MSCI Sustainability Institute

April 2024

Spotlight on carbon markets

The MSCI Net-Zero Tracker

A periodic report on progress by the world's listed companies toward curbing climate risk

Introduction

The shift to a clean-energy economy stands at a crossroads.

Earth experienced its hottest year on record in 2023.[1] The heat pushed average global temperatures at least temporarily above the 1.5°C (2.7°F) threshold that scientists tell us can stave off the worst impacts of global warming.[2] Nearly 200 countries, meanwhile, have pledged to triple reliance on renewable energy and double energy efficiency by 2030 in a push to drive down the world's dependence on oil, gas and coal.[3]

Evidence shows that the share of fossil fuels in the global energy mix is falling, albeit slowly.[4] Yet global greenhouse gas (GHG) emissions hover at all-time highs (59.8 billion tons) and the projected emissions of the world's listed companies put them on a trajectory to warm the planet 3°C (5.4°F) by the end of the century according to our data.[5]

This ninth edition of our Net-Zero Tracker examines the current moment in a climate transition that is unfolding in bursts while altering the landscape of risks and opportunities for investors.

- We look at the transition to a greater proportion of renewables as a share of the global energy mix through the generation capacity and climate plans of listed electric utilities.
- We examine the voluntary carbon market, where an acceleration of corporate climate target setting and the need to unlock climate finance is driving demand for high-quality carbon credits.
- We also take our regular snapshot of corporate climate progress, based on listed companies' projected warming and climate targets.

1 "Climate change indicators reached record levels in 2023," World Meteorological Organization, March 19, 2024

2 "February 2024 was globally the warmest on record," Copernicus Climate Change Service, March 5, 2024

3 "First Global Stocktake," United Nations Framework Convention on Climate Change, Dec. 12, 2023

4 "Major growth of clean energy limited the rise in global emissions in 2023," International Energy Agency, March 1, 2024

5 The global total, of course, masks regional differences, with both total emissions and emissions per capita falling in advanced economies while rising in China. At the same time, emissions per capita in advanced economies were about 70% higher than the global average last year. See, IEA report cited in footnote 4.

An orderly path to achieve net-zero is expected to demand an eye-watering USD 4.5 trillion in clean-energy investment in the coming decade – more than double current record levels.[6] Climate investment would need to increase nearly fourfold, to USD 2.4 trillion a year, over the same period in emerging markets outside of China.[7]

It will also demand policy that can provide capital-markets participants with clarity and predictability designed to encourage finance and investment.[8] More than 50 countries, including the U.S., the world's second-largest emitter of greenhouse gases behind China, and the European Union, are slated to hold national elections this year that could shape the pace and breadth of climate policies and influence investment incentives.[9]

The transition to a greener economy creates both opportunities and challenges for participants across capital markets. As the outcomes of COP28 suggest, smoothing the path to net-zero will demand an alignment of policy, investment, innovation and action.

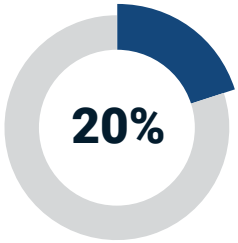
6 "Net Zero Roadmap: A Global Pathway to Keep the 1.5°C Goal in Reach, 2023 Update," International Energy Agency, September 2023

7 "Second report of the Independent High-Level Expert Group on Climate Finance," United Nations, November 2023

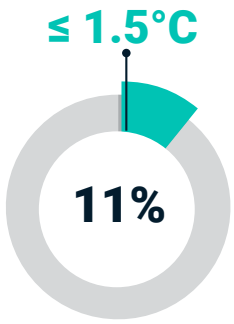
8 See "Accelerating climate progress in the largest economies," MSCI Sustainability Institute, available at msci-institute.com

9 "Over 50 countries go to the polls in 2024. The year will test even the most robust democracies," AP, Jan. 10, 2024. See also, "This Interactive Chart Shows Changes in the World's Top 10 Emitters," World Resources Institute, March 2, 2023.

Key findings

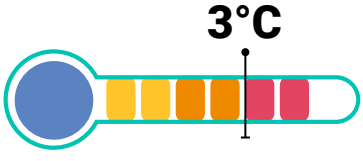


Share of listed companies that have set science-based climate targets



Share of the listed companies that align with the goal of holding the rise in average global temperatures to 1.5°C above preindustrial levels

Date by which the world's listed companies are expected to burn through their remaining 1.5°C carbon budget



Temperature by which listed companies would warm the planet, MSCI's Implied Temperature Rise metric shows

More companies are setting science-based climate targets: One-fifth of listed companies have targets that set science-based pathways for aligning their financially relevant GHG emissions with net-zero by 2050 while limiting the rise in average global temperature to 1.5°C, as of Jan. 31, 2024. This is an increase of eight percentage points from a year earlier.

- Nearly 38% of listed companies have set decarbonization targets that aim to reach net-zero, a one percentage point increase over the same period.
- Just over half (52%) of listed companies have disclosed an emissions-reduction commitment.

Emissions disclosures are growing: Nearly 60% of listed companies globally disclosed their Scope 1 and/or Scope 2 emissions, as of Jan. 31, 2024, an increase of 16 percentage points in two years.

- Nearly 42% of listed companies reported at least some of their Scope 3 emissions, a rise of nearly 17 percentage points over the same period.
- Climate disclosure rules finalized by the U.S. Securities and Exchange Commission (SEC) could help to narrow a global disclosure gap. Less than half (45%) of U.S.-listed companies disclosed their Scope 1 and 2 carbon emissions, as of Feb. 15, 2024, compared with nearly three-quarters (73%) of listed companies in developed markets globally.[10]

Listed companies are on track to burn through their share of the global carbon budget for limiting average temperature increases to 1.5°C by July 2026.

- We estimate that listed companies will produce 11.8 billion tons (gigatons) of Scope 1 GHG emissions this year, roughly the same amount they produced in 2023, or nearly one-fifth of global GHG emissions.
- Global GHG emissions would need to peak by 2025 and fall 43% by 2030 to avert the worst impacts of global warming, according to the United Nations Intergovernmental Panel on Climate Change (IPCC).[11]

The decarbonization trajectories of the world's listed companies place them on a path to warm the planet by 3°C (5.4°F) above pre-industrial levels this century, roughly double the 1.5°C threshold that science indicates would prevent the worst effects of global warming.

- The estimate reflects enhancements to MSCI ESG Research's Implied Temperature Rise metric that, as described in this report, assess companies' progress toward their climate targets and fine-tune the calculation of companies' remaining carbon budgets.
- 38% of companies are on a pathway to constrain warming to 2°C or below while 11% are aligned with a 1.5°C temperature rise.

10 For all references to laws, rules or regulations, please note that the information is provided "as is" and does not constitute legal advice or any binding interpretation. Any approach to comply with regulatory or policy initiatives should be discussed with your own legal counsel and/or the relevant competent authority, as needed.

11 "Synthesis Report of the IPCC Sixth Assessment Report (AR6), Intergovernmental Panel on Climate Change, March 20, 2023

Spotlight on carbon markets

Voluntary purchases of carbon credits can play two roles within corporate net-zero standards:

- They can enable companies to neutralize their most difficult-to-abate emissions once a company has already reduced its emissions by an amount sufficient to achieve net-zero alignment.
- They can enable companies to mitigate their climate impact during their journey to net zero, reflecting the urgency of reducing global emissions this decade if society is to prevent the worst impacts of global warming.

