



Net Zero Readiness Report 2023

KPMG ESG

kpmg.com/NZRR



Contents



Quick reader guide	03		
Foreword	05		
Key insights and observations	06		
Global sector summaries	10		
Economy	11		
Electricity	14		
Transport	16		
Industry	20		
Agriculture	25		
Country profiles	28		
Australia	29		
Brazil	32		
Canada	34		
China	37		
Denmark	40		
France	43		
Germany	45		
		India	48
		Ireland	51
		Italy	54
		Japan	57
		Mexico	60
		Netherlands	62
		New Zealand	64
		Norway	67
		Singapore	70
		South Africa	73
		South Korea	76
		Spain	78
		Sweden	80
		Switzerland	82
		United Arab Emirates	84
		United Kingdom	87
		United States of America	90
		About KPMG ESG	93
		KPMG contacts	94



Quick reader guide

The Net Zero Readiness Report (NZRR) examines steps taken by 24 countries as well as key economic sectors to reduce the greenhouse gas emissions that cause climate change. It also discusses their preparedness and ability to achieve net zero emissions of these gases by 2050.

The 2050 target date was proposed by a 2018 report of the United Nations Intergovernmental Panel on Climate Change (UN IPCC), which said that cutting net emissions by about 45 percent from 2010 to 2030 then 100 percent by 2050 would limit temperature rises to 1.5 degrees Celsius. It added that doing this would lessen the still-substantial damage that global warming will cause over the coming decades.¹

Humanity has already caused warming of approximately 1.1 degrees Celsius. In a report published in March 2023, UN IPCC said that the “pace and scale of what has been done so far, and current plans, are insufficient to tackle climate change”. Keeping warming to 1.5 degrees Celsius will require “deep, rapid and sustained greenhouse gas emissions reductions in all

sectors”. Global emissions should already be falling and will need to drop by nearly 50 percent by 2030 to achieve this.² While total global emissions fell in 2020 because of the COVID-19 pandemic, they rebounded in 2021 to about the same level as in 2019. Figures for carbon dioxide only in 2022 suggest the year may have set a new record high for emissions.³

Carbon dioxide, the most important greenhouse gas, is released when fossil fuels are burnt and work towards net zero is often called ‘decarbonization’ to reflect this. Carbon dioxide generated 74 percent of human-caused climate change in 2016. Emissions of methane, which contributed 17 percent, and nitrous oxide’s 6 percent are also included in the data used in this report.⁴



The NZRR uses the World Resources Institute definition of net zero. Primarily, this involves reducing greenhouse gas emissions caused by humans as close as possible to zero. Remaining emissions are balanced by an equivalent amount of carbon removal from the atmosphere, effectively neutralizing humanity's future impact on the world's climate.⁵

About the NZRR

This report is based on interviews with KPMG national climate change specialists in 24 countries as well as global KPMG experts in a range of economic sectors. As well as providing specific insights on countries and sectors, the report identifies insights that are critical to understanding and overcoming the challenges of the transition to net zero at a global level.

The national profiles include graphs showing how much sectors contribute to national greenhouse gas emissions and how much these emissions changed between 2005 and 2022, both by sector and across the economy. The national and sector emissions data comes from the European Commission's Emissions Database for Global Atmospheric Research (EDGAR).⁶

They are mapped to the following EDGAR sectors, which are based on UN IPCC greenhouse gas emissions categories: energy excluding electricity (fuels sector); electricity; transport; buildings (small-scale non-industrial combustion); industry (industrial combustion and industrial processes); agriculture (livestock, agricultural soils and burning of crop residues); and waste.⁷ Emissions data for France also includes data for Monaco, while the data for Spain also includes Andorra and Switzerland's also includes data for Liechtenstein.

The graphs on changes in emissions intensity are produced using national gross domestic product for the economy overall and for the transport, buildings and waste sectors. Emissions intensity data for agriculture and industry is based on the national outputs of those specific sectors. Emissions intensity for energy except electricity is derived from kilograms of carbon dioxide or equivalent per gigajoule of energy produced and for electricity from kilograms of carbon dioxide or equivalent per kilowatt hour. Ultimately countries can only progress towards net zero by cutting their absolute emissions but emissions intensity is included to recognize

progress on decarbonization of processes, particularly in fast-growing economies.

The following abbreviations are used throughout the text: CO₂ (carbon dioxide); ESG (environmental, social and governance); GDP (gross domestic product); GW (gigawatt); and ktCO₂e, MtCO₂e or GtCO₂e kilotonnes, (megatonnes or gigatonnes of CO₂ equivalent, used to measure total greenhouse gas emissions with scaling based on impact over a century for gases other than carbon dioxide). US dollar equivalents for other currencies are correct as of October 2023.

¹ 'Global Warming of 1.5°C: summary for policymakers', Intergovernmental Panel on Climate Change, October 2018. https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Hheadline-statements.pdf

² 'Urgent climate action can secure a liveable future for all', Intergovernmental Panel on Climate Change, 20 March 2023. <https://www.ipcc.ch/2023/03/20/press-release-ar6-synthesis-report/>

³ 'CO₂ emissions in 2022', International Energy Agency, March 2023. <https://www.iea.org/reports/co2-emissions-in-2022>

⁴ Hannah Ritchie and Max Roser, 'By gas: how much does each contribute to total greenhouse gas emissions?', Our World in Data. <https://ourworldindata.org/greenhouse-gas-emissions#by-gas-how-much-does-each-contribute-to-total-greenhouse-gas-emissions>

⁵ Kelly Levin, Taryn Fransen, Clea Schumer, Chantal Davis and Sophie Boehm, 'What does 'net zero emissions' mean? 8 common questions, answered', World Resources Institute, updated March 2023. <https://www.wri.org/insights/net-zero-ghg-emissions-questions-answered>

⁶ 'EDGAR — Emissions Database for Global Atmospheric Research', European Commission Directorate-General for Joint Research Centre. <https://edgar.jrc.ec.europa.eu/>

⁷ Table 3 on p29, 'GHG emissions of all world countries 2023', European Commission Directorate-General for Joint Research Centre. https://edgar.jrc.ec.europa.eu/booklet/GHG_emissions_of_all_world_countries_booklet_2023report.pdf



Foreword

KPMG published the Net Zero Readiness Index (in 2021,¹ a few weeks before the COP26 UN climate change conference in Glasgow. The event resulted in 153 countries putting forward new emissions targets for 2030 and more than 90 percent of world economic output and global emissions being covered by net zero agreements. Attempts to phase out the use of coal, the single biggest contributor to climate change, failed with weaker language to ‘phase down’ its use in the final agreement. COP26’s chairman Alok Sharma said that the conference had kept alive the hope of keeping global temperature increases within 1.5 degrees Celsius this century but added “its pulse is weak.”

The last two years have seen many countries taking steps in the right direction towards net zero, even if most have a long way to go. Some have announced significant new policies to support decarbonization, including the REPowerEU in Europe. Emissions trading schemes are expanding in several countries and the EU is phasing in its Carbon Border Adjustment Mechanism, an idea that other countries look likely to adopt. The bloc is also introducing regulations to block the import of products linked to deforestation, showing how some jurisdictions plan to go further faster to meet net zero pledges.

Next year will likely see companies in many countries starting to report on their climate change risks and plans.

Renewable energy production continues to expand rapidly around the world, investment is rising fast and there are indications that it is becoming harder to raise funding for some fossil fuel projects. Renewable production and the reshaped electricity grids it requires will inevitably impact on some local environments, their biodiversity and communities. We are going to see more conflicts between the local and the global, but if we want to reach net zero while keeping the lights on, we have to build new power infrastructure somewhere.

These issues are among those discussed in this Net Zero Readiness Report. It explores the readiness of 24 countries based on interviews with local KPMG specialists. This report also examines global trends in sectors that are key to tackling climate change: the economy, electricity, transport, manufacturing, buildings, infrastructure, oil and gas, agriculture and the blue economy.

Across these countries and sectors we can see plenty of examples of progress on decarbonization, including growth in electric vehicle sales, although from a low level in most countries. On behalf of all the KPMG specialists involved, we hope this report can contribute to helping organizations quicken their pace on the long walk towards net zero.



Mike Hayes

Climate Change and
Decarbonization Leader, Global
Head of Renewable Energy
KPMG International



David Greenall

Global Managing Director,
Climate Risk,
Decarbonization & Resilience
KPMG International

¹ ‘Net Zero Readiness Index 2021’, KPMG International, October 2021. <https://kpmg.com/xx/en/home/insights/2021/09/net-zero-readiness-index.html>



Key insights and **observations**



Key insights and observations

The Net Zero Readiness Report 2023 draws on the expertise of KPMG specialists working at an international level as well as in each of the countries covered. The following insights are based on their observations, with more details in the sector and country profiles.

1 Several of the world's biggest emitting countries have increased their net zero ambitions.

In February 2021 the US, the world's second-largest producer of greenhouse gases by volume, formally rejoined the UN Paris Agreement on climate change, and the Inflation Reduction Act introduced major tax incentives and benefits for decarbonization work with US\$370 billion allocated to energy security and climate programs.

China's President Xi Jinping said in September 2020 that the country, the largest producer of greenhouse gases by volume, would aim to reach peak carbon emissions before 2030.¹ The government has since published more detail on how it hopes to achieve this, including coal consumption starting to fall by 2030 and energy produced without fossil fuels rising to 20 percent by 2025 and 25 percent by 2030. For the next few years China sees electricity from coal as providing energy security, but massive investments in renewable energy and infrastructure indicate that it is looking beyond coal for the long term.

Australia, which has among the highest levels of greenhouse gas emissions per person, introduced new federal policies that amount to a quantum leap in the country's legislative architecture following a change of government in May 2022. These include enshrining a 2050 net zero target date in law, increasing interim reduction targets and supporting laws, targets, regulations and initiatives. Canada, which has similarly high per person emissions, included billions of dollars of incentives for 'clean economy' investments in its 2023 federal budget. Brazil, where per person emissions have fallen over the last two decades but remain higher than the global average, is discussing the introduction of a regulated carbon market that would build on the progress the country has made to reduce emissions from electricity production and road vehicles.

The EU includes some of the world's most climate-conscious countries which as a group have already made significant progress on decarbonization. However, Russia's invasion of Ukraine in February 2022 and the resulting loss of Russian natural gas from European markets caused the bloc to increase its ambitions through the REPowerEU plan, which aims to accelerate the implementation of renewable energy.

2 Net zero is weaving itself into the world's economic systems.

Jurisdictions around the world have introduced emissions trading systems that require those producing greenhouse gas emissions to buy tradable allowances or permits, although many apply only to some sectors. The EU, which established the first such scheme in 2005, is in the process of extending it to new sectors, including maritime shipping as well as reducing the number of allowances and phasing out free allocations. China is planning to extend its scheme, which covers only

power generation, to eight major industries and South Korea will move to the next phase of its system in 2026, similarly extending its coverage.

The EU is introducing its Carbon Border Adjustment Mechanism from October 2023, which will eventually require those importing some goods to pay an equivalent price for their emissions to manufacturers based in the bloc. Australia and the UK, which both have emissions trading, are considering similar mechanisms. India may challenge the EU mechanism and South Africa is considering how it should respond, but over time border adjustments look likely to reinforce the importance of low carbon production as a source of competitive advantage.

Companies in many countries may soon provide more information on climate change risks and plans under a range of new standards. These include a global baseline drawn up by the International Sustainability Standards Board, which countries including the UK plan to implement. Other jurisdictions are introducing regimes that build on this, including the EU's European Sustainability Reporting Standards, while new disclosure rules are expected from the US Securities and Exchange Commission and the Australian authorities.

3 Production of low carbon energy is growing rapidly.

At present, fossil fuels — coal, natural gas and oil — provide 82 percent of the world's primary energy but many of the decarbonization policy initiatives of the last two years have focused on extending low carbon energy. While China and India are adding both fossil fuel and low carbon generation to meet rapidly increasing demand, the International Energy Agency predicts that clean energy will receive US\$1.8 trillion (in prediction



Nuclear power, which while not a renewable energy source produces low carbon electricity reliably, remains politically unacceptable in several countries. Some have reconsidered this and are planning new capacity, given the way in which nuclear power contributes towards decarbonization in countries such as France.”

for spending on clean energy) of investment globally in 2023, encouraged by incentives from jurisdictions including the US and the EU, compared with US\$1 trillion for coal, oil and gas.²

Countries can choose from a wide range of low carbon technologies. Those with large areas of territorial waters are turning to offshore wind, which at present means fixed turbines in shallow waters. New floating platforms under development will allow wind power production in deeper seas, a particular opportunity for Japan given the depths of many of its territorial waters. Denmark is developing an artificial energy island as a connection and maintenance point for offshore wind while Ireland recently auctioned rights to construct turbines in its waters.

India is developing significant amounts of solar generation for domestic use. Some countries with plentiful sunlight and land are looking to export it through interconnectors or pipelines for green hydrogen made with solar energy, with plans for a 3,300 kilometer hydrogen-ready pipeline project between Italy and northern Africa while Singapore has approved an interconnector involving more than 1,000 kilometers of subsea cables to import renewable electricity from Cambodia. There is renewed interest in nuclear power, with the United Arab Emirates due to put the fourth and final unit of its new Barakah plant live shortly.

Scaling up production of renewable energy is regarded as one of the most critical actions required to achieve the Paris Agreement target of limiting global temperature rises to 1.5 degrees Celsius. However, at present most renewable energy developers face several serious challenges that endanger the rapid growth of renewables this decade the target requires. These include shortages of critical minerals, grid infrastructure, energy storage facilities and skilled workers along with policy inhibitors and planning bottlenecks. Tackling these requires the immediate

adoption of innovative approaches, given that not doing so will have significant consequences for the global climate.

KPMG believes that a greater understanding of the practical challenges involved in scaling up renewable production is needed if global climate ambitions for 2030 and beyond are to be achieved. In response, KPMG is undertaking a comprehensive study to identify and understand the global, regional and practical challenges that hinder rapid deployment of renewable energy, outline potential solutions and make specific recommendations as to how to overcome the challenges.³

4 Increasing electric vehicle sales show how rapidly some sectors can decarbonize.

The global sales share of electric cars tripled from 4.2 percent in 2020 to 14 percent in 2022. It rose fivefold in China to 29 percent while nearly 9 in 10 cars sold in Norway in 2022 were electric.⁴ Although from a low base and at levels that vary greatly by country, road transport is increasingly powered by electricity or, in the case of Brazil, ethanol biofuels produced from sugarcane or corn. Other road vehicles, including commercial vehicles, buses and trucks, are increasingly moving to batteries or green fuels. Other forms of transport such as shipping and aviation are starting to decarbonize by adopting green fuels, but the poor availability and high cost of such fuels as well as much longer lifespans of vessels and aircraft means change is taking place more slowly.

The growth in electric road vehicles is creating capacity issues with several countries having problems increasing vehicle charger numbers and local electricity grid capacity quickly enough to support growing electric fleets. Charger shortages could be addressed by ‘dynamic charging’ that recharges vehicles in motion, which Sweden is planning to introduce on thousands of kilometers of road. In many cases growth



in electric vehicles has required high levels of government subsidy, which in Norway has involved tax breaks and price incentives, although this has also helped the country develop an ecosystem of start-ups in this field.

5 Impacts of low carbon power projects on local environments are causing 'green on green' conflicts.

Most kinds of power production have a local impact and this can be amplified for renewable generation sited in remote rural locations. Linking large numbers of remote sites while distributing more power for vehicle charging, heating and other applications means increasing the scope and capacity of power grids. Both generation and infrastructure projects can have significant impacts on local wildlife, biodiversity and communities, leading to opposition and in some cases work being blocked. National environmental rules can cause similar clashes, with nitrogen emission permits required in the Netherlands hindering the construction of green hydrogen and biofuel plants in Rotterdam. However, several countries are devoting considerable effort to reforming systems to address these concerns proactively, including through better site planning, community consultation and benefit sharing.

Nuclear power, which while not a renewable energy source produces low carbon electricity reliably, remains politically unacceptable in several countries. Some have reconsidered this and are planning new capacity, given the way in which nuclear power contributes towards decarbonization in countries such as France.

6 Net zero backlashes occur when people fear costs and bans rather than new opportunities.

While many people support work towards net zero in principle, they may oppose measures that cost a lot of money or stop them doing something, particularly if it involves their livelihoods. The UK is struggling to move some of Europe's least efficient homes from natural gas heating to low carbon alternatives, with few homeowners choosing to install heat pumps given the costs and difficulties involved, and its government recently delayed its planned date to end sales of new gas boilers. An attempt by the German government to ban replacement natural gas boilers was significantly modified after it ran into opposition. Switzerland is providing significant financial support to help owners replace fossil fuel heating in buildings, which are already of relatively high quality by international standards.

Agriculture is experiencing acute conflicts over how to reduce emissions, with some countries flagging the need for livestock farming to share in decarbonization efforts. Attempts in New Zealand to agree a way to manage and reduce on-farm emissions between government and representatives of farmers and growers, which would be a powerful way to incentivize innovation, are yet to succeed. There are ways in which agriculture can reduce emissions, such as supplementing livestock diets to reduce methane, turning effluent into biofuels and sequestering carbon. The last also represents a 'blue economy' opportunity for coastal areas, including small island economies that are particularly threatened by climate change, through expanding areas of mangroves and other carbon-rich ecosystems.

¹ China national profile, 'Net Zero Readiness Index 2021', KPMG International.

² 'Executive summary, 'Net Zero Roadmap: A Global Pathway to Keep the 1.5°C Goal in Reach', International Energy Agency, September 2023. <https://www.iea.org/reports/net-zero-roadmap-a-global-pathway-to-keep-the-15-0c-goal-in-reach/executive-summary>

³ 'Turning the tide in scaling renewables', KPMG International, September 2023. <https://assets.kpmg.com/content/dam/kpmg/xx/images/2023/09/scaling-renewables-client-survey-landscape.pdf>

⁴ 'Global EV Data Explorer', International Energy Agency. <https://www.iea.org/data-and-statistics/data-tools/global-ev-data-explorer>



Global sector

summaries



Economy

There are several factors that look likely to constrain investments by governments and businesses on decarbonization over the next couple of years.

Many governments worldwide increased spending sharply on healthcare and economic support for individuals and businesses during the COVID-19 pandemic. Following the Russian government's invasion of Ukraine in February 2022 and subsequent increases in the price of natural gas, many European countries spent heavily to subsidize household energy bills.¹

Such support has led many governments to borrow more, with global public debt increasing from 84 percent of gross domestic product in 2019 to 92 percent in 2022 according to the International Monetary Fund.² Adding to this, rising interest rates have further increased the cost of servicing debts for governments. "It leaves less room for them to spend on meeting net zero targets," says Yael Selfin, Chief Economist, KPMG in the UK.

In addition, economic growth is relatively weak in many countries, constraining government tax revenues and putting downward pressure on profits for businesses in some sectors, which make them less able to pursue green investments. Higher interest rates also increase the cost of borrowing by companies to fund such investments. Finally, elections due in several major economies over the next two years add to the policy uncertainty as they could lead to changes in environmental policies, making companies more likely to wait before embarking on large projects.



Such support has led many governments to borrow more, with global public debt increasing from 84 percent of gross domestic product in 2019 to 92 percent in 2022 according to the International Monetary Fund. Adding to this, rising interest rates have further increased the cost of servicing debts for governments.



Carbon border adjustments

Many jurisdictions have set up emissions trading systems (ETS), also known as cap-and-trade systems, that limit or cap the total emissions that certain companies or industries are allowed to emit annually. The amounts are covered by tradeable allowances or permits, which allow the holder to emit a specified volume of greenhouse gas emissions. This sets a price on carbon by requiring companies to buy permits that cover the volume of emissions emitted during a given period or face substantial penalties.



The schemes aim to reduce emissions by having a limited number of permits available that are gradually reduced, increasing the carbon price over time. Such schemes, which typically start by covering just the largest producers of greenhouse gases, provide a long-term financial justification for cutting emissions while allowing companies to choose how they do this. However, due to increased costs from both emissions trading and decarbonization efforts, local companies can potentially be undercut on price by importers from jurisdictions that do not have equivalent carbon pricing systems, a problem typically referred to as ‘carbon leakage’.

The EU established the world’s first ETS in 2005, which now covers around 15,000 stationary installations producing some 36 percent of the bloc’s greenhouse gas emissions and including non-EU countries Iceland, Liechtenstein and Norway.³ The EU is strengthening EU ETS by extending its scope to additional sectors, phasing out free allowances and accelerating the reduction of the number of allowances in circulation, but all this heightens the risks of carbon leakage.

To address this risk the EU has introduced the world’s first carbon border adjustment mechanism (CBAM), which will require affected companies importing specified goods into the EU to buy certificates with prices based on the EU ETS weekly auction price adjusted for any recognized mandatory carbon price effectively paid in the country of origin. The intention is that importers will pay the same for the carbon emissions required to produce goods as producers within the EU, creating a level playing field and preventing carbon leakage.

EU CBAM’s transitional phase, starting on 1 October 2023, requires importers to report on emissions embedded in specified goods in a limited number of carbon intensive sectors:

cement, iron and steel, aluminum, fertilizers, electricity and hydrogen.⁴ Full implementation of the mechanism, under which importers will have to buy CBAM certificates, is linked to the phasing out of free allowances currently provided under EU ETS and is planned to start on 1 January 2026. Before this the EU will assess the mechanism’s functioning with a view to extend its scope to other carbon-intensive sectors at risk of carbon leakage. The intention is that all goods and sectors covered by EU ETS will also be covered by EU CBAM by 2030.⁵

Other countries are exploring the implementation of their own CBAMs. In March 2023 the UK, which was part of EU ETS until it left the bloc and set up its own similar scheme, said it would consult on proposals for a UK CBAM to be introduced from 2026 at the earliest. KPMG in the UK says the British proposal has similarities with EU CBAM but that businesses could still have to comply with two distinct regimes.⁶

Businesses in other countries with carbon-intensive exports may be faced with significantly increased export costs to markets covered by CBAMs, if importers choose to pass the cost of purchasing certificates on to suppliers. At the COP27 UN climate change conference in November 2022 the governments of Brazil, South Africa, India and China published a joint statement saying that “unilateral measures and discriminatory practices, such as carbon border taxes, that could result in market distortion and aggravate the trust deficit amongst parties, must be avoided”.⁷ In May India indicated that it intends to challenge EU CBAM at the World Trade Organization.⁸ South Africa’s government is considering how to respond, although KPMG in South Africa says some large companies are already working on the issue.⁹

“The introduction of the EU’s CBAM represents a new era of global trade — one where the embedded emissions of

products affect competitiveness,” says Nicole de Jager, Senior Tax Manager — Global ESG Tax, KPMG International. “As other countries explore the potential for implementation of their own CBAMs, it is clear that the production of greener products is no longer limited to sustainability departments or public perception management. The carbon content of goods is beginning to feature as a strategic business decision, one that impacts cross-border trade and companies’ future growth and prospects of surviving.”

Climate and sustainability reporting

Companies around the world will soon need to provide more information on how they will be affected by climate change and what they are doing to tackle it. The International Sustainability Standards Board (ISSB) produced what is intended as a global baseline for reporting on sustainability, drawing on the work of the Task Force on Climate-related Financial Disclosures (TCFD), which countries including the UK have indicated they will incorporate into national rules. Other jurisdictions including the EU and the US are introducing their own regimes that build on the ISSB baseline with Japan planning to do likewise.

The ISSB, EU and US all intend to improve disclosures for investors on climate change, with the EU’s draft standards also covering other stakeholders. Both the EU and US plan to phase in such reporting from the 2024 financial year for reports published in 2025. The ISSB standards will be available for 2024 financial year reports although the timing will be a matter for each jurisdiction.¹⁰

Many large companies already publish such material, with research by KPMG in 2022 finding that 96 percent of the G250 group of the world’s 250 biggest companies report on sustainability issues. The survey found that TCFD standards



were used by 61 percent of the G250, up from 37 percent in the previous survey two years earlier, with nearly three-quarters of reports including carbon targets.¹¹

“Effective ESG reporting will not happen overnight and integrating ESG into corporate strategy and operations is a substantial change management exercise,” says Dr Jan-Hendrik Grändiger, Global ESG Reporting Lead and Partner, KPMG in Germany. “Senior executives should waste no time in hastening their company’s transition to a position where non-financial reporting holds the same importance as financial reporting — and be prepared to obtain assurance.”

ESG assurance

The release of the European Sustainability Reporting Standards in the EU and the first two ISSB standards represents an important milestone, the establishment of globally accepted frameworks that companies can adopt and adhere to while also

providing a basis for assurance measures. This offers companies a structured path to follow and a robust system for validation.

ESG assurance has emerged as a crucial mechanism for offering credible and unbiased verification of a company’s progress towards achieving its net zero objectives. As companies increasingly set ambitious emission reduction targets, the precision and openness of their reported data have taken on significant importance. KPMG’s ESG Assurance Maturity Index, focusing on companies with an average revenue of US\$15.6 billion, found that only 23 percent have effectively documented, tested and implemented processes and controls for their environmental data, indicating the ongoing challenges many face in this area.¹²

As reporting standards are phased in over the coming years, ESG assurance will play a vital role in bridging the gap between intention and impact and providing necessary checks and

balances that will drive meaningful change and contribute to a more sustainable global economy. “In the journey to net zero, ESG assurance serves to enhance the public trust over ESG-related data, and is a strategic driver enhancing transparency, accountability and authenticity, propelling companies toward meaningful and impactful sustainability outcomes,” says Mike Shannon, Global Head of ESG Assurance, KPMG International.

¹ ‘Which countries are doing the most to tackle energy bills?’, BBC News, 21 December 2022. <https://www.bbc.com/news/61522123>

² ‘2023 Fiscal monitor’, International Monetary Fund, April 2023. <https://www.imf.org/en/Publications/FM/Issues/2023/04/03/fiscal-monitor-april-2023>

³ ‘EU Emissions Trading System (ETS) data viewer’, European Environment Agency, 27 July 2023. <https://www.eea.europa.eu/data-and-maps/dashboards/emissions-trading-viewer-1> and ‘The EU Emissions Trading System in 2021: trends and projections’, European Environment Agency, updated 7 February 2023. <https://www.eea.europa.eu/publications/the-eu-emissions-trading-system-2>

⁴ ‘Carbon Border Adjustment Mechanism’, European Commission. https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en

⁵ Merijn Betjes, ‘Update Carbon Border Adjustment Mechanism (CBAM): provisional agreement reached’, KPMG Meijburg in the Netherlands, 14 December 2022. <https://meijburg.com/news/update-carbon-border-adjustment-mechanism-cbam-provisional-agreement-reached>

⁶ Carol Newham, ‘Government announces UK CBAM consultation’, KPMG in the UK, 17 April 2023. <https://kpmg.com/uk/en/home/insights/2023/04/tmd-government-announces-uk-cbam-consultation.html>

⁷ ‘BASIC Ministerial joint statement at the UNFCCC’s Sharm el-Sheikh Climate Change Conference’, South Africa Department of Forestry, Fisheries and the Environment, 15 November 2022. https://www.dffe.gov.za/mediarelease/basicministerialmeeting_cop27egypt2022

⁸ Manoj Kumar and Neha Arora, ‘India plans to challenge EU carbon tax at WTO’, Reuters, 16 May 2023. <https://www.reuters.com/world/india/india-plans-challenge-eu-carbon-tax-wto-sources-2023-05-16/>

⁹ See South Africa profile.

¹⁰ ‘Comparing sustainability reporting proposals’, KPMG International, April 2023. <https://assets.kpmg.com/content/dam/kpmg/xx/pdf/2022/06/comparing-sustainability-reporting-proposals-talkbook.pdf>

¹¹ ‘Big shifts, small steps: Survey of Sustainability Reporting 2022 executive summary’, KPMG International, October 2022. <https://assets.kpmg.com/content/dam/kpmg/xx/pdf/2022/10/ssr-executive-summary-small-steps-big-shifts.pdf>

¹² ‘Road to readiness: ESG Assurance Maturity Index’, KPMG International, September 2023. <https://kpmg.com/xx/en/home/insights/2023/09/road-to-readiness.html>



Electricity

The last two years have seen renewable electricity used to respond to economic sanctions as well as decarbonization targets. The Russian government's invasion of Ukraine in February 2022 and the resulting need to replace supplies of Russian natural gas led the European Commission to accelerate and enhance existing plans to extend renewable generation, through its rapidly developed REPowerEU plan outlined in March 2022 and published in May of that year. In a recent assessment the commission says that installation of wind and solar generation both rose by nearly 50 percent in 2022 compared with 2021 while use of natural gas (for heating as well as electricity generation) was 18 percent lower between August 2022 and March 2023 compared with the previous five-year average for those months.¹

The EU's use of renewables to tackle a potential energy crisis was an important moment according to Mike Hayes, Climate Change and Decarbonization Leader, Global Head of Renewable Energy, KPMG International: "It put decarbonization solutions and particularly renewable energy at the center of the energy debate," he says. However, the sharp rises in energy costs resulting from the removal of Russian gas have also highlighted the energy trilemma involved in balancing price, availability and decarbonization.

Globally, spending to develop low carbon energy is now significantly higher than that for fossil fuels. The International Energy Agency predicts that clean energy will receive US\$1.8 trillion (in prediction for spending on clean energy) of investment in 2023 compared with US\$1 trillion for coal, gas and oil, with this year seeing more investment in solar energy than oil

for the first time.² However, the shift in investment is yet to make much of an impact on the overall mix of energy sources used to generate electricity. In 2022, renewables, hydroelectricity and nuclear combined generated 38 percent of the world's electricity according to annual data published by the Energy Institute, a professional membership body, but coal remained the single biggest source producing 35 percent with natural gas second at 23 percent.³



In a recent assessment the commission says that installation of wind and solar generation both rose by nearly 50 percent in 2022 compared with 2021 while use of natural gas (for heating as well as electricity generation) was 18 percent lower between August 2022 and March 2023 compared with the previous five-year average for those months.





While some countries are replacing coal with low carbon sources, fast-growing economies including China and India are adding both fossil fuel and low carbon generation to try to meet rapidly increasing demand. Anish De, Global Head of Energy, Natural Resources and Chemicals, KPMG in India, says India is developing more generation from nuclear, hydrogen and solar as well as storage capacity. “But that doesn’t change the balance that much,” he says, as the country has also increased coal generation rapidly over recent years.⁴

Offshore wind, solar and nuclear

Among renewable technologies, offshore wind and solar have particularly strong potential over the next few years. Offshore wind is less constrained than onshore developments, which have to compete with other land uses and planning regulations. Floating platform technology currently under development will allow turbines to be installed in deeper seas than those fixed to the seabed, opening new areas of ocean for generation. Countries with large areas of territorial waters such as Canada, China, France, Ireland, Japan, the UK and the US are among those developing offshore wind.

Meanwhile, solar power looks likely to become an increasingly important export for countries with enough sunlight and land to produce it, with those in the Middle East and north Africa

having massive potential to use new interconnector cables to sell electricity to Europe. Several countries are showing renewed interest in nuclear generation, both conventional large plants and new small modular reactors (SMRs), given this does not produce greenhouse gas emissions from production.⁵

Grids and other challenges

Connecting renewable generation to consumers typically requires the re-engineering of electricity grids, most of which were designed to distribute predictable levels of electricity from a few large power plants rather than handle lots of far-flung sites with intermittent production. Many operators are building new power lines, connection points and substations as well as changing the way they manage their grids or have plans to do so.

New renewable generation may be essential in decarbonizing economies and slowing climate change, but it often causes impacts on local environments, wildlife and biodiversity. Some projects are also opposed by those living nearby including indigenous people, such as Sámi communities in Norway and Sweden who oppose wind turbines as they affect their reindeer.

Projects can also be delayed by overstretched supply chains, although several countries are making efforts to develop local

production of components including solar panels, as well as difficulties sourcing critical minerals. While renewable energy projects can now be established with well-tested development processes that use reliable technologies to generate electricity at reasonable cost, there are still barriers to overcome.

Government policies look likely to continue to encourage greater adoption of renewable electricity generation, including the US Inflation Reduction Act, REPowerEU and similar policies elsewhere. Financial incentives introduced by governments such as carbon taxes and levies including the EU’s Carbon Border Adjustment Mechanism incentivize companies to make greater use of low carbon electricity and individuals will similarly be influenced by tax breaks and regulations on electrification of vehicles and in some countries home heating, although some may cause political controversy. “We are going to see a lot more policy measures to help drive us towards low-carbon electrification,” says Hayes.

¹ ‘REPowerEU — one year on’, European Commission, May 2023. https://energy.ec.europa.eu/topics/markets-and-consumers/actions-and-measures-energy-prices/repower-eu-one-year_en

² Executive summary, ‘Net Zero Roadmap: A Global Pathway to Keep the 1.5°C Goal in Reach’, International Energy Agency, September 2023. <https://www.iea.org/reports/net-zero-roadmap-a-global-pathway-to-keep-the-15-0c-goal-in-reach/executive-summary>, ‘Clean energy investment is extending its lead over fossil fuels, boosted by energy security strengths’, International Energy Agency, 25 May 2023. <https://www.iea.org/news/clean-energy-investment-is-extending-its-lead-over-fossil-fuels-boosted-by-energysecurity-strengths>

³ ‘Electricity generation by fuel’, Statistical Review of World Energy 2023, Energy Institute. <https://www.energyinst.org/statistical-review>

⁴ ‘India’, International Energy Agency. <https://www.iea.org/countries/india>

⁵ Kevin Masters, ‘How small modular nuclear reactors can help decarbonize power grids’, KPMG in the UK, January 2023. <https://kpmg.com/xx/en/home/insights/2023/01/how-small-modular-nuclear-reactors-can-help-decarbonize.html>



Transport

The automotive industry continues its transition from internal combustion engines to electric vehicles, although the pace of adoption varies widely from country to country. The worldwide sales share of electric cars tripled from 4.2 percent of sales in 2020 to 14 percent in 2022 according to the International Energy Agency (IEA). Electric cars' share of the EU market doubled over the same period to 21 percent and rose fivefold in China to 29 percent. In Norway, which has led the world in their adoption, 88 percent of car sales in 2022 were of electric models.¹

The IEA says that two and three-wheeler vehicles, popular in many emerging and developing economies, are already highly electrified with more than half of India's three-wheeler registrations in 2022 being for electric vehicles. Sales of electric light commercial vehicles and buses are increasing rapidly and manufacturers are bringing more electric heavy-duty models to market.²

However, growth in some countries may be constrained by the ability of charging infrastructure to keep up. Problems include incompatible charging systems between countries and within them and capacity limitations of electrical grids. Several European governments have reduced financial support for those buying electric vehicles and their price has not decreased to compensate for this. Research in December 2022 for KPMG with automotive executives in Europe shows that they had lower expectations of future growth than in 2021.³

Jonathon Peacock, Global Oil & Gas Leader, KPMG in Australia, says that better battery performance, improved

recovery of energy from braking and use of solar panels on vehicles could increase battery ranges. Meanwhile, the introduction of inductive charging that does not need a cable could make it more convenient, with Sweden planning to equip thousands of kilometers of road with this technology over the next two decades.⁴ "In geographically large environments or where there is a culture of driving such as in the US, people need confidence in their ability to recharge their vehicles," he says. "Technology can sort some of this out."

However, he adds that electric vehicles rely on the availability of a wider range and greater quantity of critical minerals that are needed for internal combustion engine ones, with a typical electrical model requiring 53 kilograms of copper compared with 22 kilograms in a conventional one according to the IEA.⁵ Some of these minerals are mined in only a few locations globally and China has 90 percent of the current processing capacity.

As well as changing the technology of private vehicles, countries can cut emissions by encouraging people to use shared alternatives. Public transport services, which typically have much lower levels of emissions per passenger kilometer than cars, saw sharp drops in use during the COVID-19 pandemic and data indicates many systems have not yet recovered. Passenger rail kilometers traveled in the EU fell from 414 billion in 2019 to 224 billion in 2020 and recovered only slightly to 261 billion in 2021, a drop of more than a third between 2019 and 2021.⁶

Use of tram and light rail systems globally followed a similar pattern, falling from around 14.8 billion trips in 2019 to around 9 billion in 2020 then remaining below 10 billion in 2021.⁷ Journeys on Transport for London's bus, Underground, tram and rail services were around 10 percent lower in the second quarter of 2023 than the same period in 2019.⁸

¹ 'Global EV Data Explorer', International Energy Agency. <https://www.iea.org/data-and-statistics/data-tools/global-ev-data-explorer>

² 'Executive summary', Global EV Outlook 2023, International Energy Agency. <https://www.iea.org/reports/global-ev-outlook-2023/executive-summary>

³ 'Charging ahead: addressing the EV cost hurdle', KPMG International, August 2023. <https://assets.kpmg.com/content/dam/kpmg/xx/pdf/2023/07/charging-ahead-addressing-the-ev-cost-hurdle.pdf>

⁴ See Sweden profile.

⁵ 'Minerals used in electric cars compared to conventional cars', International Energy Agency, 5 May 2021. <https://www.iea.org/data-and-statistics/charts/minerals-used-in-electric-cars-compared-to-conventional-cars>

⁶ 'Railway passenger transport statistics - quarterly and annual data', Eurostat, November 2022. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Railway_passenger_transport_statistics_-_quarterly_and_annual_data

⁷ 'The global tram and light rail landscape 2019-21', UITP (International Association of Public Transport), May 2023. https://cms.uitp.org/wp/wp-content/uploads/2023/06/Statistics_Brief_-_LTR-update.pdf

⁸ Comparison of data for 12 weeks from 1 April for 2019 and 2023 (reporting periods 1-3) for all transport types, 'Public transport journeys by type of transport', Transport for London, 24 June 2023. <https://data.london.gov.uk/dataset/public-transport-journeys-type-transport>



Aviation

As a sector, aviation has long timelines. For example, given a successful focus on safety, the sector is cautious on changing regulations and processes, while aircraft built now are still likely to be in service in the 2040s. “2050 as the net zero target is pretty much tomorrow for this sector,” says Christopher Brown, Partner, Aviation Strategy, KPMG in Ireland.

Airlines are mostly reliant on manufacturers, air traffic control and fuel producers in reducing their emissions. However, there are some options they can take. The biggest ‘quick win’ is to reduce the formation of condensation trails or contrails, which research suggests may contribute to comparable amounts of atmospheric warming as the carbon dioxide from fuel.¹ UAE airline Etihad is introducing technology that advises pilots on route and altitude changes that avoid conditions where contrails are more likely to form.²

Manufacturers are developing electric-powered aircraft but the weight of batteries means these are likely to serve only on short flights for the foreseeable future. Aviation’s plans to reach net zero by 2050, adopted by the International Civil Aviation Organization (ICAO) in October 2022, rest primarily on adopting sustainable aviation fuel (SAF). The organization says SAF will contribute 65 percent of decarbonization by 2050 with new technologies including hydrogen and electric engines, offsets and carbon capture making up most of the rest.³ However, this is likely to be challenging for a number of reasons, and an analysis of the energy sector’s ramp up of planned SAF production suggests this target is already at risk.

SAF, which is compatible with existing aircraft engines and airport infrastructure, is made either from biofuels or synthetic e-fuels, chemical clones of kerosene produced with low carbon



Manufacturers are developing electric-powered aircraft but the weight of batteries means these are likely to serve only on short flights for the foreseeable future. Aviation’s plans to reach net zero by 2050, adopted by the International Civil Aviation Organization (ICAO) in October 2022, rest primarily on adopting sustainable aviation fuel (SAF). ”



electricity. E-fuels look easier to produce on a large scale, as unlike biofuels they are not constrained by cropland and organic waste availability, although they would require significant amounts of low carbon electricity that most grids do not have to spare at present.⁴

SAF is typically several times as expensive as the kerosene currently used by aircraft, meaning a total switch would significantly add to ticket prices. Recent market research for KPMG has found that customers, while not prioritizing a flight’s



carbon environmental footprint in their purchase decisions, will tolerate increases in fares if these are a fair reflection of the extra cost of SAF.⁵

Moving entirely to SAFs looks technically feasible but apart from the cost, doing so by 2050 would require huge increases in production: “It looks like a task that would be exceptionally difficult to deliver on,” says Malcolm Ramsay, Global Head of Aviation, KPMG in Singapore. He adds that governments could support this by providing incentives for fuel producers to allocate capital to SAF production.

