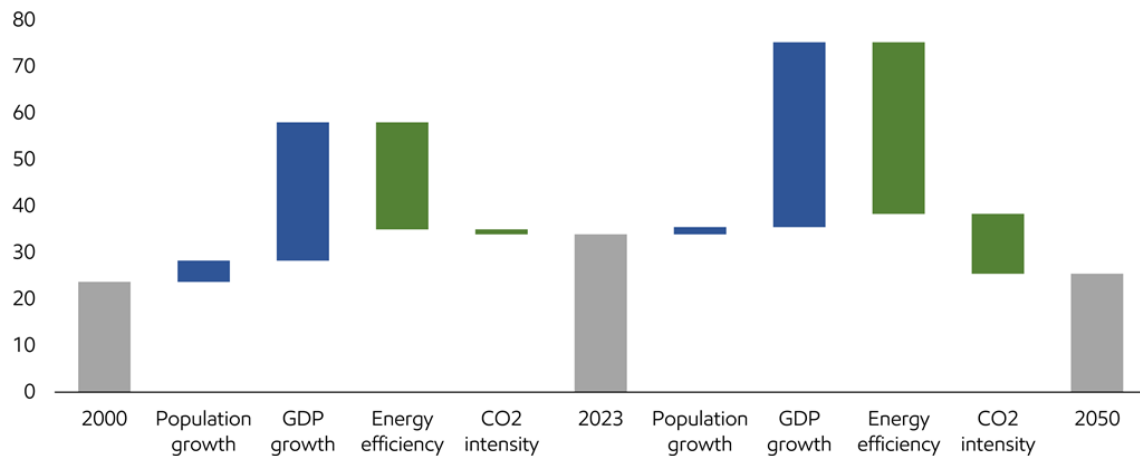
- From 2019 to today, the most progress has been made in solar and wind deployment, EV sales, and biofuels, whereas to-date, carbon capture and storage and hydrogen have yet to show meaningful progress at the global scale.
- There is a range of potential outcomes for each solution to 2030, but one message is clear: All solutions need to increase deployment this decade. This is the case for our Global Outlook, IEA STEPS, IEA APS, IEA NZE, and the IPCC Likely Below 2°C scenarios.

*"scenarios" refers to IPCC Likely Below 2°C and IEA STEPS, APS, and NZE from '23 World Energy Outlook.

Efficiency is critical to reducing emissions with growing GDP

Energy-related CO₂ emissions

Billion tonnes



Continued efficiency improvements and lower-emission solutions are critical to reducing emissions while expanding economic prosperity for a growing population.

- The primary drivers for increasing global CO₂ emissions between 2000 and 2023 were population and economic growth.
- Improving energy efficiency (energy use per unit of GDP) helped slow the growth in emissions, while global CO₂ intensity of energy use remained fairly constant in history. Increased coal use in some non-OECD countries offset emission reductions in the OECD countries.
- As the world's economy doubles by 2050, technology will be essential to mitigate emissions. The Global Outlook projects continued energy efficiency gains and a sustained improvement of CO₂ intensity with more lower-

emissions solutions such as solar, wind, nuclear, coal-to-gas switching, carbon capture and storage.

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Global Outlook

Energy mix projections

- Oil and natural gas remain the largest energy sources.
- Electricity use grows in all sectors, with generation from solar and wind growing the fastest.
- Coal is displaced by lower-emission sources, including both renewables and natural gas.
- Commercial transportation and industrial feedstocks drive continued demand for oil.

Report

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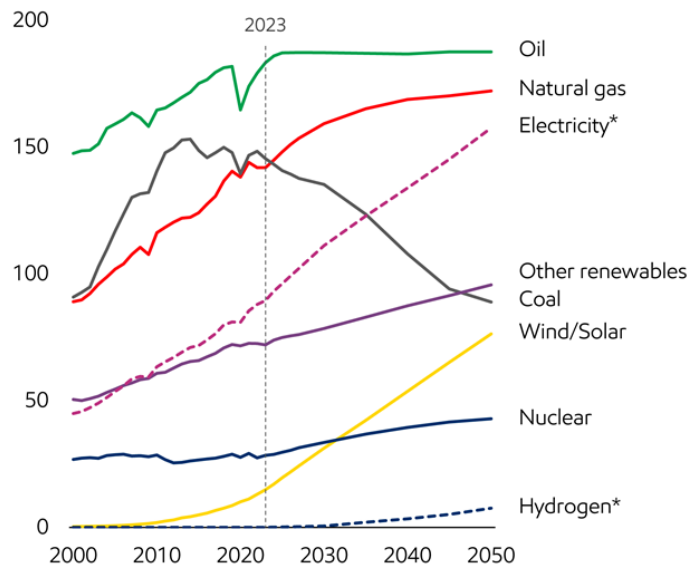
2050 insights

Oil and natural gas remain the largest energy sources, while lower-carbon energy will meet more of the world's needs.

- The biggest shift will be the rise of renewables and the decline in coal.

Global energy demand by fuel

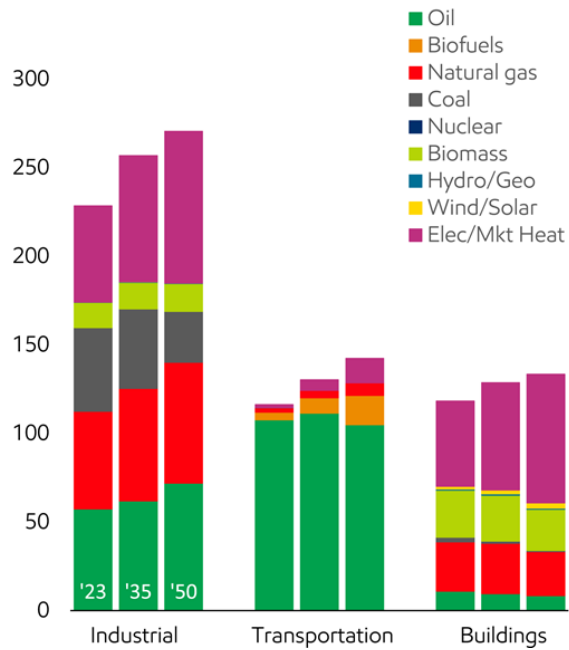
Primary energy- Quadrillion Btu



*Electricity and hydrogen are secondary energies derived from the primary energies shown.

End use energy demand

Quadrillion Btu

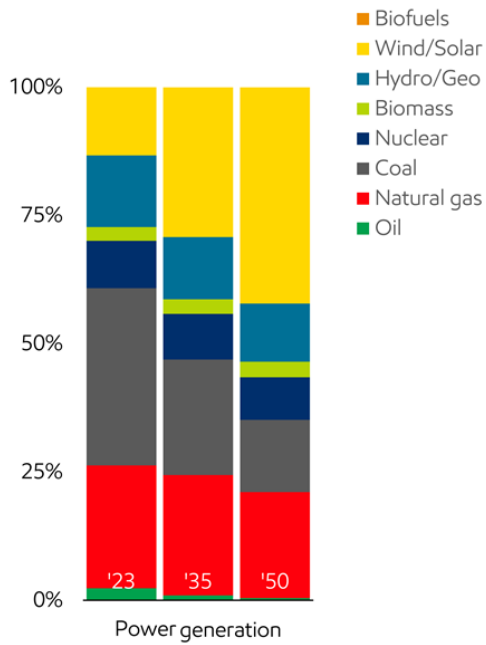


The energy mix varies by the end-use sectors.

