

We are *not on track* to meet the Paris Agreement's objectives. What should we do?

World Energy Markets
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Which *net zero*
Pathway are we
on?





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Elfije leads our Americas business for Resources & Energy Transition. Her career has been focused in the energy and utilities space, with a specialization in helping companies create and execute transformation strategies.

Are we on the right pathway to net zero emissions by 2050?

1. No matter which scenario you look at, achieving 0% fossil fuels usage by 2050 is unachievable.
2. We're not just addressing the energy demands of today, but the increase in demand associated with the growing global population and improving prosperity of developing nations.
3. We are making progress with the energy transition, but are not on track with the growth of green energy sources and need to look at additional mitigation and adaptation options.

Introduction

By now, we all know the crucial importance of achieving net zero emissions globally. Our carbon budget is running out rapidly, with 2050 commonly referred to as a "due date". Agencies around the world are scrambling to generate scenarios of how we will get there. The reality is that the challenge is far greater than most people realize.

The global population will keep growing and nations will continue to move up the prosperity line – both of which will generate increases in energy demand. A path to net zero requires accommodating demand growth while constantly finding new and better ways to decarbonize our economy.

While we made strong progress over the past decade, the reality is that we are far from being on track for the 2050 net zero goal. We must dramatically increase the rate and pace of growth for carbon-free energy sources, but that alone will remain only part of the equation. In every realistic scenario, fossil fuels, such as oil and natural gas, will also continue to play an essential role in our global energy ecosystem. We need to increase our focus on how to mitigate their impacts, not just with scalable carbon reduction technologies, but with policy and behavior changes as well.



What we are seeing

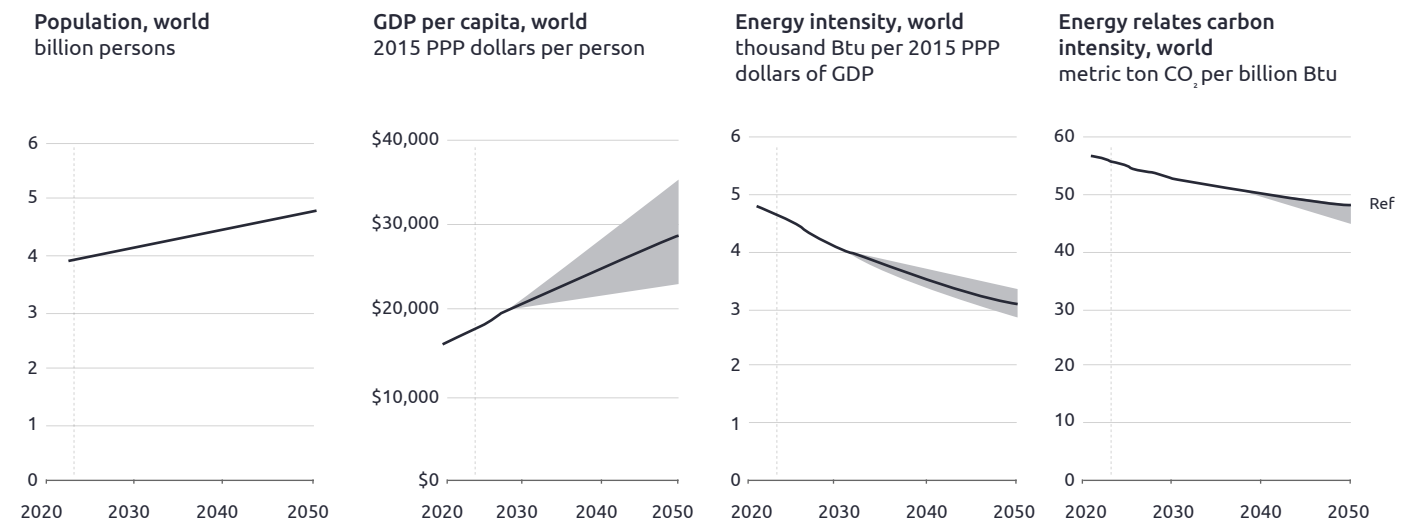
By 2050, the world's population will grow to nearly 10 billion and the average GDP per capita will increase nearly 150%.