Integrity is paramount: A range of industry stakeholders are acting to bolster the integrity of carbon credits with the goal of instilling confidence in the voluntary market among companies and investors. Each carbon credit should represent one tonne of CO_2-equivalent (CO_2e) emissions reduction or removal.

Tracking the voluntary carbon market

- Issuances of carbon credits in the first quarter of 2024 totaled 83.7 megatons (Mt) of CO_2e, roughly level with the same period a year earlier.
- The number of carbon credits retired during the first quarter totaled 54.2 Mt of CO_2e, up 10% from the same quarter a year earlier.
- Monthly average prices for carbon credits across all project types dropped to USD 4.7 per tonne of CO_2e in the first quarter, a 4% decrease from the fourth quarter of 2023 on a volume-weighted basis.

Net-zero roadmap

Publicly traded utilities play a key role in implementing the net-zero pathway agreed to at COP28. Listed utilities:

- **Owned nearly one-third** (31%) of the 8,600 GW of the generation capacity estimated by the International Energy Agency to have existed globally in 2022.
- **Tend to lean more** on coal and fossil gas for power generation than power producers globally.
- **Would own** 43% of the global wind capacity and just over 15% of the global solar capacity needed by 2030 based on the IEA's net-zero roadmap.
- **Are setting targets to deploy renewables**, although they are not expressed in comparable terms.

Turning COP28 commitments **into reality**

Countries agreed at COP28 to a "just, orderly and equitable" transition away from the use of fossil fuels in energy systems and to pursue several essential elements of the IEA's roadmap for reaching net-zero by 2050.[12] They include tripling installations of solar, wind and other forms of renewable energy to 11,000 gigawatts, which the IEA has estimated could reduce demand for fossil fuels (the leading source of global GHG emissions) by roughly 25% over the same period.

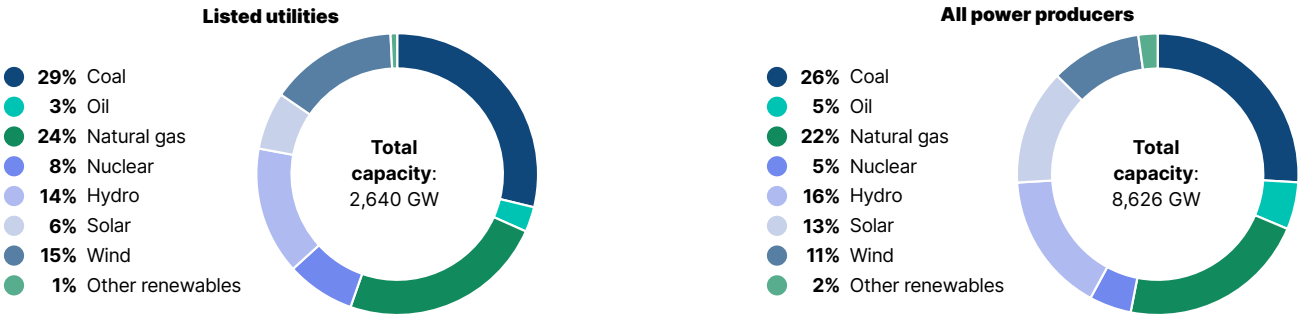
The utilities sector plays a key role in achieving these aims. Listed utilities owned about one-third (31%) of the 8,600 GW of global power generation capacity estimated in 2022 (Exhibit 1).[13] The sector contributes a sizeable share of power and faces growing demand as economies increasingly require more electricity that they want to be low-carbon.

Exhibit 1: Estimated installed power generation capacity (MW)

Source: International Energy Agency and MSCI ESG Research

Coal and natural gas currently dominate the generation capacity of listed utilities, providing about 29% and 24%, respectively (Exhibit 2). This differs slightly from global capacity for coal and natural gas, with 26% and 22%, respectively, as estimated by the IEA.

Exhibit 2: Generation capacity by fuel (2022)

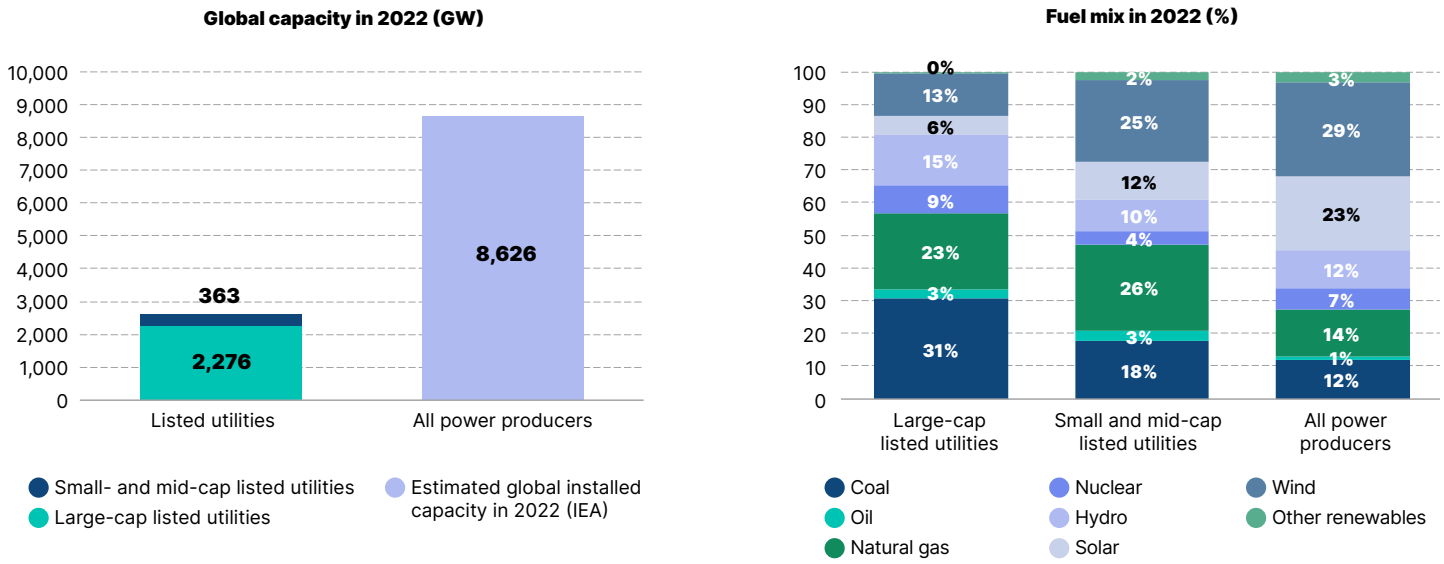


Source: International Energy Agency and MSCI ESG Research

12 "First Global Stocktake," United Nations Framework Convention on Climate Change, Dec. 12, 2023

13 Listed utilities here refers to MSCI ACWI IMI companies classified in the utilities sector as per the Global Industry Classification Standard (GICS®) jointly developed by MSCI Inc. and S&P Global Market Intelligence. The GICS® structure comprises 11 sectors, 24 industry groups, 69 industries and 158 sub-industries. For purposes of this analysis we use generation capacity as the defining metric. Given differences in capacity utilization, efficiencies and load factors, energy output from the various sources of power generation (even for plants with the same nameplate capacity) would vary over time among (and within) plants and across locations.