- Electricity grows in all sectors. Electrification of industrial equipment and vehicles can improve their efficiency, and modern buildings around the world use electricity for heating, cooling, and convenient appliances.
- Oil and natural gas remain essential for industry, serving as both a source of high heat needed for manufacturing and a feedstock for chemical production.

- Oil also remains significant in transportation, even as electricity and biofuels gain share. Liquids fuels are energy-dense, which is critical for commercial transportation modes such as aviation, marine, and heavy trucking.

End use power generation mix

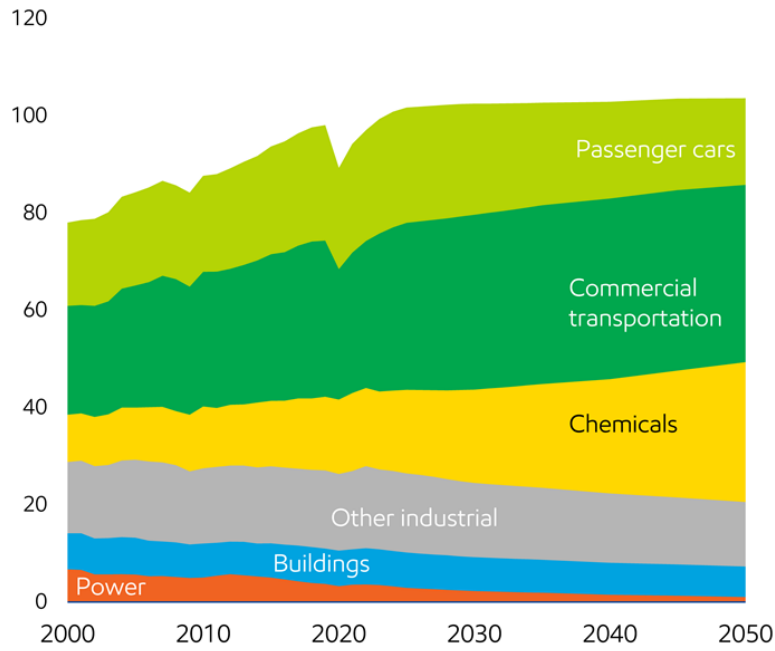


Renewables grow in share of electricity generation while natural gas continues to

contribute ~20%.

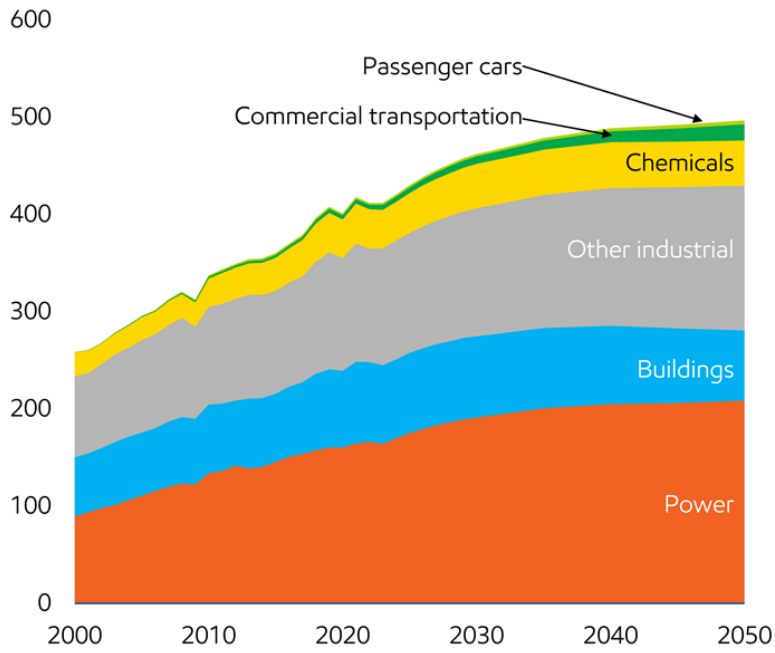
Oil demand (excluding biofuels)

Million barrels per day



Natural gas demand

Billion cubic feet per day

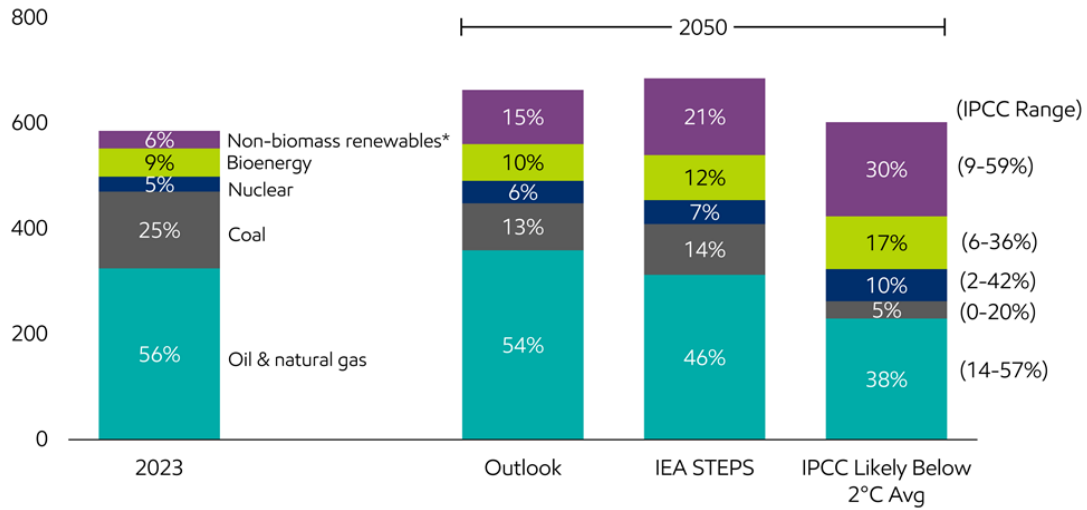


Commercial transport and chemicals drive oil demand while industrial activity and

electricity generation drive demand for natural gas.

Global energy mix

Quadrillion Btu



*Non-biomass renewables includes hydro, wind, solar, and geothermal

Source (see reference list): 2023 IEA World Energy Outlook; IPCC: AR6 Scenarios Database hosted by International Institute for Applied Systems Analysis (IIASA) release 1.0 average.

IPCC C3: "Likely Below 2°C" scenarios

While the future energy mix has many potential outcomes, all credible scenarios require the full suite of energy sources to meet projected global demand.

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**Global Outlook**

Energy demand trends

By 2050, growing population and rising prosperity in developing nations drives:

- Global electricity demand to nearly double.
- Energy demand for transportation to grow by more than 20%.
- Energy demand for industry to grow by 20%.

Report

4 min read • Aug. 26, 2024

2050 insights

15% more energy is projected to be needed in 2050 compared to 2023, driven by growing population and rising prosperity in developing nations.