The result will be a net increase in energy demand, even with partial efficiency offsets. This compounds the challenges we face with reducing global emissions.

Key data

FIGURE 1

The upward pressures of population and GDP growth outweigh the downward pressures of energy and carbon intensity on emissions



Data Source: U.S. energy information administration, international energy outlook 2023 (IEO2023)
 Note: Shaded regions represent maximum and minimum values for each projection year across the IEO2023 reference case and side cases.
 Our global population assumptions do not vary across side cases. GDP=gross domestic product; PPP=purchasing power parity; Btu=British thermal units;
 Ref=Reference case.

Source: <https://www.eia.gov/outlooks/ieo/>



There are no realistic scenarios for achieving 100% carbon-free energy by 2050

Scenarios for minimizing climate impacts

You've heard about 1.5- and 2-degree scenarios, which provide targets to achieve by 2050 to prevent (or delay) some of the more catastrophic consequences of climate change. You may have even heard about the IEA's NZE (net zero emissions) scenario, which lays out one example of what the energy mix would need to transition to in the next 26 years.

Each scenario is comprised of thousands of assumptions, from advances in technology to changes in regulation.

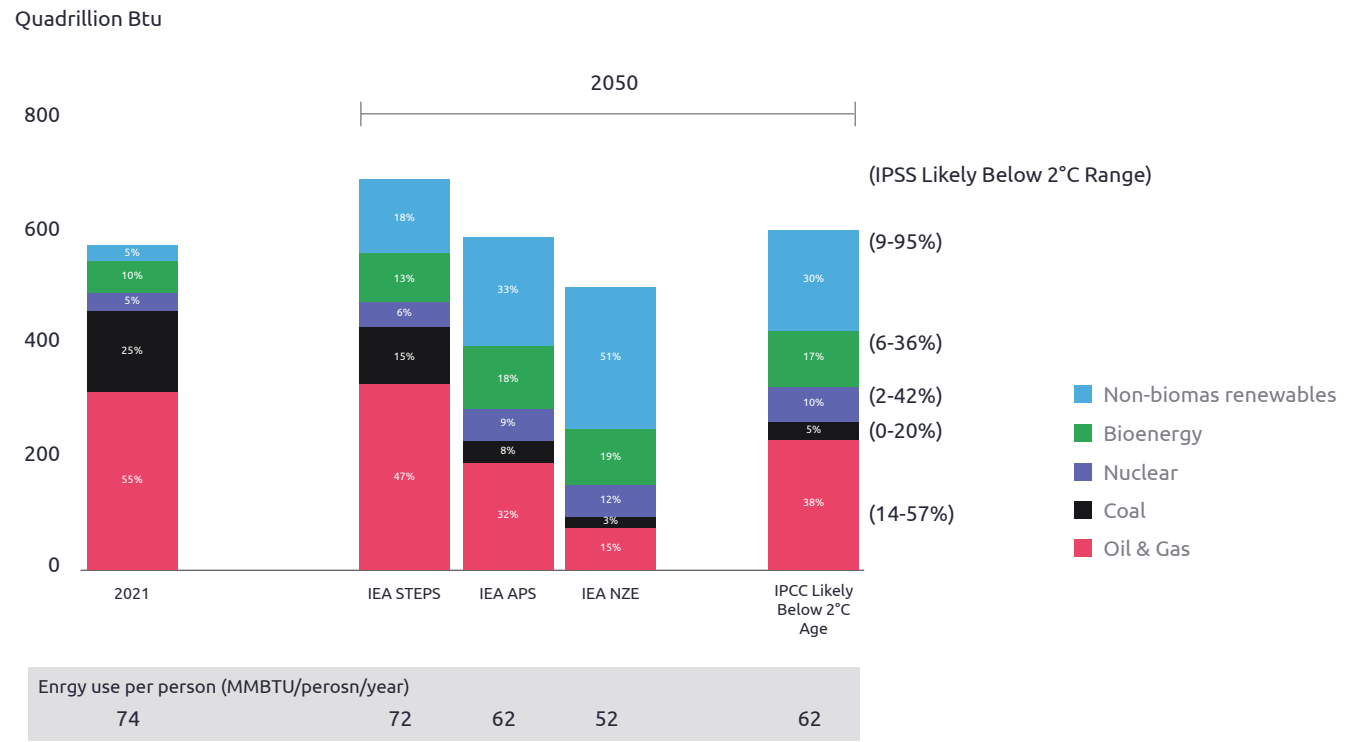
The IEA NZE scenario is viewed as a goal post, but scientists and economists around the world comment that it is highly unrealistic, as demonstrated in the following two pages.