¹ ‘Contraails: How tweaking flight plans can help the climate’, BBC News, 22 October 2021. <https://www.bbc.com/news/business-58769351>

² ‘Etihad Airways and SATAVIA collaborate to implement contrail prevention for the first time on an Atlantic crossing’, Etihad Aviation Group, 10 November 2022. <https://www.etihadaviationgroup.com/en-ae/newsroom/etihad-airways-and-satavia-collaborate-to-implement-contrail-prevention-for-the-first-time-on-an-atlantic-crossing>

³ ‘Developing sustainable aviation fuel (SAF)’, International Civil Aviation Organization. <https://www.iata.org/en/programs/environment/sustainable-aviation-fuels/>

⁴ ‘Sustainable aviation fuel’, KPMG in Ireland, November 2022. <https://kpmg.com/ie/en/home/insights/2022/11/sustainable-aviation-fuel.html>

⁵ ‘Who pays for aviation’s decarbonization?’, KPMG in Ireland, August 2023. <https://kpmg.com/ie/en/home/insights/2023/08/aviation-2030-series-who-pays-for-aviations-decarbonization-fs-aviation.html>

Logistics

The movement of goods may be less visible than moving people but it has nearly as great an impact on climate change. In 2018 road freight vehicles emitted 2.4GtCO₂ globally compared with passenger road vehicles that produced 3.6GtCO₂ according to the International Energy Agency. The organization expected that annual road freight emissions would decline by just 0.1GtCO₂ by 2030, compared with 0.5GtCO₂ less from passenger road vehicles as the latter shift to electricity.¹ The weight of batteries and longer average journey distances make trucks harder to electrify than cars although some vehicle makers have developed electric models.²

Logistics is a low-margin sector where decisions are usually based on price, making it difficult for operators to invest in decarbonization unless governments require this. Some such legislation is coming in Europe, requiring companies to collect and publish data on their emissions under the Corporate Sustainability Reporting Directive that came into force in January, as well as a proposed directive on corporate sustainability due diligence. The latter would initially oblige companies turning over more than 300 million euros (EUR) (US\$318 million) to ensure their business models and

strategies are compatible with the Paris Agreement on climate change and would be phased in over three years.³ International logistics providers need to comply with EU directives to operate within Europe while other jurisdictions including the US are introducing their own standards for corporate reporting.⁴

Collecting emissions data will not be easy for many logistics providers given high levels of subcontracting in what is a highly fragmented industry. Dr Steffen Wagner, Global Head, Transport & Leisure, KPMG International, says that accurate information can help companies to reduce their emissions and costs, such as by making use of empty trucks. Around one-fifth of the EU’s road freight kilometers in 2020 were used by empty vehicles with further unused capacity in partially empty ones.⁵ “If trucking companies collaborate, they can better use their existing resources and reduce the carbon footprint of individual goods,” says Wagner, adding that there is a trend towards using online platforms to match companies that have spare capacity with those requiring it. Logistics providers can also cut emissions by installing rooftop solar panels on warehouses and using electrically powered robots within them, as well as making greater use of road-to-rail facilities that transfer freight to railways for parts of journeys.

¹ ‘Transport sector CO₂ emissions by mode in the Sustainable Development Scenario, 2000-2030’, International Energy Agency, updated 27 May 2019. <https://www.iea.org/data-and-statistics/charts/transport-sector-co2-emissions-by-mode-in-the-sustainable-development-scenario-2000-2030>

² See Sweden profile.

³ ‘The EU’s Corporate Sustainability Due Diligence Directive’, February 2023, KPMG International. <https://kpmg.com/xx/en/home/insights/2023/02/the-eu-corporate-sustainability-due-diligence-directive.html>

⁴ See section on climate and sustainability reporting.

⁵ ‘A fifth of road freight kilometres by empty vehicles’, Eurostat, 10 December 2021. <https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20211210-1>



Shipping

Like aviation shipping is a sector that changes slowly, partly due to difficulties regulating an inherently international business and partly as vessels remain in service for several decades. There are regulatory changes taking place, including the EU phasing in the use of its emissions trading system in maritime transport between 2024 and 2027 for all large ships that use the bloc's ports regardless of flag of registration. This will likely require vessel operators to buy EU ETS allowances covering all of the greenhouse gas emissions generated while in EU ports and on voyages between them, as well as half of the emissions from journeys that either start or end in the EU.¹

Monique Giese, Global Head of Shipping, KPMG International, says that while EU ETS offers a regional solution, the International Maritime Organization (IMO) is likely to hold the key to a global one. The IMO 2020 rule to cut coastal air pollution from sulfur in fuel oil could provide a model for reducing the sector's greenhouse gas emissions. It was introduced through an amendment to the International Convention for the Prevention of Pollution from Ships and has led to vessels adopting very low sulfur fuels or installing exhaust gas cleaning systems.²

A July meeting of the IMO's member states in London adopted a net zero strategy that includes development of a pricing mechanism for maritime emissions over the next few years.³ Giese adds that the IMO 2020 sulfur rule shows a challenge to this in that countries may introduce different levels of penalties, with Singapore threatening two-year prison sentences and fines of up to 10,000 Singapore dollars (SGD) (US\$7,340) for using non-compliant fuel while other countries have much smaller fines.⁴

Batteries can power vessels for short journeys making them suitable for some ferries, but long-distance shipping will require low carbon fuels. The world's largest international shipping companies, known as liners, are making different choices over which fuels to introduce. Denmark-based Maersk has ordered 19 vessels that run on green methanol.⁵ Swiss-headquartered MSC already uses biofuels as part of blended fuels and is interested in developing use of hydrogen.⁶ In February 2023 Germany-based Hapag-Lloyd announced it will work with UK-headquartered energy group Shell on developing use of biomethane and liquified e-methane.⁷ Countries in Asia are ahead of the rest of the world in building infrastructure to supply ships with liquid natural gas (LNG), a lower emission fossil fuel.

Giese says that liners are choosing different types of low carbon fuel as supplies of each are constrained, but this fragmentation could make it difficult for energy companies to supply all of them at large scales. "It is getting better, but there is still a disconnect between energy companies and the liners," she says, adding that many in the shipping industry would welcome further regulation in this area.

It will take several decades for shipping to move to low carbon fuels as vessels are typically in service for 20 to 30 years and often cannot be refitted to use alternative fuels. Increasing efficiency through better collaboration and greater transparency offers quicker benefits. These were the aims of TradeLens, a digital platform designed to support data sharing between organizations involved in supply chains, but in November 2022 its founders Maersk and US-headquartered technology provider IBM announced its closure.⁸ Giese says TradeLens suffered from a lack of trust between organizations and regulatory concerns over sharing data. "But the idea was brilliant and I would guess that we will see something similar in the near future," she says.

¹ 'Reducing emissions from the shipping sector', European Commission. https://climate.ec.europa.eu/eu-action/transport/reducing-emissions-shipping-sector_en

² 'IMO 2020 — cutting sulphur oxide emissions', International Maritime Organization. <https://www.imo.org/en/MediaCentre/HotTopics/Pages/Sulphur-2020.aspx>

³ 'International Maritime Organization (IMO) adopts revised strategy to reduce greenhouse gas emissions from international shipping', International Maritime Organization, 7 July 2023. <https://www.imo.org/en/MediaCentre/PressBriefings/pages/Revised-GHG-reduction-strategy-for-global-shipping-adopted-.aspx>

⁴ 'In Singapore, high-sulfur fuel could lead to prison', Maritime Executive, 3 April 2019. <https://www.maritime-executive.com/article/in-singapore-high-sulfur-fuel-could-lead-to-prison>

⁵ See Denmark profile.

⁶ Bud Darr, 'Roadmap to a zero-carbon future', MSC, 2 March 2021. <https://www.msc.com/en/newsroom/stories/roadmap-to-a-zero-carbon-future>

⁷ 'Shell and Hapag-Lloyd collaborate on marine fuel decarbonisation and sign multi-year LNG supply agreement', Hapag-Lloyd, 27 February 2023. <https://www.hapag-lloyd.com/en/company/press/releases/2023/02/shell-and-hapag-lloyd-collaborate-on-marine-fuel-decarbonisation.html>

⁸ Jacob Gronholt-Pedersen, 'Maersk, IBM discontinue shipping blockchain platform', Reuters, 29 November 2022. <https://www.reuters.com/technology/maersk-ibm-discontinue-shipping-blockchain-platform-2022-11-29/>



Industry

Industrial manufacturing

Industry is historically a major producer of greenhouse gas emissions, meaning that industrial decarbonization is a lever that can make a significant impact in efforts to reach net zero. Over the last decade however, industrial manufacturing through new innovations in the field of energy-saving technologies and accelerated shift of manufacturing equipment's powering from fossil fuels to electricity has decisively repositioned itself as being an essential part of the solution to reach the world's ambitious net zero targets.

Steel produced through the blast furnace process releases CO₂ through the melting of coke and iron ore at high temperatures. It is being radically transformed through the development of so-called 'green steel' where carbon is replaced by hydrogen that if produced with low carbon energy can turn iron ore into manufactured steel with far fewer emissions. The challenge being addressed by steel industry leaders as well as low carbon energy providers is to scale up such technologies required to lead to commercially viable steel production. Currently the cost disadvantage still requires massive subsidies that require public-private sector initiatives.

Another option is to replace existing blast furnaces with electric arc furnaces (EAF), a broadly adopted technology that increases circularity by relying on scrap steel as its main input. As an example, supported by the French government, ArcelorMittal is investing EUR1.7 billion (US\$1.81 billion) building EAFs at Fos-sur-Mer near Marseille and Dunkirk, as well as a hydrogen-powered unit in Dunkirk. The company says this transformation will cut emissions by 7.8MtCO₂ a year, a tenth of the total from French manufacturing industry.¹ German steelmaker Salzgitter is working to power its blast furnaces with green hydrogen produced from renewable energy, which it says could cut 95 percent of the 8MtCO₂ annual emissions from its steelworks at a capital cost of EUR2 billion equally shared between by the company and public funding from Germany's federal government and the state of Lower Saxony.²

Stéphane Souchet, Global Head of Industrial Manufacturing, KPMG International, says what has become increasingly clear since COVID-19 and inflation exacerbated by the war in Ukraine is that government policy interventions to accelerate energy transition are in full swing in most major economies. Governments are now demonstrating a willingness to invest in industrial decarbonization at levels not seen before.

"While there is no silver bullet for achieving net zero in industrial manufacturing, a comprehensive technology portfolio is beginning to take shape. While the cost to achieve this goal adds up to a substantial portion of global GDP, the cost of inaction would far surpass it, given the increasingly tangible and visible impacts of climate change," he says.

"Policies such as Europe's Green Deal and Net Zero Industry Act and the US Inflation Reduction Act are showing paths forward but ultimate success will require unwavering collaboration between government, private business and industry players," Souchet adds.

¹ 'ArcelorMittal accelerates its decarbonisation with a €1.7 billion investment programme in France, supported by the French Government', ArcelorMittal, 4 February 2022. <https://corporate.arcelormittal.com/media/press-releases/arcelormittal-accelerates-its-decarbonisation-with-a-1-7-billion-investment-programme-in-france-supported-by-the-french-government>

² 'SALCOS', Salzgitter AG. <https://salcos.salzgitter-ag.com/en/index.html>



Buildings

Home heating

In many countries, heating is the residential sector's main energy requirement, with nearly four-fifths of EU household energy used to heat space and water. Sources of home energy and subsequent emissions vary greatly from country to country. Norwegian homes get three-quarters of their energy from low carbon electricity with almost all the rest coming from renewables and biofuels. Denmark and Sweden get about a third of their domestic energy from derived heat systems such as district heating, with most of the rest from electricity, renewables and biofuels. Natural gas provides 53 percent of the energy used by homes in Italy and 43 percent in Germany, while 42 percent of Irish home energy comes from oil and petroleum products.¹ Countries with dispersed populations and colder climates such as Canada, as well as rural areas in many countries, may find it difficult to move away from oil and natural gas for domestic heating unless these can be replaced with similarly energy-dense and transportable fuels.²

Decarbonizing residential heating that relies on fossil fuels will usually require significant work to be carried out in individual homes, causing political problems over both disruption and

who pays for this. It is possible to convert newer natural gas boilers to use green hydrogen produced with renewable electricity, but doing so would involve big increases in hydrogen fuel production. Governments including Germany and the UK, which also relies heavily on natural gas for domestic heating, have proposed electrical heat pumps as the best option to replace gas boilers. Few British homeowners have yet installed a heat pump with only a fraction of the costs met by government subsidies and many properties being unsuitable.³ In Germany, public opposition to recent plans to ban the installation of new gas-fired boilers from 2024 forced the government to allow exemptions for boilers that could be converted to hydrogen.⁴

Building efficiency

Regardless of source, many buildings make poor use of heat energy due to low levels of insulation or old designs. This is a particular problem for national net zero targets of or around 2050 as buildings tend to last for decades and constructing new ones is itself a carbon-intensive process, making renovation of existing buildings a strong option. In 2021, the European Commission said that 75 percent of buildings in the EU are not energy efficient but that 85 to 95 percent of those in use now will still be standing in 2050. Its directive on

building energy performance is set to require owners of the least efficient buildings to carry out improvements over the next few years as well as insisting that new buildings must have zero emissions by 2030.⁵ South Korea already requires new buildings to include renewable generation and will require operators of existing public sector buildings to add this from 2025.⁶

Ownership of buildings is often split between a relatively small number of institutional owners that are more likely to have resources and expertise to decarbonize properties, as well as increasing requirements to report on net zero targets, and a much larger group of private owners. The latter are more likely to find it harder to pay for and manage improvements and they can be more resistant to change, given their number and resultingly louder collective voice. Switzerland, which has passed a climate law requiring that emissions from buildings fall by 82 percent on 1990 levels by 2040, has seen some institutions selling inefficient buildings to private investors.⁷

Decarbonizing cities

More than half of the world's population lives in urban areas and this is likely to rise to two-thirds by 2050. Cities are densely populated centers of government and business, making them good locations for innovative work in this area. There are specific reasons for focusing on cities, with renewable energy-based systems such as district heating working better in dense urban areas and large buildings possessing economies of scale for retrofitting new glazing, heating and cooling systems, energy management technology and on-site renewable production. In November 2022 KPMG launched the Net Zero Urban Program⁸ that aims to help raise capital and apply digital technologies to prototype projects that can support urban decarbonization.⁹

¹ 'Energy consumption in households', Eurostat, June 2023. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Energy_consumption_in_households#Energy_consumption_in_households_by_type_of_end-use

² See Canada profile.

³ See UK profile.

⁴ See Germany profile.

⁵ 'Making our homes and buildings fit for a greener future', European Commission, 15 December 2021. https://ec.europa.eu/commission/presscorner/detail/en/fs_21_6691

⁶ See South Korea profile.

⁷ See Switzerland profile.

⁸ 'Net Zero Urban Program', KPMG International. <https://kpmg.com/xx/en/home/insights/2022/10/net-zero-urban-program.html>

⁹ 'The role of energy and utilities in achieving net zero cities', Plugged In magazine, KPMG International, March 2023. <https://kpmg.com/xx/en/home/industries/energy/power-utilities/plugged-in-magazine-2/the-role-of-energy-and-utilities-in-achieving-net-zero-cities.html>



Infrastructure

Infrastructure tends to get much less attention than the products and services directly purchased by individuals and organizations. However, based on a broad definition infrastructure is responsible for 79 percent of all emissions and will take up 88 percent of the costs of adapting to climate change, according a 2021 report produced by the UN Office for Project Services, UN Environment Programme and the University of Oxford. The water sector alone will require 54 percent of all adaptation spending to reduce risks from flooding, sea level rises, storm surges and other impacts.¹

A lot of infrastructure requires the use of concrete, with its key ingredient cement accounting for around 7 percent of global emissions, twice as much as aviation's total contribution.² This is due to the current need for fossil fuels to generate the very high temperatures required in its production. While there are options to reduce emissions from concrete a little by changing some materials, 'mineralizing' or capturing carbon dioxide generated within finished concrete could turn it into a material that removes greenhouse gases from the atmosphere rather than adds to them.³ However, this is at an early stage of development with a US startup mineralizing just 30 kilograms of carbon dioxide in concrete in a test announced in February this year.⁴

Just as in nature, evolution will take multiple paths as humanity moves towards net zero, with some that will work and some that will be dead ends, so it would be foolhardy to stand idle until the perfect solution is found. It makes sense to adopt already-proven techniques such as modern methods of construction, which transfer some smaller-scale work to factories that provide units for on-site assembly. This makes construction more efficient, reducing total carbon output through the use of fewer resources as opposed to new materials.

Infrastructure is more likely to make progress towards net zero by taking many small steps rather than a few big ones. Governments can play a role now by supporting pathfinder and demonstration projects and by instructing regulators to take a pragmatic approach, such as considering the damage from global climate change a project could help tackle along with the impacts it would have on the local environment.

Infrastructure projects typically take years or decades to get from inception through planning, approval and construction to completion and delays have always been common. The resulting assets are often used for decades or even centuries, meaning that for example roads change slowly compared with the increasingly electrically powered vehicles that use them.

However, there are trends that look likely to reshape infrastructure in ways that may support decarbonization, although these will vary significantly by country and region. What these changes look like in specific regions and jurisdictions will result from their unique conditions and the ways their societies respond to the need for change. For example, millions of people were forced to work from home during the COVID-19 pandemic and some realized they preferred to do so at least some of the time, with the period also highlighting the potential for remote meetings and collaboration. Increased home working and remote collaboration is likely to change demand for both commuter and business transport and the infrastructure required to support it.⁵ Some new infrastructure may be needed to support homeworkers who spend more or most of their time in the same town or suburb rather than traveling regularly to a city center. Similarly, moves to shorten supply chains to manufacture goods closer to customers could require changes to the scale and shape of infrastructure at and near ports.

¹ 'Infrastructure for climate action', UN Office for Project Services, UN Environment Programme and University of Oxford, October 2021. https://content.unops.org/publications/Infrastructure-for-climate-action_EN.pdf

² 'Aviation contributes 3.5% to the drivers of climate change that stem from humans', Manchester Metropolitan University (UK), 3 September 2020. <https://www.mmu.ac.uk/news-and-events/news/story/12787/>

³ 'Concrete', MIT Climate Portal. <https://climate.mit.edu/explainers/concrete>

⁴ Peter Henderson, 'Concrete traps CO2 soaked from air in climate-friendly test', Reuters, 4 February 2023. <https://www.reuters.com/business/sustainable-business/concrete-traps-co2-soaked-air-climate-friendly-test-2023-02-03/>

⁵ 'Insights on current trends in remote working', KPMG International, March 2022. <https://kpmg.com/xx/en/home/insights/2022/03/insights-on-current-trends-in-remote-working.html>



Oil and gas

The last two years have seen sharp fluctuations in the cost of oil and natural gas, primarily because of Russia's invasion of Ukraine in February 2022 and the resulting removal of Russian natural gas from energy markets, along with economic recovery from the COVID-19 pandemic. The months following the invasion saw the highest average crude oil prices since 2013 and the cost of natural gas in Europe tripling to set new records, although these prices have since returned to levels near their long-term averages due to factors including China's slow economic recovery.

While non-hydroelectric renewable generation increased by nearly a percentage point to 7.5 percent in 2022, the world continued to depend on fossil fuels for 82 percent of its primary energy.¹ Given overall global demands for energy are widely expected to increase over the next decade, oil and gas production looks likely to play a significant role for some years to come, even as low carbon sources increase.

In addition, an era of volatile and complex geopolitical relationships has caused many countries to look for ways to reduce their dependence on potentially hostile nations. This includes investing in their own energy sectors as a way of increasing their 'energy sovereignty' so they are less likely to find themselves in the position of European countries that urgently sought new supplies following the removal of Russian gas. Such investments include securing oil and gas supplies

on the grounds of self-reliance and economic development, including some countries with relatively strong records on decarbonization. For example, in July 2023 the UK said it will issue hundreds of new oil and gas licenses for its North Sea waters, arguing that the country will still obtain a quarter of its energy from these sources in 2050 when it reaches net zero and should therefore reduce its reliance on hostile states.²

Higher prices have led to higher income for governments from taxes and royalties and some are investing this in decarbonization. The Australian state of Queensland is using revenues from natural gas and mining to support renewable projects through loans and grants, with a target to increase renewable production by eight times between 2022 and 2035 through new solar, wind, pumped hydro storage and grid upgrades.³ Some countries have introduced significant financial incentives for such work including the Inflation Reduction Act in the US or the EU's Green Deal while others including Japan and South Korea are strongly encouraging their companies to undertake it.

An evolving license for companies

Increased prices have also provided oil and gas companies with much more capital. Several, particularly those headquartered in Europe, are investing some of this in developing ways to decarbonize customer use of their fuels through technologies such as green hydrogen production, carbon capture, utilization and storage, biomass and biogas. Some are also investing in





renewable generation. Jonathon Peacock, Global Oil & Gas Leader, KPMG in Australia, says this shows an evolution in how societies treat these companies: “You can continue to produce hydrocarbons provided you can demonstrate a positive intent on how you plan to or are reducing emissions,” he says, partly driven by carbon pricing in some countries as well as pressure from stakeholders including employees, communities and activist shareholders.

But these technologies are at early stages of development and represent relatively risky investments, which may or may not offer strong returns. “Companies are still trying to work out what the most economically viable means of emissions reduction looks like,” says Peacock. “It varies by geography, geology and government policy.” He adds that US-based oil and gas companies generally focus on minimizing scope 1 and scope 2 emissions from production and the composition

of products rather than those generated by customer use, known as scope 3 emissions, and generally have higher market valuations than those with a stronger focus on customer decarbonization. Those oil and gas companies trying to move to new types of energy production are being affected by a polarization in investor views between those who want the sector to deliver reliable returns from fossil fuels, increasingly from projects with relatively short timeframes, and those who avoid the sector completely because they do not think its transition plans are strong enough.

Peacock adds that there are broader reasons for rich countries and companies to work on decarbonization technologies, as these could help provide poorer countries with green, safe and reliable sources of power, including the 2.4 billion people who lack access to cleanly-fueled cooking facilities.⁴

The use of oil in producing plastics and gas in ammonia-based fertilizers as well as their current dominance of energy means both fuels will continue to be needed until societies decide to stop using derived products or researchers find adequate substitutes, something which will take time. Peacock says that oil and gas companies are well-placed to work on decarbonizing their products as they have the capital to invest in research and development, are used to working across borders and have an engineering-led approach to delivering results. “It’s not oil and gas or renewables,” he says. “They have got to work together.”

¹ ‘2022 key highlights’, Statistical Review of World Energy 2023, Energy Institute. <https://www.energyinst.org/statistical-review>

² ‘Hundreds of new North Sea oil and gas licences to boost British energy independence and grow the economy’, UK Prime Minister’s Office and Department for Energy Security and Net Zero, 31 July 2023. <https://www.gov.uk/government/news/hundreds-of-new-north-sea-oil-and-gas-licences-to-boost-british-energy-independence-and-grow-the-economy-31-july-2023>

³ ‘Queensland energy and jobs plan overview’, Queensland Government, September 2022. https://www.epw.qld.gov.au/__data/assets/pdf_file/0031/32989/queensland-energy-and-jobs-plan-overview.pdf

⁴ ‘WHO publishes new global data on the use of clean and polluting fuels for cooking by fuel type’, World Health Organization, 20 January 2022. <https://www.who.int/news/item/20-01-2022-who-publishes-new-global-data-on-the-use-of-clean-and-polluting-fuels-for-cooking-by-fuel-type>



Agriculture

As with other sectors, the Russian government's February 2022 invasion of Ukraine put global agriculture under stress. Ukraine is a major producer of grain and oilseed as well as the world's largest source of sunflower oil and the second largest supplier to the UN World Food Programme, while Russia has been a big producer of wheat, seed oil and fertilizer ingredients. Disruption in Ukraine, sanctions on Russia and sharply increasing energy prices caused by the conflict looked likely to accelerate a shift by farmers worldwide towards regenerative agriculture that uses less energy and inputs such as fertilizer.¹ Instead, it has encouraged farmers to improve efficiency by focusing on how to produce more with similar or lower levels of inputs. This reduces emissions intensities — levels of greenhouse gases generated for each unit of output — but has not made a significant difference to overall volumes.

However, emissions from agriculture have taken an increasingly high profile as other sectors make big changes to address climate change. Ian Proudfoot, Global Head of Agribusiness, KPMG International, says that at present the sector is unable to make the obvious changes equivalent to a bus company replacing diesel vehicles with electric ones. "You can't swap one cow for a lower-emissions cow at the current time," he says. "Agriculture has been found wanting on not necessarily having the answers as to how to start its journey to a lower-emissions future." While some advocate replacing the output of dairy and livestock farming with plant-based alternatives, doing so can deprive people of products that they enjoy and that contribute to a nutritionally balanced diet.

New processes, new relationships

The current lack of options may change given promising developments on reducing emissions from agriculture, many of which come from methane and nitrous oxide as well as carbon dioxide. Researchers are working on ways



However, emissions from agriculture have taken an increasingly high profile as other sectors make big changes to address climate change. Ian Proudfoot, Global Head of Agribusiness, KPMG International, says that at present the sector is unable to make the obvious changes equivalent to a bus company replacing diesel vehicles with electric ones.





to treat dairy farming effluent that can prevent nearly all methane emissions.² This effluent could also be used to produce biofuels through anaerobic digestion and farming co-operatives in Europe and the United States are looking at how they could help their members take advantage of this.³ Emissions from cattle can also be reduced by adding seaweed to their food, with research on this taking place in countries including Australia, Ireland, the US and the UK.⁴ This is one of a range of 'blue economy' opportunities that involve using oceans to reduce or sequester greenhouse gases.⁵ More broadly farmers will increasingly be able to provide ecosystem services from the carbon they are able to sequester within their farming systems, creating a new revenue stream by selling verifiable carbon credits to offset emissions from sectors that will never be able to become climate positive in the way that biologically based sectors can aspire to be.

Some retailers and food processors are changing the way they work with farmers, moving from short-term contracts based primarily on price to longer-term partnerships. These can give buyers more security over supplies as well as providing financial stability for farmers to invest in reducing the climate impact of their operations. In some cases, such companies are supporting their farmers financially to lower their emissions by adopting new equipment or processes, helping to reduce their scope 3 supplier emissions. However, many food retailers have a strong focus on prices and are currently under pressure to prioritize low prices by politicians concerned about the cost of living.

Farm-level answers

New Zealand's government has worked with organizations representing farmers and growers to develop a plan for emissions pricing at the level of individual farms, although this is still under negotiation.⁶ Regardless of the outcome in New Zealand, Proudfoot says that rewarding individual farmers looks like the best way to reduce emissions in the sector, given they have led agricultural innovation for thousands of years and have strong incentives to protect their lands, often their main asset. Governments should encourage farmers to collaborate internationally and with partners including food processors to find new ways cut their own emissions and sequester them for others: "We have got to unleash farmers to be a huge part of the solution, rather than expecting them to adopt whatever gets given to them," he says.

¹ Ian Proudfoot, 'Ukraine-Russia sector considerations: Agriculture', KPMG International, May 2022. <https://kpmg.com/xx/en/home/insights/2022/05/ukraine-russia-sector-considerations-agriculture.html>

² 'Lincoln University scientists develop game changing greenhouse gas emission reduction technology', Lincoln University (New Zealand), 11 November 2021. <https://www.lincoln.ac.nz/news-and-events/lincoln-university-scientists-develop-game-changing-greenhouse-gas-emission-reduction-technology/>

³ Natalie Long, 'Rethinking methane: Dairy farmers capture an opportunity for leadership', Land O'Lakes, 25 August 2022. <https://www.landolakesinc.com/Blog/August-2022/reducing-methane-emissions-in-agriculture>

⁴ 'Seaweed used to feed cattle in trial aimed at cutting methane emissions', RTE, 10 November 2021. <https://www.rte.ie/news/regional/2021/11/10/1259109-seaweed-cattle-feed/>

⁵ 'See Blue economy section', KPMG International, June 2023. <https://kpmg.com/xx/en/home/insights/2021/05/you-cant-go-green-without-blue.html>

⁶ See New Zealand profile.



Blue economy

Governments are increasingly looking to the world's oceans and coasts to support their moves towards net zero. Oceans already provide the planet's largest 'carbon sink' by absorbing 25 percent of all carbon dioxide emissions and 90 percent of the excess heat they generate, with mangrove forests on tropical and subtropical coasts being some of the most efficient ecosystems for storing carbon.¹ By increasing areas covered by mangroves and other natural carbon sinks, countries with suitable coastlines could benefit financially by helping to meet rapidly growing demand for carbon assets while enjoying nature-related benefits including better flood protection and an improved marine environment.²

Alternatives include protecting and encouraging the spread of underwater seaweed forests, which Canadian charity Ocean Wise says can sequester carbon more effectively than planting trees.³ There is also potential to enhance the open ocean's natural carbon sink function through methods including enhancing alkalinity, encouraging fertilization and injecting carbon dioxide, although these are yet to be fully tested.⁴

A new UN Biodiversity Beyond National Jurisdiction (BBNJ) agreement agreed in March 2023 will establish an international legal framework to protect the environment of more than the two-thirds of the oceans that are outside national management.⁵

Josh Hasdell, Head of Global Blue Economy Services, KPMG in Canada, says the agreement is indicative of a shift away from seeing oceans and coasts as places for conservation. "It's moved on from 'let's protect our oceans and keep our beaches clean' to seeing oceans as fundamental to our survival and meeting our net zero goals," he says. "We can't go green without blue."⁶ He adds that there are challenges, including reliable verification of carbon sequestered through coastal ecosystems and the oceans and a lack of funding for such projects.

As well as sequestration, oceans increasingly host renewable power generation in the form of offshore wind. There is potential to go much further, including with floating solar farms, technologies that harness tides, waves and currents and the exploitation of differences in ocean temperatures and salt concentrations.⁷ Wild fisheries provide a low carbon source of protein as well as local jobs.⁸ While there is potential to mine minerals from ocean floors, the risk of causing severe environmental damage means that countries should be highly cautious about granting permits until all the ramifications can be fully understood.

For emerging coastal and small island nations, blue economy and blue carbon ecosystems offer a platform for growth that can attract international funding and investment, allowing them to undertake cultivation while achieving just transitions and increasing economic prosperity.



¹ 'The ocean — the world's greatest ally against climate change', United Nations. <https://www.un.org/en/climatechange/science/climate-issues/ocean>

² 'The (blue) wealth of nations', KPMG International, June 2023. <https://assets.kpmg.com/content/dam/kpmg/xx/pdf/2023/06/the-blue-wealth-of-nations-Web.pdf>

³ 'Seaforestation: benefits to the climate, the ecosystems and the people of British Columbia', Ocean Wise, June 2022. <https://ocean.org/app/uploads/2022/07/OceanWise-SeaforestationV1-1.pdf>

⁴ 'Blue ecosystems are our natural allies'. KPMG International, May 2022. <https://kpmg.com/xx/en/home/insights/2022/05/blue-carbon-ecosystems.html>

⁵ Jane Collins, 'The new UN Ocean Agreement on Marine Biological Diversity of Areas Beyond National Jurisdiction', KPMG International, May 2023. <https://kpmg.com/xx/en/home/insights/2023/05/the-blue-economy.html>

⁶ 'You can't go green without blue', KPMG International, June 2023. <https://kpmg.com/xx/en/home/insights/2021/05/you-cant-go-green-without-blue.html>

⁷ Mike Hayes, 'Turning the tide on climate change. Utilizing our oceans for energy and carbon capture', KPMG International, May 2023. <https://kpmg.com/xx/en/home/insights/2023/05/the-blue-economy.html>

⁸ 'Climate change and fishing', Marine Stewardship Council. <https://www.msc.org/what-we-are-doing/oceans-at-risk/climate-change-and-fishing>



Country profiles





Australia

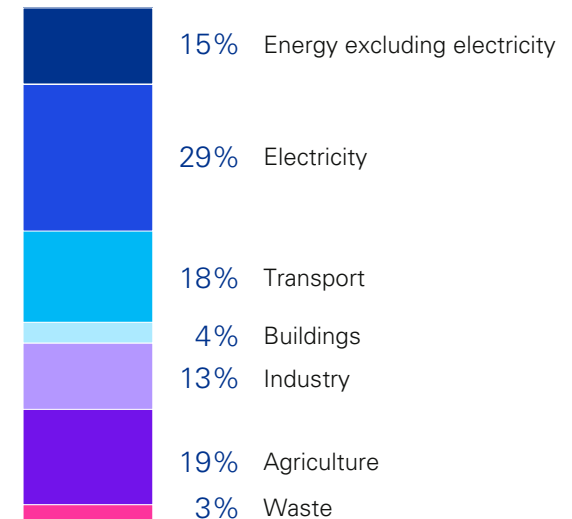
2022’s change of government has led to a legally enshrined net zero target for 2050 and supporting activity, including the expansion of emissions trading in industry and a target to increase renewable electricity’s share from 27 to 82 percent by 2030.

Following a change of government in May 2022’s federal elections, the new Labor party administration has enshrined a net zero target date of 2050 in law.¹ It has also increased the country’s interim emissions reduction target for 2030 from 26-28 percent to 43 percent below 2005 levels² and introduced a range of supporting laws, targets, regulations and initiatives. “It’s a quantum leap in Australia’s legislative architecture,” says Barry Sterland, Partner, Energy Transition Leader, Management Consulting, KPMG Australia. This has involved a rapid acceleration from the country’s previous less mature position, with supply chains and regulators struggling to keep up. “The biggest challenge is the speed of change required. You would not start from here,” he adds.

The new government has built on existing legislation by reforming the so-called Safeguard Mechanism to introduce binding emissions baselines, emissions trading and therefore carbon pricing to all non-electricity facilities that generate more than 100ktCO₂e a year, affecting industry, oil and gas production and mining.³ The strengthened version of the scheme started in July 2023 and aims to gradually reduce emissions baselines in line with the government’s emission reduction targets, in what Sterland says is a clever adaptation of an existing scheme. The government provides less restrictive baselines for trade-exposed heavy manufacturing and funding for industrial decarbonization through its Powering the Regions fund. It is considering a carbon border adjustment mechanism that would provide an alternative means of protecting trade-exposed domestic companies by levying equivalent charges or providing rebates on traded goods.

The government wants renewable electricity production to rise from 27 percent at present to 82 percent in 2030.⁴ It aims to do this in a planned way through underwriting development of transmission and renewable energy zones, which host both grid infrastructure and production including solar, onshore wind and hydroelectric generation as well as battery storage to provide stability. Federal and state

GHG emissions split by sector (2022)*



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023

*EDGAR (Emissions Database for Global Atmospheric Research) Community GHG Database, a collaboration between the European Commission, Joint Research Centre (JRC), the International Energy Agency (IEA), and comprising IEA-EDGAR CO₂, EDGAR CH₄, EDGAR N₂O, EDGAR F-GASES version 8.0, (2023) European Commission, JRC (Datasets). IEA-EDGAR CO₂, a component of the EDGAR (Emissions Database for Global Atmospheric Research) Community GHG database version 8.0 (2023) including or based on data from IEA (2022) Greenhouse Gas Emissions from Energy, <https://www.iea.org/data-and-statistics>, as modified by the Joint Research Centre.



governments are underwriting renewable production and storage, including with contracts for difference which provide a long-term price floor for the electricity produced. Indigenous Aboriginal communities are increasingly involved in renewable energy developments on their lands, such as plans for a 3 billion Australian dollar (AUD) (US\$1.92 billion) solar, hydroelectric and green hydrogen project in the Kimberley region of Western Australia.⁵ Governments are working with indigenous communities to develop a First Nations Clean Energy Strategy.

There is no nuclear electricity generation in Australia at present and this looks unlikely to change. However, roof-mounted solar generation is increasingly common in cities and the country is planning development of offshore wind, although this is unlikely to contribute significantly until the 2030s. The government is also developing a National Energy Performance Strategy on energy efficiency and

electrification.⁶ The state government of Victoria has announced new house developments will be all electric from 2024.

Sector-specific plans

In July, Climate Change and Energy Minister Chris Bowen asked the Climate Change Authority to provide statutory advice on emissions targets for 2035 and six sector-specific plans.⁷ On transport the federal government is working on emissions standards for new road vehicles, provides tax incentives for adopting electric vehicles and along with state governments helps fund charging infrastructure.

Agriculture and land use, Australia's second biggest-emitting sector after electricity, is largely regulated at a state level and in July the federal and state governments announced that they will jointly develop a national strategy.

So far, decarbonization work in agriculture has focused on research including methane emissions from livestock. Some landowners are using reforestation and similar projects to claim carbon credits that they can sell to large emitters or use against their own emissions.

"As well as regulatory developments the Australian government is moving fast to implement mandatory climate reporting on a phased basis for all large organizations," says Adrian King, Partner in Charge, Climate Change & Sustainability Services, KPMG Australia. These new climate reporting rules will be based on the global International Sustainability Standards Board. The Australian Accounting Standards Board is working on standards which KPMG Australia expects to be published in time to meet government requirements for mandatory climate reporting.⁸

¹ 'Australia legislates emissions reduction targets', Prime Minister of Australia, 8 September 2022. <https://www.pm.gov.au/media/australia-legislates-emissions-reduction-targets>

² Tiffanie Turnbull, 'Climate change: Australia signs new carbon emissions target', BBC News, 16 June 2022. <https://www.bbc.com/news/world-australia-61822046>

³ 'Safeguard mechanism', Australian Department of Climate Change, Energy, the Environment and Water. <https://www.dcceew.gov.au/climate-change/emissions-reporting/national-greenhouse-energy-reporting-scheme/safeguard-mechanism>

⁴ 'Australia has raised its climate targets and now needs to accelerate its clean energy transition, says new IEA review', International Energy Agency, 19 April 2023. <https://www.iea.org/news/australia-has-raised-its-climate-targets-and-now-needs-to-accelerate-its-clean-energy-transition-says-new-iea-review>

⁵ Daniel Mercer, 'Traditional owners take majority stake in \$3 billion Western Australian green energy project', ABC News, 17 July 2023. <https://www.abc.net.au/news/2023-07-18/traditional-owners-stake-in-australias-green-energy-transition/102611194>

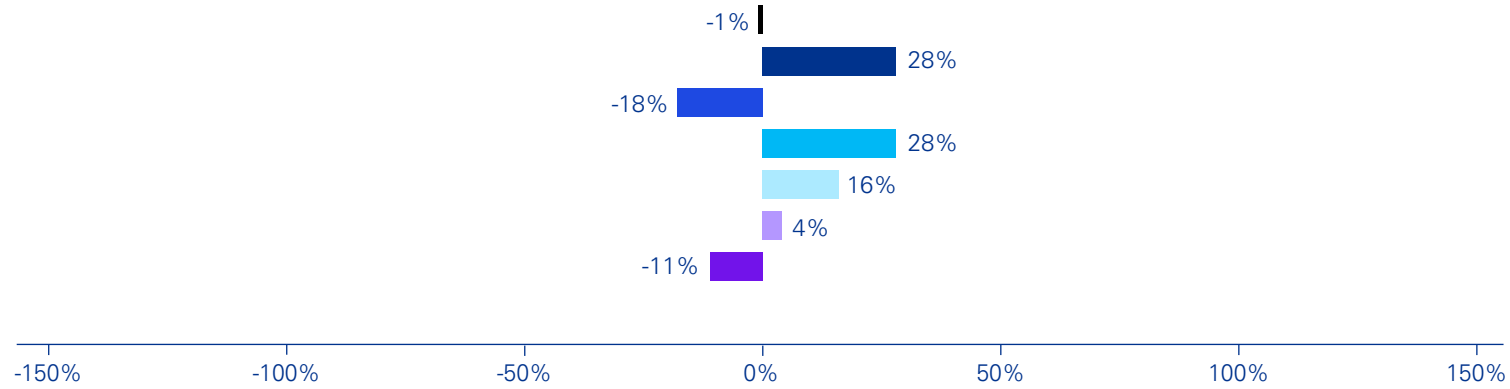
⁶ 'National Energy Performance Strategy', Australian Department of Climate Change, Energy, the Environment and Water. <https://www.energy.gov.au/government-priorities/australias-energy-strategies-and-frameworks/national-energy-performance-strategy>

⁷ Speech by Chris Bowen, Australian Minister for Climate Change and Energy, 18 July 2023. <https://minister.dcceew.gov.au/bowen/speeches/address-clean-energy-council>

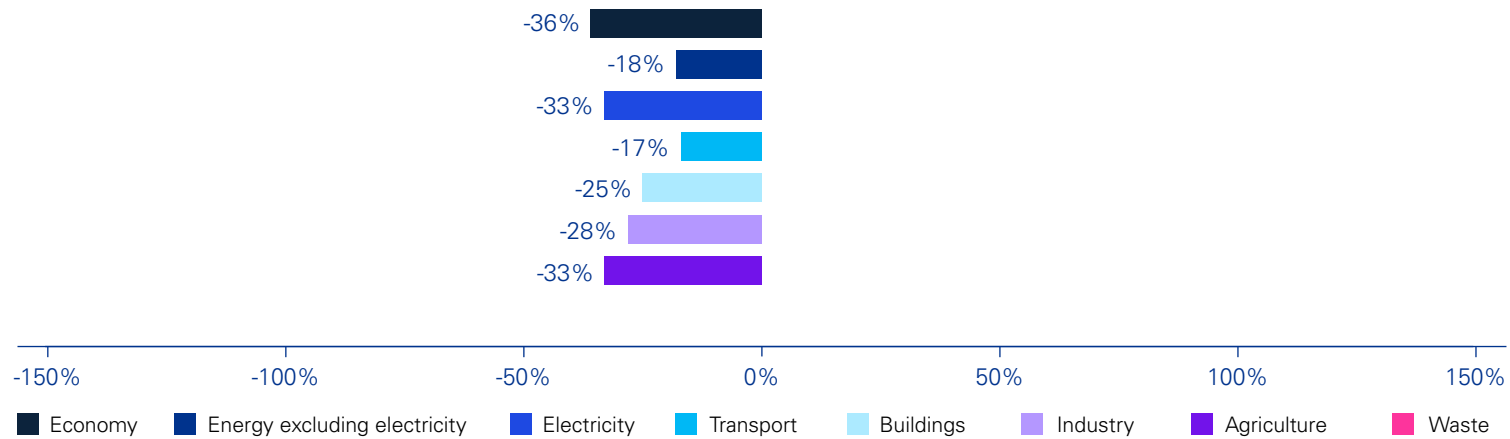
⁸ 'Get ready for global sustainability standards', KPMG in Australia, 25 July 2023. <https://kpmg.com/au/en/home/insights/2022/04/issb-sustainability-reporting-disclosures-guide.html>



Change in absolute emissions (2005–2022)



Change in emissions intensity (2005–2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023; Energy Institute's 2023 Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>; Economist Intelligence Unit (EIU) Viewpoint; The World Bank Open Data





Brazil

Brazil hopes to benefit from high levels of clean energy use when exporting to the EU under the new Carbon Border Adjustment Mechanism. A new freight railroad, a robust agriculture plan and enhanced deforestation monitoring provide further opportunities to decarbonize.