Exhibit 3: Comparing small- and large-cap listed utilities with all power producers



Source: International Energy Agency and MSCI ESG Research

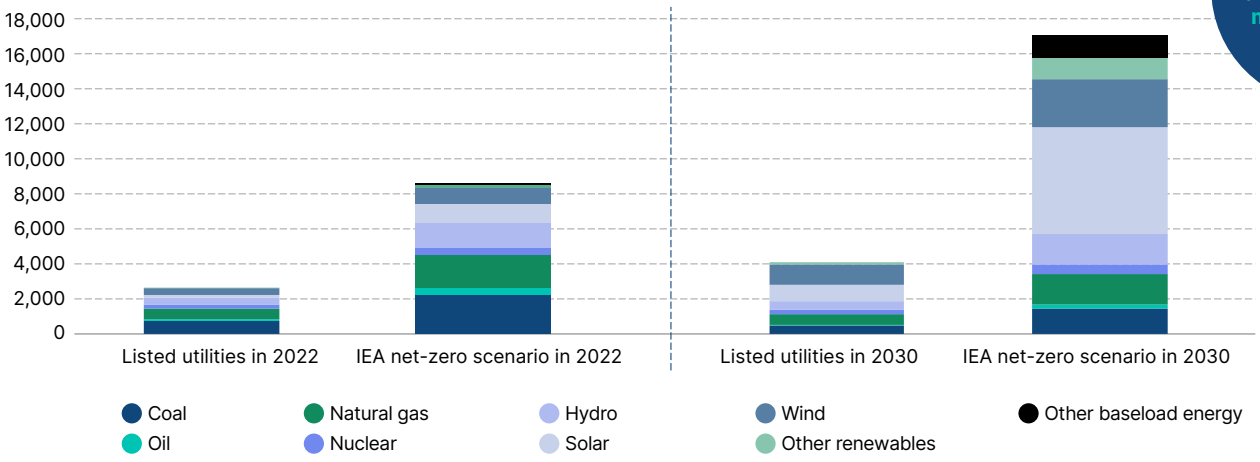
Listed utilities, in the aggregate, tend to lean more on fossil fuels for power generation than power producers globally. Larger (by market value) listed utilities tend to lean harder on coal and natural gas to generate power than their smaller counterparts. Small- and mid-cap utilities have double the share of both wind and solar in their installed capacity compared with large-cap utilities (Exhibit 3). Note, however, that total installed capacities are about six times lower at small-cap utilities than at large caps (363 GW vs. 2,276 GW).

Projecting generation capacity and fuel mix

Applying the growth rates in the IEA's net-zero scenario to the generation capacity of listed utilities, the latter would own about 43% of the wind capacity and just over 15% of the solar capacity by 2030 based on the IEA's net-zero roadmap (Exhibit 4).[14]

Exhibit 4: Comparing installed generation capacity of listed utilities with global capacity (GW)

For an interactive version of this chart, visit **msci-institute.com**.

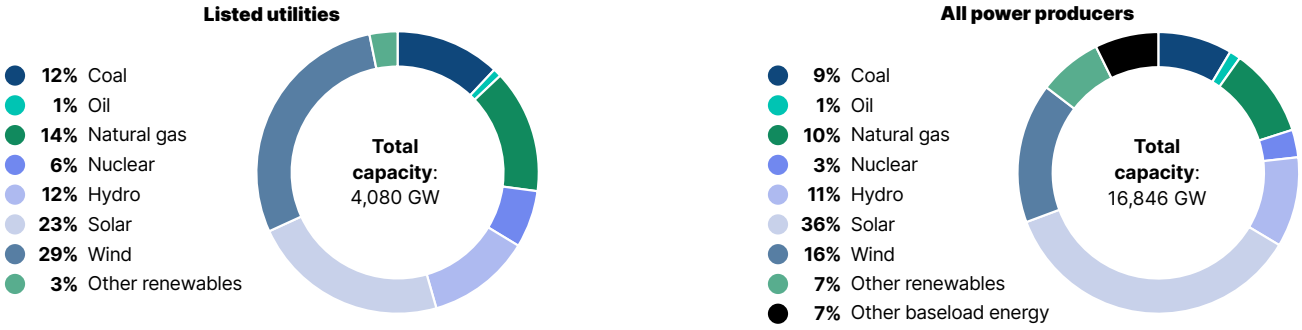


Source: International Energy Agency and MSCI ESG Research

14 To determine the aggregate fuel mix for listed issuers, we applied the IEA's projected rate of growth for each fuel. Note that we refer here to listed issuers in the aggregate, not to individual issuers.

Note that wind would account for a larger share of the generation capacity for listed utilities in 2030 than it would globally compared with the IEA scenario (29% for listed utilities compared with 16% globally), while solar would account for a smaller share of listed utilities' capacity (23% compared with 36%) (Exhibit 5). The underrepresentation of utility-scale solar may reflect both policy and market support for wind and the relative scalability of wind power. Much of the growth in solar capacity has come from rooftop and other distributed forms of solar that are not owned by utilities. More than one-quarter (26%) of total installed solar capacity in the U.S., for example, is distributed.[15]

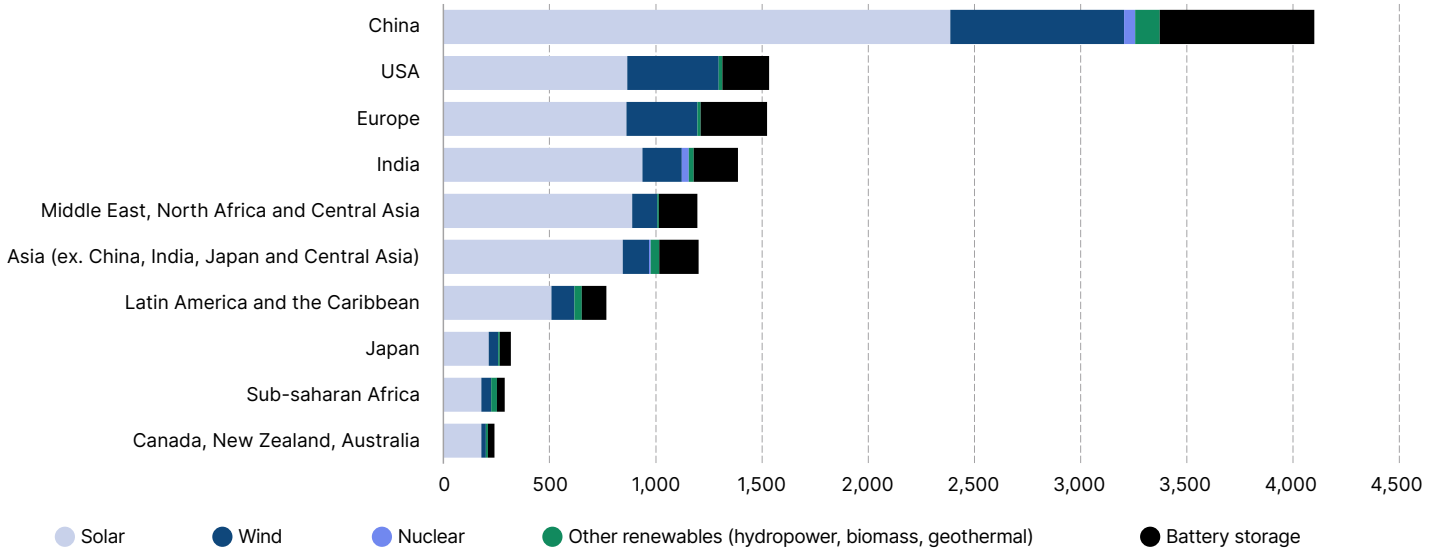
Exhibit 5: Generation capacity by fuel (2030)



Source: International Energy Agency and MSCI ESG Research

There would be disparities among listed utilities across regions, of course. China, India and Southeast Asia alone would require an estimated two-thirds (5,700 GW) of increased global capacity to replace thermal coal in the power-generation mix (Exhibit 6).[16] Utilities that provide power to those economies may need in due course to conform their fuel mix to country targets.