Electricity generation

- Global electricity demand nearly doubles by 2050, as electrification increases in buildings, industrial manufacturing, and transportation.
- Much of the world continues to shift further toward lower-emission sources for electricity generation, led by wind and solar, natural gas, and nuclear, based on local opportunities and policies.

Transportation

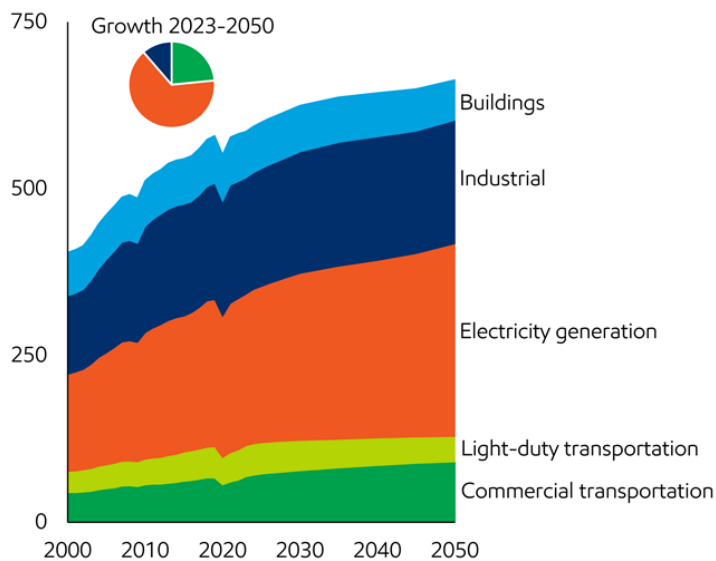
- Energy demand for transportation grows more than 20% to 2050, and remains the leading sector for liquids demand.
- The biggest growth is in commercial transportation such as trucks, shipping, and aviation, while passenger cars continue to make up ~30% of demand in 2050.

Industry

- Industrial energy demand grows 20%, driven by heavy industry (steel, cement, metals, and manufacturing) and chemicals (plastics, fertilizer, and other chemical products).
- Industry uses energy products both as a fuel and as a feedstock for chemicals, asphalt, lubricants, waxes, and other specialty products.

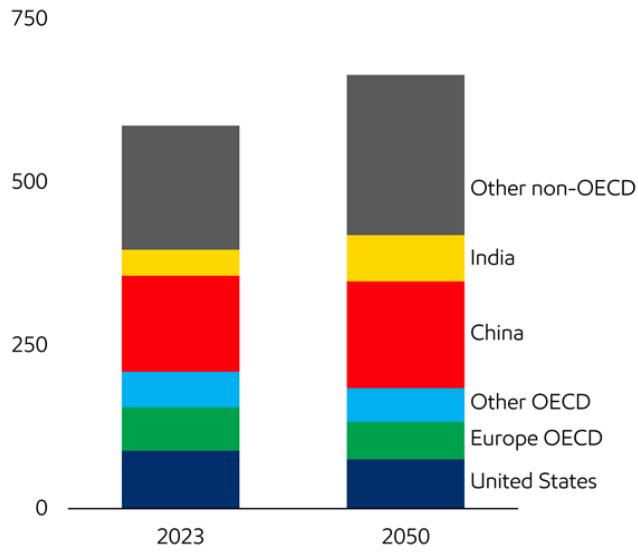
Global energy demand by sector

Primary energy - Quadrillion Btu



Developing countries lead energy demand

Primary energy - Quadrillion Btu

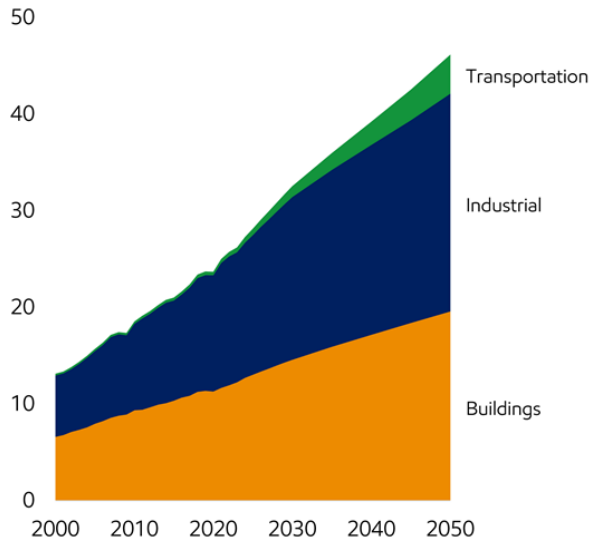


Electricity generation

Electricity use grows across all sectors driven by growing use in buildings, rising industrial activity, and increased demand from electric vehicles.

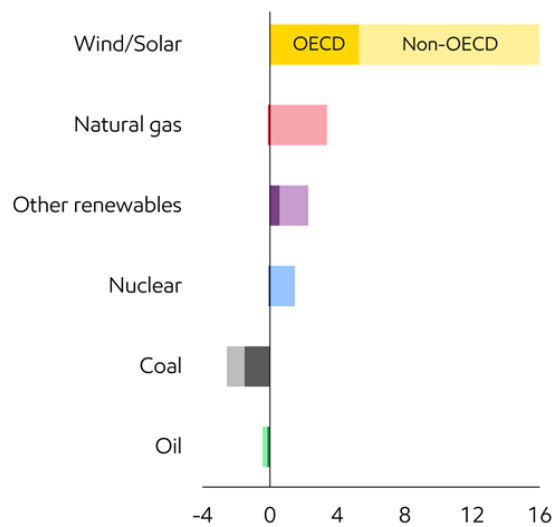
Global electricity use by sector

Thousands terawatt-hours



Renewables and natural gas dominate growth

Global growth 2023-2050 - thousand terawatt-hours (net delivered)



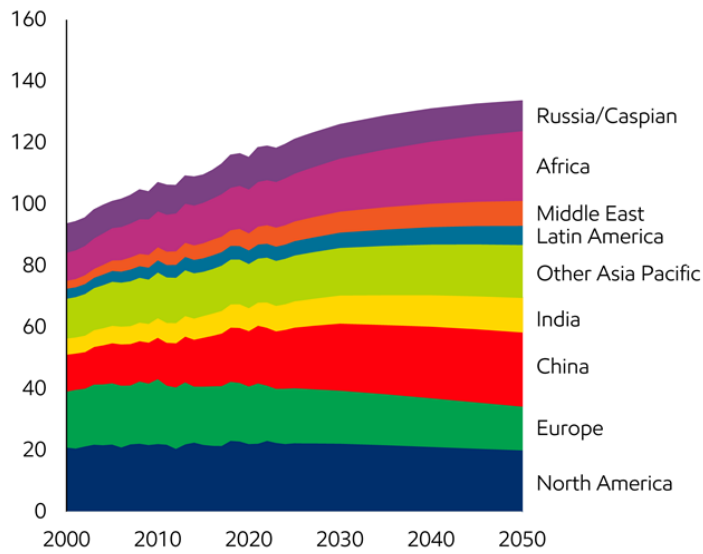
Lower-carbon sources, including renewables and natural gas dominate growth in

electricity generation.