Brazil has gone a long way towards decarbonizing its power production with almost 45 percent of its energy coming from renewable sources. Around four-fifths of electricity comes from hydropower plants and solar generation is growing quickly.¹ Most of the country’s cars are flex-fuel models that can run on ethanol biofuel produced from sugarcane or corn as well as gasoline, something the government sees as a significant point in favor of its automotive industry. Chinese manufacturer Great Wall Motor started local production of hybrid cars in April that run on 100 percent ethanol and electricity.²

Felipe Salgado, ESG Advisory Decarbonization Director for KPMG in Brazil, says the country’s progress on clean energy creates opportunities for its companies. For example, it could mean Brazilian exporters paying less than those in other countries under the EU’s Carbon Border Adjustment Mechanism (CBAM), which started its initial transitional phase on 1 October. CBAM will tax imports to the bloc in line with charges faced by European companies under its Emissions Trading System (ETS), helping countries that use low-carbon energy.³

The Brazilian government is also discussing the introduction of a regulated carbon market aligned to the EU ETS and hopes to unveil plans before November’s COP28 UN climate change conference. “This is a game changer,” says Salgado. “These two drivers, the internal regulated market and CBAM, can push the decarbonization of big companies as they start measuring and implementing carbon reduction initiatives.”

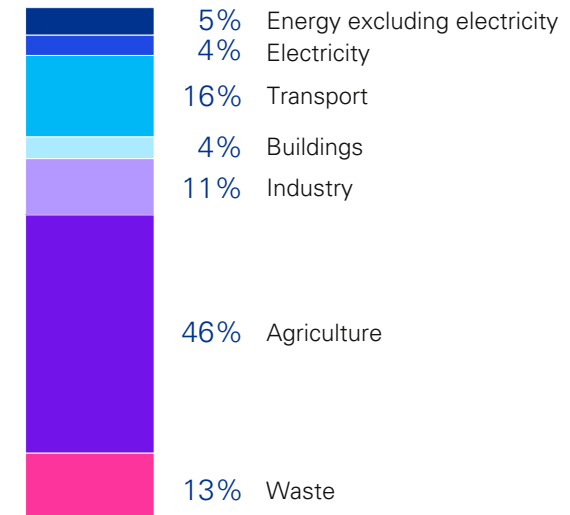
Agricultural plans and new railways

Agriculture is responsible for significant emissions and a new version of Brazil’s ABC plan for decarbonizing the sector, succeeding one which ran from 2010 to 2020, was published by the government in October 2021 for the COP26 conference

in Glasgow.⁴ Plano ABC+ includes the recovery of 15 million hectares of currently degraded pastures, expansion of the use of biological nitrogen fixation to replace nitrogen-based fertilizers and the reforestation of millions of hectares of land. Salgado says that as well as reducing net emissions and improving the country’s environment, reforestation provides commercial opportunities through the potential sale of carbon offsets.

Freight trucks in Brazil tend to use carbon-intensive diesel rather than ethanol biofuel. In June the government completed the 35-year construction of the 2,257 kilometer North-South Railroad

GHG emissions split by sector (2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023



which links areas that produce commodities including soy, corn and cotton to the sea ports of Santos near São Paulo in the southeast of Brazil and Itaqui in Maranhão in the north.⁵ Even before its completion, the railway was transporting around half of the country’s exported agricultural bulk solids. Brazil is also looking at how it can shift some freight from roads to sea transportation.

There are challenges for Brazil’s government to address. Salgado says some existing programs and policies including those on deforestation are undermined by poor inspection and enforcement and conflicts can arise between decarbonization work and social policies. The government does not currently tax ownership of older vehicles, but there are initial discussions on changing this to encourage drivers to switch to newer and typically more fuel-efficient ones. However, Salgado says that this could require financial support to help those with old vehicles to buy newer ones, rather than price them off roads.

¹ ‘Brazil’, International Energy Agency. <https://www.iea.org/countries/brazil>

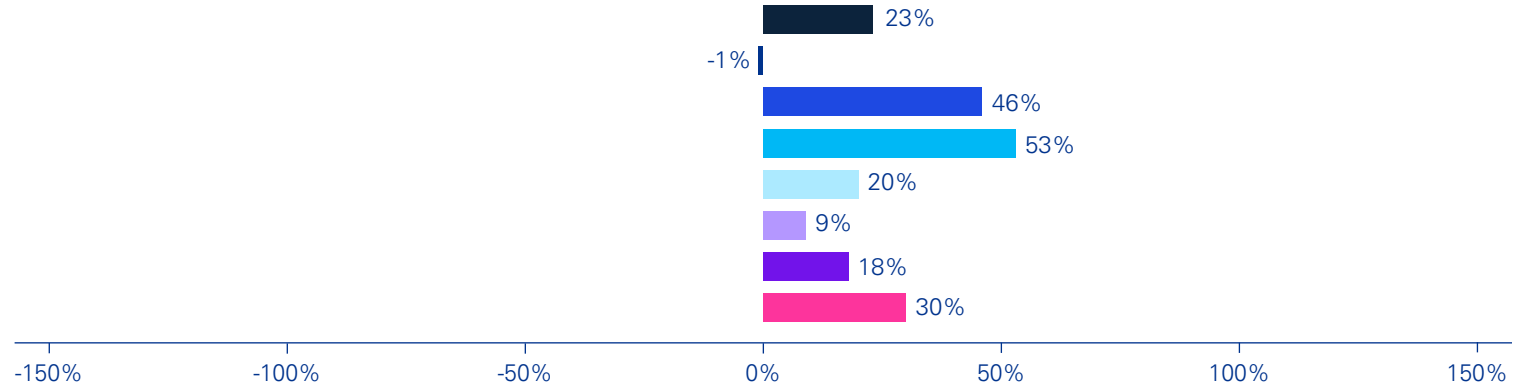
² Gabriel Araujo, ‘Hybrid-flex cars a great asset for Brazil’s decarbonization efforts, says VP’, Reuters, 28 April 2023. <https://www.reuters.com/business/sustainable-business/hybrid-flex-cars-great-asset-brazils-decarbonization-efforts-says-vp-2023-04-28/>

³ ‘Carbon Border Adjustment Mechanism’, European Commission. https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en

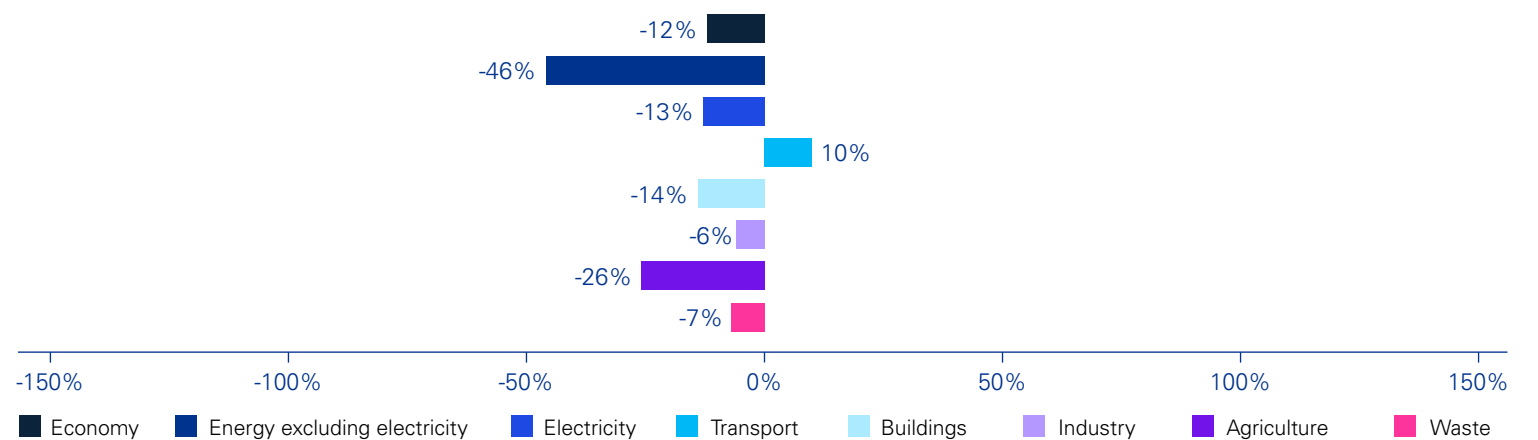
⁴ ‘Brazil expands carbon emission reduction targets’, AgênciaBrasil, 19 October 2021. <https://agenciabrasil.ebc.com.br/en/politica/noticia/2021-10/brazil-expands-carbon-emission-reduction-targets>

⁵ Pedro Rafael Vilela, ‘Railroad linking four Brazilian regions completed after 35 years’, AgênciaBrasil, 16 June 2023. <https://agenciabrasil.ebc.com.br/en/politica/noticia/2023-06/railroad-linking-four-brazilian-regions-unveiled-after-35-years>

Change in absolute emissions (2005–2022)



Change in emissions intensity (2005–2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023; Energy Institute’s 2023 Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>; Economist Intelligence Unit (EIU) Viewpoint; The World Bank Open Data



Canada

The federal government is encouraging investment in renewable energy and related technology through a range of funding mechanisms and working with provinces to enable development of related projects and industries across the country.

Like many countries, Canada has been affected by inflation and concerns over the cost of living. But it is also seeing the impact of climate change related events such as increasing numbers of extreme weather such as flooding, droughts and its worst-ever wildfire season.¹ These events have increased public awareness regarding the physical impacts of climate change and the urgent need for interventions.

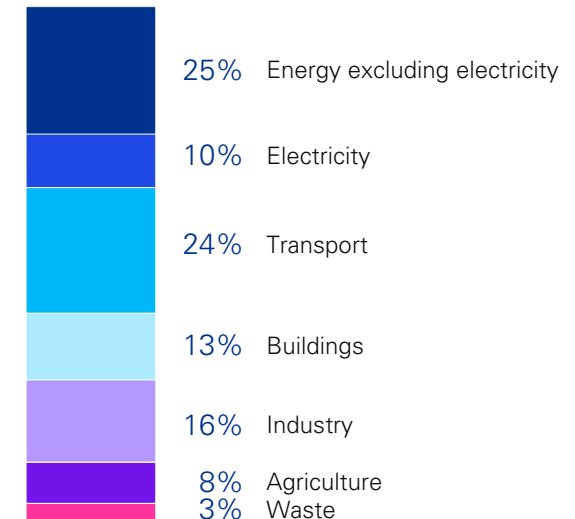
Canada has seen emissions intensities dropping across the economy and particularly in electricity, waste and transport, with other sectors falling less. This presents both challenges and opportunities says Andrew McHardy, Partner, National Decarbonization Hub Leader, KPMG in Canada. The country has the technical expertise and skills, along with abundant natural resources including critical minerals, to accelerate the move to a low-carbon future. This represents a significant opportunity for Canadians to decarbonize their communities and industries while supporting economic growth by exporting these solutions globally.

The 2023 federal budget included several incentives, financing and funding opportunities that focused on building a clean economy in Canada. This included 20 billion Canadian dollars (CAD) (US\$14.7 billion) to support investments in clean electricity, hydrogen, technology adoption, technology manufacturing and carbon capture, utilization and storage (CCUS). The budget also allocated CAD15 billion for a Canadian Growth Fund and CAD20 billion to the Canada Infrastructure Bank to support clean electricity and growth infrastructure projects along with additional funding to strengthen the electricity grid.²

Budget 2023 included consultation on the introduction of carbon contracts for difference, which would support decarbonization projects such as CCUS by providing

greater certainty on the future price of carbon to reduce upfront investment risk.³ The Clean Fuel Regulations, which became federal law in 2022, provide fuel producers with incentives to reduce carbon emissions throughout the lifecycle of extraction, processing, distribution and use.⁴ The government also remains committed to introducing a previously announced carbon tax. “The bottom line is that the government is using incentives and funding as the levers to encourage and accelerate investment in low

GHG emissions split by sector (2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023



carbon solutions,” says McHardy, which should support favorable decisions on projects that can last for many years or decades.

Potential for more energy

Around three-quarters of Canada’s electricity comes from low carbon sources, but the country has significant potential to increase this supply through the development of additional renewable energy. For example, in April 2022 the province of Newfoundland and Labrador ended a 15-year

ban on developing onshore wind farms⁵ while the country has seas suitable for much more offshore wind generation. In July, the province of Ontario said it was planning a new large-scale nuclear plant at the Bruce Power site and three more small modular reactors at Darlington in addition to one already announced.⁶

Although electric vehicle sales made up less than 10 percent of all car sales in 2022, the federal and provincial governments are supporting greater adoption through purchase incentives and by addressing supply chain constraints through investing

in the construction of vehicle battery plants. Major public transport systems are also decarbonizing, including the On-Corridor project to electrify and expand Greater Toronto and Hamilton’s rail network.⁷ However, McHardy adds that the country’s size, dispersed population and climate continue to create challenges for the transportation sector to reduce dependency on fossil fuels, with the same being true of electricity, heating and industry in remote areas.

¹ Ismail Shakil, ‘Canada on track for its worst-ever wildfire season’, Reuters, 6 June 2023. <https://www.reuters.com/world/americas/canada-track-its-worst-ever-wildfire-season-2023-06-05/>

² ‘Minister Guilbeault highlights the big five new Clean Investment Tax Credits in Budget 2023 to support sustainable made-in-Canada clean economy’, Government of Canada, 5 April 2023. <https://www.canada.ca/en/environment-climate-change/news/2023/04/minister-guilbeault-highlights-the-big-five-new-clean-investment-tax-credits-in-budget-2023-to-support-sustainable-made-in-canada-clean-economy.html>

³ Steve Scherer, ‘Exclusive: Canada budget sees contracts for difference for large clean-tech projects — source’, Reuters, 27 March 2023. <https://www.reuters.com/world/americas/canada-budget-set-up-contracts-differences-large-projects-source-2023-03-27/>

⁴ ‘What are the Clean Fuel Regulations?’, Government of Canada. modified 7 July 2022. <https://www.canada.ca/en/environment-climate-change/services/managing-pollution/energy-production/fuel-regulations/clean-fuel-regulations/about.html>

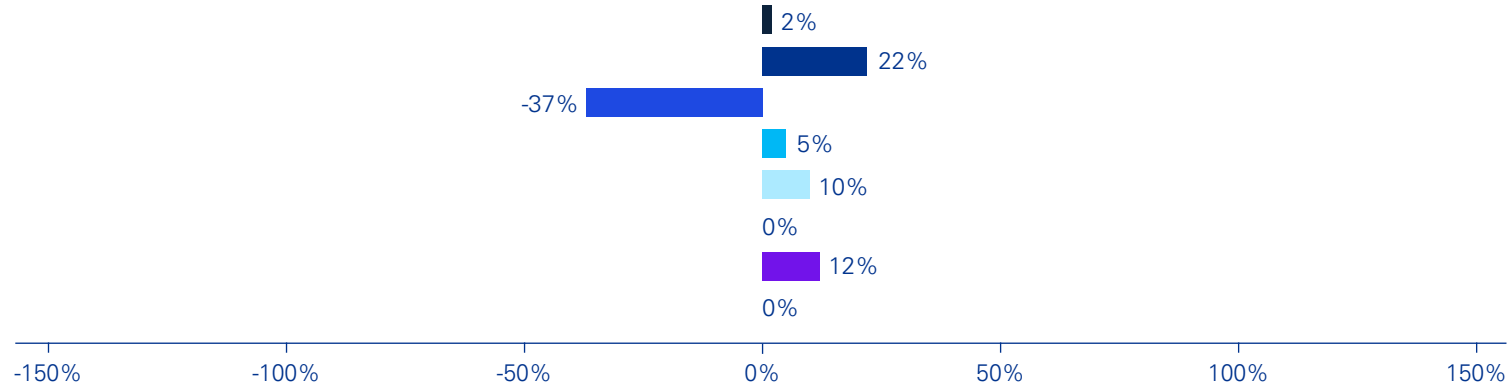
⁵ ‘N.L. government lifts 15-year ban on onshore wind farms’, CBC, 5 April 2022. <https://www.cbc.ca/news/canada/newfoundland-labrador/nl-wind-moratorium-lifts-1.6409296>

⁶ Paul Day, ‘Canada’s nuclear drive picks up speed’, Reuters, 25 June 2023. <https://www.reuters.com/business/energy/canadas-nuclear-drive-picks-up-speed-2023-07-25/>

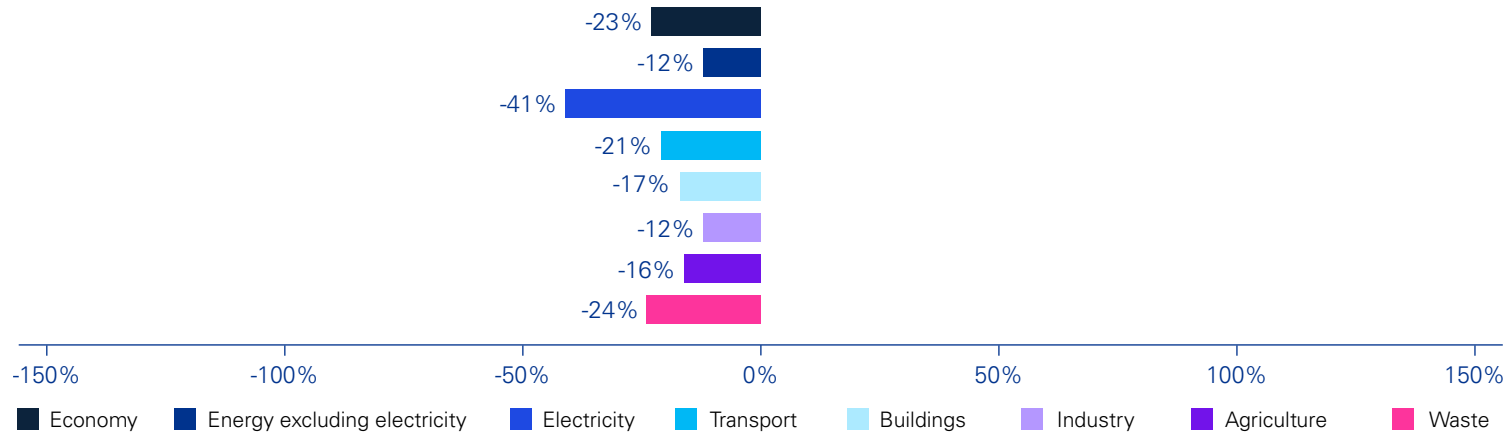
⁷ ONxpress. <https://onxpress.com/>



Change in absolute emissions (2005–2022)



Change in emissions intensity (2005–2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023; Energy Institute's 2023 Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>; Economist Intelligence Unit (EIU) Viewpoint; The World Bank Open Data





China

Rapid growth in renewable energy generation is supported by planning, high levels of investment and grid upgrades. While energy security and economic growth support short-term increases in coal consumption, achieving carbon neutrality will require a profound transformation of China’s energy system.

China, the world’s largest emitter of greenhouse gases by volume due to its large population and manufacturing sector, relies on a combination of factors to tackle this. The first is top-down planning, with the national government providing top-level design and guidance with detailed implementation schemes in key sectors and supporting plans, while provincial governments, corporates, financial institutions and others implement projects. The country also has high levels of investment on energy transition, estimated at US\$550 billion in 2022 by researcher BloombergNEF,¹ and has nearly tripled low carbon energy generation between 2010 and 2020 to reach 2,591TWh.² “They need to play all together to make it work,” says Daisy Shen, Partner, Head of Climate and Sustainability, KPMG China.

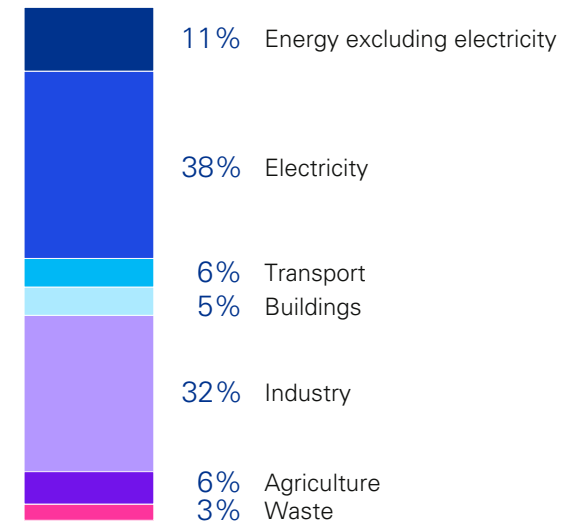
The country faces challenges in managing this growth, including upgraded grid infrastructure to link renewable generation in the west of the country to population and industrial centers in the east. The State Grid budgeted more than 500 billion Chinese yuan renminbi (RMB) (US\$68.5 billion) in 2022 for ultra high voltage power lines, other grid upgrades and digitization work.³ China is also expanding use of energy storage technologies that help to smooth the intermittent nature of renewable production, with electrochemical storage capacity more than doubling in 2022,⁴ and rapid increases in hydrogen fuel production, although mainly from coal and gas at present.⁵

Coal remains China’s most important fuel generating 4,928TWh of electricity in 2020 and electricity production accounting for just under half of Chinese emissions. In 2022, local authorities permitted 106GW of new coal generation, four times the amount in 2021 and six times as much as the rest of the world combined according to research by US data publisher Global Energy Monitor.⁶ The government sees coal

as providing energy security, having joined India and other countries to successfully negotiate that coal be “phased down” rather than phased out at the COP26 climate change conference in November 2021.⁷

“In the long term the plan is to phase out coal,” says Wei Lin, Head of Environmental, Social and Governance, KPMG China. “There is always this balance between the long-term and short-term crunches in power or economic development.” A government plan published in October 2021 projects that coal consumption will

GHG emissions split by sector (2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023



continue to rise until 2025 then start to fall by 2030, along with overall carbon dioxide emissions. The proportion of energy produced without fossil fuels is projected to rise to 20 percent by 2025, 25 percent by 2030 and exceed 80 percent by 2060.⁸

Expanding emissions trading

Emissions trading systems (ETS) represent an important policy instrument for China to achieve its climate targets. In 2013 the country launched regional carbon ETS pilots,

its first systematic attempt to use market-based instruments to regulate carbon emissions. Building on the experience of regional pilots China brought a national carbon ETS online in 2021, the largest carbon market in the world, covering only the power generation sector so far. The government plans to extend the scheme to eight major industries and restart the Chinese Certified Emission Reduction scheme by the end of 2023, providing financial incentives for cutting emissions. The country will also need to prepare for new international levies such as the EU's Carbon Border Adjustment Mechanism. Some high-emitting industries including steel

production are researching hydrogen and carbon capture and storage but this has yet to reach commercialization.

China is the world's biggest adopter of electric vehicles by number and among the largest by proportion, with electric models making up 29 percent of cars sold in 2022.⁹ The country's automotive manufacturers have developed low-cost electric vehicles such as BYD's Seagull, unveiled at the Shanghai auto show in April, with hopes for significant export potential.¹⁰

¹ 'China can achieve net-zero energy emissions by 2050 while strengthening its energy security', BloombergNEF, 30 May 2023. <https://about.bnef.com/blog/report-shows-way-for-china-to-meet-climate-goals-10-years-early/>

² 'China', International Energy Agency. <https://www.iea.org/countries/china>

³ Wei Lin, Angus Choi and Ebele Angela Onyebabo, 'Smarter grids: powering decarbonisation through technology investment', KPMG in China, 18 May 2023. <https://kpmg.com/cn/en/home/insights/2023/05/smarter-grids.html>

⁴ 'New energy storage technologies empower energy transition (synopsis)', KPMG in China and China Electricity Council, May 2023. <https://assets.kpmg.com/content/dam/kpmg/cn/pdf/en/2023/03/new-energy-storage-technologies-empower-energy-transition.pdf>

⁵ 'The fast-growing hydrogen energy industry (synopsis)', KPMG in China, 26 October 2022. <https://kpmg.com/cn/en/home/insights/2022/09/understand-the-hydrogen-energy-industry-in-one-article.html>

⁶ Yujie Xue, 'Climate change: China approved most coal power plants since 2015 last year, making environmental goals harder, research shows', South China Morning Post, 27 February 2023. <https://www.scmp.com/business/china-business/article/3211656/climate-change-china-approved-most-coal-power-plants-2015-last-year-making-environmental-goals>

⁷ Valerie Volcovici, Kate Abnett and William James, 'U.N. climate agreement clinched after late drama over coal', Reuters, 14 November 2021. <https://www.reuters.com/business/cop/un-climate-negotiators-go-into-overtime-save-15-celsius-goal-2021-11-13/>

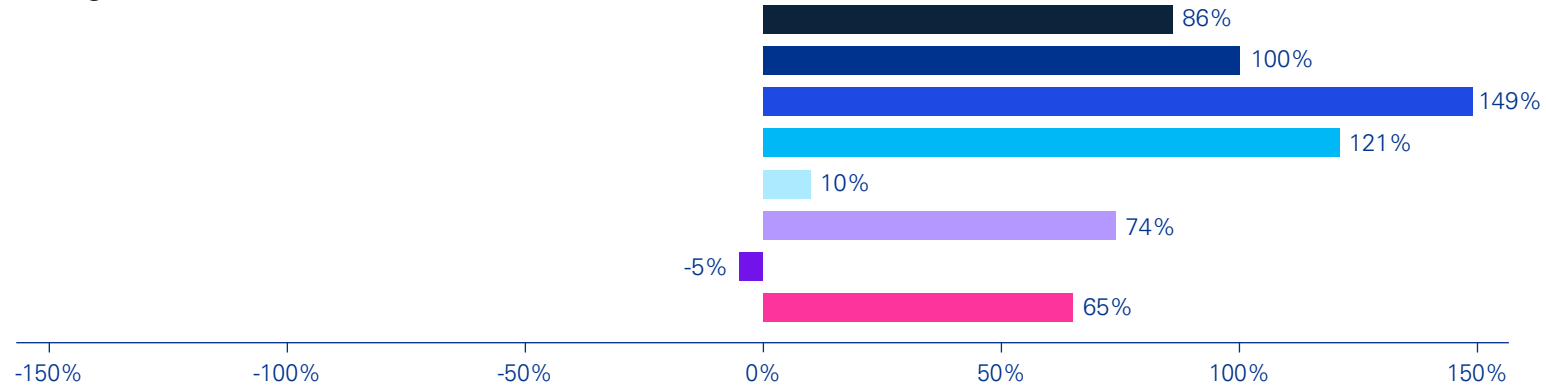
⁸ 'Action plan for carbon dioxide peaking before 2030', China Department of Resource Conservation and Environmental Protection, 27 October 2021. https://en.ndrc.gov.cn/policies/202110/t20211027_1301020.html

⁹ 'Global EV Data Explorer', International Energy Agency. <https://www.iea.org/data-and-statistics/data-tools/global-ev-data-explorer>

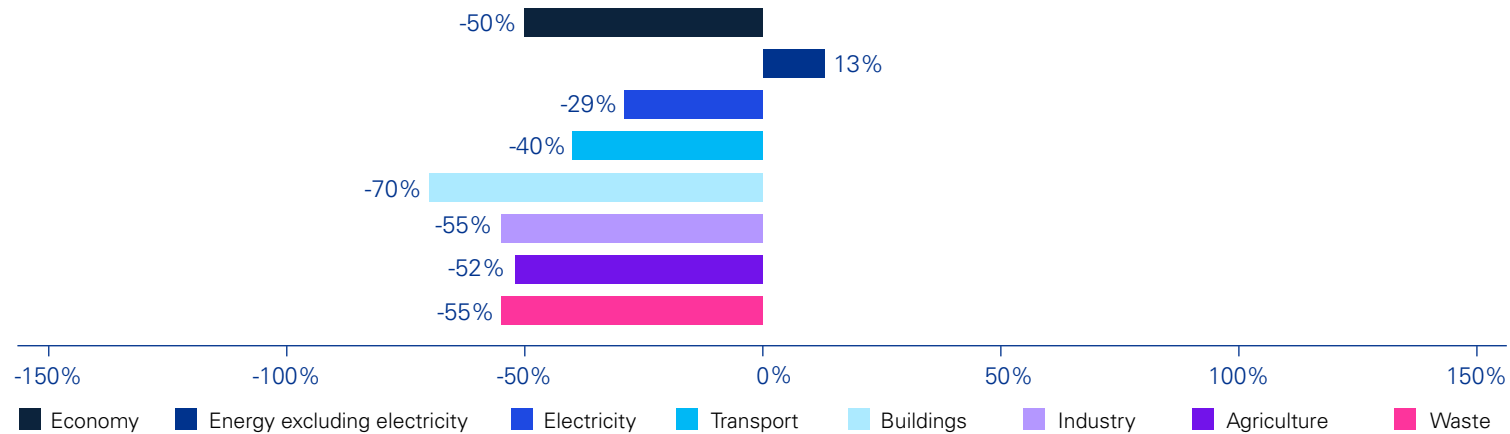
¹⁰ Zhang Yan and Casey Hall, 'As EV costs tumble in China, an export wave builds', Reuters, 19 April 2023. <https://www.reuters.com/business/autos-transportation/ev-costs-tumble-china-an-export-wave-builds-2023-04-19/>



Change in absolute emissions (2005–2022)

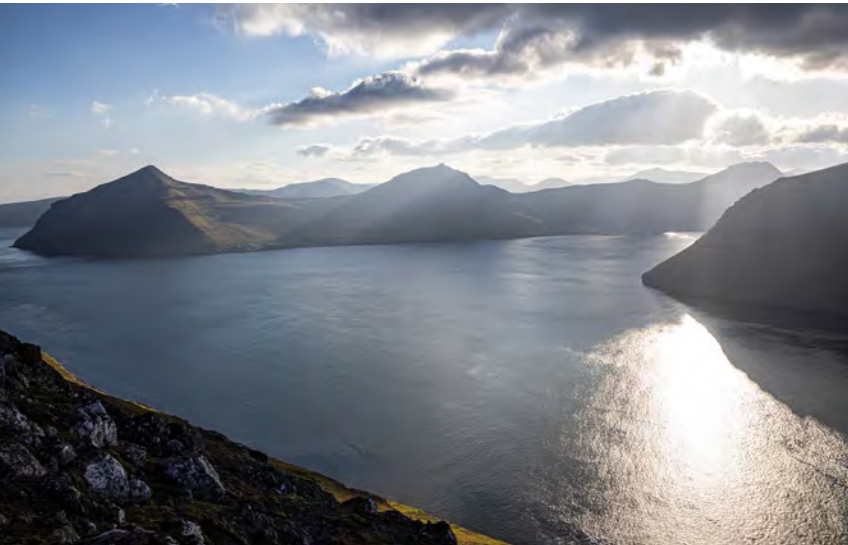


Change in emissions intensity (2005–2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023; Energy Institute's 2023 Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>; Economist Intelligence Unit (EIU) Viewpoint; The World Bank Open Data





Denmark

The long-term political focus on green, renewable energy has encouraged an ecosystem of manufacturers and financiers able to collaborate on projects including an energy island for offshore wind. The current government is working on emission-based taxes on agriculture.

Denmark has a long history of developing alternative sources of energy to fossil fuels. The majority of Danish renewable energy production comes from biomass used in power plants, including wood chips and pellets, straw from the agricultural sector and degradable household waste. This biomass is almost exclusively used in the district heat networks that are connected to nearly two-thirds of Danish homes.

The second largest renewable energy source is wind power. The country built its first commercial wind turbine in 1979 and has expanded their use to the extent that on 15 September 2019 production from wind exceeded total national demand for electricity.¹ Given this large share and the variable nature of wind, also true for solar power, Denmark has been focusing on how to integrate intermittent power production, leading to the Danish electricity transmission operator developing world-leading expertise in this area.

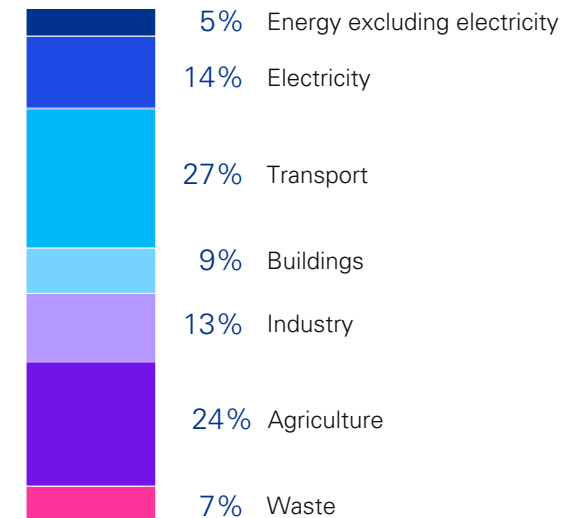
Strong interconnections with neighboring countries that allow electricity to be exported or imported help the country manage intermittent renewable production and Denmark is planning further interconnections. As wind and solar production will continue to increase for the next decade, the government also plans to develop green hydrogen production as well as direct electricity storage in either batteries or other technologies, a strategy backed by companies that have plants planned or in operation.

Denmark has developed one of the world’s largest wind turbine manufacturing sectors and is also home of the commercial fund manager Copenhagen Infrastructure Partners (CIP) which specializes in developing renewable energy, particularly offshore wind. CIP is part of a consortium working to build VindØ, an artificial ‘energy

island’ 100 kilometers away from the coast that is due to be established by 2030. This will eventually connect 10GW of offshore wind production to Denmark through a high voltage link and will also host energy storage, a harbor, maintenance facilities and accommodation for workers with the option of adding production of green fuels from electricity.²

Michael Birkebæk Jensen, Partner, Head of Products and ESG, KPMG in Denmark, sees this network of renewable energy companies as a national strength: “This is something

GHG emissions split by sector (2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023



that has been built over time. It positions us nicely to push ahead on green power,” he says. Denmark could also draw on its experience of extracting oil and gas by developing carbon capture and storage work, he adds, given the overlap in technologies and skills.

Agricultural levies

A new coalition government formed in December 2022 announced plans to introduce new levies on agriculture, the country’s second-biggest emitting sector, although it has yet to publish details. In February 2023 the government’s independent advisor recommended an emissions-based tax that would encourage farmers to switch from beef and dairy to crops and pork production, with a lobby group arguing that this would lead to bankruptcies among Danish

farmers and have little effect on global emissions, as reduced Danish production would just be substituted by increased production in other countries.³ Jensen says there are opportunities to help decarbonize agriculture through use of digital technologies such as precision farming that automates and optimizes the use of inputs.

Digital techniques can also improve the efficiency of logistics and KPMG in Denmark has worked with the maritime industry to optimize routes of ships, including through use of artificial intelligence. Decarbonization will also require new fuels and Danish shipping and logistics group Maersk, which aims to achieve net zero emissions by 2040, has ordered 19 vessels that can run on green methanol produced by renewable electricity, including six large ocean-going ships from Hyundai Heavy Industries.⁴

In September, the company’s first green methanol powered ship, a smaller container vessel, was named Laura Maersk by EU Commission president Ursula von der Leyen in a ceremony in Copenhagen.⁵

On land, Danish freight operator DSV has started to electrify its vehicle fleet in North America.⁶ In partnership with logistics and ferry operator DFDS and food groups Arla and Danish Crown, the company is also planning to establish a carbon neutral food transport corridor to the UK by using electric trucks, refrigerated trailers and greener fuels.⁷ Denmark is also nearing the 2027 completion of a program to electrify the majority of its state railway network by converting 1,362 kilometers of track.⁸

¹ “Biomasseanalyse”, Danish Energy Agency, May 2020. https://ens.dk/sites/ens.dk/files/Bioenergi/biomasseanalyse_final_ren.pdf”B

² ‘Energy Island VindØ’, Copenhagen Infrastructure Partners. <https://www.cip.com/approach/our-projects/energy-island/>

³ Johannes Birkebaek, ‘Taxing farming vital for Denmark’s climate target - govt adviser’, Reuters, 20 February 2023. <https://www.reuters.com/world/europe/taxing-farming-vital-denmarks-climate-target-govt-adviser-2023-02-20/>

⁴ ‘Decarbonising ocean transport’, Maersk. <https://www.maersk.com/sustainability/our-esg-priorities/climate-change/decarbonising-ocean-shipping>

⁵ ‘EU Commission president names landmark methanol vessel “Laura Mærsk”’, Maersk, 14 September 2023. <https://www.maersk.com/news/articles/2023/09/14/eu-commission-president-names-landmark-methanol-vessel-as-laura-maersk>

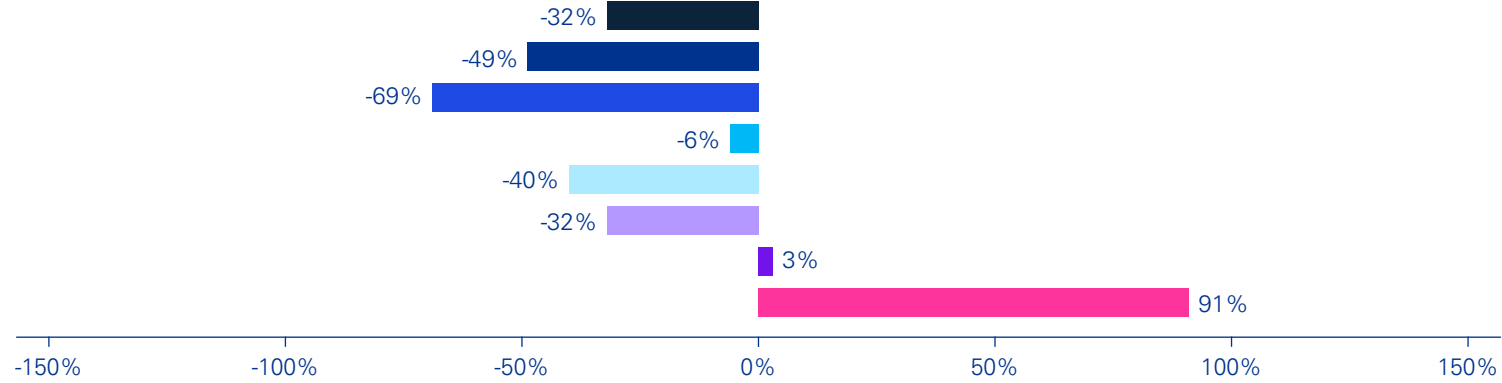
⁶ ‘DSV Places Order for 10 Electrified Trucks as Part of North American Emissions-Reduction Initiative’, DSV, 25 January 2023. <https://www.dsv.com/en-us/about-dsv/press/news/us/2023/01/north-american-emissions-reduction-trucking>

⁷ ‘Danish companies teaming up to provide climate-neutral transport between Denmark and the UK’, DSV, 20 June 2023. <https://www.dsv.com/en/about-dsv/press/news/com/2023/06/danish-companies-to-provide-climate-neutral-transport>

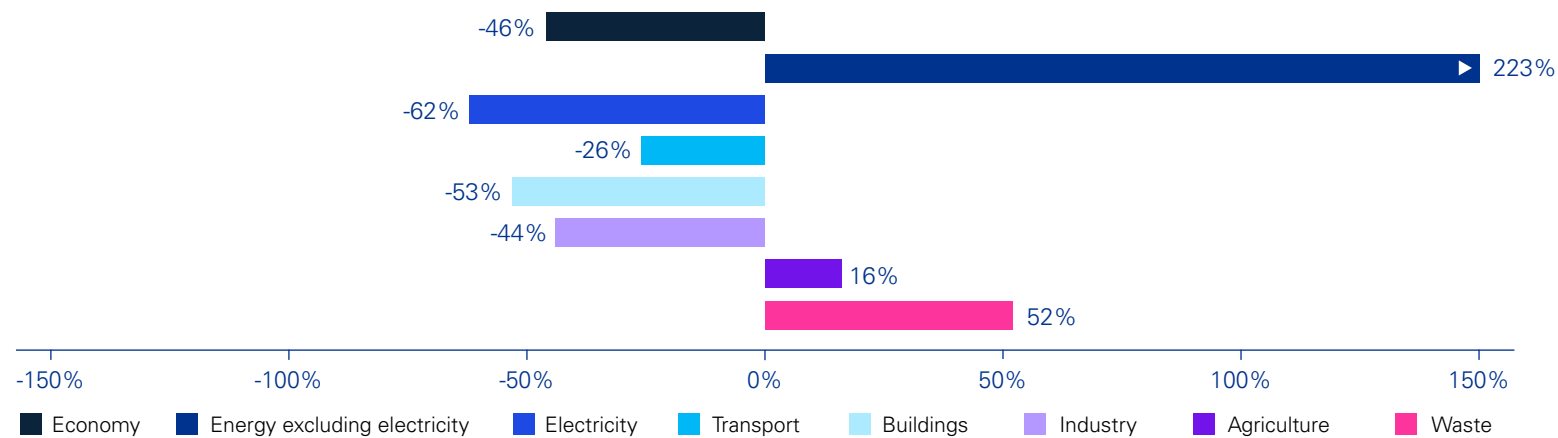
⁸ ‘Electrification programme’, Banedanmark. <https://uk.bane.dk/en/Projects/Electrification-Programme>



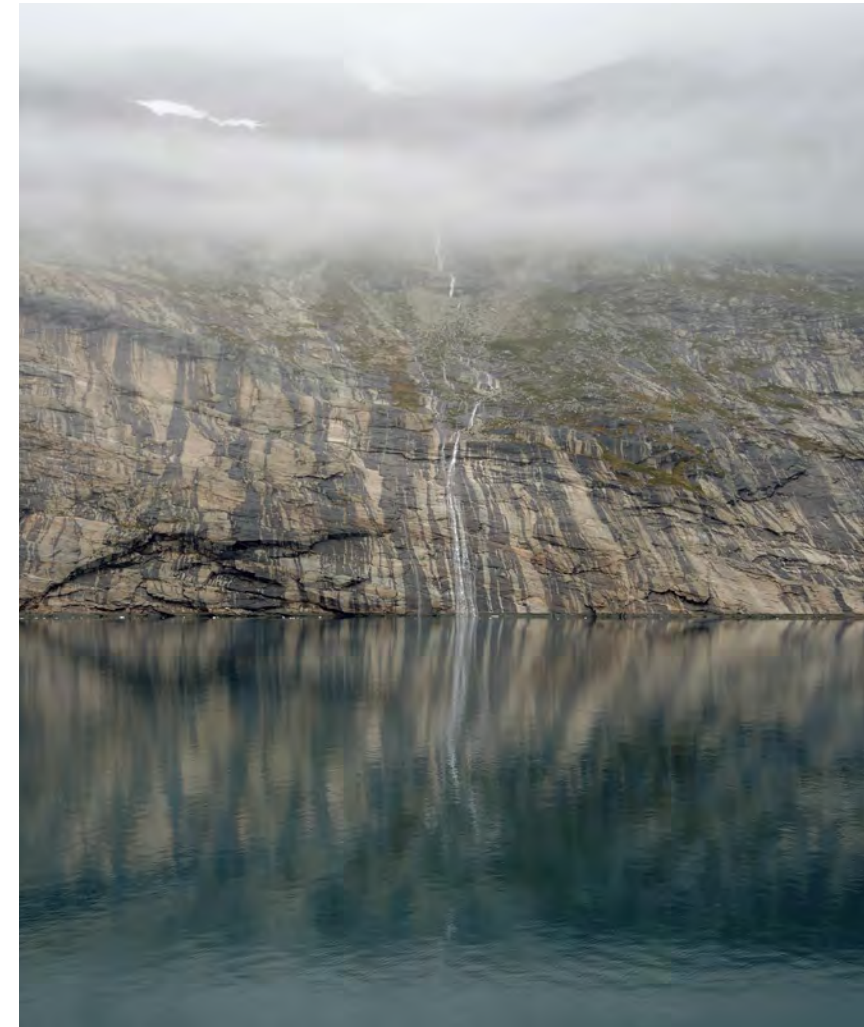
Change in absolute emissions (2005–2022)



Change in emissions intensity (2005–2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023; Energy Institute's 2023 Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>; Economist Intelligence Unit (EIU) Viewpoint; The World Bank Open Data





France

French companies have decarbonized direct emissions, partly due to government regulations and use of low carbon nuclear electricity, and want suppliers to do likewise. A government focus on transport has led it to ban flights on a few routes and increase controls on urban car use.