Exhibit 6: Gross increase in renewable and nuclear energy capacity required by 2030 under Net-Zero by 2050 scenario (GW)



*This chart uses 2020 figures instead of 2022 data, because the REMIND-MAgPIE model output in NGFS Phase 4 Scenario Explorer provides data in five-year time blocks. Source: NGFS REMIND-MAgPIE model output accessed from NGFS Phase 4 Scenario Explorer in December 2023, MSCI ESG Research's further analysis of output data

Source: International Energy Agency and MSCI ESG Research

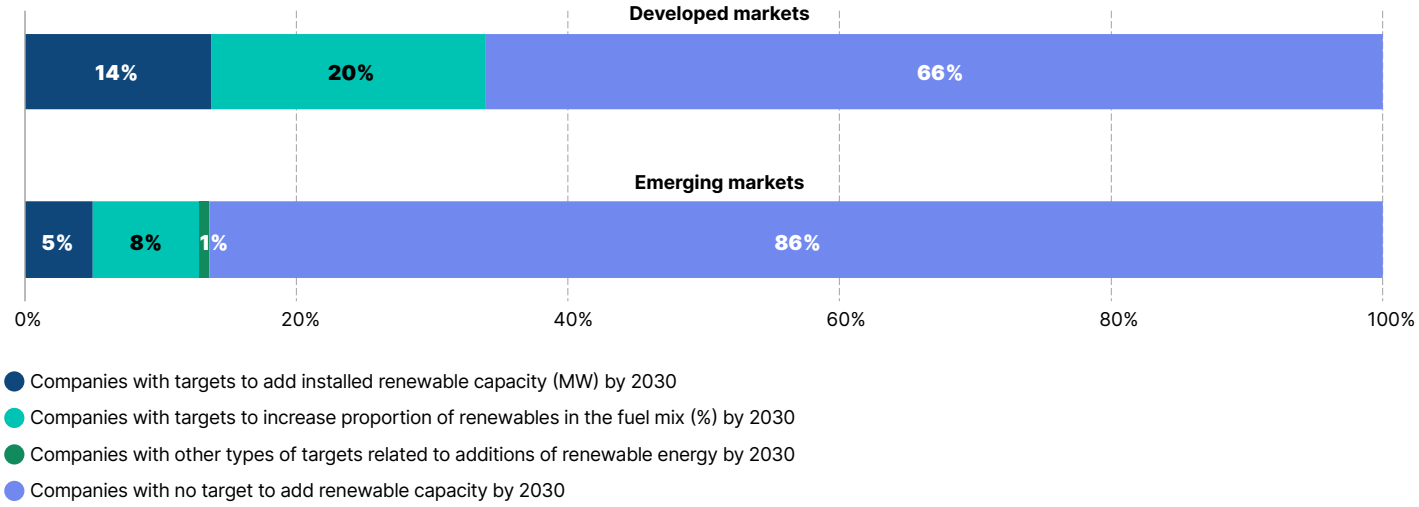
15 "Renewables 2023," International Energy Agency, January 2024

16 "Unpacking COP28 Commitments to Renewable Energy and Energy Efficiency," MSCI ESG Research, March 4, 2024

Looking at utilities' climate targets

Listed utilities' voluntary climate commitments offer an indication of their renewable-energy targets. About 34% of developed-market utilities and 14% of utilities in emerging markets have set targets either to increase renewable-energy capacity or the share of renewable energy in their fuel mix by 2030 (Exhibit 7).[17]

Exhibit 7: Share of listed electric utilities with climate targets for 2030



Source: MSCI ESG Research, company disclosures as of Jan. 5, 2024

17 Renewable energy capacity refers to maximum net generating capacity of power plants that use renewable energy to produce electricity. See "Renewable capacity statistics 2023," International Renewable Energy Agency, March 2023.

The table below shows examples of renewable energy-related commitments by some of the world's largest electric utilities (Exhibit 8).[18] It illustrates how they have committed to expanding clean energy according to varying timeframes and technologies, as well as differences among their approaches.

As the table suggests, corporate disclosure of climate targets can be vague or unstructured, making them difficult to aggregate at a global level or compare with commitments made by countries at COP28. Still, the analysis suggests a drive toward adding renewable capacity to the grid in the coming years.

Exhibit 8: Renewable energy targets of the world's most-valuable utilities by market capitalization

Company	Domicile	Renewable energy target	Total current generation capacity - MW	Renewables generation capacity - MW (% of current total)
NextEra Energy, Inc.	U.S.	Increase renewable energy generation to 77% in 2030 from 49% in 2019; Deliver 10.7 GW of new wind energy capacity by 2025	59,840	26,430 (44.4%)
China Yangtze Power Co., Ltd.	China	At least 71GW of total managed renewable energy capacity by 2023	45,595	NA
Iberdrola S.A.	Spain	Deliver 52 GW of new renewable energy capacity by 2025 and 80 GW by 2030	60,761	25,961 (42.7%)
The Southern Company	U.S.	Reach 20GW of renewable energy capacity by 2030	42,746	5,306 (12.4%)
Duke Energy Corporation	U.S.	Reach 24GW of total regulated renewable energy capacity by 2030 and 30GW by 2035	46,534	2,984 (6.4%)
ENEL - SPA	Italy	Reach 100% zero-emissions electricity generation by 2040; By 2030, add 100GW of new renewables capacity from 2021 levels, reaching total managed capacity of 100GW. By 2025, add 21GW of new renewables capacity from 2021 levels, reaching total managed capacity of 75GW (including 4GW from battery energy storage systems) Increase battery energy storage to 20 TWh by 2030	84,578	25,206 (29.8%)
ACWA Power Company SJSC	Saudi Arabia	Reach at least 50% of renewables in total installed capacity by 2030	11,124	1,423 (12.8%)
National Grid PLC	U.K.	Net Zero Carbon Emissions on Scope 1,2 and 3 by 2050. Net Zero carbon grid in UK by 2025	3,947	4.5 (0.1%)
SEMPRA	U.S.	Deliver 100% renewable or zero carbon energy to electric utility customers at San Diego Gas & Electric (SDG&E) by 2045	2,873	1,044 (36.3%)
American Electric Power Company, Inc.	U.S.	Achieve 50% renewable energy generation capacity by 2033	22,747	3,079 (13.5%)
Constellation Energy Corporation	U.S.	Achieve 95% carbon-free owned electricity generation by 2030, and 100% by 2040	32,350	1,006 (3.1%)

Source: MSCI ESG Research, data as of Jan. 31, 2024, companies in descending order of market capitalization

18 The table shows the 10 most-valuable companies by market capitalization in the utilities sector, as of Jan. 31, 2024. We have filtered their climate targets to highlight commitments tied to renewables, based on MSCI's Climate Target and Commitments dataset, and checked the results against company disclosures.