- Coal-fired generation drops from a 45% to 20% share by 2050 in developing countries, and from 15% to 1% in developed nations.

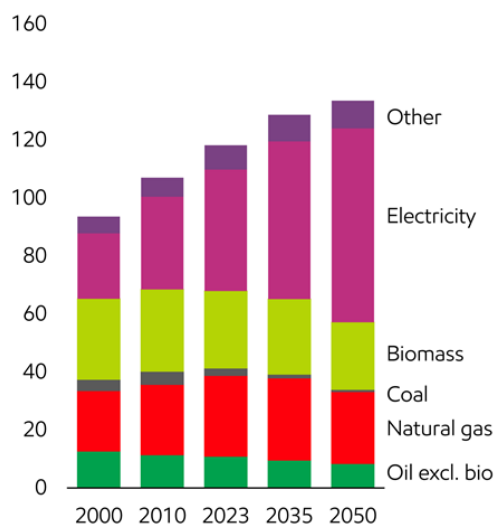
Buildings demand by region

Quadrillion Btu



Buildings demand world mix

Quadrillion Btu



Energy demand growth in residential and commercial buildings shifts to developing countries.

- 50% of energy for buildings will be powered by electricity in 2050, up from 35% today.

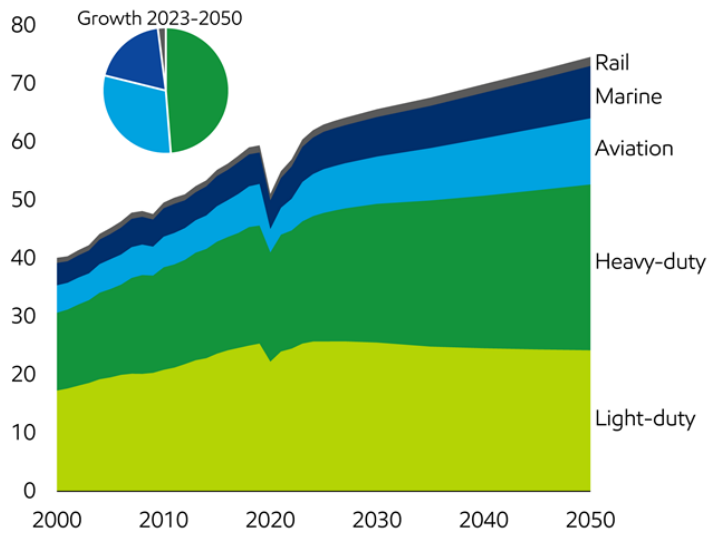
Transportation

Commercial transportation, heavy trucks, aviation, marine, and rail, grow by 35% and are the primary drivers of energy growth in transportation.

- 80% of this growth is in developing countries, driven by increases in population and GDP.

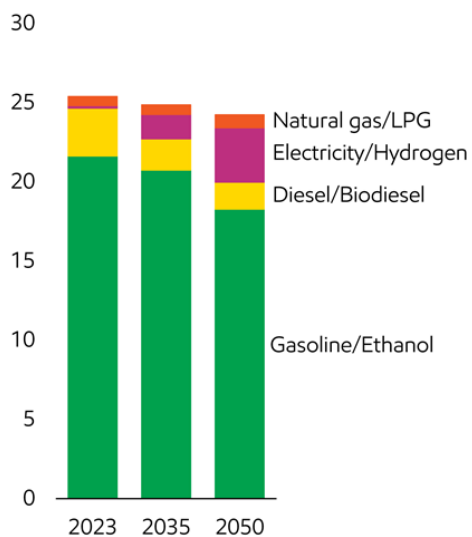
Global transportation energy demand

Million barrels per day of oil equivalent

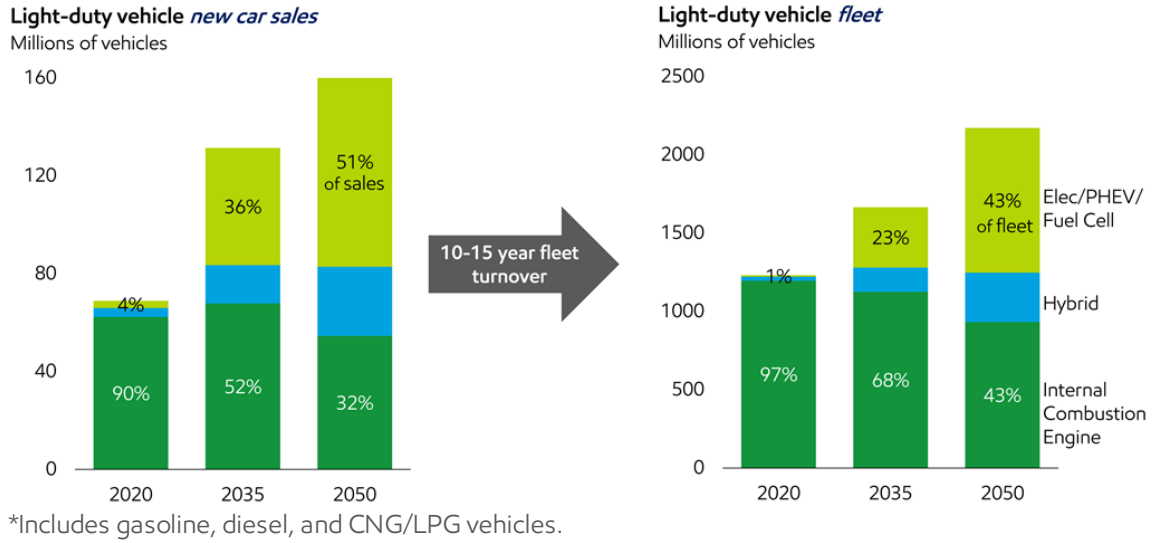


Light-duty demand drops

Million barrels per day of oil equivalent



Oil use for passenger car fuels (excluding biofuels) drops ~25%, primarily driven by improved fuel efficiency and switching to electric vehicles.

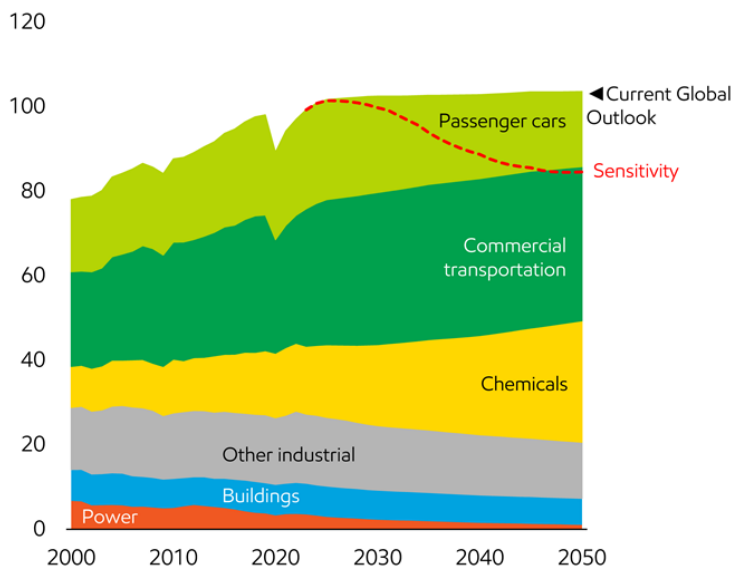


EVs continue to grow in market share.