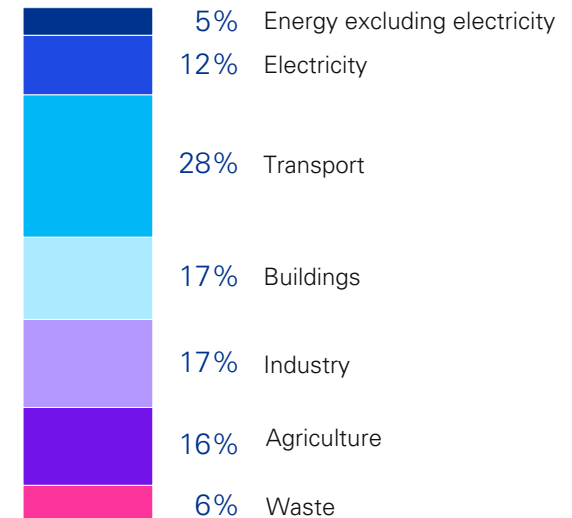
For two decades, large companies in France have compiled data on emissions, governed by legal and regulatory requirements on its accuracy, and used this to set and meet decarbonization targets. The results have been significant reductions in corporate scope 1 and scope 2 emissions, supported by use of France’s low carbon electricity, most of which is generated by its fleet of nuclear power plants. In 2022 three of the 12 corporates with the highest ‘triple A’ rating from CDP, an international not-for-profit environmental disclosure organization, were listed in France.

Jérémie Joos, Partner, KPMG in France, says that for many companies the greatest challenge comes from scope 3 emissions generated by suppliers which in some cases make up 80 percent of the organization’s total. Ignoring these can lead to double standards as a company could replace its own fleet with electric vehicles while contractors continued to use diesel and petrol. He adds that corporate scope 3 emissions often rise in line with sales, as managers for countries and regions focus on and are incentivized to increase sales rather than meet decarbonization targets.

Most French companies working on supplier decarbonization started doing so recently, although a few have a long record of this. Joos says that companies that want to reduce scope 3 emissions may need to support suppliers in doing so, particularly for dependent smaller businesses. “We need to accelerate initiatives to fund the transition of these smaller companies,” he says. “They don’t have the financing to decarbonize their activities.” One option is to offer better payment terms. Among his clients in agriculture, food and beverages, one has offered to fix prices for 2 years rather than the usual 6 months and another to pay 12 months in advance of delivery, both in order to help fund decarbonization work.

He adds that consultants can take a role in supporting smaller companies by helping to develop new ideas and initiatives. To support better decision-making across its clients, KPMG in France has integrated a process within its decarbonization methodology that works out the carbon emissions which result from the business’s main goals and the capital expenditure that would be required to tackle this, providing something meaningful to senior executives.

GHG emissions split by sector (2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023



From planes to trains

Across the economy overall emissions intensity has halved since 1990, but the highest-emitting sector transport has seen below-average declines in recent years. To tackle this, in May the French government banned the use of scheduled flights for journeys that can be made in under 2.5 hours by train, although this applied to only a handful of routes given exceptions based on train service levels. As part of work described by President Emmanuel Macron as “collective sobriety” in energy use, the government is also offering subsidies to encourage people to trade in cars for electric bicycles.¹

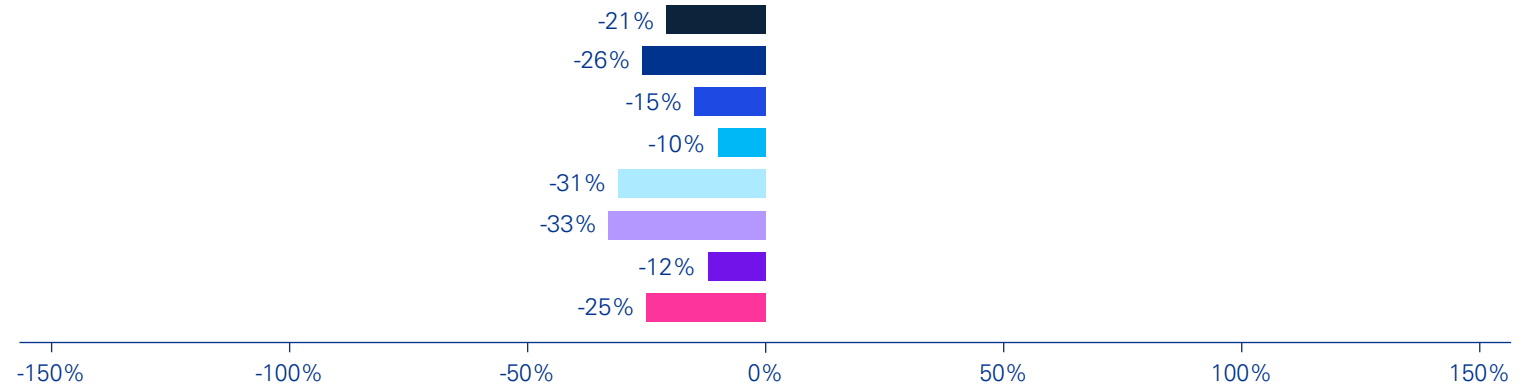
Sales of electric vehicles rose slightly to 21 percent of all car sales in 2022.² Paris is increasingly restricting access to drivers with some more-polluting vehicles already banned — although a plan to toughen these rules in the summer of 2023 was postponed until January 2025 — with the eventual intention of making the city center entirely car-free.³

¹ Lottie Limb, ‘It’s official: France bans short-haul domestic flights in favour of train travel’, Euronews, 23 May 2023. <https://www.euronews.com/green/2022/12/02/is-france-banning-private-jets-everything-we-know-from-a-week-of-green-transport-proposals>

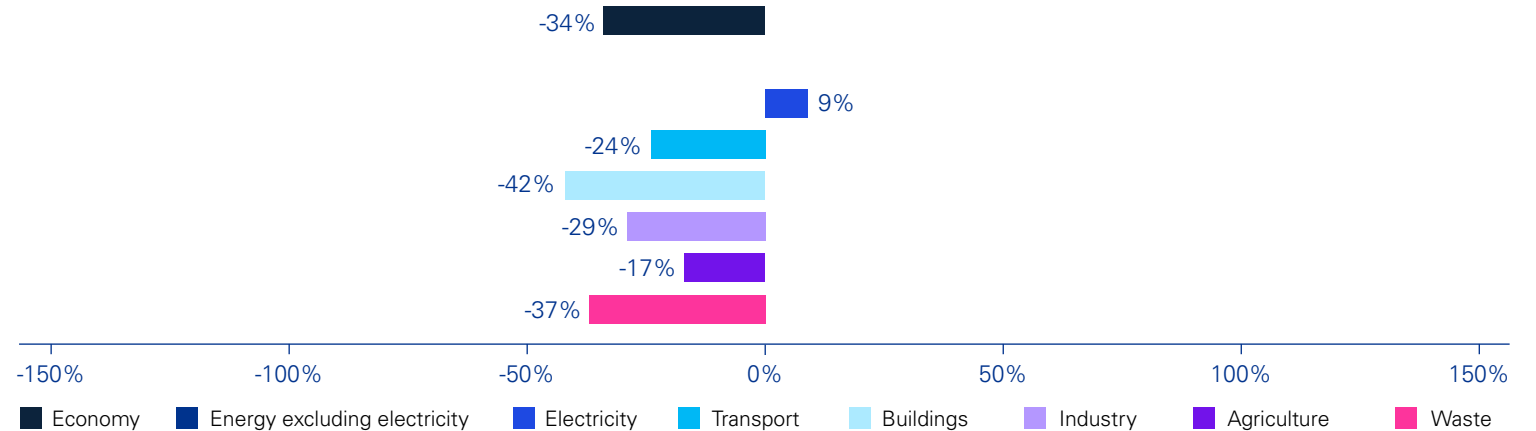
² ‘Global EV data explorer’, International Energy Agency. <https://www.iea.org/data-and-statistics/data-tools/global-ev-data-explorer>

³ ‘Paris delays ban on diesel cars’, The Local Fr, 13 July 2023. <https://www.thelocal.fr/20230713/paris-delays-ban-on-diesel-cars>

Change in absolute emissions (2005–2022)



Change in emissions intensity (2005–2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023; Energy Institute’s 2023 Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>; Economist Intelligence Unit (EIU) Viewpoint; The World Bank Open Data



Germany

Germany has committed itself to decarbonize its economy swiftly, but while most political parties and industries including automotive are strong supporters of this aim there is debate over the pace. The country needs to find ways to increase clean electricity and housing efficiency.

Germany’s politics provide strong support for its shift towards net zero. The country’s Green party is one of three making up its coalition government and people across society provide relatively high levels of consent to pursue environmental goals. Germany also hosts well-functioning capital markets and a wealth of technical innovators, giving companies access to the funding and expertise needed to decarbonize their operations.

Key industries including automotive are changing rapidly. Vehicle makers across the EU are required to stop selling cars that emit carbon dioxide by 2035,¹ but the country’s largest manufacturer Volkswagen is moving faster with more than two-thirds of its EUR180 billion (US\$191 billion) 2023–27 investment budget allocated to electrification and digitization. The company expects that a fifth of the vehicles it sells will be all-electric as early as 2025, compared with just 7 percent in 2022.²

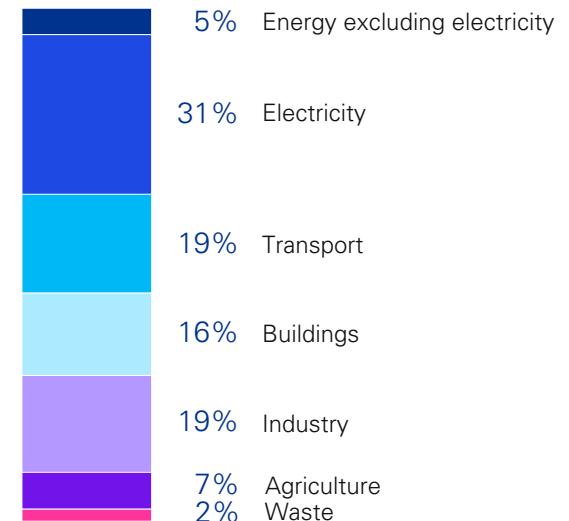
“There is a large effort to move to electrification of passenger vehicles,” says Goran Mazar, Partner, EMA and German Head of ESG and Automotive, KPMG in Germany. “It is not a question of whether we go for electrification of passenger vehicles, it is about how fast we get there.” Manufacturers are investing in green hydrogen generated with renewable energy as the replacement fuel for commercial vehicles that need more power than batteries can provide.

The automotive sector is also adopting circular economy techniques, which aim to minimize waste such as through repairing, reusing and recycling. Mazar says that a new EU directive on electric vehicle batteries which mandates their recycling should reduce emissions as well as reducing the sector’s dependency on imports of raw materials for batteries, supporting the shift to electric vehicles.³

Tripling electricity demand

Germany’s economy is strongly focused on manufacturing compared with many other developed countries. Moving energy-intensive sectors including automotive, steel and chemical production and processing from fossil fuels could mean the country needing three times as much electricity over the next decades as today. The country has increased low-carbon production from a low base to generating nearly half of its electricity, but maintaining this momentum could be challenging. The strongest potential for wind generation

GHG emissions split by sector (2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023



in Germany is in the north of the country and off its northern coastline, but demand is mainly in the middle and south, which will require new grid infrastructure. Germany is unlikely to develop new nuclear power generation as this is not supported by the main political parties in either government or opposition.

Decarbonizing residential property faces similar practical issues. The German government's plans to require all new domestic heating systems to run on at least 65 percent renewable energy, effectively blocking the installation of new gas-fired boilers, ran into significant public opposition leading to exemptions such as for boilers that could be converted

to run on hydrogen.⁴ More broadly, the current form of an unfinalized EU directive would require 30 percent of residential buildings with the lowest energy efficiency ratings to undergo upgrades by 2030.⁵ "That cannot be done by the owners of these properties alone," says Dr Stefan Otremba, Partner, Risk and Compliance Services, KPMG in Germany, adding that government subsidies or incentives are likely to be needed.

For companies in particular, the pressure to find ways to decarbonize will likely continue to increase. From 2024, the EU's Corporate Sustainability Reporting Directive will require the largest listed companies to publish much more

detailed information on environmental and social issues⁶ and this requirement will eventually cover some 15,000 German companies.⁷ These are part of an international movement, with the International Sustainability Standards Board recently publishing its first two standards to aim to co-ordinate these globally.⁸ Otremba says that the greater availability of such information, combined with the increasing environmental focus of capital providers, will be "a huge driver" for companies to accelerate their moves towards net zero emissions.

¹ Kate Abnett, 'EU countries approve 2035 phaseout of CO2-emitting cars', Reuters, 29 March 2023. <https://www.reuters.com/business/autos-transportation/eu-countries-poised-approve-2035-phaseout-co2-emitting-cars-2023-03-28/>

² 'Volkswagen Group's solid financial performance lays basis for profitable growth in key markets', Volkswagen Group, 14 March 2023. <https://www.volkswagen-group.com/en/press-releases/volkswagen-groups-solid-financial-performance-lays-basis-for-profitable-growth-in-key-markets-16940>

³ Goran Mazar and Arnoud Walrecht, 'Sustainable batteries', KPMG International, March 2023. <https://kpmg.com/xx/en/home/insights/2023/03/sustainable-batteries.html>

⁴ Holger Hansen and Riham Alkousaa, 'Germany's coalition agrees changes to green heating law after dispute', Reuters, 13 June 2023. <https://www.reuters.com/world/europe/germanys-coalition-agrees-changes-green-heating-law-after-dispute-2023-06-13/>

⁵ 'Energy performance of buildings (recast)', European Parliament, 14 March 2023. https://www.europarl.europa.eu/doceo/document/TA-9-2023-0068_EN.pdf

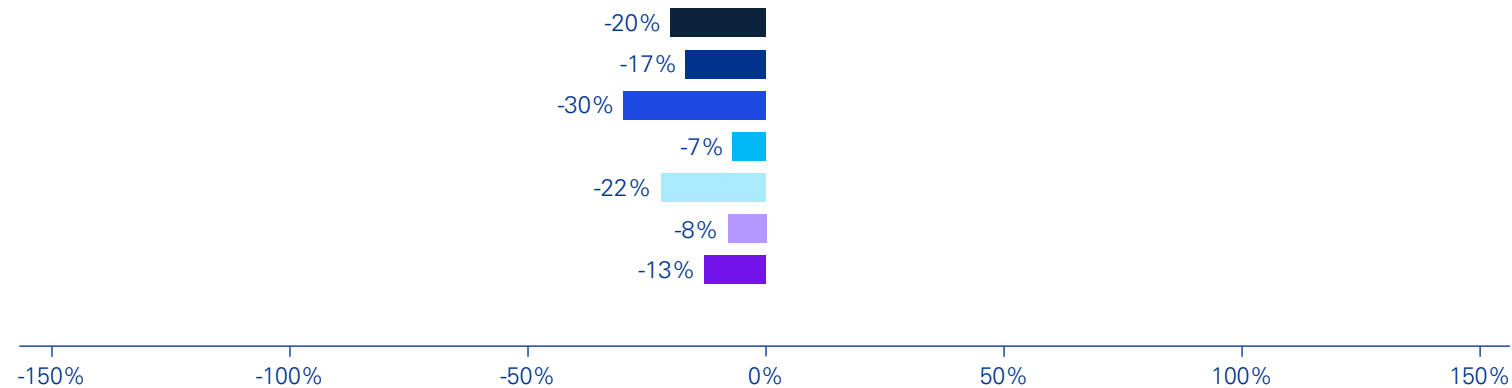
⁶ 'Get ready for a new level of ESG reporting', KPMG International, January 2023. <https://kpmg.com/xx/en/home/insights/2023/01/get-ready-for-the-next-wave-of-esg-reporting.html>

⁷ Goran Mazar and Dr Jan-Hendrik Gnändiger, 'Corporate Sustainability Reporting Directive (CSRD)', KPMG in Germany. <https://kpmg.com/de/en/home/insights/overview/esg/corporate-sustainability-reporting-directive.html>

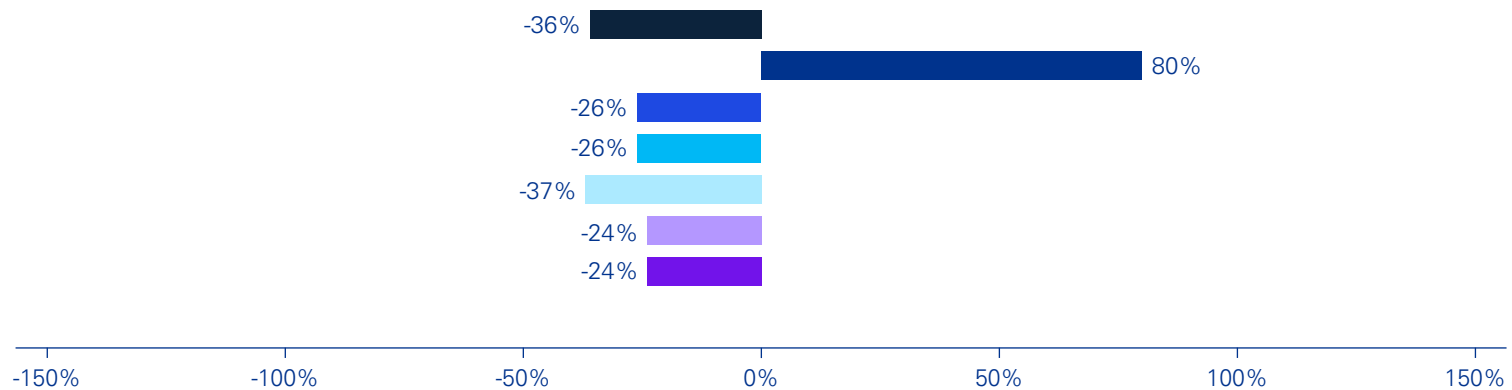
⁸ Mark Vaessen, 'ISSB standards are now live', KPMG International, 26 June 2023. <https://kpmg.com/xx/en/home/insights/2023/06/issb-ifrss1-ifrss2-talkbook.html>



Change in absolute emissions (2005–2022)



Change in emissions intensity (2005–2022)



Economy
 Energy excluding electricity
 Electricity
 Transport
 Buildings
 Industry
 Agriculture
 Waste

Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023; Energy Institute's 2023 Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>; Economist Intelligence Unit (EIU) Viewpoint; The World Bank Open Data





India

India is rapidly increasing renewable generation, which fits well with a prime ministerial target of “energy independence” by 2047. The government has significant programs to decarbonize transport and industry, but agriculture is likely to present challenges.

India has been working to decarbonize its power sector at the same time as greatly expanding its capacity. Overall energy consumption has more than doubled since 2000 with the country providing access to electricity for nearly all households according to the International Energy Agency (IEA).¹ Despite this, the proportion of electricity produced from low carbon sources has risen slightly to nearly one-quarter.

Apurba Mitra, Partner, ESG, KPMG in India, says the shift was initially driven by government incentives to develop wind power which attracted investments from individuals as well as corporates and encouraged domestic manufacturing. The solar boom since 2009 has seen a new focus on cost with the government using reverse auctions that favor very large solar and wind projects that use imported equipment. Overall, renewable electricity generation capacity increased from 27GW in 2000 to 154GW in 2021 according to IEA data and the agency expects it to double to at least 300GW by 2027.²

Mitra says that falling global prices as well as government action have supported increased use of renewables, which now have comparable costs to coal for electricity generation. Given intermittent supply of wind and solar, coal will still be needed for the near future: “We are still dependent on coal for the baseload, as we don’t have access to much natural gas.” There are efforts to build more storage capacity, but at present India is relatively weak on distribution and technology for scheduling consumption.

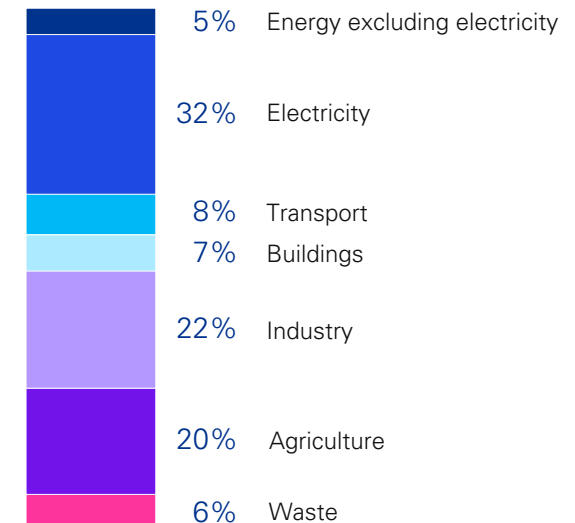
India has economic as well as environmental motivations to change its energy mix. In 2021, Prime Minister Narendra Modi set a target of “energy independence” by 2047, a century after the country’s national independence. He said this would include much more hydrogen production and use

of electric vehicles, although also increased use of natural gas.³ In February 2022 the government announced a policy which aims to make the country a hub for production and export of green hydrogen produced with renewable energy.⁴

Programs for transport and industry

Unlike most other sectors which have seen sharp declines since 2005, India’s emissions intensity from transport has fallen only slightly since that date. Government support for vehicle electrification has changed, with the third version of the

GHG emissions split by sector (2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023



Faster Adoption and Manufacturing of Electric vehicles (Fame) subsidy program currently under consideration,⁵ following a shift from vehicles to batteries between its first and second versions. So far, drivers of two and three-wheeled vehicles have been more likely to shift to electric models than those of four-wheeled cars. Among larger vehicles, electric buses are growing in popularity, supported by many being operated by public-sector organizations, but such a shift is not yet seen for commercial trucks.

Industrial energy consumers in some sectors are encouraged to reduce use through Perform, Achieve and Trade, a regulatory instrument managed by the Ministry of Power's Bureau of Energy Efficiency allowing savings to be traded.⁶ Work is

underway on subsuming this and a similar scheme for the energy sector into a cross-sectoral trading system.

Agriculture in India, as in other countries, may find it challenging to make significant further cuts despite some decline in its emissions intensity. Fertilizer is subsidized by government which can encourage overuse and it would be difficult to reduce methane emissions from dairy livestock. "This is a sector that will probably take longer than others to decarbonize," says Mitra.

India plans to reach net zero by 2070 as part of Prime Minister Modi's Panchamrit climate goals. These also include reducing emissions intensity by 45 percent by 2030

compared with 2005 levels rather than a figure for overall volumes given the country's economically developing status. While this means there may be less money for decarbonization than in some other countries, Mitra says there are opportunities too: India is probably yet to build half of the infrastructure it will need by 2050, meaning this can be constructed in an energy-efficient fashion while other countries have to rely on retrofitting. The Panchamrit goals for 2030 also include increasing non-fossil fuel energy capacity to 500GW, meeting half of energy requirements from renewable sources and reducing projected carbon emissions by 1GtCO₂e.⁷

¹ 'Energy in India today', India Energy Outlook 2021, International Energy Agency. <https://www.iea.org/reports/india-energy-outlook-2021/energy-in-india-today>

² Renewables Data Explorer using data from 'Renewables 2022', International Energy Agency. <https://www.iea.org/data-and-statistics/data-tools/renewables-data-explorer>

³ 'PM Modi sets 2047 target for becoming energy independent', Times of India, 15 August 2021. <http://timesofindia.indiatimes.com/articleshow/85342771.cms>

⁴ 'India's green hydrogen policy', Invest India, 9 March 2022. <https://www.investindia.gov.in/team-india-blogs/indias-green-hydrogen-policy>

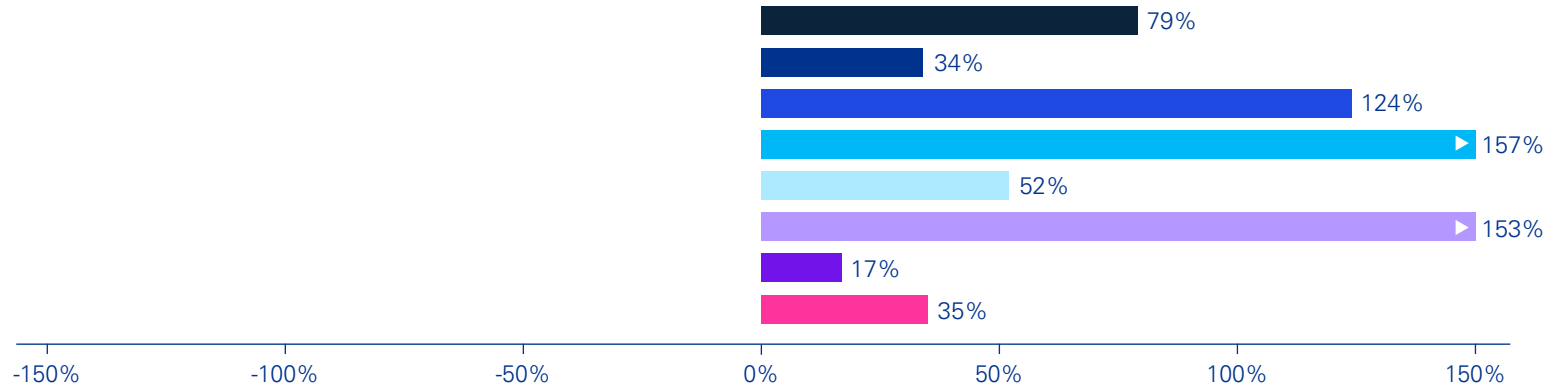
⁵ 'Fame 3.0: Govt considers fresh subsidy plan for EVs', Times of India, 13 July 2023. <https://timesofindia.indiatimes.com/business/india-business/fame-3-0-govt-considers-fresh-subsidy-plan-for-evs/articleshow/101711387.cms>

⁶ 'Perform Achieve and Trade (PAT)', India Bureau of Energy Efficiency. <https://beeindia.gov.in/en/perform-achieve-and-trade-pat-0>

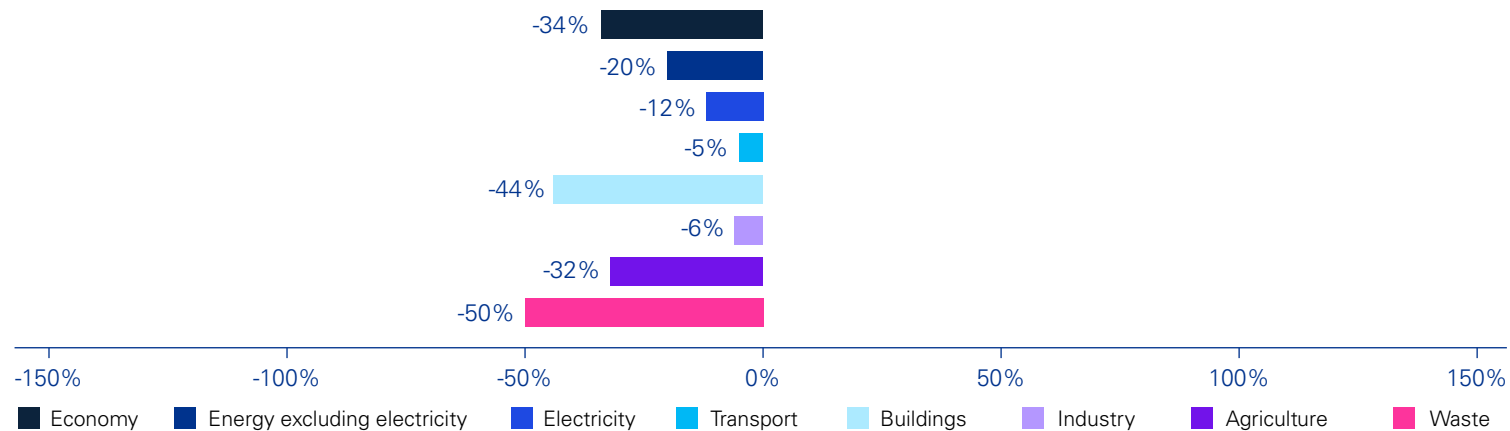
⁷ 'Cabinet approves India's updated nationally determined contribution to be communicated to the United Nations Framework Convention on Climate Change', India Ministry of Environment, Forest and Climate Change, 3 August 2022. <https://pib.gov.in/PressReleasePage.aspx?PRID=1847813>



Change in absolute emissions (2005–2022)



Change in emissions intensity (2005–2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023; Energy Institute's 2023 Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>; Economist Intelligence Unit (EIU) Viewpoint; The World Bank Open Data





Ireland

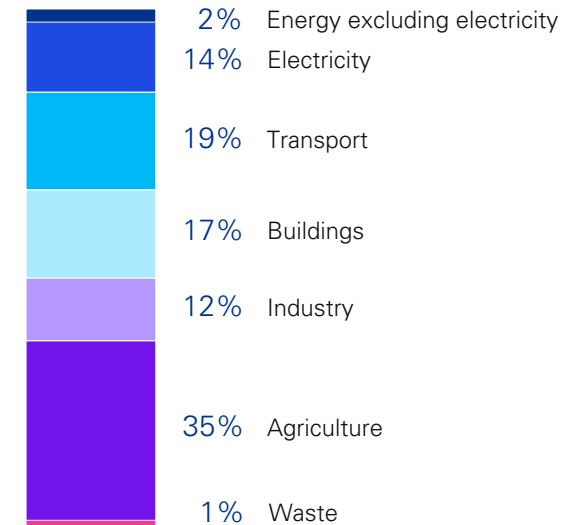
Ambitious targets to halve emissions by 2030 will mean extending already extensive use of wind power through offshore projects, although grid capacity and planning could cause delays. Transport and the country’s dairy and beef herds represent further challenges.

In July 2021 the Republic of Ireland committed to cutting greenhouse gas emissions by 51 percent by 2030 compared with 2018 levels, on the way to reaching net zero emissions no later than 2050.¹ While there is political consensus on these legally binding targets there are doubts about how quickly they can be delivered. A June 2023 assessment by Ireland’s Environmental Protection Agency projected that the country would reduce emissions by only 29 percent over the period based on current trajectories.² “We have really ambitious targets for 2030,” says Philip Connolly, Associate Director, Sustainable Futures, KPMG in Ireland. “Whether or not we achieve them is another question, but having those interim targets and being ambitious is a key strength for Ireland as everyone knows where we have to get to.”

Ireland already has the highest percentage of its electricity generated from onshore wind at more than 40 percent.³ It is now working to develop offshore wind, which as well as meeting domestic demand could allow the country to become an exporter of green hydrogen according to a National Hydrogen Strategy published in July.⁴ The government wants to see 5GW of offshore wind capacity by 2030 then increase this to at least 30GW through the use of floating platforms that can operate in deeper seas.⁵ In June the system operator EirGrid concluded ORESS 1, its first auction for offshore wind support, which approved four projects with total generation capacity of just over 3GW, three off the east coast near Dublin and one off the west coast county of Galway.⁶ Ireland has also attracted international investment including a joint venture between Denmark-based renewables developer Ørsted and Irish utility ESB to develop up to 5GW of offshore wind projects.⁷

The development of offshore wind will contribute to the government’s target of increasing the proportion of electricity from renewables from just below half to up to 80 percent.⁸ Russell Smyth, Head of Sustainable Futures, KPMG in Ireland, says growth has slowed recently. “The grid is beginning to get saturated and the easy early wins have been used up,” he says. “Planning and policy are proving sluggish. Things are still positive but it’s getting harder to move that proportion.”

GHG emissions split by sector (2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023



Transport and agriculture challenges

In July the Department of Transport cut maximum grants for privately purchased electric vehicles from EUR5,000 (US\$5,310) to EUR3,500 although it has maintained the levels of grants for businesses. It has also published a strategy to improve charging infrastructure, including funding for fast chargers at hundreds of sports clubs around the country.⁹ Connolly says that transport emissions rising by 6 percent in 2022 shows that even with increased sales of electric vehicles more needs to be done to offer people safe and sustainable alternatives to private cars. He adds that cost alone is unlikely to change behavior

given that 2022 saw demand for petrol and diesel increasing despite high prices.

Smyth adds that there is a lack of clarity over emissions reductions in agriculture, Ireland's largest source of greenhouse gases and dominated by dairy and beef produced for export. While a 2021 KPMG study found that emissions reductions of around 20 percent could be achieved through widespread adoption of proven technologies, going beyond this at present would require reduced animal numbers.¹⁰

Note on emissions intensity relative to GDP: Ireland's gross domestic product rose by 159 percent between 2014 and 2022 to EUR506 billion, with a significant proportion of this growth caused by multinational companies booking billions of euros of international revenues in the country. This means that measures of emissions intensity based on GDP tend to overstate Ireland's recent progress on decarbonization. The country's Central Statistics Office compiles an alternative measure designed to exclude 'globalization effects' called modified gross national income, which rose by 83 percent to EUR273 billion over the same period.¹¹

¹ 'Ireland's ambitious Climate Act signed into law', Ireland Department of the Environment, Climate and Communications, 23 July November 2021. <https://www.gov.ie/en/press-release/9336b-irelands-ambitious-climate-act-signed-into-law/>

² 'Ireland projected to fall well short of climate targets, says EPA', Ireland Environmental Protection Agency, 1 June 2023. <https://www.epa.ie/news-releases/news-releases-2023/ireland-projected-to-fall-well-short-of-climate-targets-says-epa.php>

³ Russell Smyth and James Delahunty, 'Ireland's offshore wind pipeline', KPMG in Ireland, 14 March 2022. <https://kpmg.com/ie/en/home/insights/2022/03/irelands-offshore-wind-pipeline-infra-gov.html>

⁴ 'National Hydrogen Strategy', Ireland Department of the Environment, Climate and Communications, 12 July 2023. <https://www.gov.ie/en/publication/624ab-national-hydrogen-strategy/>

⁵ 'Offshore Wind Delivery Taskforce', Ireland Department of the Environment, Climate and Communications, 11 August 2022. <https://www.gov.ie/en/publication/c8749-offshore-wind-delivery-taskforce/>

⁶ 'Renewable Electricity Support Scheme: ORESS 1 final auction results', EirGrid, 14 June 2023. [https://www.eirgridgroup.com/site-files/library/EirGrid/ORESS-1-Final-Auction-Results-\(OR1FAR\).pdf](https://www.eirgridgroup.com/site-files/library/EirGrid/ORESS-1-Final-Auction-Results-(OR1FAR).pdf)

⁷ 'ESB and Ørsted enter partnership in landmark Irish offshore wind agreement', Ørsted, 2 June 2023. <https://orsted.com/en/media/newsroom/news/2023/06/20230602683411>

⁸ 'Climate Action Plan 2021 — Securing Our Future', Ireland Department of the Taoiseach, 4 November 2021. <https://www.gov.ie/en/press-release/16421-climate-action-plan-2021-securing-our-future/>

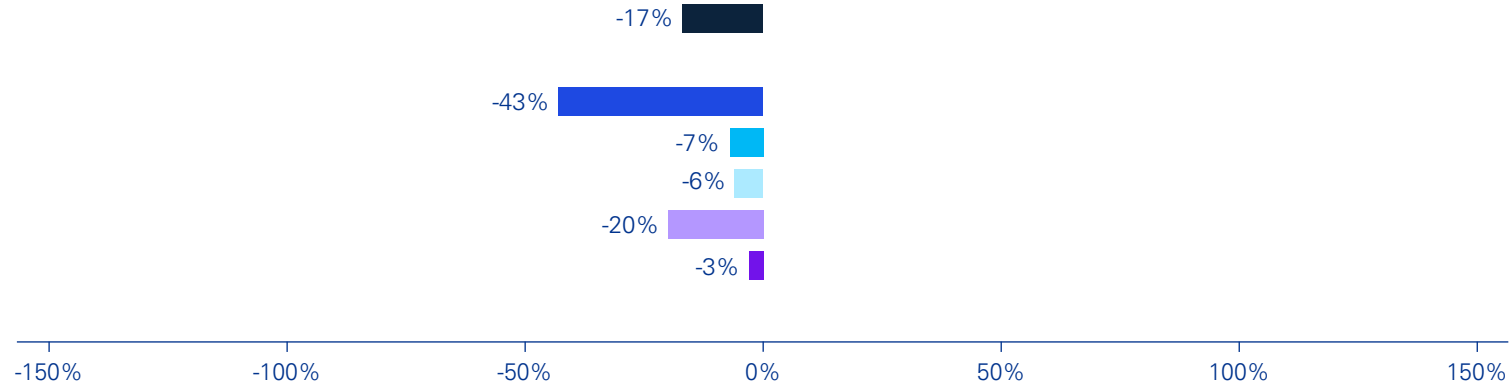
⁹ 'Changes to grants for privately purchased electric vehicles', Ireland Department for Transport, 22 March 2023. <https://www.gov.ie/en/press-release/e0766-changes-to-grants-for-privately-purchased-electric-vehicles/>

¹⁰ 'Ireland's 2030 carbon emissions targets — an economic impact assessment for the agriculture sector', KPMG in Ireland, October 2021. <https://assets.kpmg.com/content/dam/kpmg/ie/pdf/2021/11/ie-ireland-2030-carbon-emissions-targets.pdf>

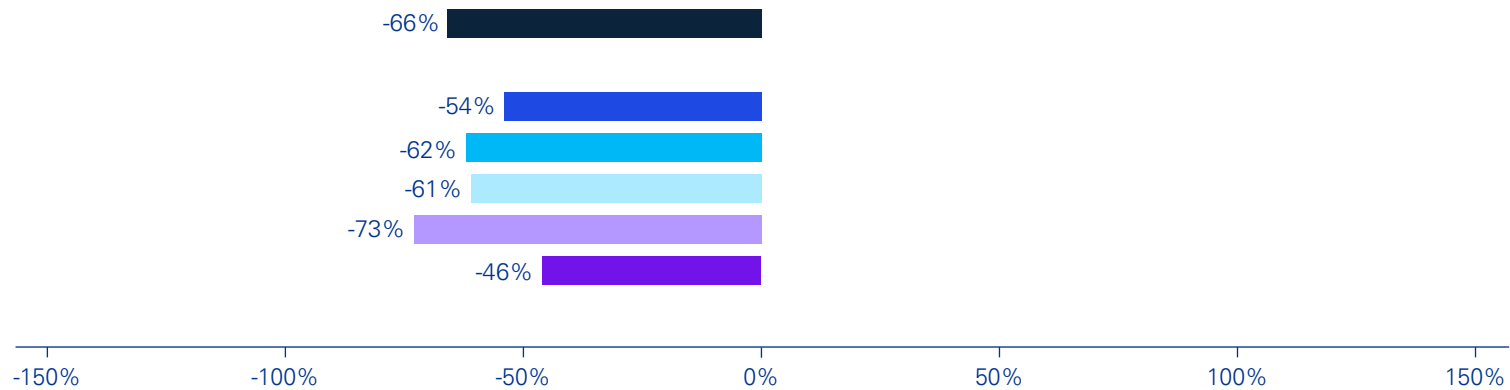
¹¹ 'Annual National Accounts 2022: GNI* and De-Globalised Results', Ireland Central Statistics Office, 14 July 2023. <https://www.cso.ie/en/releasesandpublications/ep/p-ana/annualnationalaccounts2022/gniandde-globalisedresults/>



Change in absolute emissions (2005–2022)



Change in emissions intensity (2005–2022)



Economy
 Energy excluding electricity
 Electricity
 Transport
 Buildings
 Industry
 Agriculture
 Waste

Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023; Energy Institute's 2023 Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>; Economist Intelligence Unit (EIU) Viewpoint; The World Bank Open Data





Italy

Italy has strengths in energy efficiency and its plans to become a hub for green hydrogen, but difficulties gaining authorizations to develop new power generation and renovate homes, particularly older and historic ones, pose challenges.