Carbon Markets

The role of carbon credits in corporate decarbonization

Nearly 3,400 listed companies have pledged to reduce their GHG emissions to net-zero.[19] More than 1,800 of them have set a target validated by (or submitted for validation by) the Science Based Targets initiative (SBTi), a key arbiter of corporate climate pledges.[20] Such companies pledge to reduce emissions within their operations or value chain. Carbon credits do not count toward meeting their science-based emissions reduction targets.[21]

At the same time, these 3,400 companies have a combined GHG footprint (Scopes 1 and 2) of 9.3 gigatons (Gt) of carbon dioxide equivalent (CO_2e) emissions per year.[22] Hence, a meaningful proportion of the world's emissions are now covered by corporate net-zero targets.[23] Collectively these targets are, on paper at least, ambitious. Achieving them will also be costly: Reducing emissions often requires companies to undertake upfront investments. The cost of abating residual emissions can be as high as $500/tCO_2e in some industries (Exhibit 9).[24]

Exhibit 9: Costs of reducing emissions by industry

Industries	Estimated average cost of abatement to achieve 40% emissions reduction by 2030 (USD/tCO_2e)	
	Range	Average
Aviation	200 – 600	400
Chemicals and chemical processes (including ammonia)	250 – 650	450
Electricity generation	50 – 300	175
Non-ferrous metals and processes (including aluminum)	450 – 660	555
Non-metallic minerals and processes	100 – 580	340
Other energy transformation (fossil fuels)	440 – 600	520
Other transport (rail)	200 – 300	250
Residential	180 – 400	290
Road Transport	200 – 800	500
Services	180 – 460	320
Shipping	130 – 200	165
Iron & steel and processes	350 – 640	495

Source: MSCI Carbon Markets, based on the average cost of each sector reducing its emissions 40% from 2019 levels by 2030 in line with science-based 2050 net-zero scenarios. See "Using Carbon Credits to Meet Corporate Climate Targets," Trove Research, Nov. 24, 2023, and "Synthesis Report of the IPCC Six Assessment Report (AR6)," Intergovernmental Panel on Climate Change, March 20, 2023.

19 As of Jan. 31, 2024

20 "The Corporate Net-Zero Standard," SBTi, April 2023

21 See note 19

22 MSCI ESG Research, data as of March 31, 2024

23 To be sure, companies' carbon footprints overlap; the Scope 3 emissions for one company are the direct emissions of its suppliers or customers. Similarly, companies' Scope 2 emissions can be electric utilities' Scope 1 emissions. For discussion of double-counting in emissions scopes, see "Scope 3 Frequently Asked Questions," Greenhouse Gas Protocol, June 2022

24 Estimate by MSCI Carbon Markets, based on the average cost of each sector reducing its emissions 40% from 2019 levels by 2030 in line with science-based 2050 net-zero scenarios. See "Using Carbon Credits to Meet Corporate Climate Targets," Trove Research, Nov. 24, 2023, and "Synthesis Report of the IPCC Sixth Assessment Report (AR6), Intergovernmental Panel on Climate Change, March 20, 2023.

The cost to companies of reducing GHG emissions directly rises as they reduce their overall emissions (as remaining emissions become increasingly more difficult to abate). This is where the argument for the economic efficiency of carbon trading has come in. The rationale is that companies can reduce their residual GHG emissions at lower cost outside of their supply chain; a tonne of GHG emissions eliminated from the atmosphere combats global warming regardless of where the source of those emissions happens to be. **In short, carbon trading may offer companies more abatement for a similar level of investment.**

Well established

The concept of carbon trading is well established in compliance markets around the world. The largest such scheme is in the European Union (known as the "EU ETS"), which covers around half of all of Europe's carbon emissions. A growing number of jurisdictions, including China, the U.K., South Korea and California, have instituted similar schemes. Within such markets, large carbon emitters in designated sectors can trade the right to release emissions. Regulators typically cap the total amount of emissions released annually in line with national or sub-national targets. Trading of emissions allowances among participating firms allows for emissions reductions to be achieved by firms with the lowest abatement costs. The traded value of these compliance markets is significant, with the EU ETS alone reaching USD 900 billion in 2023.[25]

The same principle of economic efficiency underpins the voluntary carbon market, with the critical difference that companies participate voluntarily rather than because they are required to by regulation. Expanding the range of abatement opportunities beyond their business allows companies with high abatement costs to lower the cost of reducing and eliminating their net emissions without, in theory, any trade-off for the environment, provided their carbon credits meet specific criteria for quality and credibility. The opportunities can be as diverse as controlling methane emissions from landfills or pipelines, deploying cookstoves in rural Africa, developing low-carbon agricultural practices, reforesting degraded land, or removing carbon permanently from the atmosphere through underground storage. **More than 250 different project types are currently eligible for carbon credits under the various international standards.**

The cost of purchasing carbon credits ranges widely. Carbon credits for afforestation and reforestation, for example, can sometimes trade at over USD 30/tCO_2e. Credits for controlling methane emissions have averaged around USD 4/tCO_2e this year but have traded as high as USD 10 for certain projects, primarily in North America. Credits that permanently remove emissions from the atmosphere, such as through carbon sequestration, are much more costly but allow companies to show that emissions that they have created are neutralized permanently. Despite the increasing costs of developing high-quality carbon-credit projects in recent years, they are often significantly less expensive than the mitigation options available in many industries.

Unlike reducing emissions within their value chain that companies can reduce permanently, companies incur the cost of purchasing carbon credits every year that they continue to generate excess emissions. The cost of carbon credits, like the cost of reducing emissions, goes up as emissions go down. Finding the trade-off between upfront cost and long-term savings requires careful consideration by credit buyers.

25 "Global carbon markets value hit record $909 bln last year," Reuters, Feb. 7, 2023

When and how carbon credits can be used

Nearly every corporate climate initiative – from SBTi to net-zero frameworks developed by the United Nations "Race to Zero" alliances – envisions a mitigation hierarchy in which companies prioritize deep reductions of emissions across their value chain before looking to reduce emissions outside of it. Carbon credits play two roles within such corporate climate standards.

The first, for which there is relatively strong consensus, is for use by companies to **offset residual hard-to-abate emissions** once a company has reduced its emissions as much as possible (by 90% for most sectors under SBTi) in order to claim net-zero alignment.[26] SBTi's standard, for example, requires these credits to be produced by projects that remove and store emissions from the atmosphere permanently.[27] This has led to a recent focus within carbon markets on the scaling of engineered carbon dioxide removal (CDR) technologies. While still tiny in terms of its current emissions impact, the CDR sector has been among the largest recipients of carbon-market funding from both governments and the private sector in recent years, with companies such as Airbus, Microsoft, Swiss Re making purchases of credits for direct air capture.[28]

The second, and more debated role for carbon credits within corporate standards, is their use by companies in relation to **interim targets** on the path to net-zero by 2050 aspirations. Interim targets, including targets for 2030 and 2035, are a key component of industry target-setting frameworks, where they reflect both a need for credibility and the urgency of reducing emissions this decade.[29]

Some companies have purchased an amount of carbon credits equal to their annual emissions in order to assert a claim of so-called **carbon neutrality**. Such claims, particularly in Europe, are now seen to be misleading, given problems of integrity and permanence for many carbon credits (see next section), and the absence, in some earlier carbon-neutrality standards, of a requirement for companies to first reduce their emissions before resorting to credits. (Though research has shown that, in practice, companies that rely on carbon credits, on average, have reduced their emissions much more quickly than those that do not).[30]

Carbon credits also increasingly could provide a mechanism for **unlocking private investment** needed to fund the green transition in developing countries and protect nature and support broader biodiversity goals.[31]

Most standards recommend that companies use carbon credits as a way to further mitigate their emissions impact. The latest guidance from SBTi, for example, recommends that companies set near- and long-term targets to reduce their own GHG emissions as well as help to reduce emissions beyond their value chain.[32] Companies can reduce emissions beyond their value chain through the purchase of high-quality carbon credits or by investing in carbon-credit projects, SBTi has stressed.