- However, even as EV sales increase, it takes 10-15 years for the passenger car fleet to turn over. Therefore, internal combustion engines will continue to be on the road beyond 2050.

Oil demand (excluding biofuels) back to 2010 levels in sensitivity

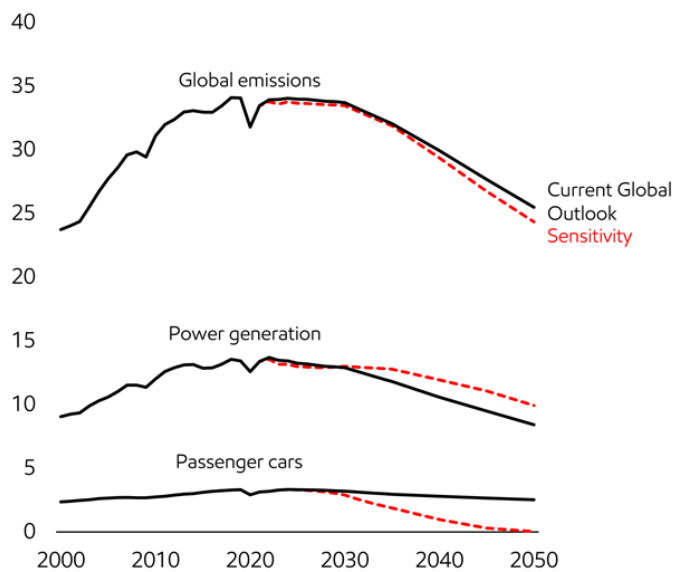
Million barrels per day of oil equivalent



This reflects an ExxonMobil hypothetical sensitivity; not a base case.

Energy-related CO₂ emissions down 5% in sensitivity

Billion tonnes



This reflects an ExxonMobil hypothetical sensitivity; not a base case.

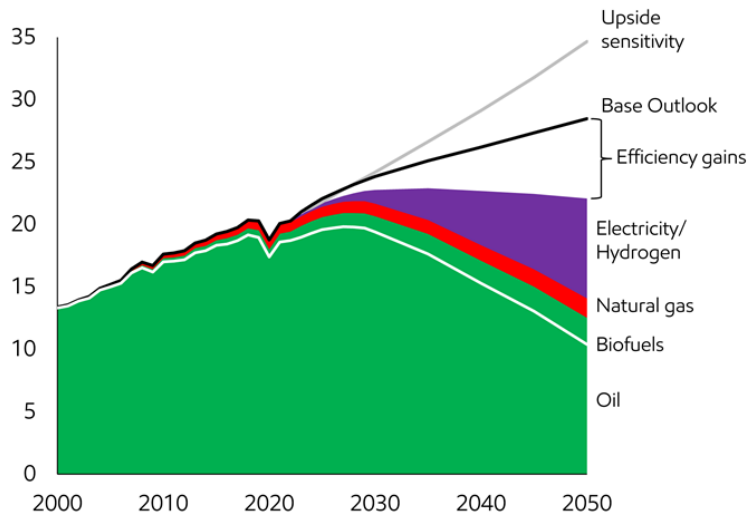
Passenger car sensitivity analysis: What if global car sales achieved 100% battery-electric by 2035?

- The Global Outlook projects battery-electric vehicles to be ~25% of all new car sales by 2035 and ~35% by 2050 (excluding plug-in hybrid electric vehicles and Fuel Cell). Compare that to this sensitivity, which assumes 100% battery electric vehicle sales from 2035 onward, resulting in an almost fully electrified global car fleet by 2050.
- This 100% electric fleet would reduce global demand for oil back to the same levels they were in 2010. CO₂ emissions decrease ~4% versus the Global

Outlook, with the decline in light-duty CO₂ emissions partially offset by emissions from increased power generation.

Heavy-duty fuel demand

Million barrels per day of oil equivalent



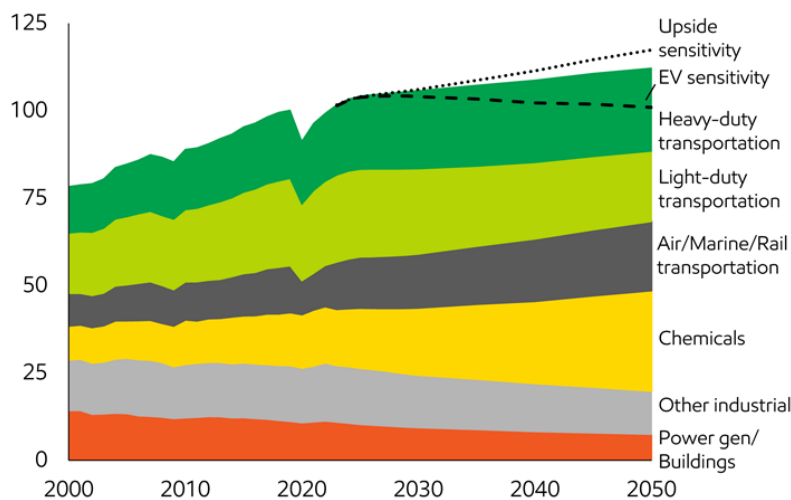
Alternate EV sales assumption: 100% LCV by 2035, and 70% MCV and 20% HCV by 2040.

This reflects an ExxonMobil hypothetical sensitivity; not a base case.

Fuel share analysis is based on IEA The Future of Trucks, 2017, IEA Transport Project (see reference list), ExxonMobil analyses.

Liquids demand with heavy-duty truck sensitivity

Million barrels per day of oil equivalent



Alternate EV sales assumption: 100% LCV by 2035, and 70% MCV and 20% HCV by 2040.

This reflects an ExxonMobil hypothetical sensitivity; not a base case.

Fuel share analysis is based on IEA The Future of Trucks, 2017, IEA Transport Project (see reference list), ExxonMobil analyses.

Heavy-duty truck sensitivity analysis: What if technology advances enabled faster transition to lower-emission freight solutions?

- This technology sensitivity evaluates nearly 100% electrification of light commercial vehicles, about 70% alternative fuels in medium commercial vehicles, and about 20% penetration of alternative fuels in long-haul commercial vehicles by 2050.
- This technology sensitivity results in 2050 liquids demand similar to current levels.
- Technology development to drive continued efficiency gains is also important. The upside sensitivity explores the impact of a potential fuel efficiency gains slow down at half (0.6% improvement per year) of historical trends (1.2% improvement per year), resulting in a 20% increase of heavy-duty fuel demand in 2050.

Industry

The industrial sector provides the goods and builds infrastructure underpinning global economic expansion.