Italy has made strong progress on energy efficiency, with the International Energy Agency (IEA) noting in a recent report that since 2010 energy demand has decoupled from economic growth and that the country is on track to reach its 2030 national target in this area.¹ The country is also planning to end use of coal to generate electricity by 2025 and may manage this in 2024, its environment minister Gilberto Pichetto Fratin said in June. It increased its use of coal in 2022 to provide alternatives to gas imported from Russia, but the country intends to increase the proportion of electricity generated from renewables from one-third to two-thirds by 2030, he added, although there are no plans to reintroduce nuclear power after the country voted to abandon it in a 1987 referendum.²

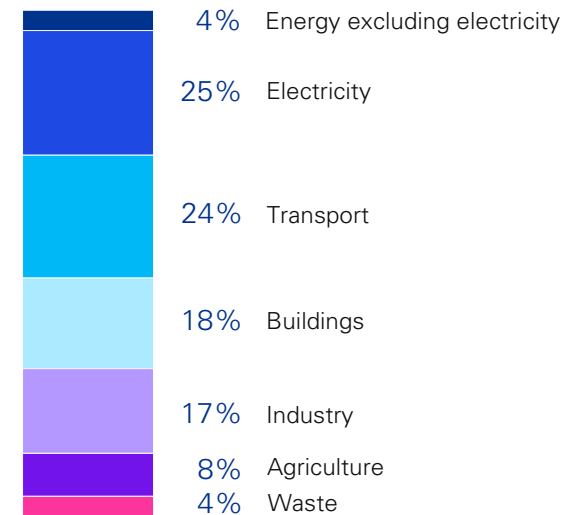
The government is focused on developing green hydrogen produced from renewable energy, based partly on Italy's location between northern Africa and central Europe. In June, the German Chancellor Olaf Scholz and Italian Prime Minister Giorgia Meloni agreed to a pipeline that could carry hydrogen as well as natural gas between their two countries, following an announcement in May by the Italian, German and Austrian governments supporting a SouthH2 Corridor hydrogen-ready pipeline system that would stretch 3,300 kilometers between Italy and northern Africa.³

In October 2022, energy companies Enel Green Power and ENI announced they will receive public funding to set up electrolysis systems to produce green hydrogen at two ENI refineries in Gela and Taranto.⁴ In June this year, French energy company EDF's Italian subsidiary Edison opened a renovated natural gas-fired power station near Venice that can run partly on hydrogen, which was presented by the government as a strategic development in the country's energy transition.⁵

Obstacles to authorization

However, some obstacles are slowing the development of new energy generation, while infrastructure aimed at capturing and storing carbon dioxide is limited or still to be developed. "Authorization processes slow down the development of new installations," says Stefano Giacomelli, Associate Partner, KPMG in Italy. Building a new solar photovoltaic plant requires the involvement of many stakeholders and institutions that can

GHG emissions split by sector (2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023



take a long and unpredictable time to complete their work, he says, with plans influenced by the presence of nearby historic sites in a country that has many of them.

Italy has already achieved some progress in decarbonizing buildings. The IEA says that energy consumption is falling for residential and commercial property, with the sector expected to provide 60 percent of overall annual energy savings, encouraged through government policies designed to encourage refitting existing buildings.⁶ Giacomelli

says that further progress may be challenged by the age of many Italian homes that were built before energy-saving regulations were introduced, meaning they require renovation, and this will be harder for those of historic importance. There are also conflicting demands on the government to provide more social housing.

The country's industrial users will be affected by the withdrawal of almost all free allowances under the EU Emissions Trading Scheme and the transition to the bloc's

Carbon Border Adjustment Mechanism. Riccardo Lucarelli, Assistant Manager — Sustainability & Climate Change Services, KPMG in Italy, says it will be important to ensure that these changes encourage decarbonization in a targeted way, such as through developing green hydrogen and carbon capture and storage.

¹ 'Energy efficiency', Italy 2023 energy policy review, International Energy Agency, May 2023. <https://www.iea.org/reports/italy-2023>

² Francesca Landini, 'Italy could abandon coal by 2024, environment minister says', Reuters, 5 June 2023. <https://www.reuters.com/world/europe/italy-could-abandon-coal-by-2024-environment-minister-says-2023-06-05/>

³ Rachel More and Francesca Landini, 'Germany, Italy support new hydrogen-ready pipeline project', Reuters, 8 June 2023. <https://www.reuters.com/business/energy/germany-italy-support-new-hydrogen-ready-pipeline-project-2023-06-08/>

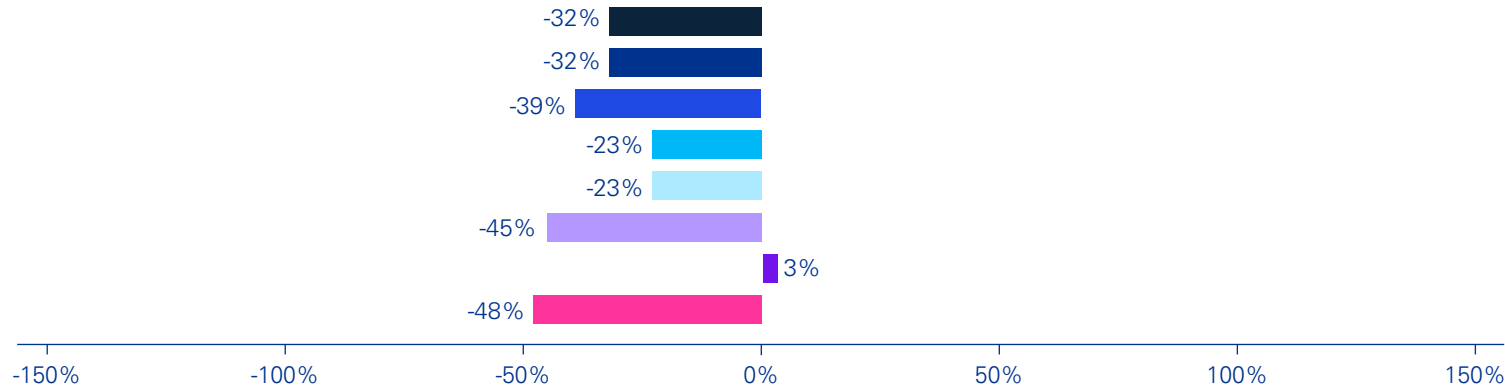
⁴ 'Green hydrogen: IPCEI Hy2USE to fund joint projects in Gela and Taranto between Enel Green Power and ENI', ENI, 13 October 2022. <https://www.eni.com/en-IT/media/press-release/2022/10/green-hydrogen-projects-gela-taranto.html>

⁵ Giancarlo Navach and Francesca Landini, 'Edison opens 'strategic' hydrogen-ready power plant near Venice', Reuters, 16 June 2023. <https://www.reuters.com/business/energy/edison-inaugurates-power-station-running-hydrogengas-mix-2023-06-16/>

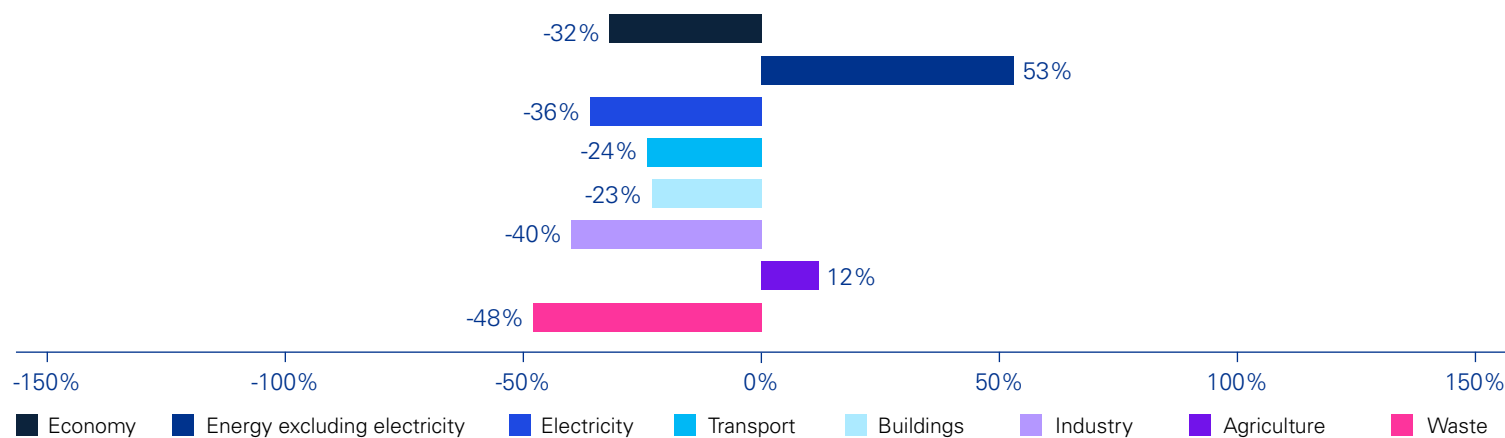
⁶ 'Foreword', Italy 2023 energy policy review, International Energy Agency (as above).



Change in absolute emissions (2005–2022)



Change in emissions intensity (2005–2022)



Legend: Economy (black), Energy excluding electricity (dark blue), Electricity (blue), Transport (cyan), Buildings (light blue), Industry (purple), Agriculture (dark purple), Waste (pink)

Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023; Energy Institute's 2023 Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>; Economist Intelligence Unit (EIU) Viewpoint; The World Bank Open Data





Japan

The government looks to develop low carbon energy sources, including floating wind, green hydrogen and nuclear, while establishing green transformation policies and initiatives including a GX League for companies to collaborate on decarbonization.

Japan has limited land for onshore renewable power generation and few shallow seas suitable for fixed-bottom wind turbines.¹ To utilize deep water areas, the government has updated its Basic Plan on Ocean Policy and prepared legislation that would allow the development of floating wind turbines in Japan’s large exclusive economic zone of ocean as well as within its much smaller territorial waters.² The government acknowledges that wind power plays a major role for reaching net zero emission targets.

While the country is looking at developing green hydrogen and ammonia production, doing so would require large amounts of low-carbon electricity. Ayako Torii, Manager at KPMG in Japan, says Japan aims to supply 12 million tonnes of hydrogen annually by 2040 through the public and private sectors investing 15 trillion yen (JPY) (US\$101 billion) according to the government’s revised hydrogen strategy published in June 2023.³

In August 2022, Prime Minister Fumio Kishida announced a new focus on nuclear generation, representing a significant shift in policy.⁴ The country idled most its plants and planned to phase out nuclear power by 2030 after an earthquake and tsunami in 2011. Following Kishida’s remarks, in December 2022 the government adopted a plan to extend the life of working reactors beyond an existing 60-year limit, restart stations not currently in use and build new reactors.⁵

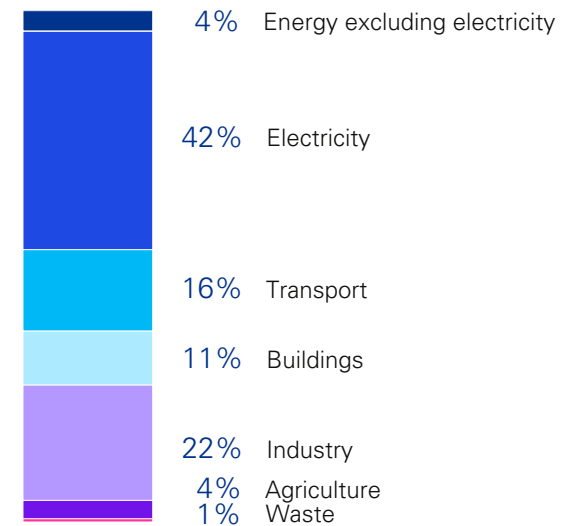
GX League and policy

Technology is at the heart of other aspects of Japan’s decarbonization efforts. In February 2022 the Ministry of Economy, Trade and Industry announced plans for a GX League, a group of companies willing to work towards carbon

neutrality by 2050 through the use of green transformation or ‘GX’.⁶ With companies from a range of industries, the group is working to develop plans including rules to create markets and a carbon credit exchange scheme.⁷

In February this year, the government published a broad GX policy which was approved by Japan’s Cabinet in July. As well as covering the expansion of nuclear power and renewables and exploring the use of carbon capture and storage for power

GHG emissions split by sector (2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023



generation, it includes plans for the gradual introduction of an emissions trading system and carbon pricing mechanism.⁸ Torii says GX transition bonds will be issued to support private investment towards decarbonization. The government is focusing GX work on hydrogen and ammonia production, carbon recycling fuel, fuel cells and other decarbonization technologies.

Japan has been relatively successful in decarbonizing transport, but there are challenges ahead. Automotive manufacturers including

Mitsubishi and Nissan were among the first to produce electric vehicles, but their success in selling hybrids that combine use of fossil fuels and battery technology has led to them falling behind Chinese, American and European manufacturers on sales of purely electric vehicles.⁹ Meanwhile, public use of Japan's renowned rail system fell sharply during the COVID-19 pandemic leading some people to move to carbon-intensive car travel. However, rail passenger numbers during April and May 2023's Golden Week holiday period recovered to 94 percent of the 2018 level.¹⁰

The agriculture ministry has developed a strategy for sustainable food systems known as Midori, which includes ending fossil fuel use in agriculture, forestry and fisheries by 2050 and has similarities with the EU's 'farm to fork' food systems strategy.¹¹ In August 2022 the ministry set interim targets for 2030 under its strategy, including a 10.6 percent reduction in carbon dioxide emissions.¹²

¹ 'Offshore wind power in Japan, too', Renewable Energy Institute (Japan). https://www.renewable-ei.org/en/activities/projects/osw_message_202304.php

² 'Japan's new maritime policy to promote decarbonization, offshore wind power', Japan News, 2 March 2023. <https://japannews.yomiuri.co.jp/business/economy/20230302-94570/>

³ 'Japan to invest \$100bn in hydrogen supply for decarbonization', Nikkei Asia, 6 June 2023. <https://asia.nikkei.com/Spotlight/Environment/Japan-to-invest-100bn-in-hydrogen-supply-for-decarbonization>

⁴ Mayu Sakoda and Yoshifumi Takemoto, 'Japan signals return to nuclear power to stabilise energy supply', Reuters, 24 August 2022. <https://www.reuters.com/world/asia-pacific/japan-pm-call-development-construction-new-generation-nuclear-power-plants-2022-08-24/>

⁵ Mari Yamaguchi, 'Japan adopts plan to maximize nuclear energy, in major shift', Associated Press, 22 December 2022. <https://apnews.com/article/russia-ukraine-business-japan-climate-and-environment-02d0b9dfec8cdc197d217b3029c5898>

⁶ 'GX League Basic Concept Announced, Call for Endorsing Companies Starts', Japan Ministry of Economy, Trade and Industry, 1 February 2022. https://www.meti.go.jp/english/press/2022/0201_001.html

⁷ 'About GX League', GX League. <https://gx-league.go.jp/en/>

⁸ Takeo Kumagai and Atsuko Kawasaki, 'Japan's green transformation policy to alter LNG contract strategies', S&P Global Commodity Insights, 17 February 2023. <https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/energy-transition/021723-japans-green-transformation-policy-to-alter-lng-contract-strategies>

⁹ Ko Fujioka, 'How success in hybrid cars turned Japan into an EV laggard', Nikkei Asia, 29 December 2022. <https://asia.nikkei.com/Business/Business-trends/How-success-in-hybrid-cars-turned-Japan-into-an-EV-laggard>

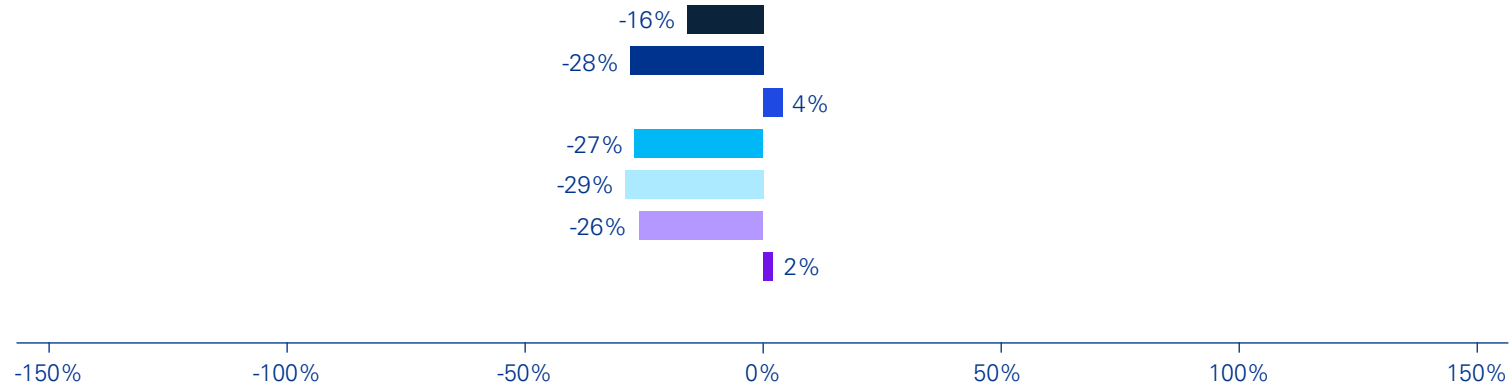
¹⁰ 'Golden Week express train passengers at 94% of pre-pandemic level', The Japan Times, 8 May 2023. <https://www.japantimes.co.jp/news/2023/05/08/national/golden-week-train-passengers/>

¹¹ 'Strategy for Sustainable Food Systems, Midori', Japan Ministry of Agriculture, Forestry and Fisheries. https://www.maff.go.jp/e/policies/env/env_policy/meadri.html

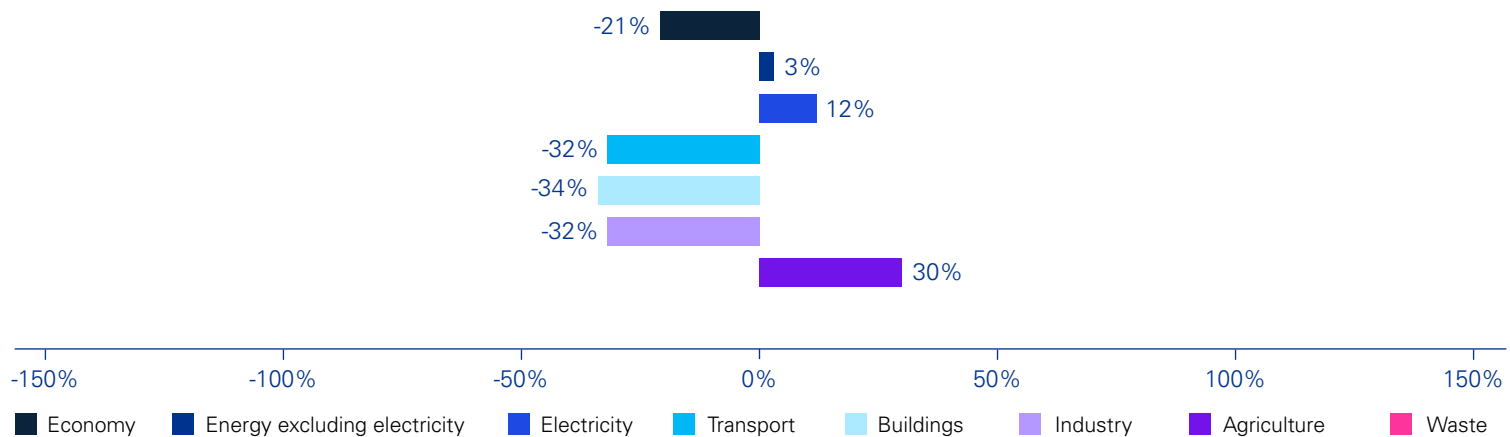
¹² 'Japan sets new 2030 targets for Green Food System Strategy', US Department of Agriculture Foreign Agricultural Service, 22 August 2022. <https://www.fas.usda.gov/data/japan-japan-sets-new-2030-targets-green-food-system-strategy>



Change in absolute emissions (2005–2022)



Change in emissions intensity (2005–2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023; Energy Institute's 2023 Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>; Economist Intelligence Unit (EIU) Viewpoint; The World Bank Open Data





Mexico

The country has strengthened its decarbonization targets and produced sector-specific strategies with social as well as environmental aims, while renovating hydroelectric power plants and designing state-level strategies for addressing climate ambitions.

Mexico’s work towards net zero emissions is being strengthened under four major constituent parts according to Alicia Moreno Lara, ESG Strategy Director, KPMG in Mexico. The Mexican Emissions Trading System moved in 2023 from a pilot phase to an operational one. In 2022, Mexico toughened its UN climate change nationally determined contributions, increasing its greenhouse gas emissions reduction target from 22 percent to 35 percent by 2030, compared with 1990 levels, with the possibility of increasing the target to 40 percent if it receives sufficient international support on finance, innovation and technology transfer.¹ During recent years the government has implemented carbon taxes at specific state level jurisdictions and in March 2023 it launched the Mexican sustainable taxonomy, a classification system designed to define criteria for sustainable projects and activities that are aligned to positive environmental and social impacts.²

Challenges include establishing financial mechanisms and commitments for long-term support as well as developing detailed plans at federal and regional level, Lara says. Mexico should identify and implement useful technologies and ensure the technical skills and capacities to use these as well as to implement mitigation and adaptation actions based on political will and public-private collaboration.

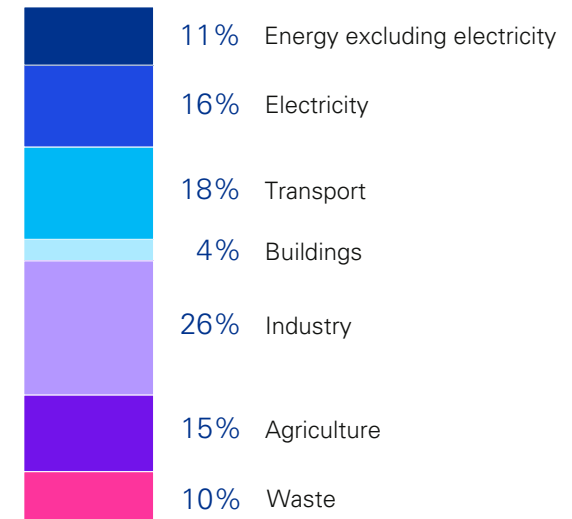
Mexico currently generates most of its electricity from fossil fuels but plans to change this through a range of measures, including upgrading the hydroelectric power plants that produce much of the country’s renewable energy.³ The country is also working to integrate clean energy into electricity generation, substitute high-carbon fuels with natural gas in power plants and reduce technical losses in the power grid. It is also working on the development of solar powered homes and the promotion of green hydrogen use.

On transport, the government is focusing on public services where improvements also have social benefits, such as by

introducing electric bus rapid transit vehicles. Other work includes regulations on vehicle efficiency, the development of clean transportation programs, urban planning that increases space for pedestrians and the expansion and rehabilitation of the rail network. The government has issued a decree that makes lithium, used in batteries, a strategic mineral and published a national strategy to promote remote working and reduce commuting.

As well as participating in emissions trading and carbon pricing mechanisms, the government is aiming to decarbonize industry through a range of strategies, including the circular economy.

GHG emissions split by sector (2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023



In agriculture it is promoting fertilizer substitution, reduced agricultural burning and the capture and management of livestock biogas. The country is working to develop carbon capture through its ENAREDD+ strategy to reduce emissions from deforestation and forest degradation, although it needs to set and strengthen specific actions to meet its ambitious goals to increase the land covered by natural protected areas.

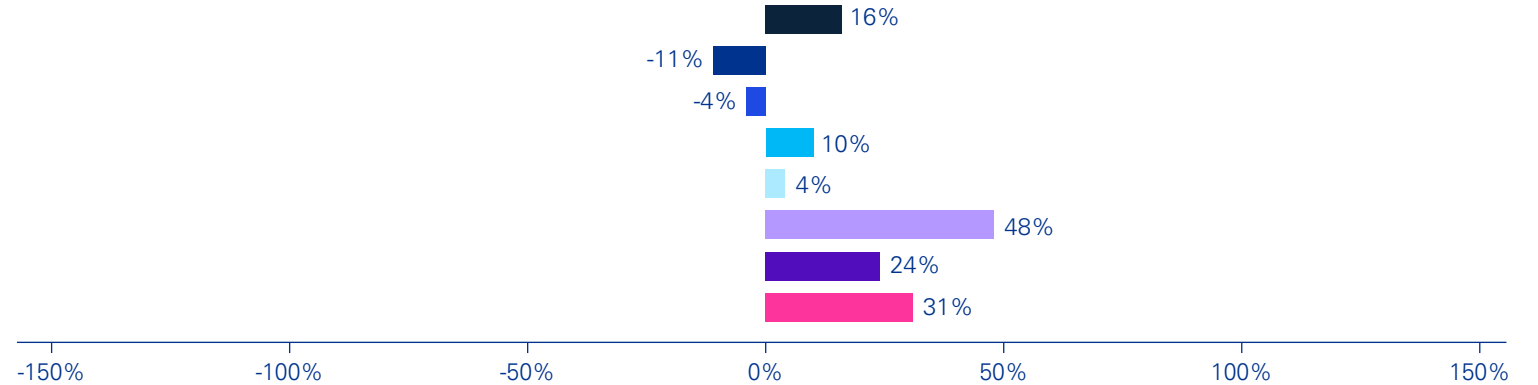
While the government has developed numerous strategies, Lara says that a lot of initiatives in place still need to set clear rules of operation, including mechanisms such as the Emissions Trading System and carbon taxes. “There are still questions over how these will be applied, how the public, private and third sectors are going to collaborate, how skills and capabilities will be attained and how we are going to access sustainable finance for leveraging these plans,” she says.

¹ ‘Mexico announces new commitments to combat climate change at COP27’, Government of Mexico, 14 November 2022. <https://www.gob.mx/sre/prensa/mexico-announces-new-commitments-to-combat-climate-change-at-cop27>

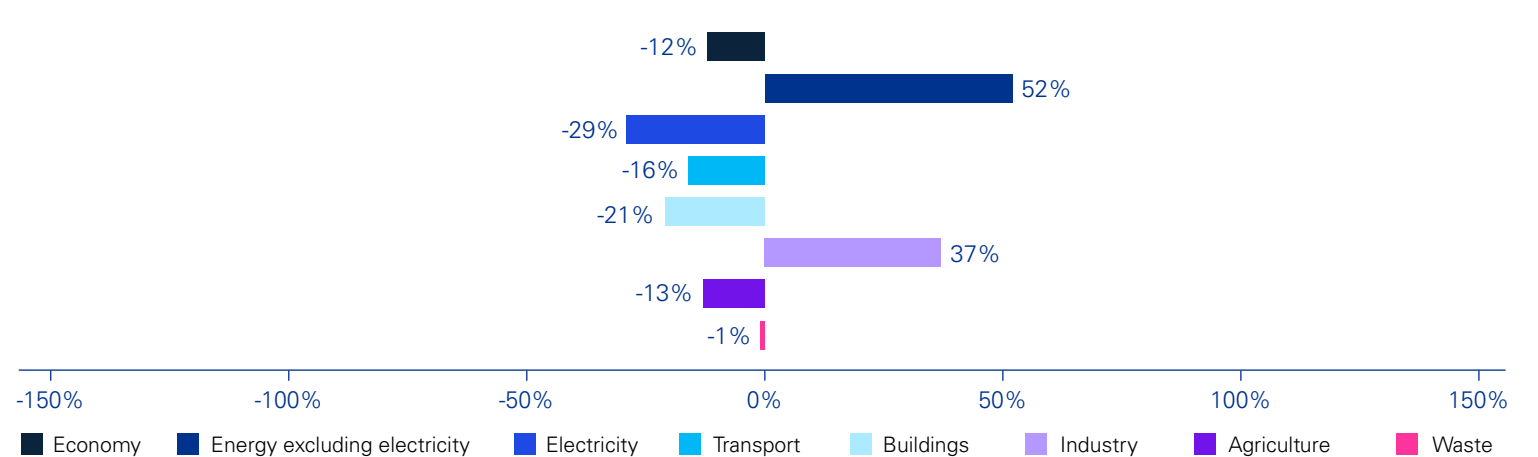
² ‘Comunicado No. 16 La Secretaría de Hacienda presenta la Taxonomía Sostenible de México’ (in Spanish), Government of Mexico, 15 March 2023. <https://www.gob.mx/shcp/prensa/comunicado-no-16-la-secretaria-de-hacienda-presenta-la-taxonomia-sostenible-de-mexico>

³ Cas Biekmann, ‘Mexico’s hydropower modernization examined’, Mexico Business News, 1 October 2021. <https://mexicobusiness.news/energy/news/mexicos-hydropower-modernization-examined>

Change in absolute emissions (2005–2022)



Change in emissions intensity (2005–2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023; Energy Institute’s 2023 Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>; Economist Intelligence Unit (EIU) Viewpoint; The World Bank Open Data



Netherlands

The country has strong ambitions and national net zero policies, but is seeing significant implementation problems, with EU-driven requirements to cut nitrogen emissions leading to mass protests by farmers and delays to new renewable energy plants, along with a reluctance to subsidize emerging energy technologies.

The Netherlands has included net zero emissions objectives in a range of national policies, including those on waste reduction, rural areas, energy and transport. The latest version of its decades-old Delta flooding and water management program includes preparing for extreme weather such as the torrential rainfall experienced in Limburg in 2021 across the country.¹ In 2019 government, companies and organizations agreed a climate agreement as part of the country’s regularly updated climate plan.

But the Netherlands is experiencing problems implementing some of these policies. A 2019 court ruling on reducing nitrogen emissions, which led to a plan to close around 11,200 livestock farms and significantly reduce the size of 17,600 more, resulted in widespread protests by farmers.² A protest party founded to oppose these plans won more seats in March 2023 elections to the Dutch Senate than Prime Minister Mark Rutte’s party.³ This was one factor contributing to the failure of Rutte’s attempts to continue his coalition government in July, leading to a general election in November and an interim government until then.⁴ “A lot of plans will be delayed significantly due to there being no room for decisions,” says Ubbo van Zessen, Head of ESG, KPMG in the Netherlands.

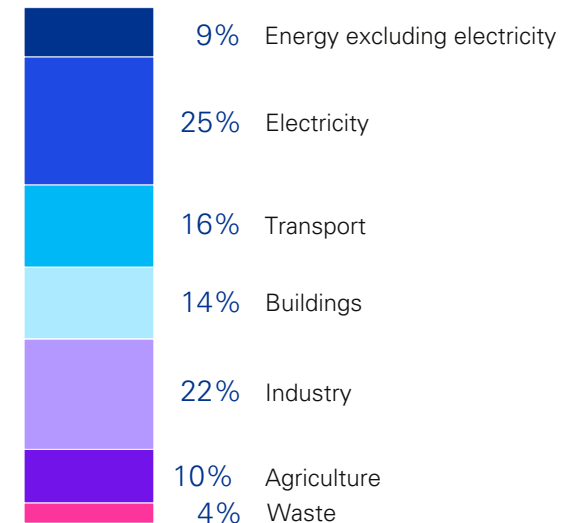
The nitrogen reduction rules have also blocked or slowed construction work, including some for new low carbon energy production. In July the outgoing chief executive of the port of Rotterdam said that the need to apply for nitrogen emission permits is hindering construction of green hydrogen and biofuel plants by companies including Shell and Neste at the port.⁵

Improving existing energy technologies

The government focuses its energy development subsidies on improving existing technologies such as solar, offshore wind and carbon capture and storage, rather than emerging ones including green hydrogen and geothermal. “They are not risk-minded,” says Bob Hoogendoorn, Director of Sustainability, KPMG in the

Netherlands. “They are really careful about where they spend their money, but that means you often make stronger what is already strong, making it difficult to develop new ideas.” For example, the Netherlands has made strong progress on developing solar power production but there are physical and administrative constraints in grid infrastructure. This means that in some areas the grid network operator will not allow new or expanded connections, which particularly affects new onshore wind parks, installation of solar energy and expansion of charging infrastructure for electrical vehicles. As a result, more energy storage capacity and innovation to develop this further will be a key part of the Netherlands’ energy transition.

GHG emissions split by sector (2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023



The country faces issues with its carbon pricing system, which gives some industrial exporters advantages which can work against smaller companies in the food processing sector, although international competition and EU policies are counteracting this. Meanwhile, the implementation of the EU’s Corporate Sustainability Reporting Directive, requiring companies to report on climate change as well as other impacts on the environment and society, is likely to accelerate corporate decarbonization work and should motivate government agencies to do likewise.

The Netherlands also has the potential to develop carbon capture and storage, alternative construction materials and work to save energy. It has made significant progress on saving energy recently due to high energy prices, something which is an essential part of meeting decarbonization targets and making a success of the energy transition.

¹ ‘Brochure outlines Delta Programme 2023’, Netherlands National Delta Programme, 20 September 2022. <https://english.deltaprogramma.nl/documents/publications/2022/09/20/brochure-outlines-delta-programme-2023-english>

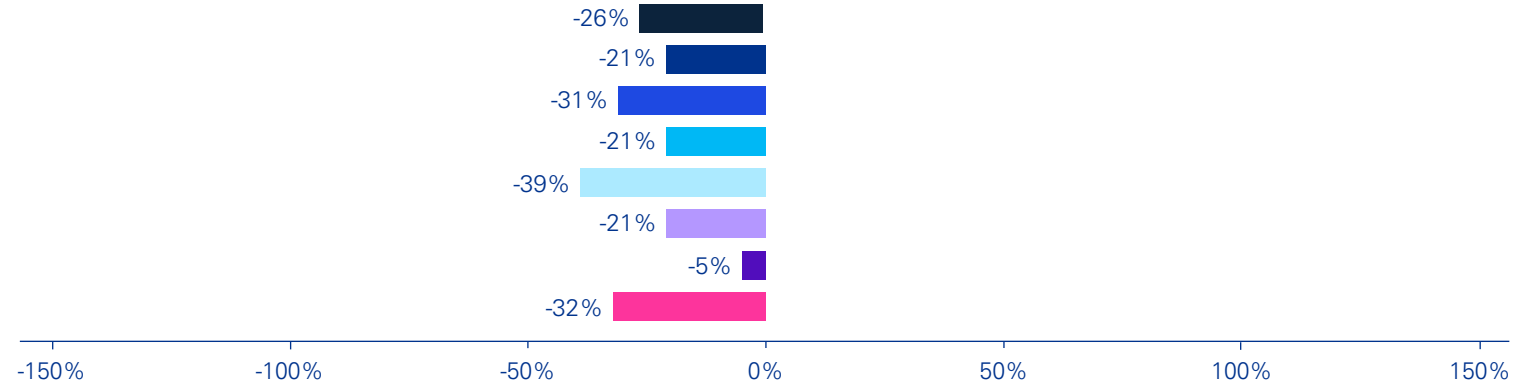
² ‘Why Dutch farmers are protesting over emissions cuts’, BBC News, 29 July 2022. <https://www.bbc.com/news/world-europe-62335287>

³ Bart Meijer, ‘Dutch farmers’ protest party scores big election win, shaking up Senate’, Reuters, 16 March 2023. <https://www.reuters.com/world/europe/farmers-protest-party-set-shake-up-dutch-political-landscape-2023-03-15/>

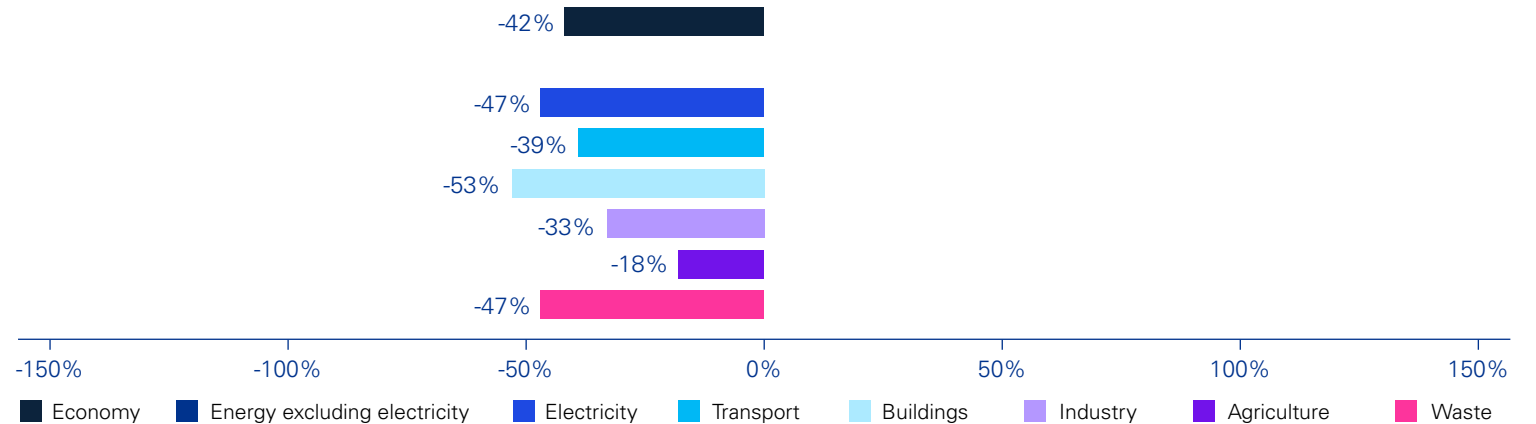
⁴ Charlotte Van Campenhout and Bart Meijer, ‘Dutch polls, first in years without PM Rutte at VVD helm, set for November’, Reuters, 14 July 2023. <https://www.reuters.com/world/europe/dutch-election-be-held-nov-22-nos-2023-07-14/>

⁵ Andy Bounds, ‘Dutch emissions laws stall €10bn of green investment at Europe’s biggest port’, Financial Times, 19 July 2023. <https://www.ft.com/content/cc024ad9-f9ab-46f8-a212-a5a23b531c0e> and ‘Haven van Rotterdam: als stikstofcrisis niet snel wordt opgelost, dreigen we miljarden mis te lopen’ (in Dutch), NPO Radio 1, 9 May 2023. <https://www.nporadio1.nl/nieuws/binnenland/ed4eb9c2-6145-4cb9-9942-ed3636c9fd9a/directeur-haven-van-rotterdam-als-stikstofcrisis-niet-snel-wordt-opgelost-dreigen-we-miljarden-mis-te-lopen>

Change in absolute emissions (2005–2022)



Change in emissions intensity (2005–2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023; Energy Institute’s 2023 Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>; Economist Intelligence Unit (EIU) Viewpoint; The World Bank Open Data



New Zealand

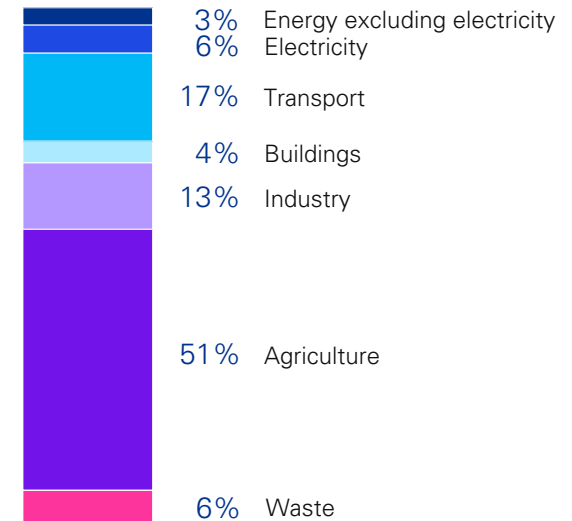
A lack of agreement on plans to reduce emissions from livestock farming and a reversed government intervention in the emissions trading scheme are causes for concern, but the industrial and electricity sectors are making good progress.