26 See, "The Corporate Net-Zero Standard," SBTi, April 2023

27 See note 26. See also, "Above and Beyond: An SBTi report on the Design and Implementation of Beyond Value Chain Mitigation (BVCM)," Version 1.0, February 2024.

28 "Unlocking the potential of direct air capture: Is scaling up through carbon markets possible?," International Energy Agency, May 11, 2023

29 See, for example, "Target Setting Protocol, third edition," UN-convened Net-Zero Asset Owner Alliance, January 2023, and "Implementation Guide," Net Zero Investment Framework, Paris Aligned Investment Initiative, Version 1.0, March 2021

30 "Corporate emission performance and the use of carbon credits," Trove Research, June 1, 2023

31 The Biden administration, the Rockefeller Foundation and the Bezos Earth Fund, for example, are spearheading an initiative that will use voluntary purchases of carbon credits to fund electricity generation in developing countries. See, "Energy Transition Accelerator: Core Framework," December 2023.

32 "Above and Beyond: An SBTi Report on the Design and Implementation of Beyond Value Chain Mitigation," Version 1.0, SBTi, February 2024

The Voluntary Carbon Markets Integrity Initiative (VCMI) has promulgated among the more prominent standards governing corporate use of carbon credits, and one explicitly highlighted by the SBTi. VCMI has developed a claims code that comprises tiers (silver, gold and platinum), depending on the proportion of emissions being offset.[33] The VCMI requires that companies use only high-quality carbon credits and are also on track to reduce their own emissions in line with the goal of limiting warming to 1.5°C, or roughly 7% per year.[34]

To address concern over the high cost of reducing emissions within companies' value chains, the VCMI is also proposing to allow a so-called Scope 3 flexibility claim, which would allow companies to use high-quality carbon credits to help meet Scope 3 targets in a given year so long as they are otherwise reducing Scope 1 and 2 emissions in line with a 1.5°C target.[35] Use of carbon credits for this purpose would be limited in time (up to a maximum of 10 years), by which time the company would be expected to have reduced its Scope 3 emissions in line with its overall target. A consensus on use of credits for this purpose has yet to develop, and it remains to be seen if such a use case becomes a substantial driver of demand for voluntary carbon credits.

Beyond voluntary action, carbon credits can also be used within a number of compliance or compliance-like schemes. In California's Cap-and-Trade Program, for example, covered entities may use carbon credits to satisfy between 4-6% of their overall compliance obligation.[36] In aviation, airlines are required, starting this year, to offset with specific types of carbon credits or by using low-carbon fuels, international flight emissions that exceed 85% of their 2019 levels.[37] Such demand currently represents a relatively small proportion of the market but could become more material over time.

The importance of carbon-credit quality

Whether carbon credits are used to meet a compliance target or for a voluntary claim, each carbon credit should represent one tonne of CO_2e reduction or removal. In both cases, the measurement of the quantity of emissions saved relies on evidence of what would have happened in the absence of the project. The emissions reduction or removal achieved by the carbon credit also needs to be permanent.[38] Offsetting is not credible if shortly after being made, the emissions reduced or removed by the credit are released back into the atmosphere, for example, by a wildfire burning down a newly forested area.

Unfortunately, carbon credits have long been troubled by questions, many of them valid, about their integrity. Some carbon credits have overstated, for example, the quantity of emissions they have reduced or removed from the atmosphere (a problem seen mainly with nature-based and clean cooking projects) or understated the likelihood that those emissions reductions would have happened in the absence of the carbon credit (an "additionality" problem most associated with renewable energy and projects intended to reduce deforestation).[39]

33 "Claims Code of Practice, Building integrity in voluntary carbon markets," v. 2, November 2023, VCMI

34 See note 33

35 "See note 33

36 "Direct Environmental Benefits in the State, Quantitative Usage Limits," California Air Resources Board, available at https://ww2.arb.ca.gov/

37 "Offsetting CO_2 Emissions with CORSIA," International Air Transport Association, available at iata.org

38 Note that permanence, an essential attribute of carbon-credit quality, can vary. Carbon emissions injected into rock, for example, may remain there for thousands of years, whereas emissions stored in a forests may remain there for hundreds of years.

39 See, for example, "Comprehensive review of carbon quantification by improved forest management offset protocols," Haya et al., Frontiers in Forests and Global Change, Volume 6 – 2023, March 21, 2023

Some projects have had the permanence of their emissions impact questioned (particularly among North American nature-based projects) or their impacts on local communities or biodiversity criticized.[40] These shortcomings have generated news coverage and charges of greenwashing against carbon-market participants.[41]

At the same time, a range of industry stakeholders have taken steps to bolster the integrity of carbon credits with the goal of instilling confidence in the voluntary market among companies and investors:

- The market's main registries and standards bodies, including Verra, Gold Standard, Climate Action Reserve, and American Carbon Registry, are continuing to improve their methodologies. In December, Verra, the largest registry, unveiled a major overhaul of its methodologies for quantifying carbon credits from forest conservation projects.[42] The initiative included a decision by Verra to, for the first time, apply one of its updated methodologies retroactively to all previously issued carbon credits.[43]
- The Integrity Council for the Voluntary Carbon Market (ICVCM) – a cross-industry governance body – has created a set of Core Carbon Principles designed to improve the practices of standard setting bodies and ensure that carbon credits create real climate impact.[44] The first Core Carbon Principle-labeled credits are expected to come to market this year.[45]
- The largest independent crediting programs agreed at COP28 to create a framework designed to improve transparency and consistency across the voluntary carbon market by aligning standards to shared principles for quantifying removals and reductions.[46]
- National financial regulators are increasingly requiring or encouraging companies to disclose in greater detail their use of carbon credits with the aim of ensuring that corporate climate claims are underpinned by the use of high-quality credits.[47]

The private sector has continued to innovate, including through the introduction of carbon-credit specific insurance designed to protect against key risks, and the growth in a range of data and analytics designed to assess the integrity of carbon-credit projects.

40 See, for example, "The CFTC Should Raise Standards and Mitigate Fraud in the Carbon Offsets Market," Center for American Progress, Oct. 7, 2022

41 See, for example, "Revealed: top carbon offset projects may not cut planet-heating emissions," The Guardian, Sept. 19, 2023, and "Junk Offsets Are Feeding Wave of Greenwashing, Study Shows," Bloomberg, Aug. 24, 2023

42 See, "Verra Launches New Era of Forest Protection with Transformative REDD Methodology," news release, Nov. 27, 2023, and "Verra's New Methodology for Unplanned Deforestation Aims to Silence the Critics, "MSCI Carbon Markets, Dec. 1, 2023

43 See note 42

44 See "The Core Carbon Principles, Plus the Program-Level Assessment Framework and Assessment Procedure," and "The Core Carbon Principles Assessment Framework," both available at icvcm.org

45 See generally, "Potential Impact of the Core Carbon Principles on the Global Carbon Credit Market," Trove Research, Sept. 20, 2023

46 "Independent Crediting Programs Announce Ground-Breaking Collaboration to Increase the Positive Impact of Carbon Markets," Verra, Dec. 4, 2023

47 See, for example, "The Enhancement and Standardization of Climate-Related Disclosures for Investors," Final rules, Securities and Exchange Commission, March 6, 2023

COP28 underscored the importance of the voluntary carbon market

Governments failed to agree at COP28 on a framework for international emissions trading under the so-called Article 6 mechanism of the Paris Agreement.[48] The main sticking points in international talks revolved around the eligibility of project types and technical points relating to the calculation of carbon benefits. Integrity initiatives such as the ICVCM and registries such as Verra and Gold Standard have been addressing similar issues in the voluntary carbon market for several years.