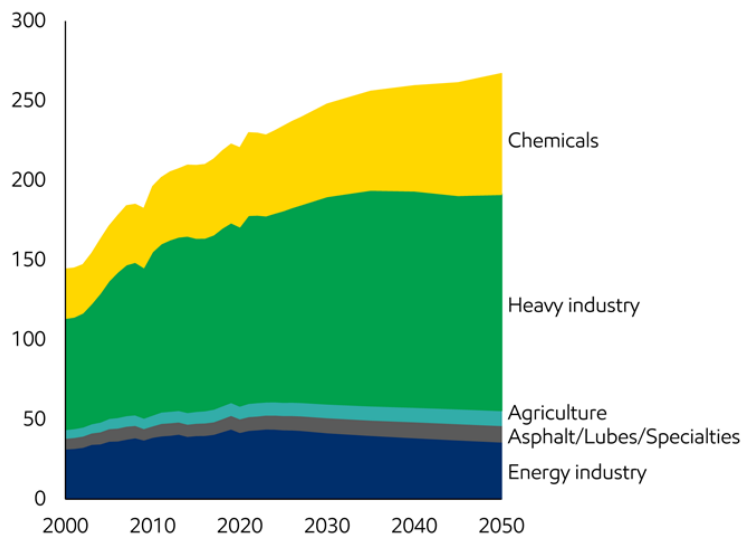
- Industrial energy demand grows nearly 20% by 2050 as the sector produces the basic materials, such as steel, cement, and chemicals needed for modern

living.

- The industrial sector also currently provides about a billion jobs for people who work to feed, clothe, shelter, and improve the lives of people around the world.

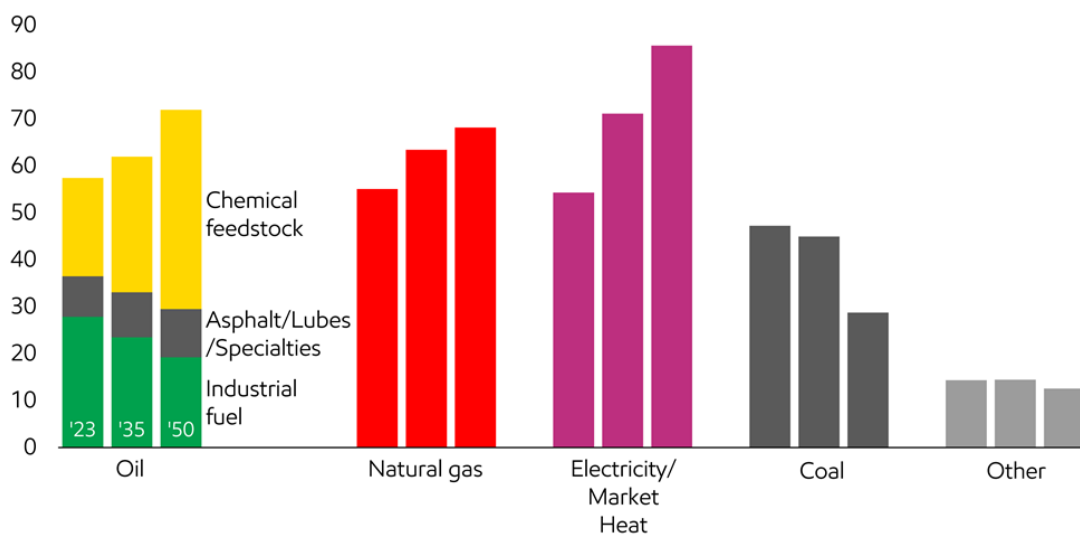
Global industrial energy demand

Quadrillion Btu



Oil, natural gas, and electricity fuel industry growth

World - Quadrillion Btu



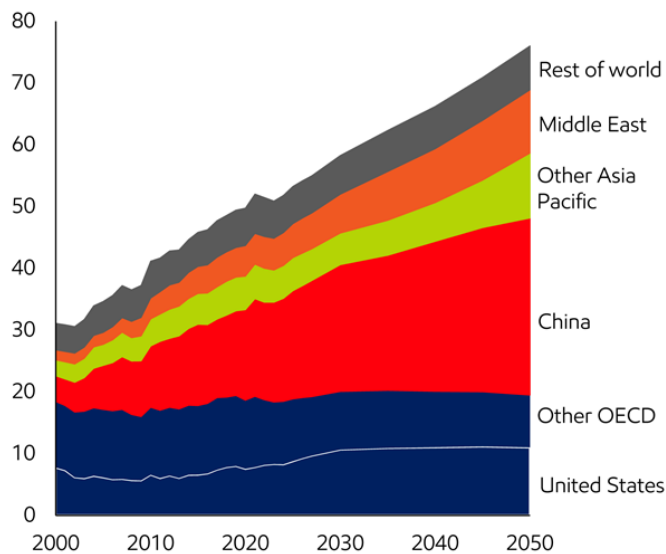
Oil, natural gas, and electricity contribute almost all the energy needed to replace coal and meet industrial energy growth to 2050.

- Oil and natural gas are important feedstocks used to make products as well as provide high heat for large industrial processes.

- Electrification is well suited for lower temperature or less energy intensive applications.

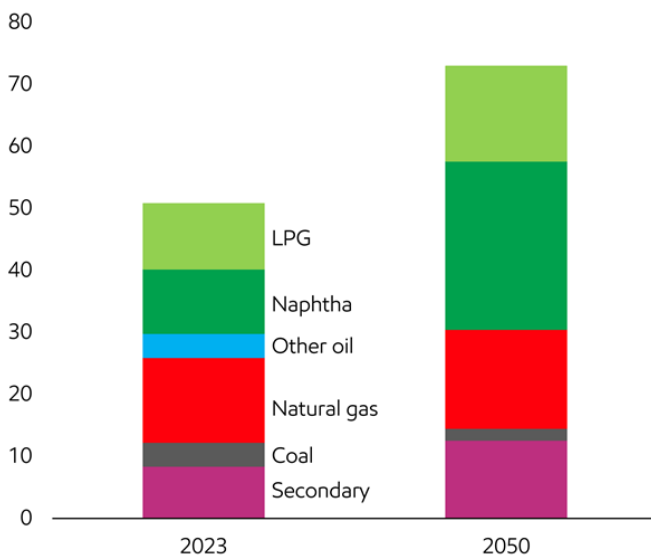
Chemicals feed and energy growth

Quadrillion Btu



Chemicals production relies on oil and natural gas

World - Quadrillion Btu



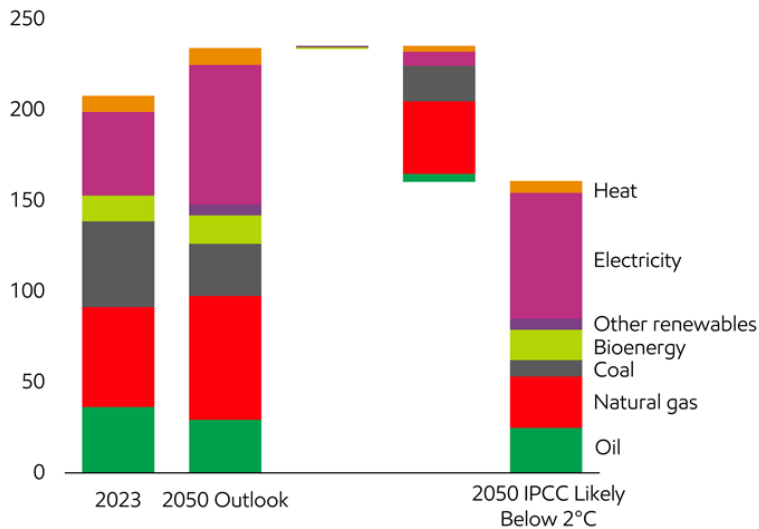
Consumer demand boosts the need for chemicals.