New Zealand is one of just two countries in the NZRR where agriculture and land use are responsible for more than half of total emissions. The country is a major agricultural exporter, expecting to sell 25.1 billion New Zealand dollars (NZD) (US\$15.1 billion) of dairy products and NZD11.9 billion of meat and wool overseas in the year to June 2023.¹ New Zealand’s agricultural sector is already highly efficient and continues to make progress in decoupling emissions from production. However, the speed and scale of reductions in agricultural emissions required to meet the country’s 2030 commitments are not being realized, says Dr Charles Ehrhart, Head of Climate Risk, Resilience and Adaptation, KPMG International and Partner, Co-Lead Climate Change, Decarbonization, ESG and Sustainability, KPMG in New Zealand.

The government formed a partnership, He Waka Eke Noa, with representative organizations of farmers and growers, which was tasked with establishing a plan to measure, manage and reduce on-farm agricultural greenhouse gas emissions and adapt to climate change. The partnership’s work included developing proposals for an effective system to price agricultural emissions from 2025. In October 2022, it published a proposal on emission pricing at the farm level.² Ehrhart says: “He Waka Eke Noa has not succeeded in developing a mutually acceptable approach to pricing agricultural emissions. We are not making the progress required to identify, much less execute, a collaborative solution to decarbonizing New Zealand’s agriculture sector.” If a scheme for the sector cannot be agreed with farmers, the government plans to add agriculture to the New Zealand Emissions Trading Scheme (NZ ETS) by January 2025.

The government’s management of the NZ ETS has itself caused problems. In December 2022 the government decided to loosen its price and unit settings over concerns that its gradually increasing carbon price would contribute to higher fuel and electricity costs for consumers, despite advice against this from the country’s Climate Change Commission.³ “The changes resulted in market participants losing

GHG emissions split by sector (2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023



confidence, failed auctions of credits and a slide in the carbon price from around NZD90 per MtCO₂e in November 2022 to NZD35 on 5 July 2023,” says Markus Vencatachellum, Senior Advisor, Carbon Markets practice, KPMG in New Zealand.⁴ The price rose sharply on 25 July when the government announced it was tightening price and unit settings again, having lost a judicial review.⁵

Fund for industrial decarbonization

In other sectors, New Zealand is making good progress. The government is channeling proceeds from its ETS through the Government Investment in Decarbonising Industry (GIDI)

Fund, which aims to accelerate decarbonization by providing co-funding for initial capital costs of fuel switching to renewables.⁶ KPMG in New Zealand has advised the fund’s manager, the New Zealand Energy Efficiency and Conservation Authority, on structuring grant funding for the steel industry.⁷ With GIDI support, NZ Steel will replace existing technology with what is slated to be the first electric arc furnace in New Zealand, reducing industrial greenhouse emissions by an estimated 800ktCO₂e annually.⁸

Industry’s decarbonization is supported by the fact that most electricity comes from low-carbon sources. There is cross-party agreement on further developments to support

clean electricity, such as easing bottlenecks on planning and permits for new renewable generation and increased grid capacity to support this.

Transport decarbonization is more challenging, with most of the country lacking population densities that can support effective public transport and neglected rail and coastal shipping services. Ehrhart says that more coherence from government on decarbonizing the sector, including work to encourage adoption of electric vehicles, would be welcome.

¹ ‘Situation and outlook for primary industries’, New Zealand Ministry for Primary Industries, June 2023. <https://www.mpi.govt.nz/resources-and-forms/economic-intelligence/situation-and-outlook-for-primary-industries/>

² ‘Consultation on proposals to price agricultural greenhouse gas emissions’, New Zealand Ministry for the Environment, 11 October 2022. <https://environment.govt.nz/news/consultation-on-government-proposals-to-price-agricultural-greenhouse-gas-emissions/>

³ Marc Daalder, ‘Cabinet overrides Shaw and Commission on carbon price’, Newsroom, 16 December 2022. <https://www.newsroom.co.nz/sustainable-future/cabinet-overrides-shaw-and-commission-on-carbon-price>

⁴ Agamoni Ghosh and Kshitiz Goliya, ‘New Zealand carbon prices rally as government strengthens ETS price settings’, S&P Global Commodity Insights, 27 July 2023. <https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/energy-transition/072723-new-zealand-carbon-prices-rally-as-government-strengthens-ets-price-settings>

⁵ ‘Emissions Trading Scheme settings updated’, New Zealand Government press release, 25 July 2023. <https://www.beehive.govt.nz/release/emissions-trading-scheme-settings-updated>

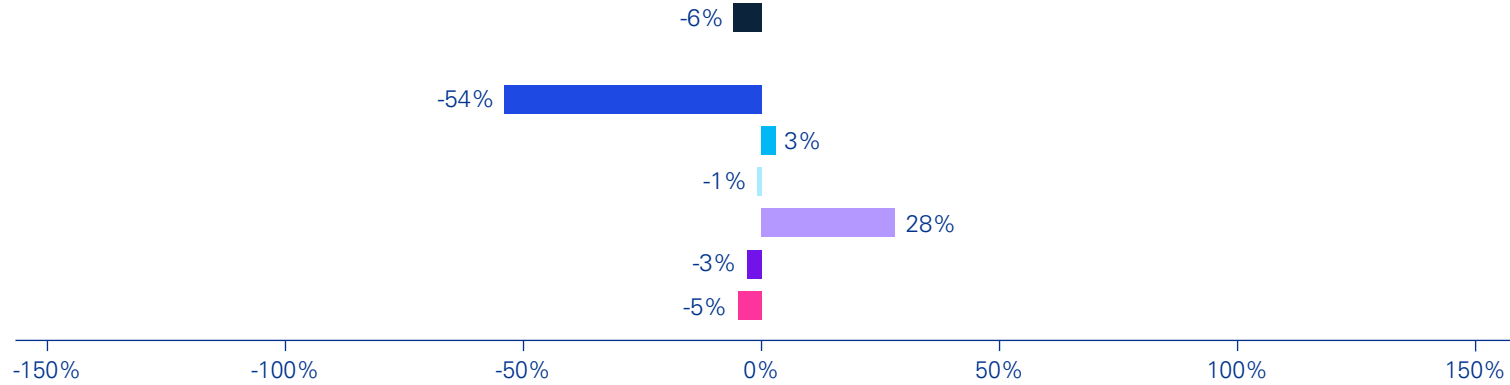
⁶ ‘About the Government Investment in Decarbonising Industry Fund’, New Zealand Energy Efficiency and Conservation Authority. <https://www.eeca.govt.nz/co-funding/industry-decarbonisation/about-the-government-investment-in-decarbonising-industry-fund/>

⁷ ‘NZ’s biggest ever emissions reduction project unveiled’, New Zealand Government press release, 21 May 2023. <https://www.beehive.govt.nz/release/nz%E2%80%99s-biggest-ever-emissions-reduction-project-unveiled>

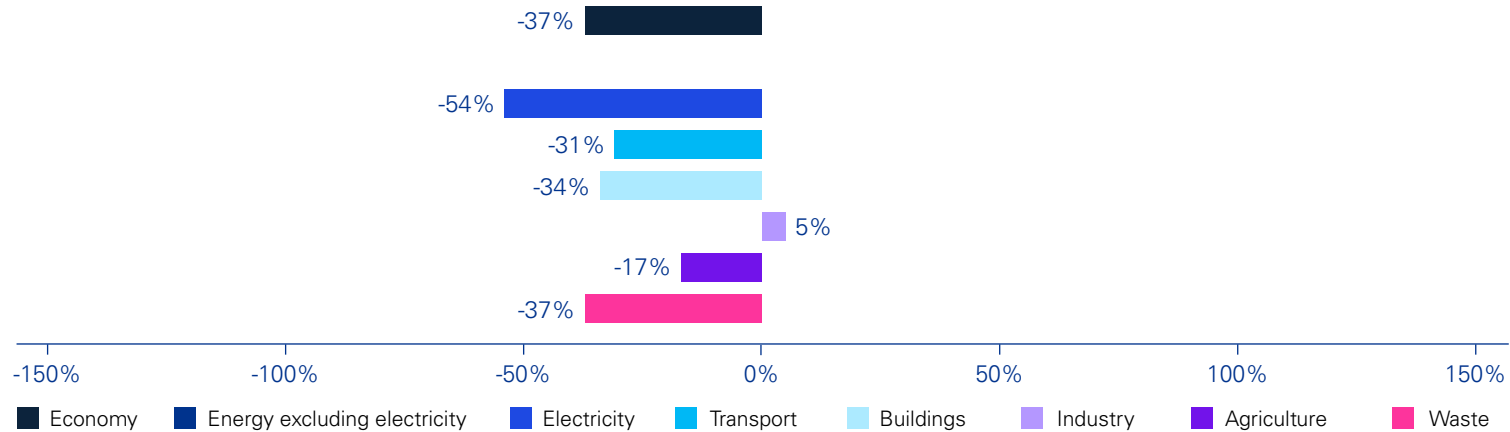
⁸ Luke Malpass, ‘Government announces massive emissions-cutting deal with NZ Steel, Contact Energy’, Stuff, 21 May 2023. <https://www.stuff.co.nz/national/politics/132102525/government-announces-massive-emissions-cutting-deal-with-nz-steel-contact-energy>



Change in absolute emissions (2005–2022)



Change in emissions intensity (2005–2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023; Energy Institute's 2023 Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>; Economist Intelligence Unit (EIU) Viewpoint; The World Bank Open Data





Norway

The country is a leader in decarbonization efforts with most new cars now electrically powered, but a new government is developing rather than dismantling the country’s economically key oil and gas production, reflecting dilemmas over how to make a net zero transition work.

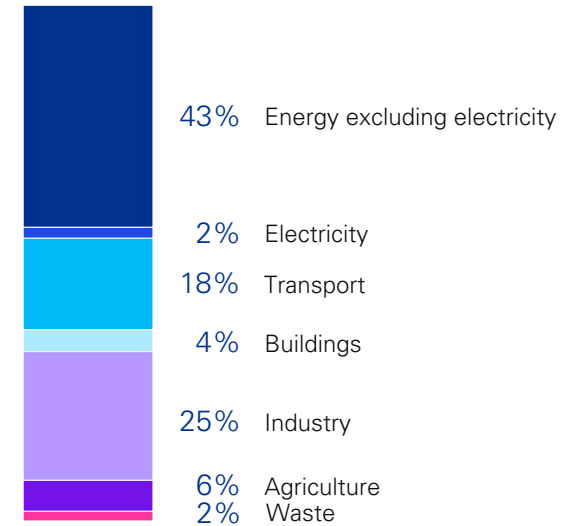
Norway generates nearly all of its electricity from hydro power, uses this renewable electricity to heat most homes as well as power them and has led the world in adopting electric vehicles. The country has set a legally binding target to reach net zero emissions by 2050 but is aiming to be carbon neutral as soon as 2030 by offsetting its emissions, including through an agreement with the EU to take part in its Emissions Trading System despite not being a member of the bloc.

But a new government elected in October 2021, led by the center-left Labor party with the support of the rural-focused Center party, said soon after that the country’s large oil and gas sector would be “developed, not dismantled”.¹ In January this year it offered a record number of areas in its Arctic territorial waters to companies for oil and gas exploration.² In June, its parliament approved the development of 19 oil and gas fields which will involve investments in excess of 200 billion Norwegian krone (NOK) (US\$18.4 billion), despite protests by environmentalists.³

Carl Christian Christensen, Head of ESG Advisory & Assurance, KPMG in Norway, says that other European countries have put pressure on Norway to produce more oil and gas to help compensate for supplies reduced following embargos of Russian gas supply. “We are in a dilemma where on one side we are determined to make this transition to net zero work over time, but in the short and medium term we still have to produce our share of what the market needs in terms of oil and especially gas to Europe,” he says. More broadly, Norway’s determination to decarbonize comes into conflict with its national wealth and welfare system, built largely on revenue from oil and gas production.

The country is developing offshore wind generation, drawing on its experience in offshore oil and gas, and by 2040 hopes to allocate areas with the capacity to produce 30GW of electricity. In March, the government announced competitions to build turbines in the Utsira Nord and Sørlige Nordsjø II project areas.⁴ At the same time, the building of a large onshore wind farm of 151 turbines in Norway’s Fosen district has led to protests and legal action by an indigenous Sámi community who use the area for reindeer herding.⁵

GHG emissions split by sector (2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023



Electric ecosystem

Norway has led the world in electrifying road transport, with 88 percent of new cars sold in the country in 2022 either battery or plug-in hybrid electric vehicles, compared with 21 percent across the EU's 27 members, and just over a quarter of all cars on the road in Norway are electric.⁶ The government encouraged adoption through tax breaks and price incentives, with previously low electricity prices providing further encouragement. This has helped develop Norwegian start-ups, including companies like Zaptec, which makes electric vehicle home chargers,⁷ and Tibber,

a digital native electricity supplier whose technology helps customers charge vehicles when electricity prices are lowest.⁸ The combination of tax incentives and a fast growing and well-functioning ecosystem has accelerated the adoption of electric vehicles especially by consumers.

In 2021 the agricultural industry agreed to reduce its emissions by 5MtCO₂e by 2030 through measures including more climate-friendly and sustainable livestock fodder, a shift to low carbon fuels such as electricity, biofuels and hydrogen for farm machinery and using soil for carbon storage.⁹ But in some sectors the country is

being challenged on decarbonization by the US Inflation Reduction Act, with Norwegian chemical manufacturer Yara announcing a joint-venture in March to produce low-carbon 'blue' ammonia in Texas.¹⁰

Christensen says that despite the challenges, Norway's consensual culture means it is likely to continue to press on with decarbonization, including companies adopting standards, plans and targets: "Norway is a high-trust society. Based on experience, this will likely support the transition towards net zero for Norway," he says.

¹ 'Norway's oil and gas sector will not be dismantled, new government says', BBC News, 13 October 2021. <https://www.bbc.com/news/world-europe-58896850>

² Nerijus Adomaitis and Gwladys Fouche, 'Norway plans to offer record number of Arctic oil, gas exploration blocks', Reuters, 24 January 2023. <https://www.reuters.com/business/energy/norway-offers-up-92-new-oil-gas-exploration-blocks-2023-01-24/>

³ Terje Solsvik, 'Norway approves more than \$18 billion in oil, gas investments', Reuters, 28 June 2023. <https://www.reuters.com/business/energy/norway-approves-more-than-18-bln-oil-gas-investments-2023-06-28/>

⁴ 'Havvind' (in Norwegian), Norwegian Government. <https://www.regjeringen.no/no/tema/energi/landingssider/havvind/id2830329/>

⁵ 'Respect existence or expect resistance: Protests in Norway against wind farm on Sami land', Euronews Green, 2 June 2023. <https://www.euronews.com/green/2023/06/02/respect-existence-or-expect-resistance-protests-in-norway-against-wind-farm-on-sami-land>

⁶ 'Global EV Data Explorer', EV sales and EV stock shares for Norway and EU27 for 2022, International Energy Agency. <https://www.iea.org/data-and-statistics/data-tools/global-ev-data-explorer>

⁷ 'About Zaptec', Zaptec. <https://brand.zaptec.com/d/K8pkbUYNXePL/press-kit-1#/company/about-zaptec-1686317475>

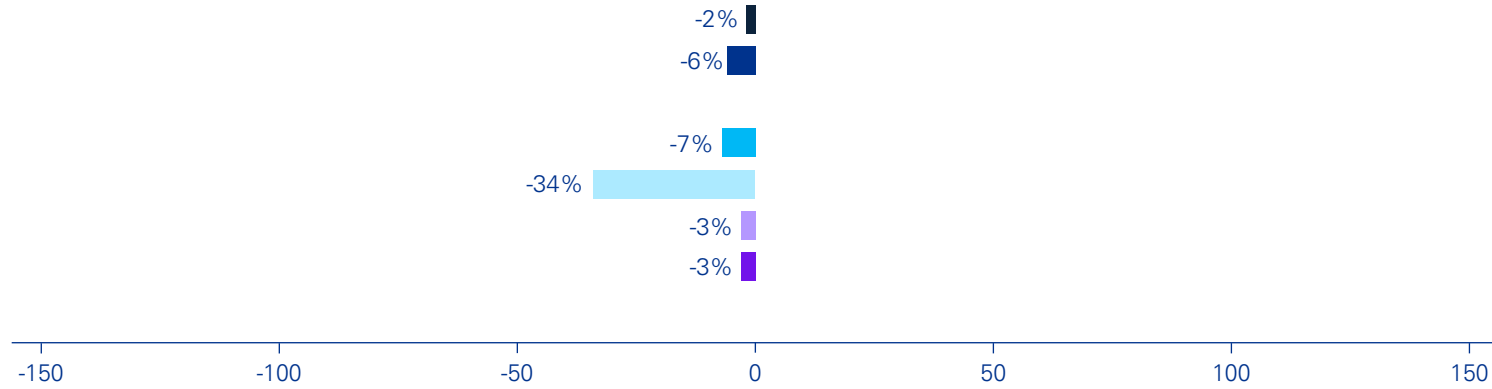
⁸ 'About us', Tibber. <https://tibber.com/en/about-us>

⁹ 'Landbrukets klimaplan 2021-2030' (in Norwegian), Norges Bondelag. <https://www.bondelaget.no/bondelaget-mener/miljo-og-klima/klima/les-klimaplanen-her>

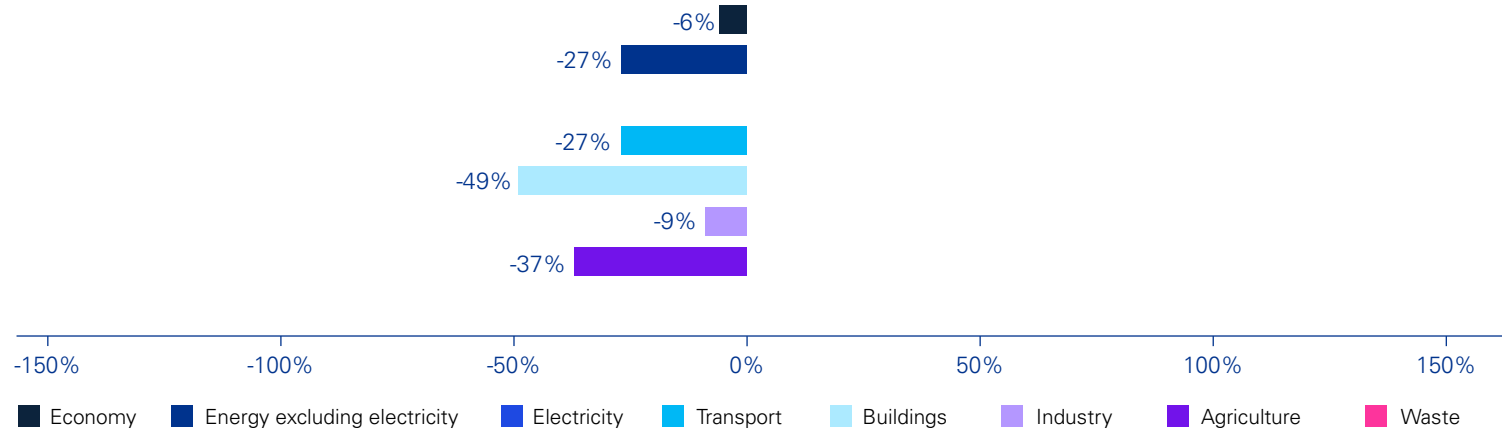
¹⁰ Victoria Klesty and Rod Nickel, 'Yara and Enbridge plan \$2.9 bln ammonia plant in Texas', Reuters, 31 March 2023. <https://www.reuters.com/business/energy/yara-enbridge-eye-29-bln-texas-ammonia-plan-2023-03-31/>



Change in absolute emissions (2005–2022)

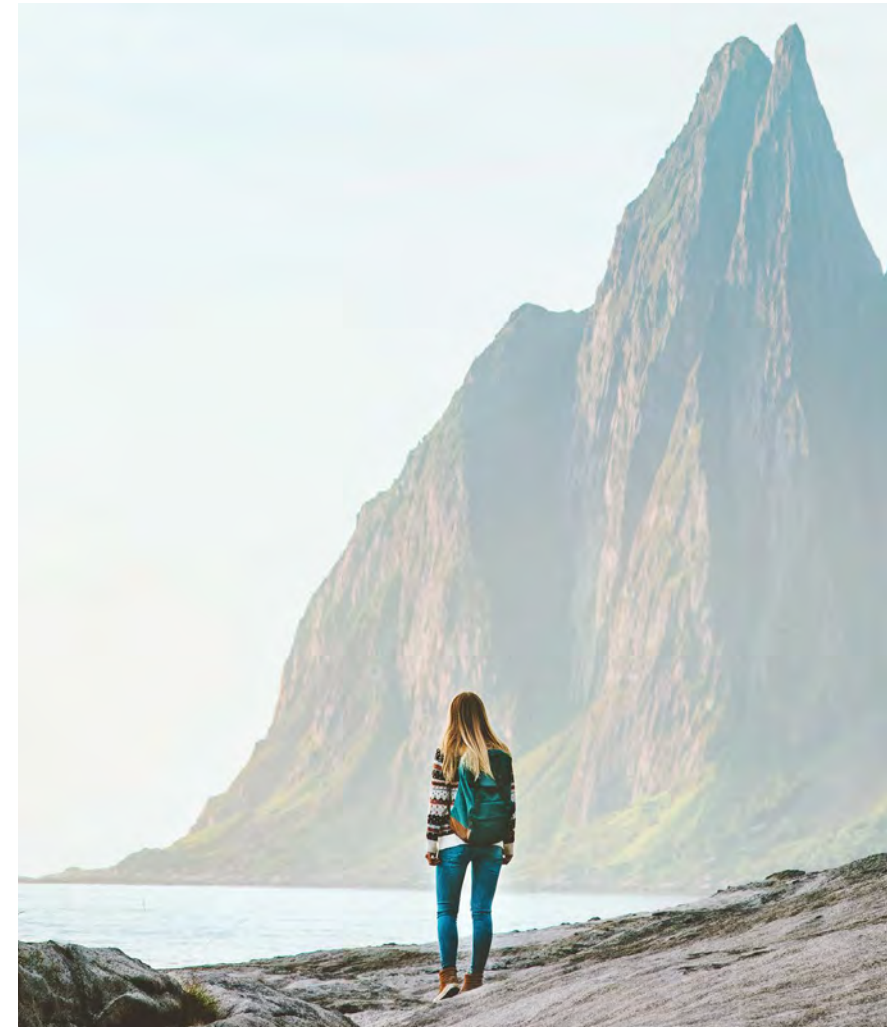


Change in emissions intensity (2005–2022)



Legend: Economy (black), Energy excluding electricity (dark blue), Electricity (blue), Transport (light blue), Buildings (light purple), Industry (purple), Agriculture (dark purple), Waste (pink).

Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023; Energy Institute's 2023 Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>; Economist Intelligence Unit (EIU) Viewpoint; The World Bank Open Data





Singapore

Singapore has committed to net zero by 2050 while raising its carbon tax and looking to neighboring countries for renewable electricity. It is working to replace shipping's bunker fuel with green ammonia and continuing to decarbonize land transport.

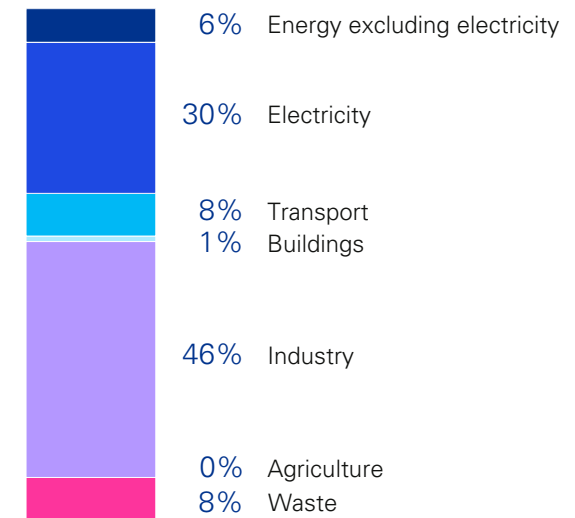
In October 2022 Singapore's government said it plans to reach net zero emissions by 2050, rather than around this date as previously, as well as set a target for 2030 of 60MtCO₂e compared with a 2020 business as usual projection of 77.2MtCO₂e.¹ "Over the last five years Singapore has made a conscious decision to move towards net zero," says Sharad Somani, Head of Infrastructure for KPMG Asia Pacific and Head of KPMG ESG at KPMG in Singapore. "For a city-state dependent on imports for almost all its supplies of necessities and being a petrochemicals and logistics hub, this is the start of large-scale economy-wide transformation." He adds that the government's reputation for stability and the pursuit of high standards will support its increasing focus on decarbonization.

Singapore introduced a carbon tax in 2019, the first country in the region to do so, which applies to about 50 high-emitting facilities. It is currently set at SGD5 (US\$3.67) per tonne of carbon dioxide equivalent emitted but will rise sharply to SGD25 at the start of 2024 then to SGD45 in 2026, with a range from SGD50-80 planned for 2030.² The government has also legislated for companies to appoint energy managers and publish energy conservation plans on a voluntary basis, which it hopes will help develop business opportunities in green financial services.

Almost all of the city-state's energy comes from imported fossil fuels and there is very little space for renewable energy production, although the government envisages the installation of about 2GW of roof-top and floating solar by 2030. Last year the Energy Market Authority of Singapore launched a tender for the import of up to 4GW of low-carbon electricity by 2035 from neighboring countries. In March this year it granted conditional approval for 1GW of renewable

electricity from Cambodia through subsea cables of more than 1,000 kilometers in length.³ The remaining 3GW is expected to be awarded by end of 2023. By 2050 the country is looking to develop green hydrogen produced with renewable energy as its main energy source and is running research and proof of concept work, which should provide opportunities to develop an import and export hub for green hydrogen given its experience in research and development.⁴

GHG emissions split by sector (2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023



The city-state imports water from neighboring Malaysia under a long-term water supply agreement which runs until 2061.⁵ Singapore plans to become water independent before that date through rain water harvesting, desalination plants and water recycling as well as imported water. Desalination is highly energy intensive so the water authority PUB is working on technology improvements to improve efficiency.⁶

Cleaning up transhipment

Singapore hosts the world's largest port for transhipment, the process of moving cargo from one vessel to another as part of a journey. Shipping currently relies on bunker oil, which generates local air pollution as well greenhouse gas emissions, but following feasibility and safety work the Maritime and Port Authority of Singapore expects it can start fueling vessels with green ammonia produced with renewable electricity from 2026.⁷ It has also published a long-term decarbonization plan for its maritime sector.⁸

The city-state has already done a lot to decarbonize local transport, including plans for all buses to run on electricity by 2025. It has cut the number of certificates of entitlement for private car ownership it auctions to enforce zero growth in overall numbers.⁹ As a result, the 3-month average cost of a 10-year certificate for a larger car tripled from SGD39,500 in December 2019 to SGD118,900 in July 2023.¹⁰

¹ 'Singapore Commits to Achieve Net Zero Emissions by 2050 and to a Revised 2030 Nationally Determined Contribution', Singapore National Climate Change Secretariat, 25 October 2022. <https://www.nccs.gov.sg/media/press-releases/singapore-commits-to-achieve-net-zero/>

² 'Carbon tax', Singapore National Climate Change Secretariat. <https://www.nccs.gov.sg/singapores-climate-action/mitigation-efforts/carbontax/>

³ 'EMA Grants Conditional Approval for 1 Gigawatt (GW) of Electricity Imports from Cambodia', Singapore Energy Market Authority, 16 March 2023. https://www.ema.gov.sg/media_release.aspx?news_sid=20230316xWTI36SCKjwW

⁴ Sharad Somani, 'Taking Singapore forward as a regional green hydrogen hub', KPMG in Singapore, 2 July 2022. <https://kpmg.com/sg/en/home/media/press-contributions/2022/07/taking-singapore-forward-as-a-regional-green-hydrogen-hub.html>

⁵ 'Water agreements', Singapore Ministry of Foreign Affairs. <https://www.mfa.gov.sg/SINGAPORES-FOREIGN-POLICY/Key-Issues/Water-Agreements>

⁶ 'Desalinated water', Singapore PUB. <https://www.pub.gov.sg/watersupply/fournationaltaps/desalinatedwater>

⁷ Rong wei Neo, 'INTERVIEW: Singapore's MPA sees earliest ammonia bunkering from 2026, methanol pilot to pave way', S&P Global Commodity Insights, 3 July 2023. <https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/Ing/070323-interview-singapores-mpa-sees-first-ammonia-bunkering-from-2026-methanol-pilot-to-pave-way>

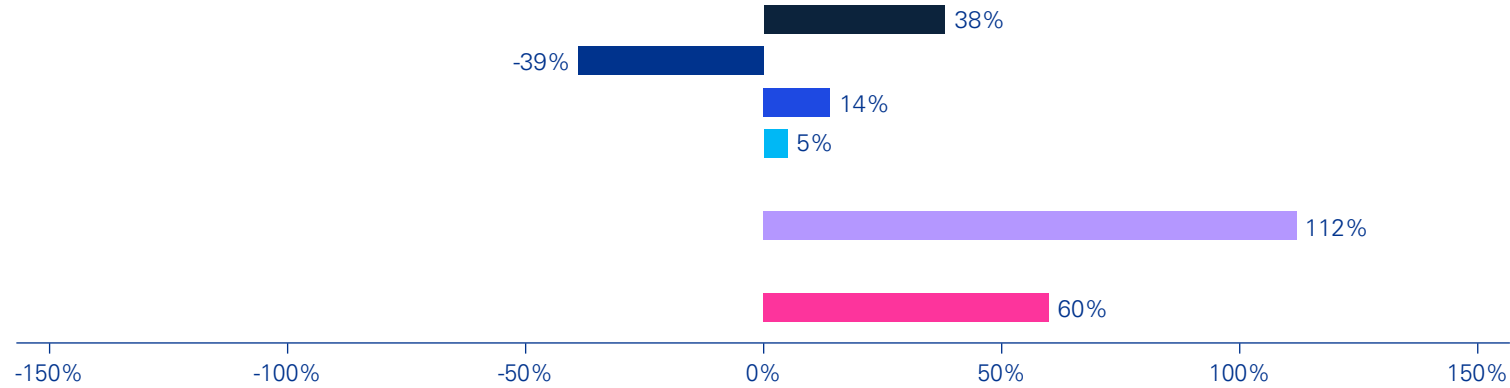
⁸ 'Maritime Singapore Decarbonisation Blueprint: Working Towards 2050', Maritime and Port Authority of Singapore, 2022. <https://www.mpa.gov.sg/maritime-singapore/sustainability/maritime-singapore-decarbonisation-blueprint>

⁹ 'Certificate of Entitlement Quota for November 2021 to January 2022, and Vehicle Growth Rate to maintain until 31 January 2025', Singapore Land Transport Authority, 15 October 2021. https://www.lta.gov.sg/content/ltagov/en/newsroom/2021/10/news-releases/COE_quota_for_Nov21_to_Jan_22.html

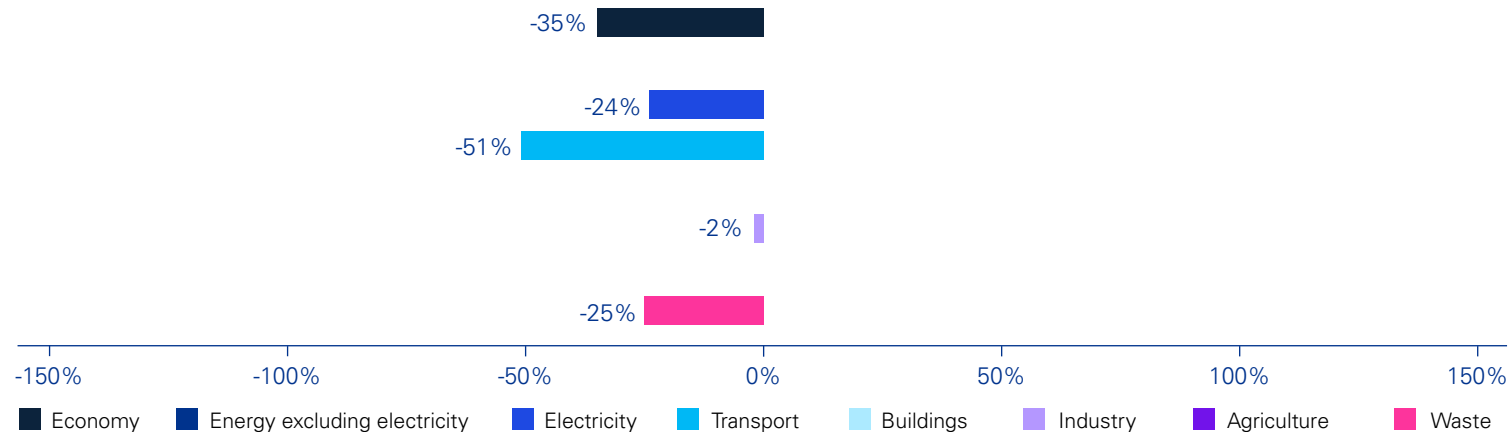
¹⁰ COE bidding results, quota premium and prevailing quota premium data from 'Statistics', Singapore Land Transport Authority. https://www.lta.gov.sg/content/ltagov/en/who_we_are/statistics_and_publications/statistics.html



Change in absolute emissions (2005–2022)



Change in emissions intensity (2005–2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023; Energy Institute's 2023 Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>; Economist Intelligence Unit (EIU) Viewpoint; The World Bank Open Data





South Africa

Companies are likely to lead decarbonization work but the state of the economy, slow pace of regulatory change and unreliability of electricity supply are hindering progress, while heavy-emitting industries could be affected by the EU’s Carbon Border Adjustment Mechanism.

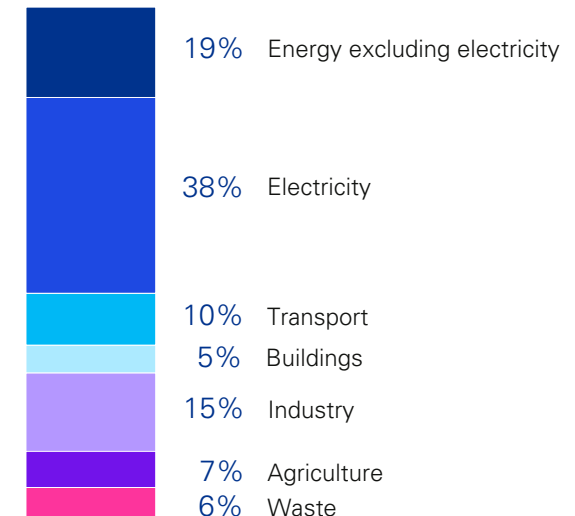
South Africa’s greatest opportunities to move towards net zero at present come from the private sector. Foreign-listed multinationals and companies with international investors will in many cases have to increase their reporting on climate change risks and develop plans to decarbonize. However, there are financial pressures to delay such work. “There is not a big drive for companies in South Africa that are trying to make ends meet in a very slow economy to embrace additional measures linked to net zero,” says Pieter Scholtz, Partner and Africa ESG Lead, KPMG in South Africa.

The government is doing little to help or force companies to decarbonize, whether through legislation or other measures. A June 2021 speech by President Cyril Ramaphosa discussed an expansion of renewable energy, which at present provides only a small proportion of the country’s electricity, but this has not been sustained. “The slow pace of regulatory change is a challenge,” says Poogendri Reddy, Associate Director, Sustainability Services, KPMG in South Africa. Plans from 2019 to break up the government-owned and coal-dependent power group Eskom are progressing slowly, although in July the country’s energy regulator licensed its plans to set up a separate transmission operator.¹

Eskom frequently imposes ‘load shedding’ — planned power cuts — on customers, given a chronic lack of capacity resulting from severe financial, plant and labor problems with cuts occurring on 288 days in 2022. In February, President Ramaphosa declared a state of disaster because of what he called “the electricity crisis”.² As part of its response, in March the government created a new minister of electricity post, initially held by Kgosientsho Ramokgopa, previously the head of the Presidency’s Investment and Infrastructure Unit.³

The government has also allowed Eskom to bypass sulfur dioxide pollution controls at its Kusile coal power station so the company could resume production from generation units proving 2GW of electricity, despite this risking severe health problems for those living nearby.⁴ “Stability of supply right now outweighs current emissions concerns,” says Reddy, although this has an impact on the uptake of levers for decarbonization adopted in other countries. One example is the slow adoption of electric vehicles if access to power needed for charging them is unreliable and such power is still generated from coal.

GHG emissions split by sector (2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023



CBAM's industrial impact

The introduction of the EU's Carbon Border Adjustment Mechanism (CBAM) as well as similar schemes elsewhere will provide the country's heavy-emitting industrial companies with financial reasons to decarbonize, by applying charges on imports designed to match carbon taxes levied on domestic producers. A February 2023 paper published by South Africa's Presidential Climate Commission found that EU countries imported an annual average of US\$1.4 billion

of products from South Africa that could attract charges under CBAM from 2017-21 with iron, steel and aluminum production most likely to be affected.⁵ The South African Revenue Service and National Treasury are considering responses to CBAM, which will be phased in over the next few years.

Scholtz says that some large companies in the energy and natural resources sectors have been working on CBAM programs for a couple of years, but the large scale of the

changes required means these will take time to implement. He says that South African companies of all kinds need to have a strategy for net zero based on gathering accurate data on their current emissions, including scope 3 ones from suppliers, then develop long-term plans based on these with a target net zero date and interim reduction targets. He adds that companies in some sectors, including energy, natural resources and telecoms, are making good progress on such planning.