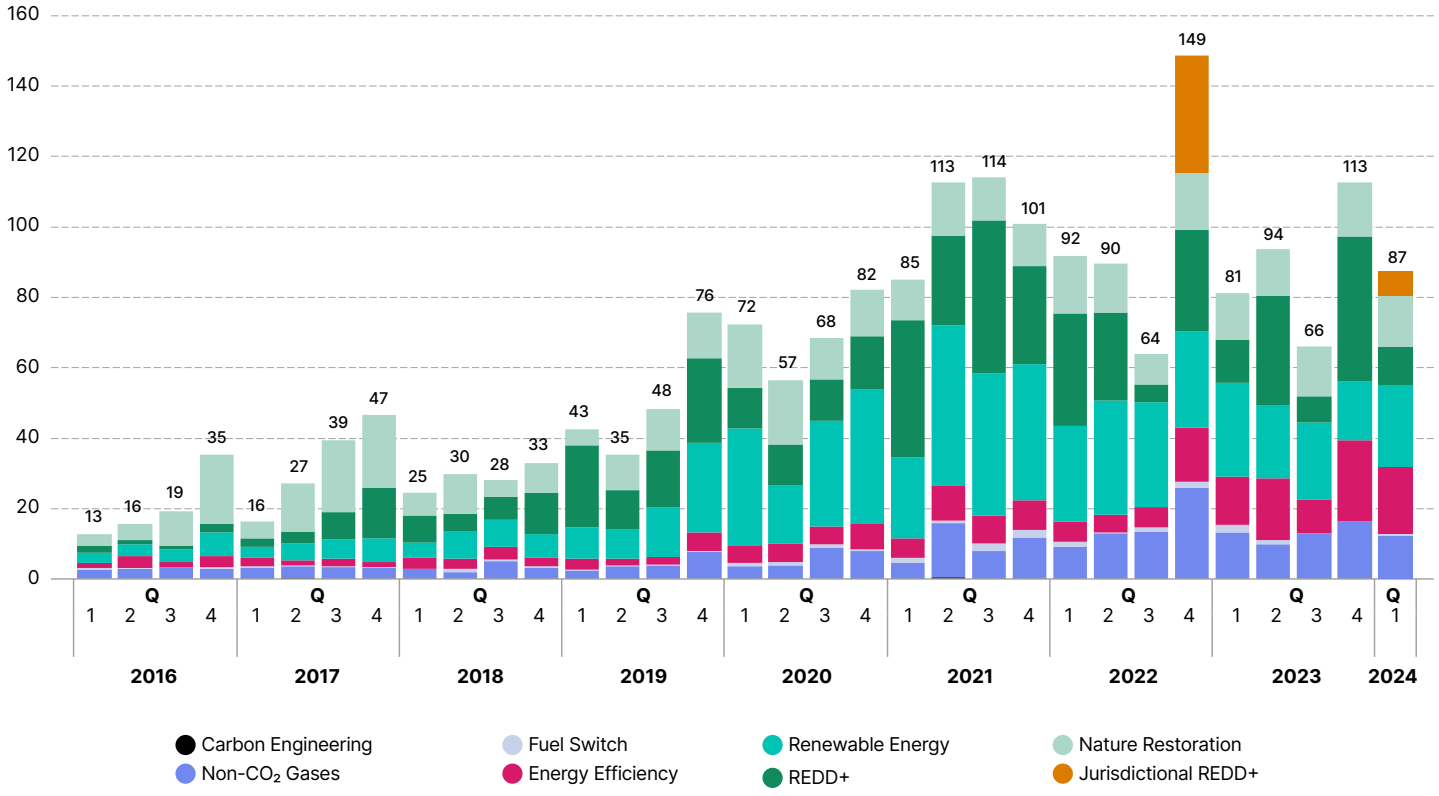
A single set of credible, science-based standards that establish how project-based credits should be defined, measured and used in all situations – for both compliance markets and the voluntary carbon market – would be the ultimate achievement for establishing market integrity and unlocking investments. In its absence, however, the onus is on the voluntary market to show the effectiveness and scalability of such solutions.

Tracking the voluntary carbon market

Below we provide a snapshot of key indicators of the voluntary carbon market: Issuances of carbon credits by project type (an indicator of supply), retirements (an indicator of demand) and price, as of March 31, 2024.

Issuances. Issuances of carbon credits in the first quarter fell 23% (-26 Mt of CO_2e) from the fourth quarter of 2023 to 87 Mt but were up 7.4% from the same period a year earlier (81 Mt), highlighting stability in the voluntary carbon market. The quarter-on-quarter slowdown in the supply of credits was driven predominantly by a drop in REDD+ issuances, which fell 74% (-30 Mt) to their third-lowest quarterly total in three years (see Key Terms section for definitions of carbon credit types). Notably, the first quarter saw the second-ever issuance of Jurisdictional REDD+ credits (7.1 Mt) from Guyana.

Exhibit 10: Quarterly issuances of voluntary carbon credits by project type (MtCO2e)



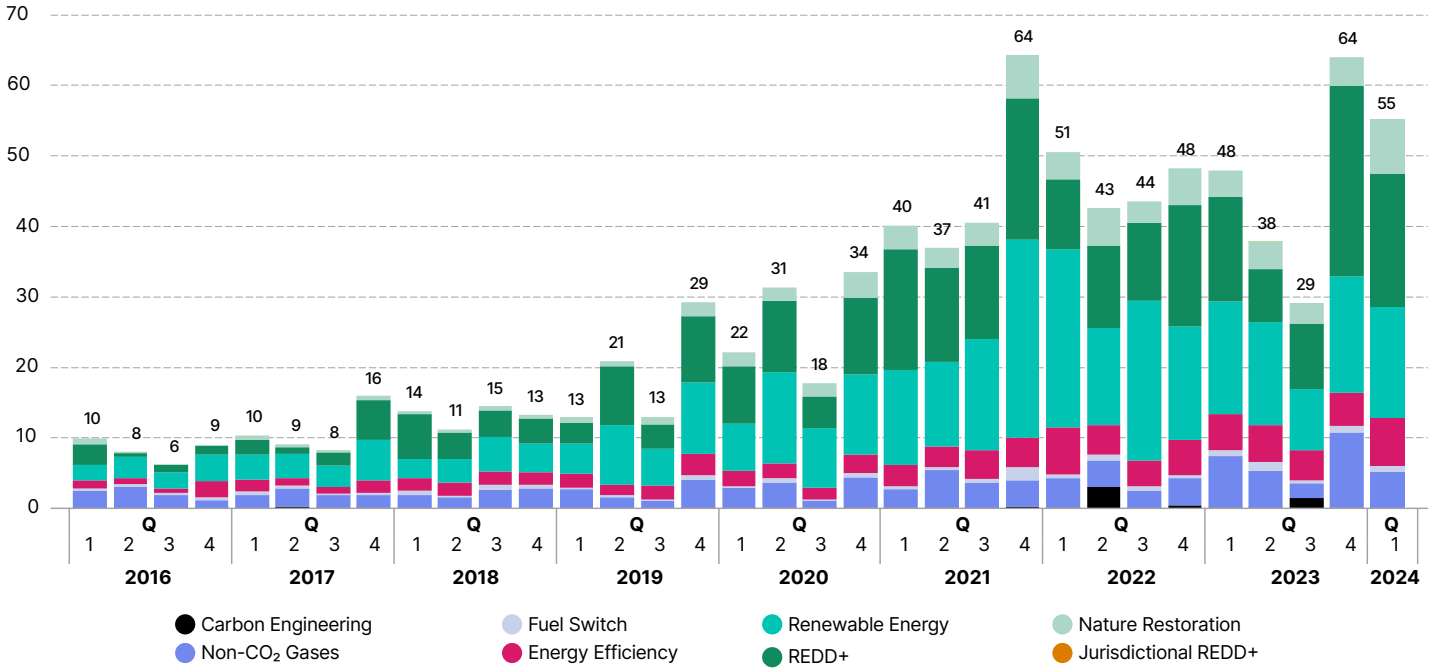
Registries included: Verra, Gold Standard, ACR, CAR, CDM - NDC Eligible, Climate Forward, ART Trees, Puro Earth, EcoRegistry, BioCarbon, GCC & ACCU