It is impossible to know which model or scenario will be closest to reality, but a pattern is noticeable in each.

Fossil fuels remain a key part of the energy mix

To accommodate the projected growth in energy demand, all sources of energy will still be required, including fossil fuels. In fact, the Intergovernmental Panel on Climate Change's (IPCC) mostly likely scenario for 2050 indicates that fossil fuels will still need to make up as much as 43% of the energy mix. Low-carbon energy sources simply cannot grow at a fast enough pace to fill this gap. Since oil and gas production is naturally depletive, continued investment must be made to accommodate an additional 55 million equivalent barrels per day needed by 2050.

FIGURE 2
2050 Energy mix



Source: ExxonMobil 2023 global outlook, IEA world energy outlook 2023, IPCC sixth assessment report <https://spotlight.bloomberq.com/story/global-oil-outlook-to-2050/page/4/2>



Client Story



Wade Maxwell
Vice President, Engineering

In a keynote address at the 2024 ARC Forum, Wade spoke about ExxonMobil's efforts towards energy transition. He introduced "the AND equation".



What we are seeing

"Alternate sources of energy like solar and wind are playing an increasing role in the global energy mix. However, under most credible scenarios, including the net zero pathways, oil and gas will continue to play a significant role for decades to come. With that in mind, we are continuing to work in multiple areas to meet the needs of society today for reliable and affordable energy products while working to reduce our own greenhouse gas emissions as well as helping others do the same. That's the 'AND' equation."

What we are doing











ExxonMobil is innovating new technology across multiple disciplines, including carbon capture, direct air capture (DAC), Hydrogen, and Lithium. "We plan to invest more than 20 billion dollars in lowering emissions between 2022 and 2027," Maxwell said. "About half of that investment is intended to reduce emissions from our own operated assets. The balance is reducing emissions from other companies. We are delivering on both sides of the 'AND' equation."

<https://www.automation.com/en-us/articles/may-2024/the-and-equation-exxonmobil-energy-transformation>



Pathway to net zero is insufficient across almost all dimensions

Deployment progress to be made by technology – main levers (1/2)

Regions	Today (Parc / Production 2023 YE)	2030 pace / objective	2050 pace / objective	Are we on track?
Wind 	2023 total capacity: 1,021 GW (Fleet) 2023 added: 115.0 GW	150 GW / y	500 GW / y	
Solar PV 	2023 total capacity: 1,418 GW (Fleet) 2023 added capacity: 345 GW	550 GW / y	615 GW / y	
Nuclear 	2023 total capacity: 396 GW (440 units) (Fleet) 2023 added capacity: 33.0 GW	541 GW (Fleet)	1,160 GW (Fleet)	
Low-carbon Hydrogen 	2023 total capacity: 1 Mt / y 2023 added capacity: 0.3 Mt / y	125 Mt / y	523 Mt / y	
Storage 	96 GWh stationary 8,500 GWh pumped	600 GWh	6,000 GWh 10,000 GWh	