¹ 'Energy regulator decisions of meeting number 262 of 27 July 2023', National Energy Regulator of South Africa. https://www.nersa.org.za/wp-content/uploads/bsk-pdf-manager/2023/07/Media-Statement-Energy-Regulator-Decisions-of-Meeting-No-262-of-27-July-2023_-1.pdf

² Cecilia Macaulay, 'Eskom crisis: What does South Africa's state of disaster mean?', BBC News, 10 February 2023. <https://www.bbc.co.uk/news/world-africa-64594499>

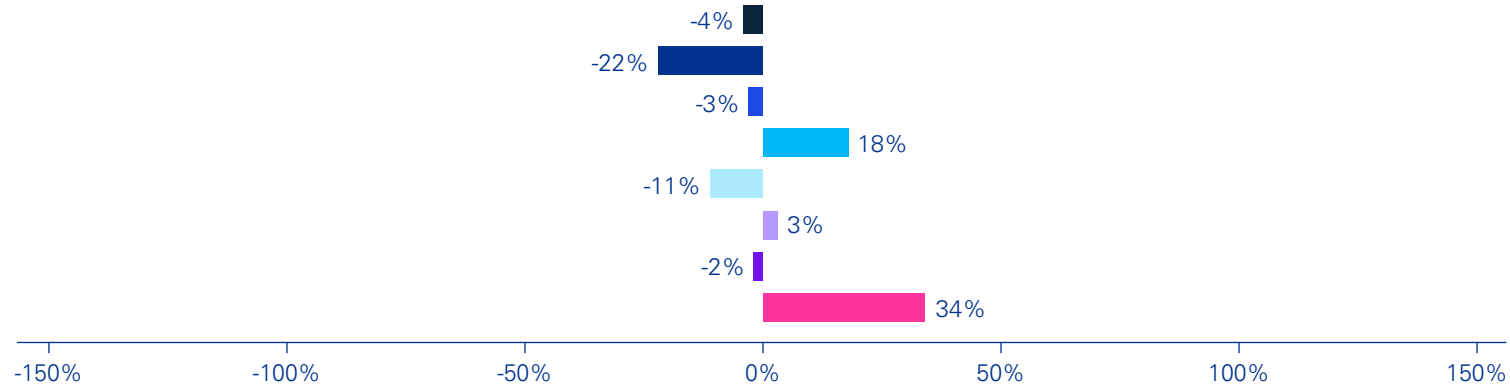
³ Paballo Lephaka, 'Profile: meet SA's Minister of Electricity, Dr Kgosisentsho Ramokgopa', SABC News, 7 March 2023. <https://www.sabcnews.com/sabcnews/profile-meet-sas-minister-of-electricity-dr-kgosisentsho-ramokgopa/>

⁴ Sheree Bega, 'Eskom's Kusile pollution rules exemption to ease blackouts threatens health', Mail and Guardian, 16 March 2023. <https://mg.co.za/environment/2023-03-16-kusile-pollution-rules-exemption-to-ease-blackouts-threatens-health/>

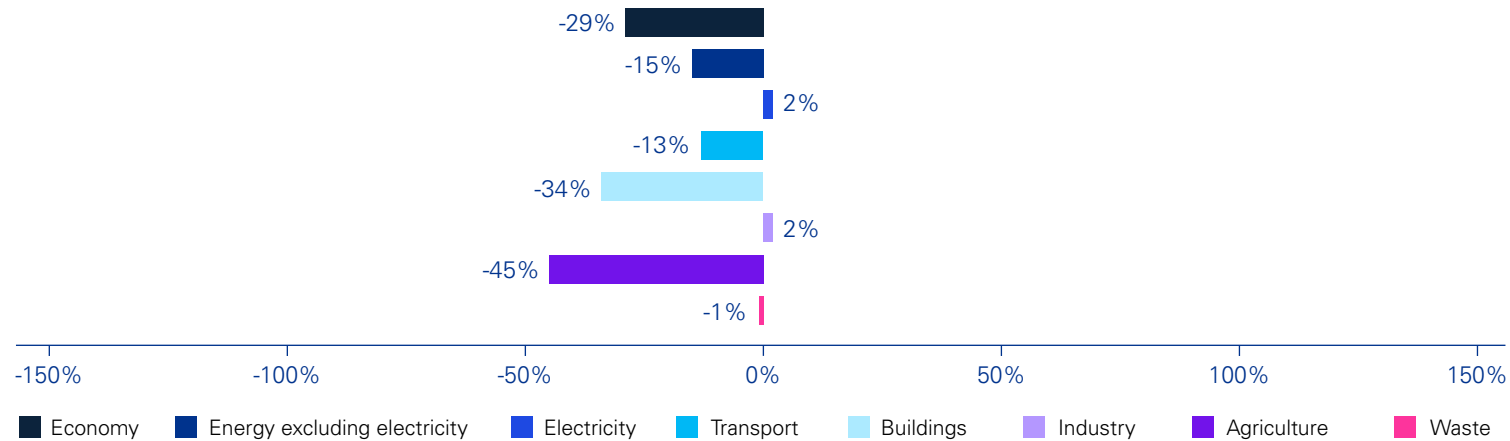
⁵ 'Carbon border adjustment mechanisms and implications for South Africa', Presidential Climate Commission, February 2023. <https://www.climatecommission.org.za/publications/cbam>



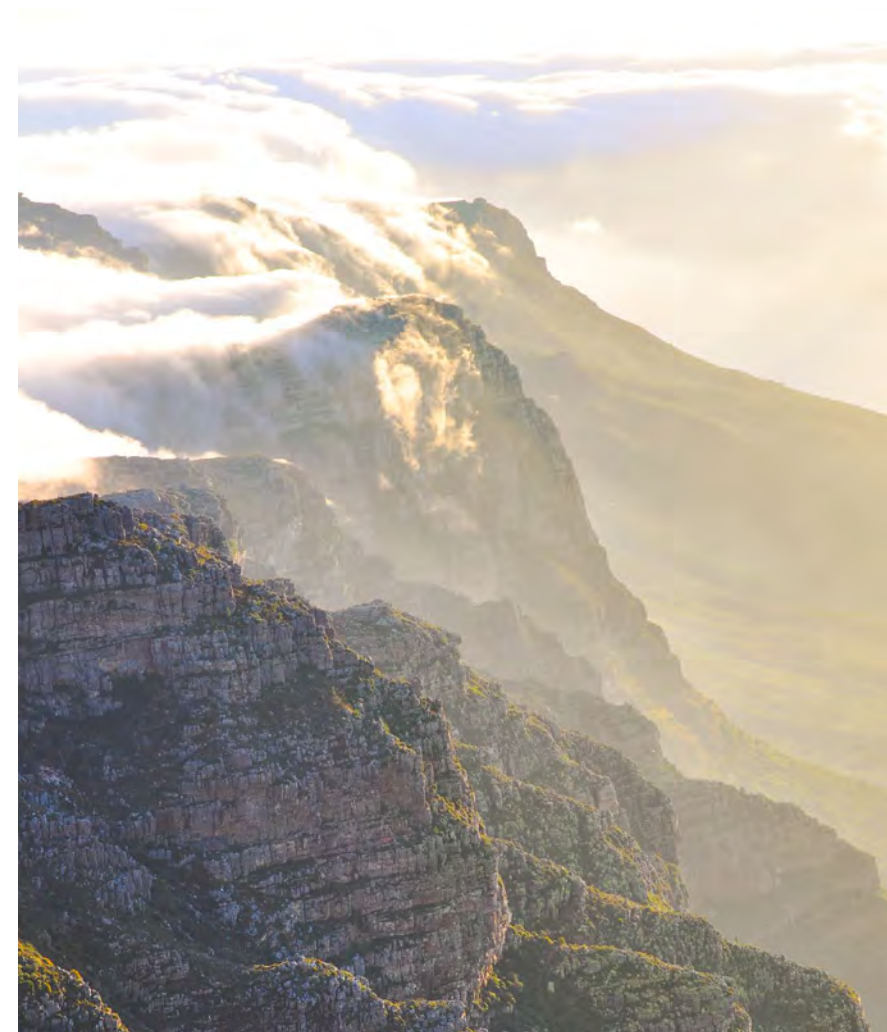
Change in absolute emissions (2005–2022)



Change in emissions intensity (2005–2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023; Energy Institute's 2023 Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>; Economist Intelligence Unit (EIU) Viewpoint; The World Bank Open Data





South Korea

Plans to cut 40 percent of emissions by 2030 involve expansion of nuclear and renewable energy but reducing heavy use of fossil fuels will take effort. Some manufacturing groups are supporting suppliers in decarbonization while the automotive sector shifts to electric vehicles.

In March, South Korea’s government confirmed its 2030 target of cutting greenhouse gas emissions by 40 percent compared with 2018, on the way to carbon neutrality by 2050. However, it reduced a sector-specific reduction target for industry by planning to accelerate a shift to renewable energy and nuclear power, which the previous government had intended to phase out. President Yoon Suk Yeol, who took office in 2022, is expanding the use of nuclear energy to provide more than 30 percent of electricity by 2030 while halving coal’s current share of more than 40 percent as part of meeting the country’s UN emissions targets.¹

Diana Ah Ryung Lee, Senior Manager, KPMG in Korea, sees the way the government uses emission reduction targets as a strength. “The government seeks achievable actions that can reduce greenhouse gas emissions and boost the economy at the same time,” she says. However, it may be difficult to expand renewable generation significantly given limited amounts of suitable land and it will take a lot of effort to move away from existing heavy use of coal, natural gas and oil. “We still see chronic issues relating to energy and power generation,” she adds.

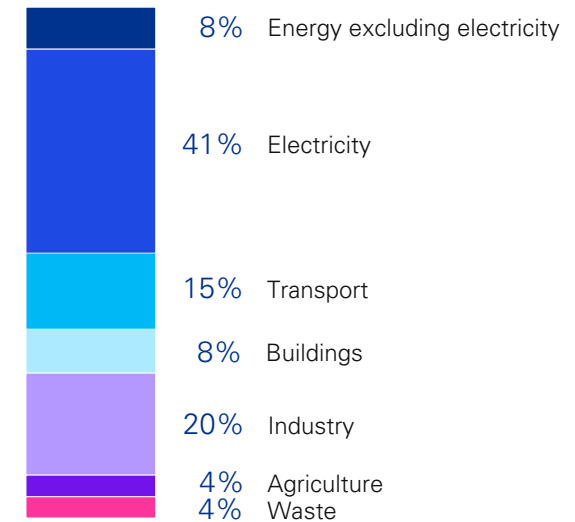
Companies supporting suppliers

Korea’s economy is reliant on manufacturing with small and medium companies in the sector, typically suppliers of the country’s large industrial groups and some of the latter are providing training and financial help for their suppliers’ efforts to decarbonize. In an environmental strategy published in September 2022 Samsung Electronics said it would support its suppliers in setting and meeting emissions targets, including by sharing research on cutting emissions from semiconductor production. The company also committed to achieving net zero emissions by 2050 and joined the global RE100 group of

companies that seek to use 100 percent renewable energy, although Samsung will initially aim to achieve this only for electricity used outside Korea.²

A range of emitters will be affected by phase 4 of Korea’s Emissions Trading Scheme (K-ETS) which begins in 2026, updating a scheme that started in 2015 and moved to the current phase 3 in 2021.³ Lee says the changes to K-ETS are likely to include reductions in free carbon allowances and coverage of additional sectors, although these are yet to be decided, and that this looks likely to encourage companies to

GHG emissions split by sector (2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023



increase decarbonization work. The country’s Zero Emissions Buildings regulations already mean that new buildings must include renewable generation capacity and from 2025 these will also require that operators of existing public sector buildings remodel these.

In February, the government announced reforms to electric vehicle subsidies which will give higher weighting to the performance and safety of vehicles as well as to technological innovation and customer service levels.⁴ June saw Hyundai Motor, the country’s leading automotive manufacturer whose brands include Kia and Genesis, announcing accelerated electrification transition plans with a 2030 annual sales target of two million electric vehicles constructed in both new and converted factories.⁵ Lee says that across the Korean automotive sector the focus is on moving to electric-only vehicles rather than hybrids.

¹ Hyonhee Shin, ‘South Korea cuts 2030 emissions reductions targets for industry’, Reuters, 21 March 2023. <https://www.reuters.com/business/sustainable-business/south-korea-cuts-2030-emissions-reductions-targets-industry-2023-03-21/>

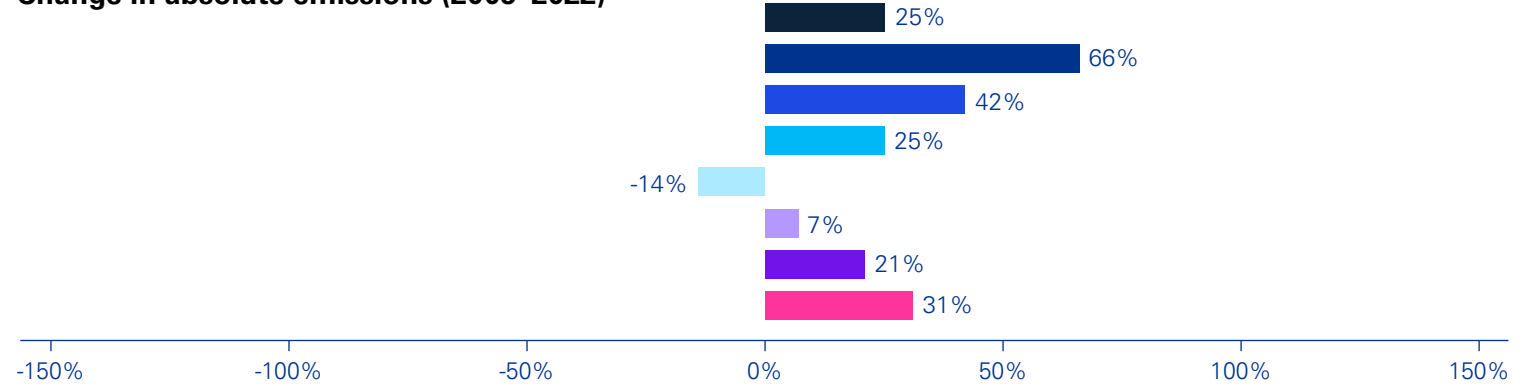
² ‘Samsung Electronics announces new environmental strategy’, Samsung Electronics, 14 September 2022. <https://news.samsung.com/us/samsung-new-environmental-strategy-announcement-2022/>

³ ‘South Korea approves initial wave of near-term ETS reforms’, International Carbon Action Partnership, 5 December 2022. <https://icapcarbonaction.com/en/news/south-korea-approves-initial-wave-near-term-ets-reforms>

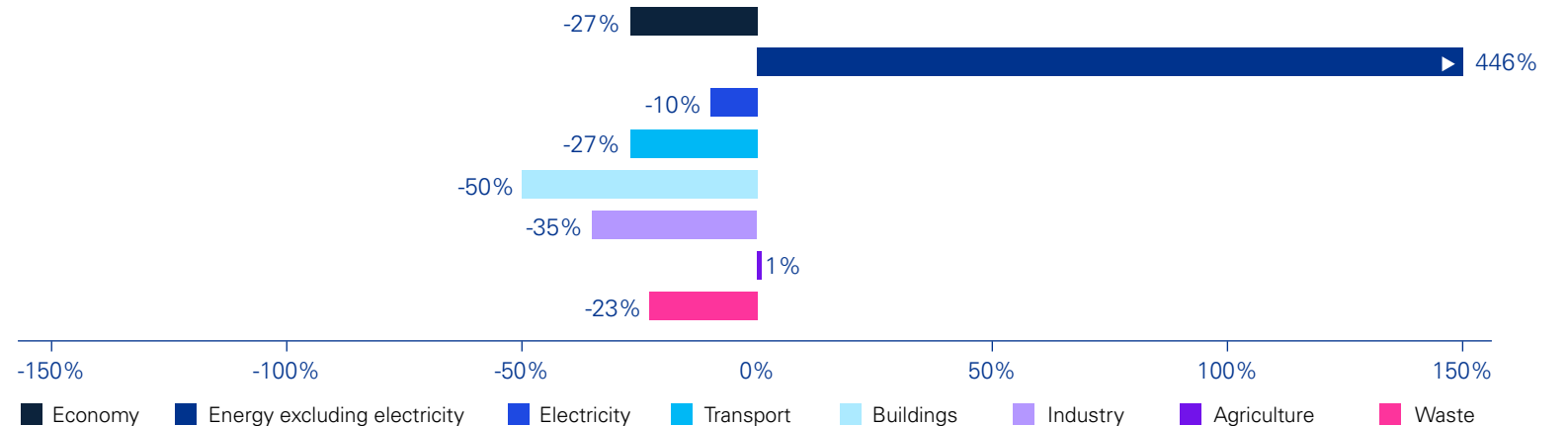
⁴ ‘Environment ministry to reform rule on subsidies for the purchase of EVs in 2023 to popularize EVs’, South Korea Ministry of Environment, 24 February 2023. <https://eng.me.go.kr/eng/web/board/read.do?menuId=461&orgCd=&boardId=1582640&boardMasterId=522>

⁵ ‘Hyundai Motor Way sets course for accelerated electrification and future mobility goals at 2023 CEO investor day’, Hyundai Motor Company, 20 June 2023. <https://www.hyundai.com/worldwide/en/company/newsroom/%E2%80%98hyundai-motor-way%E2%80%99-sets-course-for-accelerated-electrification-and-future-mobility-goals-at-2023-ceo-investor-day-0000017048>

Change in absolute emissions (2005–2022)



Change in emissions intensity (2005–2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023; Energy Institute’s 2023 Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>; Economist Intelligence Unit (EIU) Viewpoint; The World Bank Open Data



Spain

The government has ambitious plans to develop renewable generation, phase out nuclear and coal by 2025 and upgrade the country’s electrical grid, but adoption of electric vehicles may be slowed by a lack of public chargers and financial incentives to switch.

Spain has developed a strong regulatory framework on climate change by combining national and European regulations, with membership of the EU also providing access to finance. “As a result of that, companies and emitters need to adapt,” says Ramón Pueyo, Head of Sustainability, KPMG in Spain. “I think we were latecomers on climate change but citizens are now aware of how big an issue this is and how we need to decarbonize.”

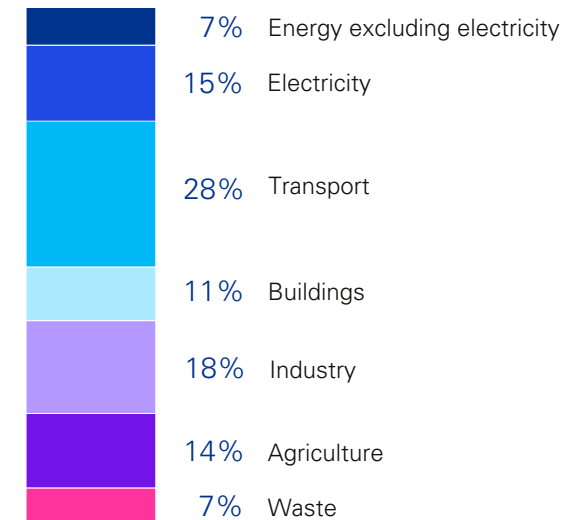
A key part of this regulatory framework is the country’s energy and climate plan (Plan Nacional Integrado de Energía y Clima, PNIEC). The first version of this was published in 2020 and the government is consulting on increasing its targets for 2030, including that 81 percent of electricity and 48 percent of all energy use would come from renewable sources.¹ A draft plan published in June 2023 also doubled the country’s 2030 target for biogas production and nearly tripled the target for green hydrogen, along with smaller percentage increases for wind, solar and power storage. It also confirmed plans to phase out the use of nuclear energy and brought forward the date for ending use coal for electricity from 2030 to 2025.² In 2022 the government agreed improvements to Spain’s electricity grid to help integrate more renewable production, including 2,700 kilometers of new transmission lines, 700 kilometers of undersea cables and upgrades to 8,000 kilometers of the existing network.³

Electric vehicles and chargers

The government is ambitious to make progress on energy generation but this is less true of other sectors, says Pueyo. Transport, the highest-emitting sector, has seen electric vehicles sales grow to 8.9 percent of all cars in Spain in 2022, but this is below the EU average of 21 percent.⁴ Pueyo says that drivers may need financial incentives and more

public chargers to encourage them to go electric, with Spain having 20 electric vehicles for each public charging point compared with the EU average of 13 last year.⁵ The Climate Change and Energy Transition law passed in 2021 requires Spanish ports to reduce direct emissions to zero by 2050 and for the government to promote the use of rail for passengers and freight traveling distances greater than 300 kilometers. As with transport, Pueyo adds that the buildings sector is likely to require financial incentives to help homes and businesses decarbonize.

GHG emissions split by sector (2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023



Spain’s agricultural sector will be affected by the updated version of the EU’s Common Agricultural Policy (CAP) which came into effect in January 2023 and includes strengthened protections for environmental and climate objectives. Spain’s strategic plan on how it plans to implement CAP requirements includes financial support to develop renewable energy production by farms as well as improving energy efficiency through better thermal insulation of agricultural buildings.⁶

Smaller companies in the industrial sector would benefit from more pragmatic advice on decarbonization to support smaller companies in setting plans and targets. “We have a lack of awareness among managers, directors and officers at small and medium-size companies,” says Pueyo. This particularly applies to new reporting requirements under 2021’s Climate Change and Energy Transition law and the EU’s Corporate Sustainability Reporting Directive.

¹ ‘Public consultation on the draft update of 2023-2030 PNIEC’, Spain Ministry for the Ecological Transition and the Demographic Challenge. <https://energia.gob.es/en-us/participacion/paginas/detalleparticipacionpublica.aspx?k=607>

² Pietro Lombardi, ‘Spain raises bet on green hydrogen, biogas in draft plan’, Reuters, 28 June 2023. <https://www.reuters.com/sustainability/climate-energy/spain-doubles-down-green-hydrogen-biogas-2023-06-28/>

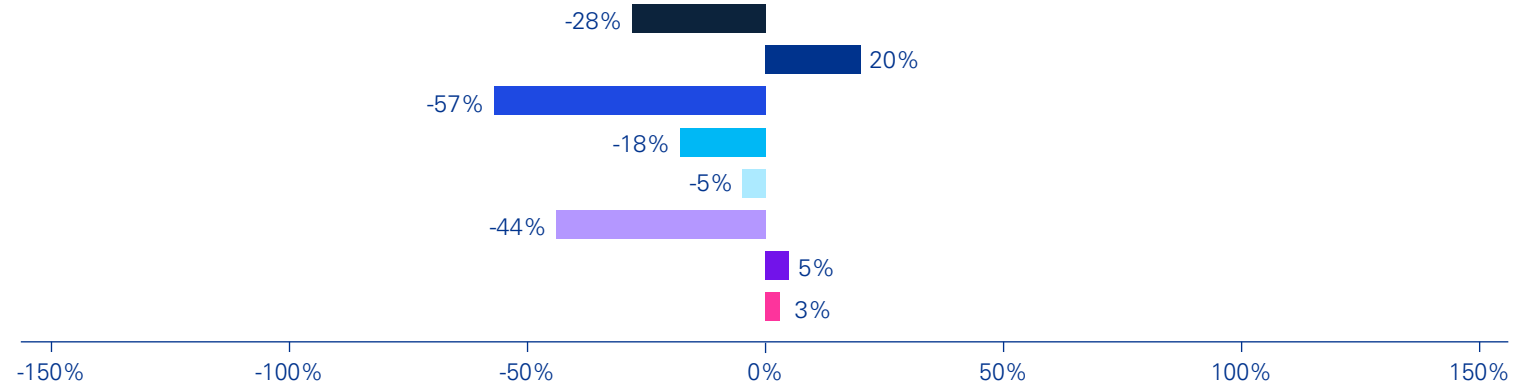
³ ‘2026 Electricity Grid Development Plan’, International Energy Agency, updated 11 May 2023. <https://www.iea.org/policies/17479-2026-electricity-grid-development-plan>

⁴ ‘Global EV data explorer’, International Energy Agency. <https://www.iea.org/data-and-statistics/data-tools/global-ev-data-explorer>

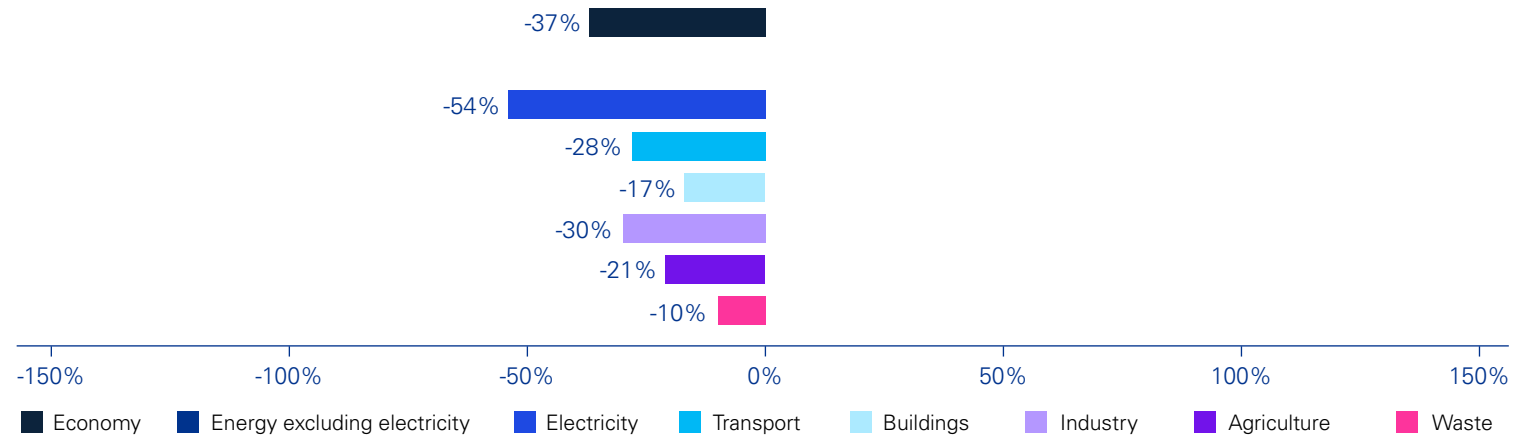
⁵ ‘Number of electric LDVs per public charging point’, Global EV Outlook 2023, International Energy Agency. <https://www.iea.org/reports/global-ev-outlook-2023/trends-in-charging-infrastructure>

⁶ ‘At a glance: Spain’s CAP strategic plan’, European Commission, 24 April 2023. https://agriculture.ec.europa.eu/system/files/2023-04/csp-a-a-glance-spain_en.pdf

Change in absolute emissions (2005–2022)



Change in emissions intensity (2005–2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023; Energy Institute’s 2023 Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>; Economist Intelligence Unit (EIU) Viewpoint; The World Bank Open Data



Sweden

To continue its strong record of decarbonization, Sweden will need to generate more low carbon electricity from a range of sources including nuclear power. The country’s geography requires the use of road freight, with companies developing electric trucks and batteries.

Sweden has been a leader on sustainability for several decades with high levels of awareness among both companies and individuals. More than 90 percent of electricity comes from low carbon sources, primarily hydropower and nuclear, and the country has cut its overall emissions intensity by around 60 percent over the last three decades.

But to go further it needs more electricity. The country could greatly cut its remaining emissions by moving a few large industrial coal users in sectors including mining, steel and cement to either green hydrogen generated with low carbon electricity or directly to electricity, says Torbjörn Westman, Partner, KPMG Assurance Services and the Head of Assurance, KPMG in Sweden. Finding the extra generation capacity would be a significant challenge with no easy options. Some plans to expand onshore wind generation are opposed by stakeholders in different parts of Sweden, for example indigenous Sámi communities as turbines disturb their reindeer and ways of living.¹ In June the government won parliamentary approval to build new nuclear plants, 40 years after the country voted to phase them out, changing its energy target from 100 percent renewable to 100 percent fossil-free, but they remain controversial.²

Westman says that as well as small-scale nuclear, it would make sense for the country to consider carbon capture, storage and lower consumption: “It is a combination that we need. Renewables will not be enough.” Expanding the country’s electricity generation to levels sufficient to meet its net zero targets could take 20 or 30 years, he adds.

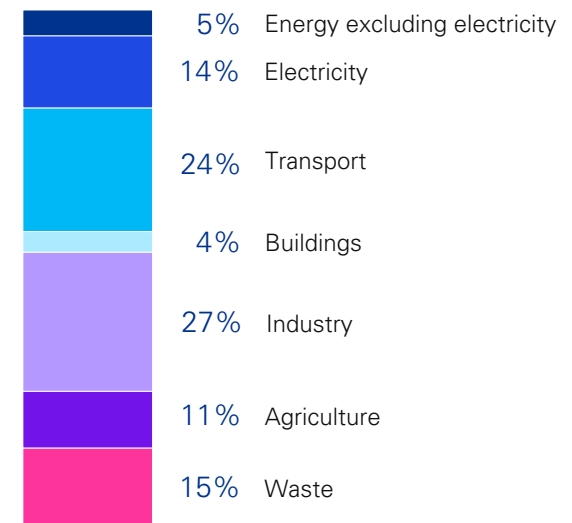
Southern people, northern energy

Most of Sweden’s population live in the south of the country while much of energy generation potential and some heavy industrial emitters are hundreds of kilometers to the north across rugged terrain, requiring more grid infrastructure that would need

capital and land to build. The country’s dispersed geography also makes transport decarbonization challenging, as it requires use of road as well as rail for freight. Sweden has several companies working to electrify heavy road transport, with truck maker AB Volvo offering electric freight vehicles³ and its competitor Scania recently announcing a jointly developed battery cell for electric trucks with green battery maker Northvolt.⁴ However, their high cost can be off-putting for users.

Electric cars are now the majority of new vehicles, making up 54 percent of sales in 2022.⁵ Westman says growth is likely to continue although it may be slowed by the economic downturn

GHG emissions split by sector (2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023



and the government’s withdrawal of a ‘climate bonus’ subsidy in November 2022.⁶ He adds that charging infrastructure will be essential in sustaining adoption of electric cars and trucks. In May Sweden announced it will install permanent ‘dynamic charging’ to recharge vehicles in motion on the E20 motorway by 2025, with plans to have 3,000 kilometers of road similarly equipped by 2045.⁷

While most sectors have seen significant reductions in emissions intensity over the last three decades, agriculture has made less progress. Westman says it is a particularly difficult activity to decarbonize given the high cost of new vehicles and equipment and a lack of capital available to many farmers, meaning they tend to keep old equipment in service for as long as possible.

¹ Kasia Strek and Jonas Ekblom, ‘Europe’s green revolution threatens indigenous culture’, Bloomberg, 26 June 2023. <https://www.bloomberg.com/features/2023-sweden-indigenous-sami-green-energy/>

² Simon Johnson, ‘Swedish parliament passes new energy target, easing way for new nuclear power’, Reuters, 20 June 2023. <https://www.reuters.com/sustainability/climate-energy/swedish-parliament-passes-new-energy-target-easing-way-new-nuclear-power-2023-06-20/>

³ ‘Electric trucks’, AB Volvo. <https://www.volvotrucks.com/en-en/trucks/renewable-fuels/electric-trucks.html>

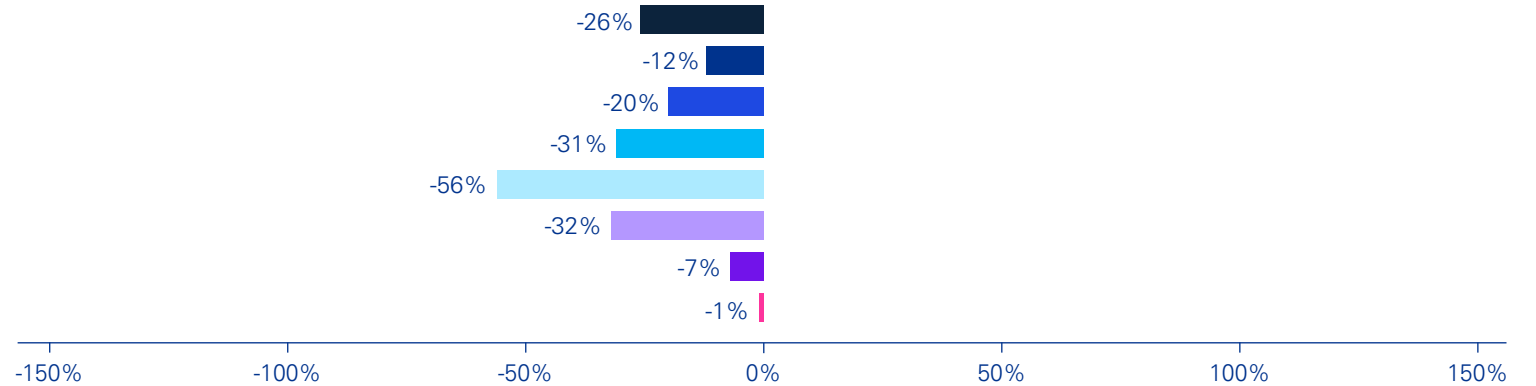
⁴ ‘Northvolt and Scania unveil green battery capable of powering trucks for 1.5 million kilometers’, Northvolt, 19 April 2023. <https://northvolt.com/articles/northvolt-scania-cell/>

⁵ ‘Global EV data explorer’, International Energy Agency. <https://www.iea.org/data-and-statistics/data-tools/global-ev-data-explorer>

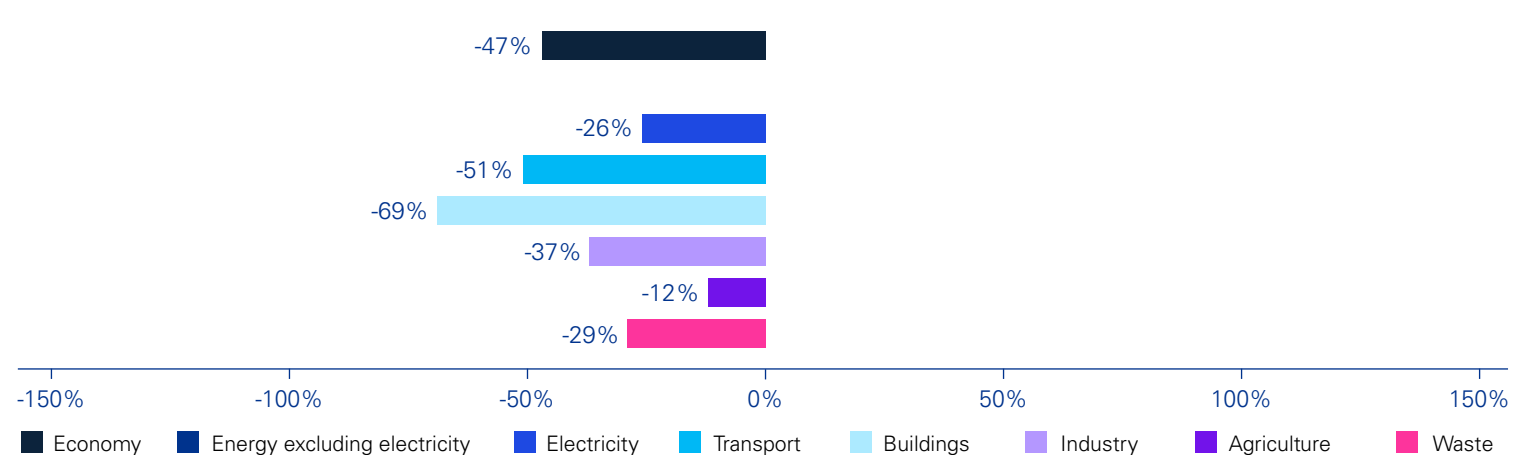
⁶ ‘Klimatbonusen upphör den 8 november’ (in Swedish), Swedish Government, 7 November 2022. <https://www.regeringen.se/pressmeddelanden/2022/11/klimatbonusen-upphor-den-8-november/>

⁷ Roselyne Min, ‘Sweden is building the world’s first permanent electrified road for EVs to charge while driving’, 6 July 2023, Euronews. <https://www.euronews.com/next/2023/05/09/sweden-is-building-the-worlds-first-permanent-electrified-road-for-evs-to-charge-while-dri>

Change in absolute emissions (2005–2022)



Change in emissions intensity (2005–2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023; Energy Institute’s 2023 Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>; Economist Intelligence Unit (EIU) Viewpoint; The World Bank Open Data



Switzerland

New climate act enshrines 2050 net zero goal and includes specific targets for buildings, transport and industry but excludes supplier emissions and the financial sector. From 2024 large Swiss companies will have to disclose climate risks, impacts and plans.

In June, Swiss voters approved the country’s new climate act in a referendum. This enshrines in law that Switzerland will reach net zero greenhouse emissions by 2050 and be ‘net negative’, removing and storing more emissions than are released, after that date. It also includes intermediate targets for emissions including cuts by 2040 of at least 75 percent compared to 1990, as well as sector-level targets for buildings, transport and industry for 2040 and 2050. It calls for all Swiss companies to achieve net zero by 2050 on scope 1 and 2 emissions and encourages them to develop plans for this before 2029.¹

While passing the law represents a strength for the country it has certain weaknesses according to Patrick Schmucki, Director, Financial Services, Corporate Responsibility Officer, KPMG in Switzerland. “Scope 3 emissions are scoped out,” he says, referring to those caused by suppliers. This is significant given the country has among the world’s highest emissions per person when supply chains are included, with Switzerland’s emissions in 2020 more than tripling if carbon emissions embedded in trade are included.² The act also relies on considerable levels of offsetting and lacks a specific target for the country’s economically vital financial services sector, although it does allow for further sector targets to be added later.

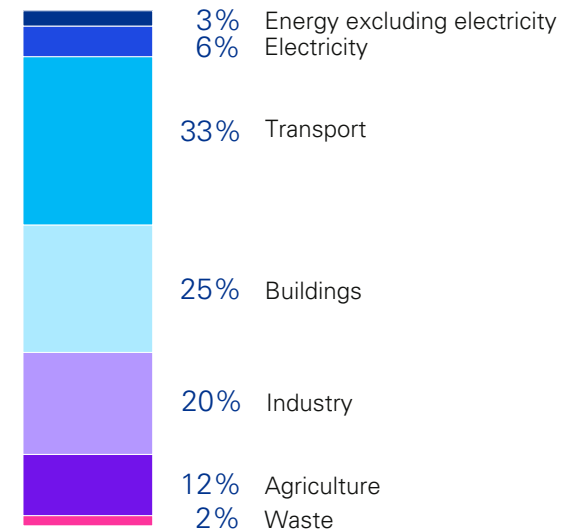
Targeting buildings and transport

Some sectors have more demanding targets than others, with the act requiring the buildings sector to cut emissions by 82 percent on 1990 levels by 2040. Schmucki says that the country’s building stock is already of a relatively high quality compared with other countries and that institutional real estate investors are engaging well with decarbonization work. But there are questions over whether individuals who own buildings will do likewise and some institutions have sold inefficient buildings to private investors. To

support change the government is providing financial support of 2 billion Swiss francs (CHF) (US\$2.22 billion) over 10 years to help replace fossil fuel heating.³

The climate act sets a less severe target for the transport sector of reducing emissions by 57 percent by 2040 compared with 1990. Schmucki says this reflects the economic importance of logistics with high volumes of imports, exports and goods transiting the country by road and air. “It requires more time so as not to harm the economy of Switzerland,” he says.

GHG emissions split by sector (2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023



Electricity is a strength for Switzerland, given it has generated nearly all of its supply from low carbon sources for several decades and has the lowest carbon intensity of the International Energy Agency's member countries.⁴ It relies on hydroelectric and nuclear power, with four reactors still producing significant amounts of power despite a 2017 vote to decommission these over time.⁵ The country plans to expand solar and wind production from their present low base.

The country will soon require large companies to report on climate change based on the international recommendations of the Task Force on Climate-related Financial Disclosures. From January 2024, public companies, banks and insurance companies with more than 500 employees and CHF20 million in assets or CHF40 million in turnover will have to publish financial risks from climate-related activities, the impact of these activities on the climate, their corporate emission reduction targets and how they plan to meet them.⁶

¹ Julian Meitanis and Manfredi Fiorillo, 'Swiss companies need to develop a decarbonization plan', KPMG in Switzerland, 22 June 2023. <https://kpmg.com/ch/en/blogs/home/posts/2023/06/swiss-companies-need-develop-decarbonization-plan.html>

² 'CO₂ emissions embedded in trade, 2020', Our World in Data. <https://ourworldindata.org/grapher/share-co2-embedded-in-trade>

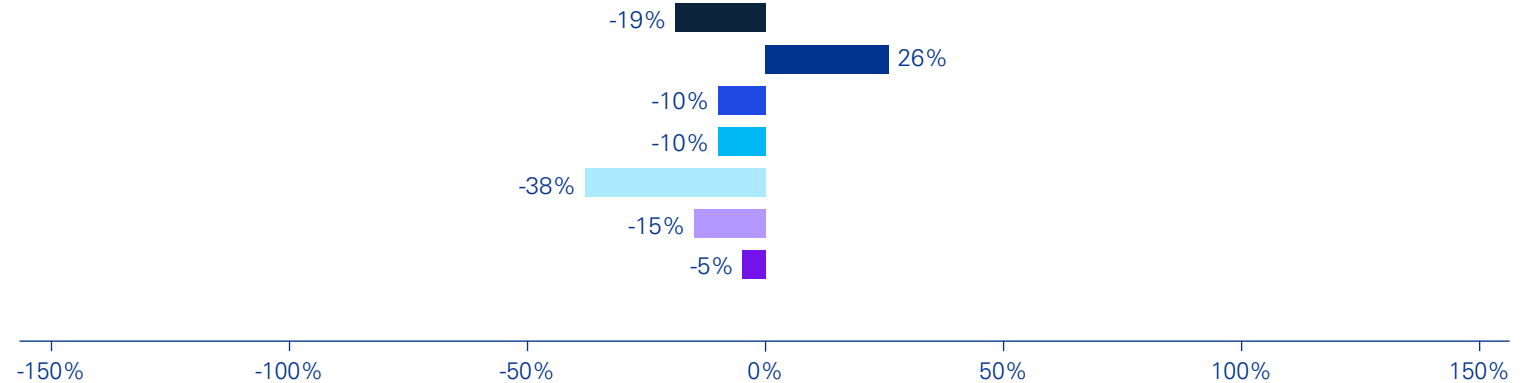
³ 'Swiss companies need to develop a decarbonization plan', KPMG in Switzerland as above.