- Chemicals play a vital role in meeting our basic needs of food, clothing, shelter, and healthcare. For example, chemicals are used in fertilizers for agriculture, synthetic fibers for clothes, and building materials for modern structures.
- Asia Pacific's chemicals production grows to meet the needs of its rising middle class.

- Naptha (an oil product) remains the dominant feedstock in Asia, while North America and the Middle East rely on natural gas liquids and natural gas.

Industrial energy demand excluding feedstocks

World - Quadrillion Btu



Source (see reference list): IPCC: AR6 Scenarios Database hosted by International Institute for Applied Systems Analysis (IIASA) release 1.0 average of IPCC C3: "Likely Below 2°C" scenarios.

For comparability with IPCC Likely Below 2°C scenario, Global Outlook industrial demand is restated to include fuel but exclude feedstocks, notably Naptha and LPG in the chemicals sector.

Transforming and decarbonizing the manufacturing industry will be challenging. It's large and complex, and it takes large amounts of heat to make basic materials such as cement and steel.

- Our projection indicates more efforts will be required to further decarbonize industry to reduce emissions to the level of the IPCC Likely Below 2°C scenarios.

- Carbon capture and storage can provide a scalable solution to capture the emissions of both energy use and processing, for example from cement production.

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Global Outlook

Energy supply

- The world's demand for oil and natural gas remains strong.
- Oil and natural gas supply from existing wells naturally declines over time, making sustained investments more important than ever.
- Growing demand for LNG, driven by the Asia Pacific region, is underpinned by growing North America and Middle East supply.

Report

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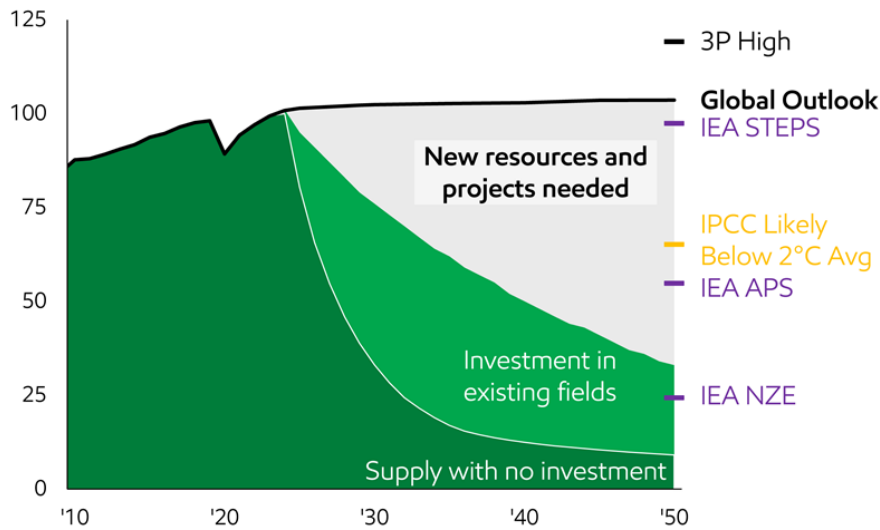
2050 insights

Significant new oil and natural gas supplies are needed to meet society's demand.

- Decline rates of existing fields are the biggest driver for new supply needed, and the reason significant investment is still required even before accounting for demand growth.
- The annual decline of existing supply is higher now, with an increasing mix of unconventional resources, such as U.S. tight oil, which decline faster than conventional oil and natural gas resources.

Global oil projected supply and demand

Million barrels per day



Oil excludes biofuels.

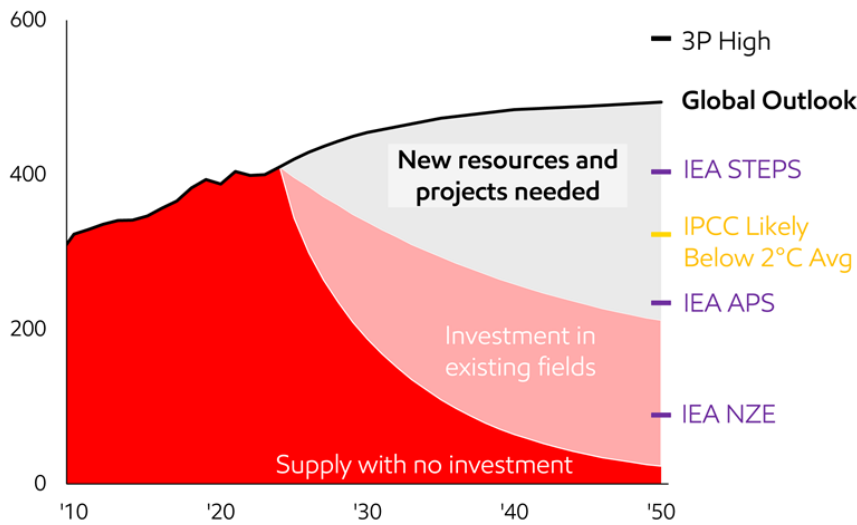
IPCC AR6 Scenarios Database hosted by International Institute for Applied Systems Analysis (IIASA) release 1.0 average of 306 IPCC C3: "Likely Below 2°C" scenarios.

IEA scenarios from '23 World Energy Outlook; 3rd Party high 2023 OPEC World Oil Outlook 2045: Laissez-Faire case (see reference list).

Decline rates based on 10-yr CAGR.

Natural gas projected supply and demand

BCFD



Excludes flaring.

IPCC AR6 Scenarios Database hosted by International Institute for Applied Systems Analysis (IIASA) release 1.0 average of 306 IPCC C3: "Likely Below 2°C" scenarios.

IEA scenarios from '23 World Energy Outlook; 3rd Party high 2023 OPEC World Oil Outlook 2045: Laissez-Faire case (see reference list).

Decline rates based on 10-yr CAGR.