Wind:
<https://www.statista.com/statistics/268363/installed-wind-power-capacity-worldwide/>
<https://www.irena.org/Energy-Transition/Technology/Wind-energy>
https://gwec.net/wp-content/uploads/2023/04/GWEC-2023_interactive.pdf

Solar:
[IRENA Renewable Capacity statistics 2024](https://www.irena.org/Energy-Transition/Technology/Wind-energy)









Nuclear:
<https://www.iea.org/data-and-statistics/charts/global-nuclear-power-capacity-and-cop28-pathway-2030>
<https://world-nuclear.org/information-library/current-and-future-generation/nuclear-power-in-the-world-today>
<https://www.iea.org/reports/nuclear-power-and-secure-energy-transitions/executive-summary>
<https://world-nuclear.org/our-association/publications/world-nuclear-performance-report/global-nuclear-industry-performance#:~:text=In%202022%20the%20end%20of,down%20%20GWe%20from%202021.>

Low-carbon Hydrogen:
<https://www.woodmac.com/press-releases/oil-gas-majors-share-just-8-of-global-low-carbon-hydrogen-capacity/>



Pathway to net zero is insufficient across almost all dimensions

Deployment progress to be made by technology – main levers (2/2)

Regions	Today (Parc / Production 2023 YE)	2030 pace / objective	2050 pace / objective	Are we on track?
Electric transportation 	40 M (Fleet) 14 M (2023 sales +35% YoY)	360 M (Fleet)	2180 M ((Fleet)	
Heat pumps 	200 M units (Fleet) + 18 M pa / +11% YoY (Growth)	450 M (Fleet)	800 M (Fleet)	
Carbon Capture and Storage 	0,4 GT capture / y (production)	1.7 GT / y	3.3 GT / y	
Energy Intensity improvement 	1.3% / y (growth)	3.3% / y	2.8% / y	

Energy Intensity Improvement:

https://mc-cd8320d4-36a1-40ac-83cc-3389-cdn-endpoint.azureedge.net/-/media/Files/IRENA/Agency/Publication/2023/Jun/IRENA_World_energy_transitions_outlook_2023.pdf?rev=db3ca01ecb4a4ef8accb31d017934e97

<https://www.iea.org/energy-system/energy-efficiency-and-demand/energy-efficiency>



Climate change is inevitable – how do we prepare?

Mitigation must accelerate

We are already seeing the impacts of climate change around the world. It seems that each year continues to claim “the hottest year on record” and the impacts of wide-spread droughts, large-scale floods, and increasing weather extremes are more noticeable than ever.

We must start thinking of the “AND” scenario – utilizing fossil fuels where absolutely necessary AND improving energy efficiency AND rapidly developing negative carbon tech. All levers must be pulled.

Governments can’t do it alone. Market-based solutions must accelerate to drive the right behaviors. Examples include a carbon tax on businesses and incorporating the cost of climate impacts in the price of goods and services that emit greenhouse gases.