⁴ 'Switzerland', International Energy Agency. <https://www.iea.org/countries/switzerland>

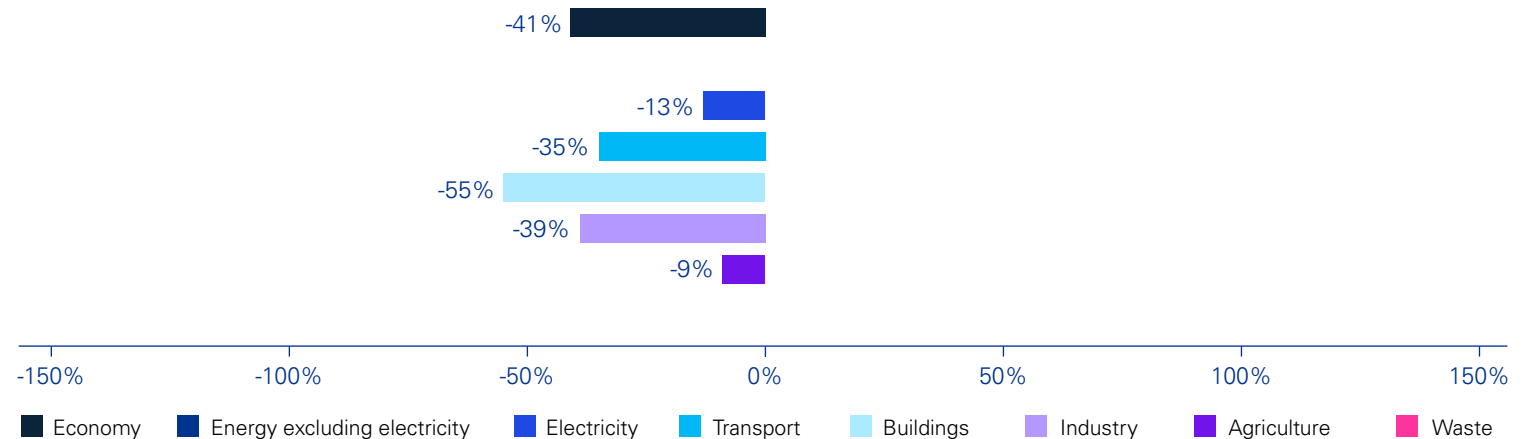
⁵ Sara Ibrahim, 'Nuclear yes or nuclear no: where does Switzerland's energy strategy go?', SWI, 21 May 2022. <https://www.swissinfo.ch/eng/sci-tech/nuclear-energy-strategy-switzerland-russia-ukraine-electricity-renewables/47610154>

⁶ 'Federal Council brings ordinance on mandatory climate disclosures for large companies into force as of 1 January 2024', Switzerland Federal Office for the Environment, 23 November 2022. <https://www.bafu.admin.ch/bafu/en/home/documentation/news-releases/anzeige-nsb-unter-medienmitteilungen.msg-id-91859.html>

Change in absolute emissions (2005–2022)



Change in emissions intensity (2005–2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023; Energy Institute's 2023 Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>; Economist Intelligence Unit (EIU) Viewpoint; The World Bank Open Data



United Arab Emirates

A major oil exporter pushes to announce decarbonization strategies before it hosts the COP28 conference, including tripling renewable energy capacity by 2030, greener industry and adoption of electric vehicles.

The United Arab Emirates has demonstrated a renewed commitment to decarbonizing in advance of hosting this November's COP28 UN climate change conference. In July the UAE said it plans to cut emissions by 40 percent from the 1990 baseline used under the Paris Agreement, up from a 31 percent cut previously, on its way to net zero by 2050. It also announced a target of producing 1.4 million tonnes of hydrogen by 2031, with 1 million tonnes of this being green hydrogen produced with renewable energy, with the total increasing to 15 million tonnes by 2050, as well as a tripling of renewable energy capacity between now and 2030.¹ The country has an abundance of solar energy potential with two large solar parks already in operation.

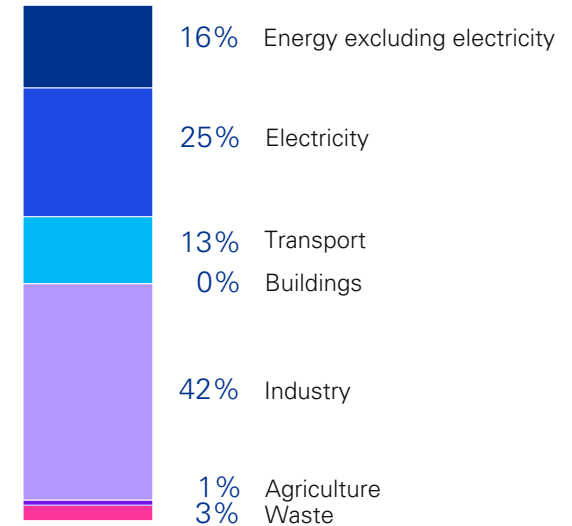
Fadi Al Shihabi, Partner and Head of ESG Advisory Services, KPMG Lower Gulf, says that on present data the UAE has work to do on cutting emissions, but it is making significant changes. "Because of COP28 coming up, there is a push to announce strategies and targets to decarbonize," he says, with "a huge shift into implementation" likely to follow in the next couple of years. The country's oil revenues provide it with the financial resources to fund such work, including investments in research and development which Al Shihabi thinks are likely to become increasingly significant for the country.

It is also completing new nuclear capacity, with Emirates Nuclear Energy Corporation saying in June that the fourth and final unit of its Barakah energy plant in Abu Dhabi is undergoing tests before going live, with the other three units already in service. When fully operational, the nuclear plant will provide around a quarter of the UAE's electricity and the operator says that this has already pushed gas demand in Abu Dhabi to an 11-year low.²

Industrial circular economy

Industry was responsible for 42 percent of the country's emissions in 2022, including energy-intensive production of aluminum and steel. In June, Abu Dhabi, one of the seven emirates that make up the UAE, launched an industrial strategy involving investment of 10 billion Emirati dirhams (AED) (US\$2.72 billion) which includes environmentally focused aspects, including circular economy regulatory work,

GHG emissions split by sector (2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023



procurement that considers environmental issues and incentives for improving environmental sustainability.³ Abu Dhabi also makes use of natural carbon sequestration, reckoning that in 2018 the equivalent of around 5 percent of its carbon emissions were removed from the atmosphere by plantations including forests, mangrove wetlands and croplands.⁴

Only a few thousand electric vehicles are currently on the UAE's roads but this looks set to increase rapidly with the emirate of Dubai's Green Mobility Strategy requiring 30 percent of public sector and 10 percent of all vehicle sales to be either electric or hybrid by 2030. Dubai also plans for all taxis to be hybrid or electric by 2027 and it has more than 620 electric vehicle charging stations with a target of more

than 1,000 by 2025. Abu Dhabi is exploring hydrogen fuel for vehicles and its national energy company wants to install more than 70,000 electric charging points across the UAE by 2030.⁵ Etihad Rail, the country's recently completed national rail system, aims to reduce the UAE's annual transport emissions by 8.2MtCO₂e through moving freight off the roads.⁶

¹ Maha El Dahan, 'UAE's revised energy strategy includes big hydrogen plans', Reuters, 11 July 2023. <https://www.reuters.com/world/middle-east/uaes-revised-energy-strategy-includes-big-hydrogen-plans-2023-07-11/>

² 'Greenhouse gas inventory and projections for Abu Dhabi emirate', April 2021, Abu Dhabi Environment Agency. <https://www.ead.gov.ae/-/media/Project/EAD/EAD/Documents/Resources/EAD-GHG-Executive-Summary-Report-EN-final.pdf>

³ 'United Arab Emirates electric vehicle market', US International Trade Administration. <https://www.trade.gov/market-intelligence/united-arab-emirates-electric-vehicle-market>

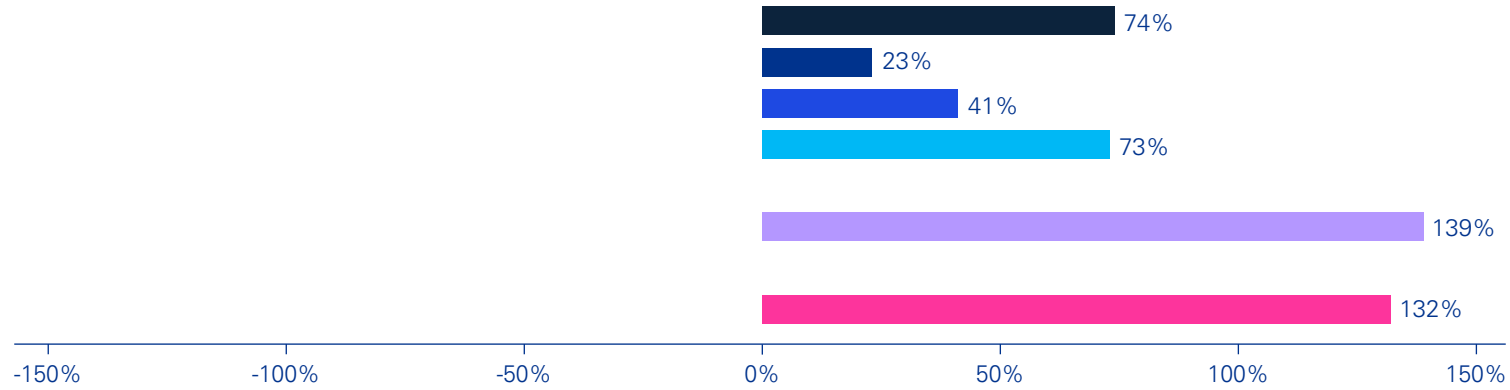
⁴ John Dennehy, 'How Etihad Rail's freight service aims to cut travel times for UAE motorists', The National News, 16 May 2023. <https://www.thenationalnews.com/uae/2023/05/16/how-etihad-rails-freight-service-will-improve-your-commute/>

⁵ 'Greenhouse gas inventory and projections for Abu Dhabi emirate', April 2021, Abu Dhabi Environment Agency. <https://www.ead.gov.ae/-/media/Project/EAD/EAD/Documents/Resources/EAD-GHG-Executive-Summary-Report-EN-final.pdf>

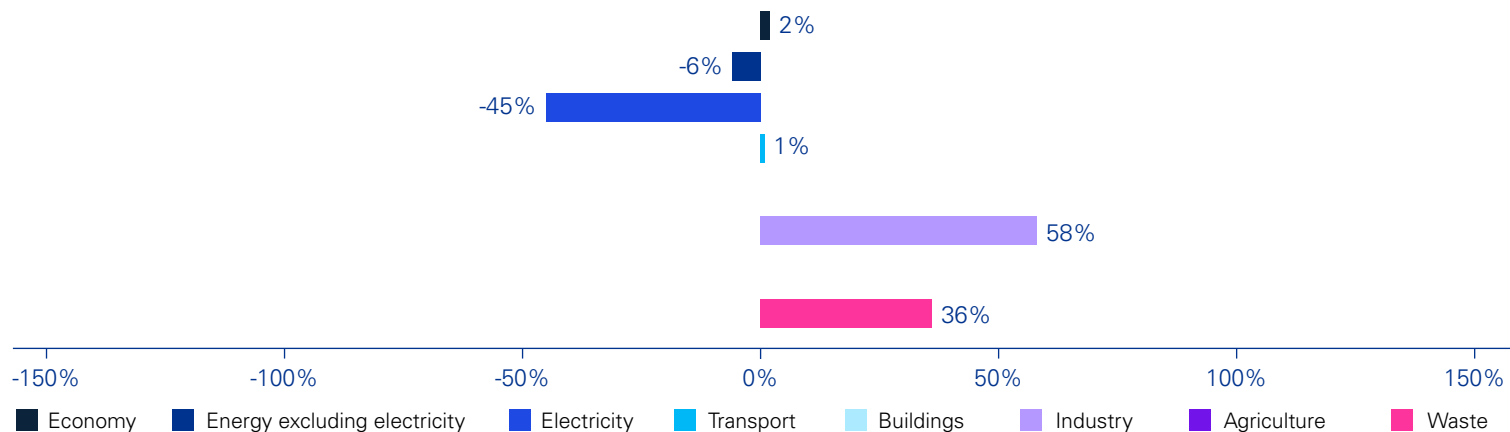
⁶ 'Final unit of the Barakah plant commences operational readiness preparations', Emirates Nuclear Energy Corporation, 8 June 2023. <https://www.enec.gov.ae/news/latest-news/final-unit-of-the-barakah-plant-commences-operational-readiness-preparations/>



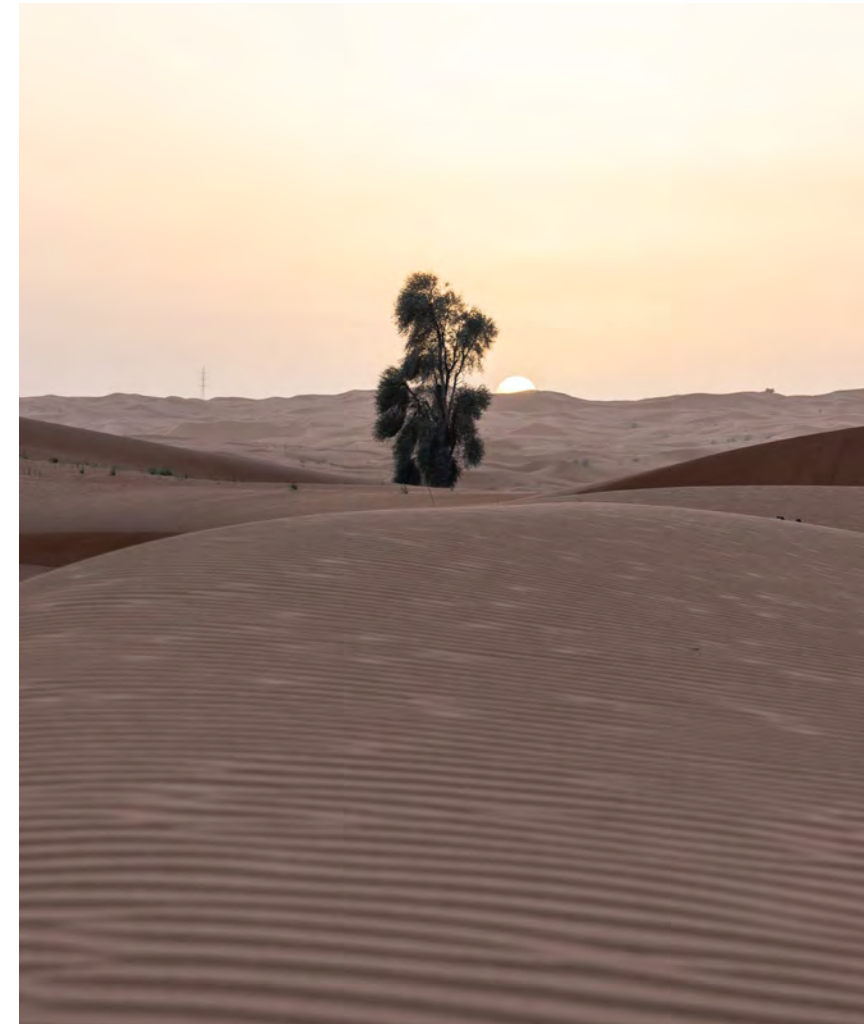
Change in absolute emissions (2005–2022)



Change in emissions intensity (2005–2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023; Energy Institute's 2023 Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>; Economist Intelligence Unit (EIU) Viewpoint; The World Bank Open Data





United Kingdom

Successes on cutting total emissions and expanding renewable electricity production are welcome, but the UK faces a big challenge in making homes more energy efficient and converting them from natural gas to low carbon forms of heating.

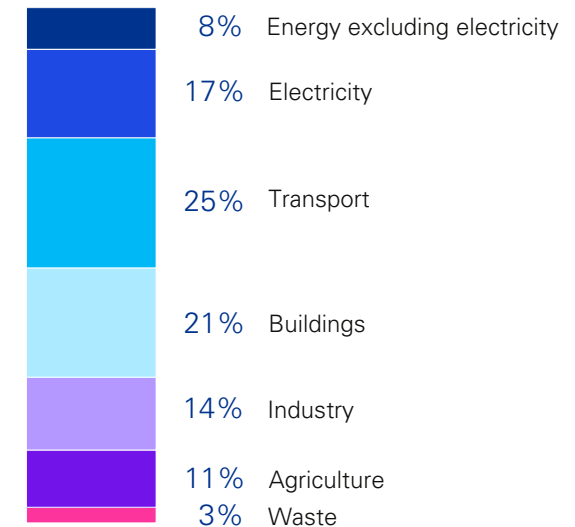
The United Kingdom has recorded some major achievements on its journey towards net zero. It has cut greenhouse gas emissions by almost half since 1990, one of the best records of any developed country, while growing the size of its economy by around two-thirds. “It shows you can decarbonize while still growing,” says Simon Virley, Vice Chair and Head of Energy and Natural Resources, KPMG in the UK.

About half of the UK’s electricity now comes from low carbon sources, mainly renewables with some nuclear energy. Coal is a rarely used standby option and renewable generation continues to grow rapidly, shown by the electricity system operator National Grid registering a record low in Great Britain’s electricity carbon intensity of 33gCO₂e per kilowatt hour on 10 April 2023, compared with quarterly averages of 400-500gCO₂e from 2010-14.¹ The UK has also led efforts on requiring companies to report on climate risks and plans, improving transparency and encouraging action, measures that many other countries are adopting.

The UK now faces major challenges on buildings, industry and some types of transport. “We have done the easy bit,” says Virley. “The next part may be a lot harder.” At 2021’s UK-hosted COP26 climate change conference the government set a 2030 target of cutting emissions by 68 percent compared with 1990. In a report this June, the independent Climate Change Committee said that the annual rate of reduction outside electricity will likely need to quadruple to hit this, adding it was markedly less confident the target will be reached than a year ago.²

In September 2023, the government announced a “more pragmatic” approach to reaching net zero, delaying a ban on new petrol and diesel cars from 2030 to 2035, the same date as the EU. It also delayed bans on the installation of new fossil fuel boilers while increasing cash grants for replacing such boilers with heat pumps by 50 percent to 7,500 British pounds (GBP) (US\$9,220).³

GHG emissions split by sector (2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023



Inefficient gas-heated homes

The UK has some of the least energy efficient homes in Europe⁴ and around four-fifths are heated with natural gas. To tackle the latter the government wants to see 600,000 electrically powered heat pumps installed annually by 2028, but the Climate Change Committee says the current rate is about one-ninth of this while implementation of other energy efficiency measures continued to fall in 2022. The UK's housing stock includes many poorly insulated decades-old terraces as well as tower blocks, both of which could present challenges for heat pump installation. With new homes, Laura Forzani, ESG Chief Operating Officer, KPMG in the UK, says that decarbonization should be embedded in the planning but this is often not

the case with many including natural gas boilers despite a forthcoming ban on these in new homes.

Virley says that the UK government has not ramped up efforts on energy efficiency to nearly the same extent as most other European countries in response to the Ukraine war. The private sector could play a significant role in housing's decarbonization by making it easier for owners to install heat pumps and insulation, offering long-term loans to pay for this and supporting a national awareness and engagement program that includes personalized advice and easier customer processes.⁵

Many UK-based industrial emitters are interested in using green hydrogen as a route to decarbonization, but a lack of clarity from government over subsidies and where supplies of hydrogen will come from is holding back progress. There are significant challenges in the transport sector, such as over how aviation and international shipping can switch to low carbon fuels, but more encouragingly 23 percent of cars sold in the UK in 2022 were electric powered.⁶ Using such vehicles can encourage people to think more broadly about their power consumption and consider tariffs that offer cheaper electricity when demand is lower, Virley says: "I think the take-up of EVs has the potential to change the public's relationship with energy."

¹ National Grid ESO, 'We've double checked the data...', Twitter, 14 April 2023. <https://twitter.com/NationalGridESO/status/1646856505872769025> National Grid ESO, Historic GB Generation Mix data for 2010-2014. https://data.nationalgrideso.com/carbon-intensity1/historic-generation-mix/r/historic_gb_generation_mix

² 'Better transparency is no substitute for real delivery', UK Climate Change Committee, 28 June 2023. <https://www.theccc.org.uk/2023/06/28/better-transparency-is-no-substitute-for-real-delivery/>

³ 'PM recommits UK to Net Zero by 2050 and pledges a "fairer" path to achieving target to ease the financial burden on British families', UK Prime Minister's Office, 20 September 2023. <https://www.gov.uk/government/news/pm-recommits-uk-to-net-zero-by-2050-and-pledges-a-fairer-path-to-achieving-target-to-ease-the-financial-burden-on-british-families>

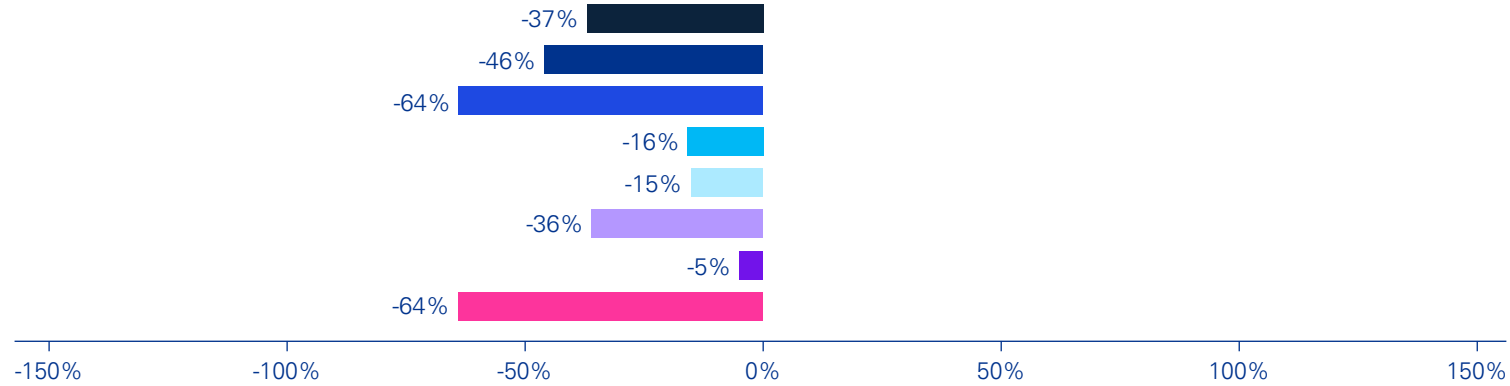
⁴ Simon Levey, Jez Fredenburgh and Caroline Brogan, 'UK behind European countries on home upgrades to combat bills and climate crisis', Imperial College London, 14 December 2022. <https://www.imperial.ac.uk/news/242271/uk-behind-european-countries-home-upgrades/>

⁵ 'Home is where the heat is', Sustainable Homes and Buildings Coalition with KPMG in the UK, 21 October 2021. <https://www.natwestgroup.com/news-and-insights/news-room/press-releases/climate/2021/oct/home-is-where-the-heat-is.html>

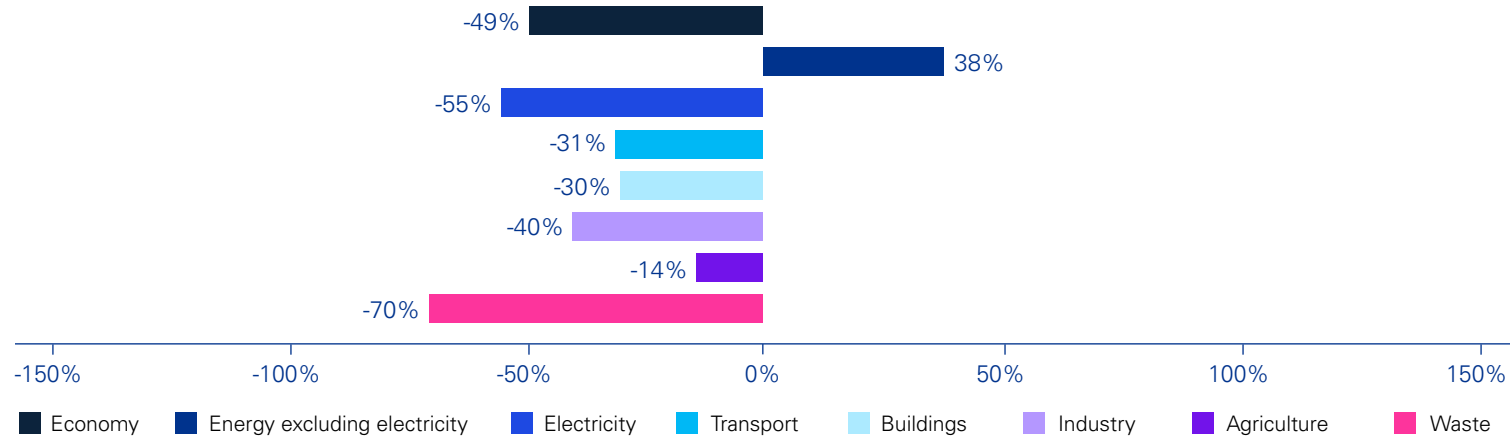
⁶ 'Global EV data explorer', International Energy Agency. <https://www.iea.org/data-and-statistics/data-tools/global-ev-data-explorer>



Change in absolute emissions (2005–2022)



Change in emissions intensity (2005–2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023; Energy Institute's 2023 Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>; Economist Intelligence Unit (EIU) Viewpoint; The World Bank Open Data





United States of America

The 2022 Inflation Reduction Act has turbocharged investment in low-carbon energy and waste reduction in the United States. Supplier requirements to decarbonize and an ongoing focus on sustainability by investors provide additional incentives for companies to act.

The United States has an abundance of renewable energy potential, including from solar, wind, geothermal and hydropower. 2022 marked the first year that electricity from renewables exceeded coal with 21 percent of production from the former and 20 percent from the latter according to the US Energy Information Administration. Natural gas remained the largest source with 39 percent.¹ With a strong record for innovation, the US is well-positioned to lead the transition to a low-carbon economy but many factors hang in the balance.

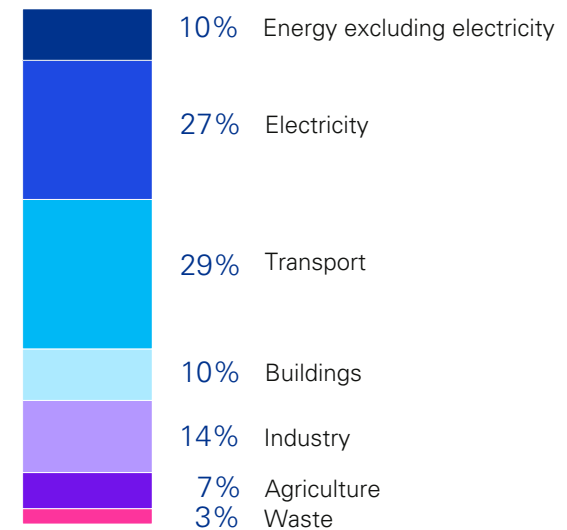
In August 2022, President Joe Biden signed into law the Inflation Reduction Act, which contains major tax incentives and benefits for work focused on decarbonization.² The act has turbocharged investment in low-carbon energy technologies and production, says Rob Fisher, US ESG Lead and Partner, KPMG in the US. “We have consistently decarbonized and reduced our emissions intensity, but emissions intensity is still high compared to a number of other economies,” he says of the trend over the last few decades. The Inflation Reduction Act and increasing investor demands are likely to lead to a further reduction in emissions, with an analysis from the National Renewable Energy Laboratory predicting that the legislation will help the US get to around 80 percent clean electricity by 2030.³

New climate disclosure rules from the Securities and Exchange Commission expected during 2023 should further support investments by providing more information and greater transparency for investors, Fisher adds. However the shift to renewables, which produce electricity intermittently compared with fossil fuels and nuclear, and increasing demands to recharge electric vehicles will require increasing investment in US electricity grid infrastructure.

Reducing waste, decarbonizing suppliers

The Inflation Reduction Act encourages manufacturers to go further on reducing waste, such as circular economy efforts to find other uses for materials that would otherwise be discarded, which reduces emissions as well as having other environmental benefits. Fisher says that a number of large US-headquartered companies are also increasingly requiring that their suppliers improve their environmental performance, helping to decarbonize whole value chains.

GHG emissions split by sector (2022)



Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023



For example, technology giant Microsoft requires its suppliers to commit to reducing greenhouse gas emissions by 55 percent by 2030 unless otherwise agreed, with support for some suppliers in developing countries to decarbonize through assistance and financing. The company is aiming to become carbon negative by 2030 and says that scope 3 emissions including those from suppliers make up the majority of its overall emissions.⁴

Fisher adds that in the US it is paramount that ESG strategies and programs enhance financial value or they will not be sustainable as either a company would lose market share or the programs would be cut as organizations tighten their belts through different economic cycles. The US\$370 billion allocated to energy security and climate programs in the

Inflation Reduction Act has helped make the near-term economics of investing in decarbonization more viable and financially attractive.

KPMG in the US has seen dealmakers such as private equity firms placing increasing weight on sustainability when undertaking due diligence work. Recent market turmoil has led to volumes of deals falling sharply, with global mergers and acquisitions activity in the second quarter of this year 36 percent lower than the same period in 2022 according to researcher Dealogic.⁵ As deal levels bounce back and with sustainability now built into due diligence processes, a company's ability to tell its own data-driven sustainability story can mean a higher valuation or the difference between whether or not a deal closes. A KPMG survey conducted

in April 2023 found that 59 percent of corporate investors have had deals canceled due to material findings from due diligence related to ESG reporting, while 46 percent of financial investors had a deal canceled or opted for a price reduction after a material ESG due diligence finding.⁶

Fisher notes that when it comes to sustainable consumer products, it is important to meet people where they are. For example, inflation-pinched American households may not always be willing to buy the product with the least amount of emissions associated with it if it means a significant price increase. As more consumer-facing companies continue to embed sustainability into their processes, there should be less of a premium on sustainable products as they become the baseline market expectation.

¹ Isabella O'Malley, 'US renewable electricity surpassed coal in 2022', Associated Press, 28 March 2023. <https://apnews.com/article/renewable-energy-coal-nuclear-climate-change-dd4a0b168fe057f430e37398615155a0>

² 'Inflation Reduction Act changes the game for energy transformation', Plugged In magazine, KPMG International, March 2023. <https://kpmg.com/xx/en/home/industries/energy/power-utilities/plugged-in-magazine-2/inflation-reduction-act-changes-the-game-for-energy-transformation.html>

³ Ella Nilsen, 'Can Biden achieve his cornerstone climate goal? Why 100% clean power is still out of reach', CNN, 14 July 2023. <https://edition.cnn.com/2023/07/14/politics/biden-clean-electricity-goal-report-card-climate/index.html>

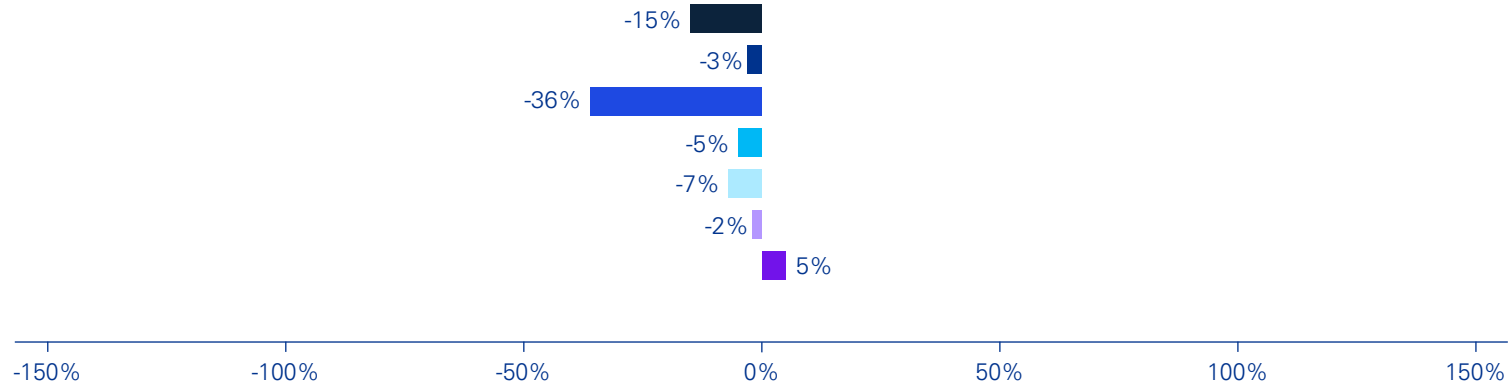
⁴ FAQs on environmental protection, 'Learn about your responsibilities as a Microsoft supplier', Microsoft. <https://www.microsoft.com/en-us/procurement/supplier-conduct.aspx?activetab=pivot:primaryr11>

⁵ Anirban Sen and Andres Gonzalez, 'Global mergers and acquisitions plunge in second quarter, dealmakers see green shoots', Reuters, 30 June 2023. <https://www.reuters.com/markets/deals/global-mergers-acquisitions-plunge-q2-dealmakers-see-green-shoots-2023-06-30/>

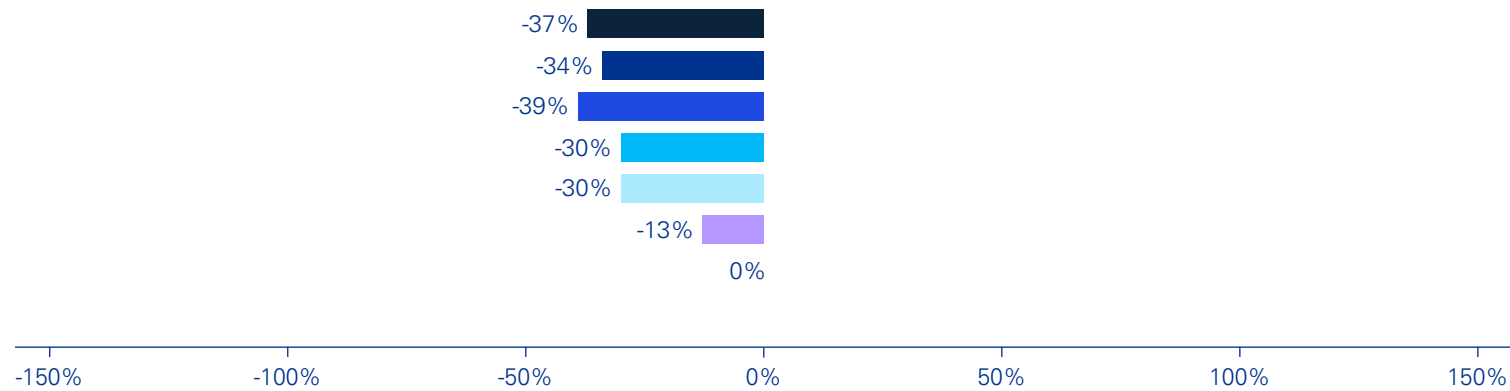
⁶ 'KPMG study: most US investors want a dedicated ESG due diligence product that can analyze risks and opportunities', KPMG in the US, 27 July 2023. <https://info.kpmg.us/news-perspectives/industry-insights-research/kpmg-esg-due-diligence-survey-2023.html>



Change in absolute emissions (2005–2022)



Change in emissions intensity (2005–2022)



Economy
 Energy excluding electricity
 Electricity
 Transport
 Buildings
 Industry
 Agriculture
 Waste

Source: Calculated by KPMG International using data from EDGAR, https://edgar.jrc.ec.europa.eu/report_2023; Energy Institute's 2023 Statistical Review of World Energy, <https://www.energyinst.org/statistical-review>; Economist Intelligence Unit (EIU) Viewpoint; The World Bank Open Data





About KPMG's decarbonization, climate and nature services

Business commitments to reach net zero emissions and reduce their impacts on the planet have increased rapidly. As the global push towards decarbonization accelerates and the impacts of climate change play out globally, businesses are preparing for a low-carbon future — rising to stakeholder demands for accountability on plans, action and progress.

Strong decarbonization targets and robust transition plans to decarbonize business operations and supply chains, together with targets and actions to reduce impacts on nature, are now expected. Boards are under significant pressure to address environmental issues, and it is critical that businesses grasp the implications of climate and nature risks and opportunities.

KPMG decarbonization, climate and nature teams form an extensive global network of deep expertise, established services, innovative technologies and carefully selected alliances, spanning:

- Climate and nature risk
- Decarbonization strategy and implementation
- Climate policy and incentives advisory
- Low carbon deal advisory

KPMG professionals can help navigate this increasingly complex landscape, enabling you to deliver on your environmental ambitions for your business, people and the planet.

Learn more

KPMG, as a global organization, knows the intrinsic power of ESG to transform your business. KPMG ESG professionals can show you how to enhance trust, mitigate risk and unlock new value as you transform to build a sustainable future.

Visit kpmg.com/esg to explore more.

Subscribe today to receive the latest ESG-related content straight to your inbox.

KPMG ESG insights

For more information about how you can help your organization in achieving its ESG goals, check out and subscribe to ESG insights, which is an ongoing subscription that allows you to receive articles, publications, webcasts and podcasts curated for ESG leaders.

kpmg.com/esg

kpmg.com/esginsights



KPMG contacts

Climate Change and Decarbonization Leader, Global Head of Renewable Energy
Mike Hayes
 E: mike.hayes@kpmg.ie

Global Managing Director
David Greenall
 E: dgreenall@kpmg.ca

Global Head of Transport & Logistics
Steffen Wagner
 E: steffenwagner@kpmg.com

Global Head of Energy, Natural Resources and Chemicals
Anish De
 E: anishde@kpmg.com

Chief Economist
Yael Selfin
 E: yael.selfin@kpmg.co.uk

Global Head of Oil & Gas
Jonathan Peacock
 E: jjpeacock@kpmg.com.au

Global Head of Shipping
Monique Giese
 E: moniquegiese@kpmg.com

Director, Global Strategy Group
Christopher Brown
 E: christopher.brown@kpmg.ie

Major projects advisory
Lisa Kelvey
 E: lisa.kelvey@kpmg.co.uk

Global Head of Industrial Manufacturing
Stéphane Souchet
 E: ssouchet@kpmg.fr

Senior Tax Manager — Global ESG Tax
Nicole de Jager
 E: dejager.nicole@kpmg.com

Global Head of ESG Reporting
Jan-Hendrik Gnändiger
 E: jgnaendiger@kpmg.com

Global Head of ESG Assurance
Mike Shannon
 E: mshannon@kpmg.com

Global Head of Agribusiness
Ian Proudfoot
 E: iproudfoot@kpmg.co.nz

Australia
Barry Sterland
 E: bsterland@kpmg.com.au

Brazil
Felipe Salgado
 E: felipesalgado@kpmg.com.br

Canada
Andrew McHardy
 E: amchardy@kpmg.ca

China
Daisy Shen
 E: daisy.shen@kpmg.com

Denmark
Michael Birkebæk Jensen
 E: mijensen@kpmg.com

France
Jeremie Joos
 E: jeremiejoos@kpmg.fr

Germany
Goran Mazar
 E: gmazar@kpmg.com

India
Anish De
 E: anishde@kpmg.com

Apurba Mitra
 E: apurbamitra@kpmg.com

Ireland
Russell Smyth
 E: russell.smyth@kpmg.ie

Italy
PierMario Barzaghi
 E: pbarzaghi@kpmg.it

Japan
Ayako Torii
 E: ayako.torii@jp.kpmg.com

Mexico
Alicia Moreno
 E: aliciamoreno@kpmg.com.mx

Netherlands
Bob Hoogendoorn
 E: hoogendoorn.bob@kpmg.nl

New Zealand
Charles Ehrhart
 E: cehrhart@kpmg.co.nz

Norway
Carl Christian Christensen
 E: carl.christian.christensen@kpmg.no

Singapore
Sharad Somani
 E: sharadsomani@kpmg.com.sg

South Africa
Ron Stuart
 E: ron.stuart@kpmg.co.za

South Korea
Diana Ah Ryung Lee
 E: ahryunglee@kr.kpmg.com

Spain
Ramon Pueyo Viñuales
 E: rpueyo@kpmg.es

Sweden
Torbjörn Westman
 E: torbjorn.westman@kpmg.se

Switzerland
Patrick Schmucki
 E: pschmucki@kpmg.com

United Arab Emirates
Fadi Alshihabi
 E: falshihabi@kpmg.com

Amro Osman
 E: aosman2@kpmg.com

United Kingdom
Richard Andrews
 E: richard.andrews@kpmg.co.uk

United States of America
Rob Fisher
 E: rpfisher@kpmg.com

kpmg.com/esg



The information contained herein is of a general nature and is not intended to address the circumstances of any particular individual or entity. Although we endeavor to provide accurate and timely information, there can be no guarantee that such information is accurate as of the date it is received or that it will continue to be accurate in the future. No one should act on such information without appropriate professional advice after a thorough examination of the particular situation.

Throughout this document, “we”, “KPMG”, “us” and “our” refers to the global organization or to one or more of the member firms of KPMG International Limited (“KPMG International”), each of which is a separate legal entity.

©2023 Copyright owned by one or more of the KPMG International entities. KPMG International entities provide no services to clients. All rights reserved.

KPMG refers to the global organization or to one or more of the member firms of KPMG International Limited (“KPMG International”), each of which is a separate legal entity. KPMG International Limited is a private English company limited by guarantee and does not provide services to clients. For more detail about our structure please visit kpmg.com/governance.

The KPMG name and logo are trademarks used under license by the independent member firms of the KPMG global organization.

Designed by Evalueserve.

Publication name: Net Zero Readiness Report 2023

Publication number: 139001-G

Publication date: November 2023