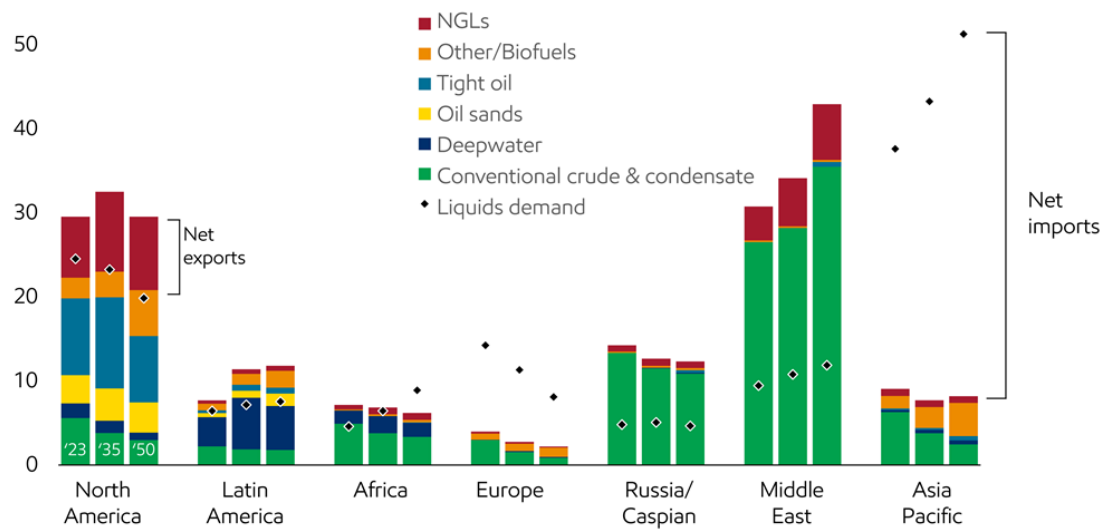
Sensitivity analysis on constrained oil and natural gas investment:

- In the absence of any further investment, oil supply would be expected to quickly decline at ~15% per year, leading to major shortages of critical energy supplies. Similarly, natural gas supply would decline by ~11% per year without investment.
- Some have advocated for continued investment in existing fields, but no new oil and natural gas developments. This would still lead to energy shortages, as oil supply would decline by ~4% per year and natural gas by ~3% per year.

- The resulting supply in either case of constrained investment would be well below levels needed to meet projected demand, even in the majority of the IPCC’s Likely Below 2°C scenarios.

Liquids supply by region and type

Million barrels per day of oil equivalent



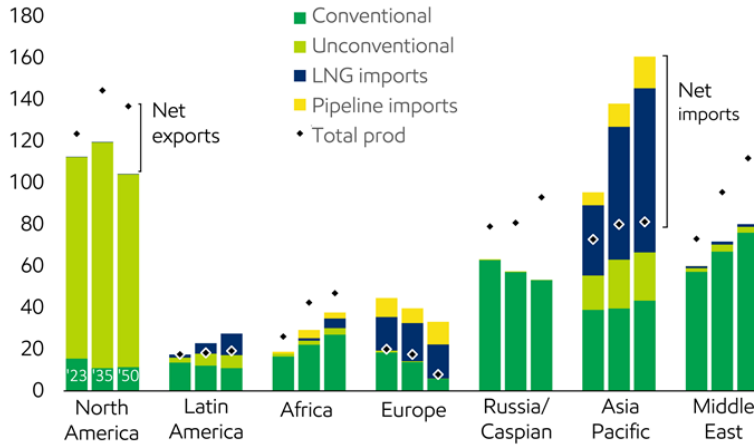
Liquids supply / demand balance varies by region.

- Asia Pacific remains the largest and fastest-growing region for liquids demand, and increasingly relies on imports.
- North America supply is expected to peak sometime next decade as U.S. tight oil fields mature, but the region remains a large net exporter.

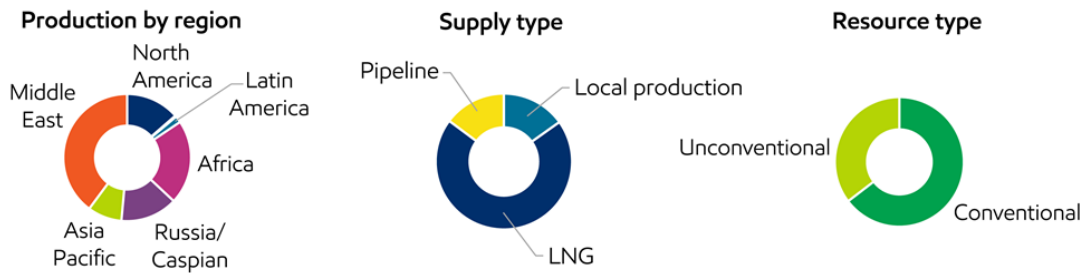
- The Middle East is projected to gain share post 2035, and support nearly all future growth in demand.

Natural gas supply diversifies and trade grows to meet rising demand

Billion cubic feet per day

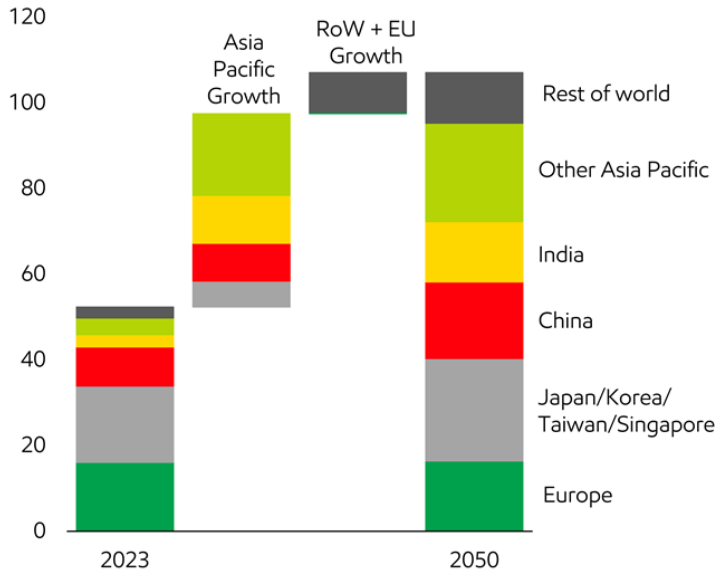


Share of supply growth 2023-2050



Asia Pacific and Europe benefit from LNG imports

Billion cubic feet per day

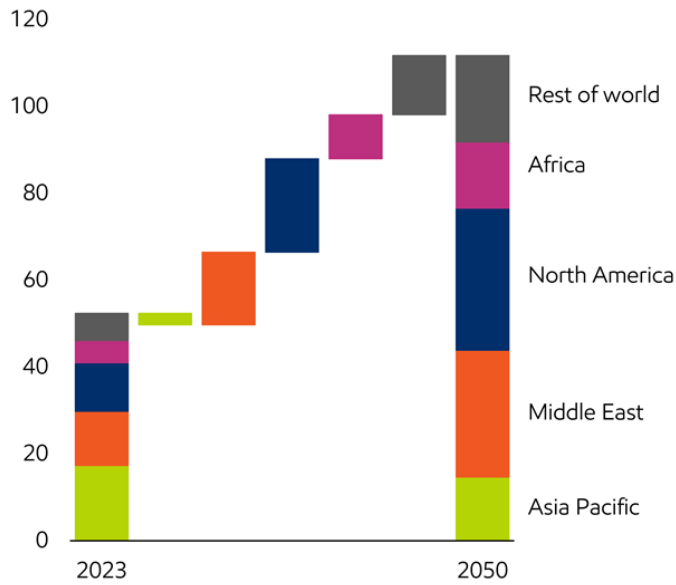


Natural gas supply diversifies, and LNG trade grows to meet rising demand.

- By 2050, LNG trade will meet nearly 20% of the world’s natural gas needs, driven by growth in Asia Pacific.

LNG exports by region

Billion cubic feet per day



Diverse natural gas supplies underpin new LNG exports.

- North America and the Middle East significantly increase export capacity to meet the world's growing needs.

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