Adapting our lives will be essential

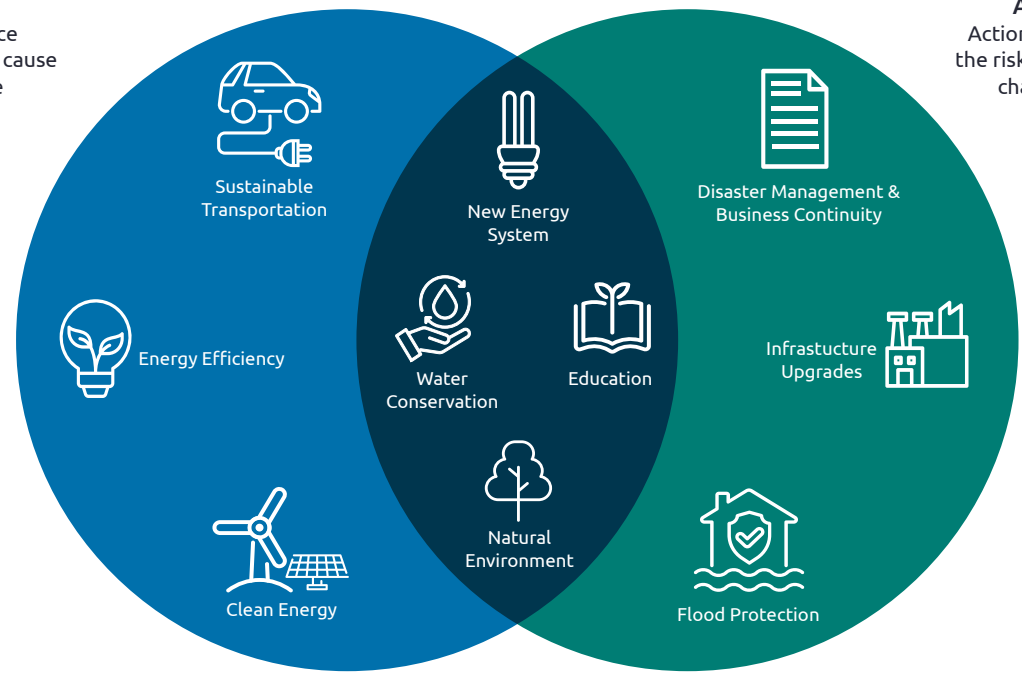
While focusing on solving the root cause of climate change is a natural priority, we must not forget the importance of preparing for what’s inevitable.

Engineers will need to build roads and bridges that withstand higher temperatures and storms. Cities will need to improve drainage for flood prevention. Farmers will need to plant and diversify drought-resistant crops and find ways make irrigation more efficient. Buildings will need better insulations, improved cooling technologies and more shade trees. Water conservation will have to become an everyday standard, enforced through restrictions and incentives. Families will need to consider relocating from at-risk coastlines and prepare for longer weather events that impact electricity, water and food supplies. Governments will need to prepare for a wider-range of disaster scenarios and need to fund mitigation efforts.

FIGURE 3
Mitigation & Adaptation

Mitigation
Action to reduce emissions that cause climate change

Adaptation
Action to manage the risks of climate change impact



Source: <https://connectedcountyofhuron.ca/corporate-climate-change-adaptation-plan>



Our Convictions

- The rate and pace of our current low-carbon energy efforts has improved but is not nearly enough to meet targets. Future growth must be on an exponential scale.
- While it's clear that oil and gas will continue to play an essential role in our global energy ecosystem for many decades to come, we must accelerate the ways in which we offset its impact.
- Negative carbon technologies must be a substantial part of the equation. Carbon capture, utilization and storage (CCUS) is one example where technology advances are needed to modularize, improve affordability, and ultimately scale globally. We must move from capturing 0.4 GT/yr today to over 3.3 GT/yr by 2050 and will need to develop additional technologies to achieve this.
- Changing consumer behavior on a global scale is imperative and will only happen with market-based solutions.
- We must focus both on mitigation actions and how we adapt to the inevitable.



About Capgemini

Capgemini is a global business and technology transformation partner, helping organizations to accelerate their dual transition to a digital and sustainable world, while creating tangible impact for enterprises and society. It is a responsible and diverse group of 340,000 team members in more than 50 countries. With its strong over 55-year heritage, Capgemini is trusted by its clients to unlock the value of technology to address the entire breadth of their business needs. It delivers end-to-end services and solutions leveraging strengths from strategy and design to engineering, all fueled by its market leading capabilities in AI, cloud and data, combined with its deep industry expertise and partner ecosystem. The Group reported 2023 global revenues of €22.5 billion.

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