

McKinsey Explainers

# What is net zero?

Net zero is an ideal state where the amount of greenhouse gases (GHGs) released into the earth's atmosphere is balanced by the amount of GHGs removed. Decarbonization efforts are needed to reach net zero.



**If you follow** sustainability and climate topics, you've probably heard the term net zero thrown around. Still puzzled?

A net-zero gain of GHG in the atmosphere is achieved when the level of GHG emissions released into the atmosphere is equal to the amount removed. This is also referred to as carbon neutrality.

CO<sub>2</sub> is a gas found in the Earth's atmosphere—and it's part of the planet's air, along with nitrogen, oxygen, methane, and other gases. CO<sub>2</sub> helps to trap heat, but too much of it can cause problems, such as heat waves or flooding. It occurs both naturally and as a byproduct of human activities such as burning fossil fuels.

All industries—not just the energy sector—must achieve net zero to avoid a permanently warmer planet. Read on to learn more about what net zero means, and how it can be achieved.

## What is decarbonization?

Decarbonization is the mitigation, cessation, or reduction of carbon in the atmosphere. It is achieved by switching to energy sources or materials that emit less carbon, often from high carbon-emitting fossil fuels and by counteracting any carbon that is emitted.

Keeping global warming to 1.5°C above preindustrial levels by limiting the buildup of atmospheric GHGs will be necessary to prevent permanent warming of the planet and catastrophic consequences. Those efforts are referred to as decarbonization. Many companies, countries, and organizations have pledged to decarbonize, or to make the net-zero transition, in the coming years. The power, oil and gas, and transport industries are frequently cited as the biggest emitters, but all industries need to work toward decarbonization to achieve net zero.

Getting to net zero is most significant at the global level, given the universal nature of the transition. Seven major energy and land-use systems (power, industry, mobility, buildings, agriculture, forestry, and waste) contribute to emissions, and all of them will need to undergo transformation, especially considering the interdependency of these systems. But people and organizations can set their own net-zero aspirations. Actions that can help include choosing low-carbon-emitting alternatives, such as solar and wind power, instead of fossil fuels, and counteracting any new emissions through active carbon removal. Circularity can also be a significant lever for decarbonization. For instance, in steel production, increasing the share of recycled steel—which emits less carbon dioxide than creating new steel—is an important pathway to reducing emissions.

It's not feasible to reduce carbon emissions to zero, so widely employing effective carbon removal and long-term storage will be necessary to halt the progression of global warming.

## What would a net-zero transition involve?

In describing the net-zero transition, it's important to note that McKinsey's research is not a projection or prediction, and it does not claim to be exhaustive; instead, it simulates one hypothetical, orderly path toward 1.5°C using the Net Zero 2050 scenario from the Network for Greening the Financial System (NGFS). This provides an order-of-magnitude estimate of economic costs and societal adjustments associated with the net-zero transition. (A full discussion of the research methodology can be found in our full report, *The net-zero transition: What it would cost, what it could bring.*)

With that understood, our analysis suggests six characteristics that define a global net-zero transition:

1. *Universal.* All energy and land-use systems would need to be transformed, affecting every country and every sector of the economy, directly or indirectly.
2. *Significant.* Spending on physical assets that could help reach net zero would need to rise from \$3.5 trillion spent per year today to \$9.2 trillion annually. Total spending through 2050 could reach \$275 trillion.
3. *Front-loaded.* The spending on physical assets could be more significant in the early stages of the shift, likely rising to almost 9 percent of global GDP from 2026 to 2030 (compared with just under 7 percent in 2022) before falling. Likewise, electricity costs could increase for a time before stabilizing or decreasing from 2020 levels.
4. *Uneven.* Sectors representing about 20 percent of the global economy would see the most economic exposure to the transition. Also, developing countries and fossil-fuel-rich regions are more susceptible to changes in output, capital stock, and employment because exposed sectors make up relatively large parts of their economies.
5. *Exposed to risks.* A transition in which high-emissions assets are retired before low-emissions assets come online could lead to volatile energy supply and prices if not managed carefully.
6. *Rich in opportunity.* The net-zero transition would create new efficiencies and new markets for low-emissions products.

### **How can business leaders create value in the net-zero transition?**

As the momentum toward net zero becomes undeniable, investors, customers, and regulators have raised their expectations for companies.

Nearly 90 percent of emissions are now targeted for reduction under net-zero commitments, and financial institutions responsible for more than \$130 trillion of capital have pledged that they will manage these assets along a 1.5°C commitment pathway.

To keep up, businesses must be bold. Instead of playing defense, as organizations have largely done until now, business leaders must pivot to an offensive position, working to meet growing demand for climate-friendly goods and services, and the green energy, equipment, and infrastructure needed to produce them. First movers can gain an advantage by using low-cost green financing to build out carbon-free production capacities. They can also win big contracts to fill orders for scarce commodities such as green steel or recycled plastics.

Some companies are already taking advantage of the opportunity at hand. In analyzing their approaches, four tactics stand out:

1. transforming business portfolios with special attention to industry segments with serious growth potential
2. building green businesses that enable them to penetrate new markets
3. differentiating with green products and new value propositions in existing markets to gain market share and price premiums
4. decarbonizing operations and existing supply chains

For business leaders looking to go on the offense, McKinsey has identified 11 high-potential value pools that could be worth up to more than \$12 trillion of yearly revenues by 2030.

## What will it take to decarbonize industries?

Each industry and company is affected by different factors in decarbonizing its operations, so companies looking to decarbonize will opt for approaches that suit their needs. Here's a look at some of the most affected sectors, which together account for about 85 percent of global GHG emissions through their operations or products:

- *Fossil fuels.* Combustion of fossil fuels produces 83 percent of global CO<sub>2</sub> emissions. In the decarbonization journey for fossil-fuel industries, players are pursuing energy efficiency, driving electrification, and managing fugitive methane emissions (for example, those that escape through degraded flange joints, valve glands, or seals), among other actions. Oil and gas companies in particular are making the low-carbon transition by working several levers, including transforming into diversified energy players.
- *Power.* Decarbonizing the power sector will require phasing out power generation from fossil fuels and adding capacity for low-emissions power to meet demand that's currently coming from economic development and the electrification of other sectors.
- *Mobility.* Road transportation accounts for three-quarters of all mobility emissions, so decarbonizing it will be crucial. Efforts here could involve replacing vehicles that have internal-combustion engines with vehicles that have battery electric power or hydrogen fuel cells.
- *Industry.* Steel and cement are core components of this category, and together they account for about 14 percent of global CO<sub>2</sub> emissions. Decarbonization efforts might involve installing equipment for carbon capture

and storage or switching to processes or fuels with low or no emissions.

- *Buildings.* Decarbonizing the buildings and real-estate sector will involve improving energy efficiency (for instance, by using insulation) and replacing heating and cooking equipment powered by fossil fuels with low-emissions systems.
- *Agriculture and food.* A few actions can help reduce agricultural emissions. Using greenhouse-gas-efficient farming practices can aid in decarbonization, as can changes at a consumer level—for example, if people eat fewer ruminant animals (such as cows) that generate lots of methane.
- *Forestry and land use.* CO<sub>2</sub> emissions in this sector often come from land clearing and deforestation. What can curtail these emissions? Efforts could include halting deforestation and speeding up efforts to restore natural environments, such as forests, that can be a net sink for emissions.
- *New energy sectors (hydrogen and biofuels).* There will be a lot of opportunities to expand low-emissions energy technologies. And even if expanding capacity and infrastructure for low-carbon fuels requires additional capital spending of \$230 billion per year through 2050, the hydrogen and biofuels sectors could create around two million jobs by then.

Our collection of articles “Decarbonizing the world’s industries: A net-zero guide for nine key sectors” also offers insight on decarbonizing the world’s industries.

## Do companies need to decarbonize supply chains?

Companies increasingly recognize the need to reduce emissions that occur in their upstream or

downstream value chain—and these are sometimes referred to as scope 3 emissions, as defined in the Greenhouse Gas Protocol. For many companies, scope 3 emissions account for as much as 80 percent of their total climate impact (as compared with scope 1 and scope 2 emissions, which are produced directly by companies or indirectly through the purchase of energy). But targeting scope 3 emissions will be challenging. Here are five issues that companies need to address to make supply chain decarbonization happen:

- a lack of carbon accounting foundations
- overreliance on secondary data for scope 3 emissions
- uncertainty over the cost and technical feasibility of carbon-reduction levers
- industry-wide collaboration to address many sources of emissions
- sustained engagement by internal and external stakeholders in long-term change programs

### What about climate technology?

Climate technology is any technology that works to reduce emissions or to address the effects of global warming. It involves many subcategories of use, all aimed at slowing the progression of global warming and transitioning operations to a greener state. Some of that abatement technology is still in the R&D stage, but McKinsey estimates that 60 percent of the necessary emissions abatement in the European Union for reaching net zero will come from widely deploying proven technologies. Five areas offer considerable promise when it comes to technology and climate change, and they could attract \$2 trillion in capital by 2025:

- *electrification*, including better electric-vehicle (EV) batteries and more efficient building systems
- *agriculture*, including zero-emissions farming equipment and bioengineering efforts

- *power grid improvements*, including long-duration storage and high-efficiency materials
- *hydrogen*, including efforts to build infrastructure and facilitate low-cost production
- *carbon capture, use, and storage (CCUS)* technologies to decarbonize hard-to-abate sectors or to remove GHGs from the atmosphere to drive “negative emissions”
- *circularity*, meaning reusing products when they reach the end of their life cycles, which has the potential to be a driver for decarbonization in the steel and cement industries

Climate technology both improves on existing processes to lower carbon production and presents ways to actively prevent atmospheric emissions or remove carbon from the atmosphere. The past decade has seen strides in climate technology. For example, the cost of some renewable-energy projects dropped by almost 90 percent. With capital increasing and fiscal support for low-carbon innovation from some governments, there’s a lot of potential in climate technology, even if the challenge is formidable.

*McKinsey has pledged to reach net-zero climate impact as a firm by 2030. For more in-depth exploration of decarbonization and net zero, see McKinsey’s Sustainability Insights. Learn more about sustainability consulting, plus decarbonization transformation and net-zero and ESG strategy—and check out sustainability-related job opportunities if you’re interested in working at McKinsey.*

Articles referenced include:

- “Playing offense to create value in the net-zero transition,” April 13, 2022. Michael Birshan, Stefan Helmcke, Sean Kane, Anna Moore, and Tomas Nauclicr.
- “What it will cost to get to net-zero,” January 29, 2022, by Gautam Kumra and Jonathan Woetzel

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- “The net-zero transition: What it would cost, what it could bring,” January 25, 2022, Mekala Krishnan, Hamid Samandari, Jonathan Woetzel, Sven Smit, Daniel Pachod, Dickon Pinner, Tomas Nauc ler, Humayun Tai, Annabel Farr, Weige Wu, and Danielle Imperato
- “Innovating to net zero: An executive’s guide to climate technology,” October 28, 2021, by Tom Hellstern, Kimberly Henderson, Sean Kane, and Matt Rogers
- “Making supply-chain decarbonization happen,” June 4, 2021, Peter Spiller
- “How negative emissions can help organizations meet their climate goals,” June 30, 2021, by Peter Cooper, Emma Gibbs, Peter Mannion, Dickon Pinner, and Gregory Santoni

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