Source: MSCI Carbon Markets, data as of March 29, 2024

48 See "Why COP28 Underscores the Importance of Voluntary Carbon Markets," MSCI Carbon Markets, Dec. 21 2023

Retirements. Companies retired 55 $MtCO_2e$ of carbon credits during the first quarter, up nearly 15% from the same quarter a year earlier, demonstrating resilience in the voluntary carbon market (Exhibit 11). The increase from a year ago largely reflected demand for nature-based projects (REDD+ and Nature Restoration credit retirements, which rose 27% and 105%, respectively). The quarter included the first retirements of Bioenergy with Carbon Capture and Storage (BECCS) credits from Puro Earth – the first of many projects designed to scale this approach to carbon dioxide removal.

Exhibit 11: Quarterly retirements of voluntary carbon credits by project type (MtCO2e)



Registries included: Verra, Gold Standard, ACR, CAR, CDM - NDC Eligible, Climate Forward, ART Trees, Puro Earth, EcoRegistry, BioCarbon, GCC & ACCU

Source: MSCI Carbon Markets, data as of March 29, 2024

Shell and Eni were the largest retirees in the first quarter, indicating the continued importance of the voluntary carbon market to oil and gas firms, which also included retirements from transportation companies (Exhibit 12). Contemporary Amperex Technology (CATL), the Chinese battery maker, moved significantly upward from last year, reflecting the growing significance of demand in Asian markets.

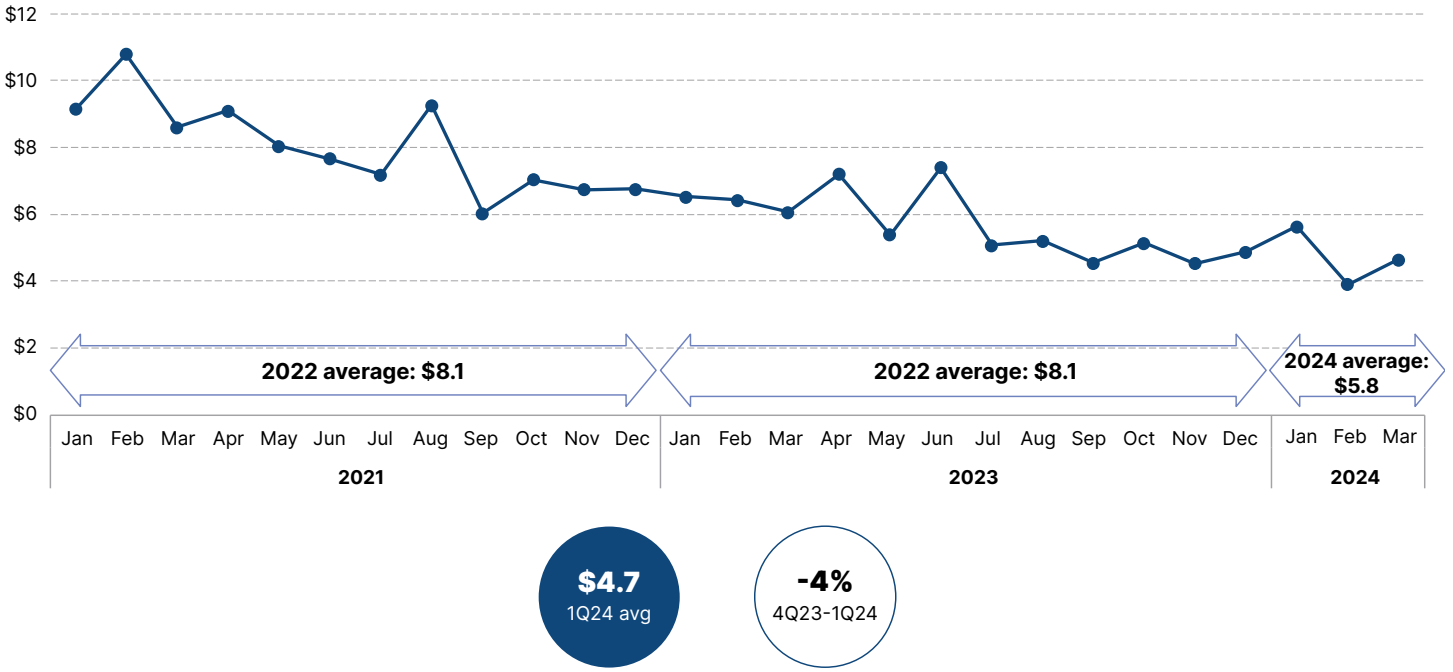
Exhibit 12: Top 10 disclosed retirees, first quarter 2024

Company	Credit volume (tCO2e)	Rank 1Q24	2023 ranking
Shell PLC	5,698,736	1	1
ENI S.P.A.	4,644,154	2	11
Takeda Pharmaceutical Company Limited	2,211,470	3	2
The Boeing Company	853,000	4	8
Woodside Energy Group Ltd.	655,643	5	15
Norwegian Cruise Line Holdings Ltd.	528,407	6	6
Primax Colombia	497,259	7	3
Contemporary Amperex Technology Co., Ltd.	438,871	8	41
Turo	435,000	9	26
The Walt Disney Company	408,413	10	12

Source: MSCI Carbon markets, data as of March 29, 2024

Price. Monthly average prices for carbon credits across all project types fell to USD 4.7 per tonne of CO2e in the first quarter, a 4% decrease from the previous quarter on a volume-weighted basis (Exhibit 13). Nature-based credits diverged, with REDD+ prices down by 30% from USD 5.8 to USD 4.1, whereas Nature Restoration prices increased by 8%, from USD 10.7 to USD 11.6. Non-CO_2 Gas and Energy Efficiency credits exhibited similar trends with the former declining by 19% from USD 3.6 to USD 2.9 and the latter rising by 21% from USD 4.9 to 6. Renewable Energy remained steady, within its longstanding USD 2-2.5 range.

Exhibit 13: Monthly average credit price - all project types (USD/tCO2e)



Registries included: Verra and Gold Standard

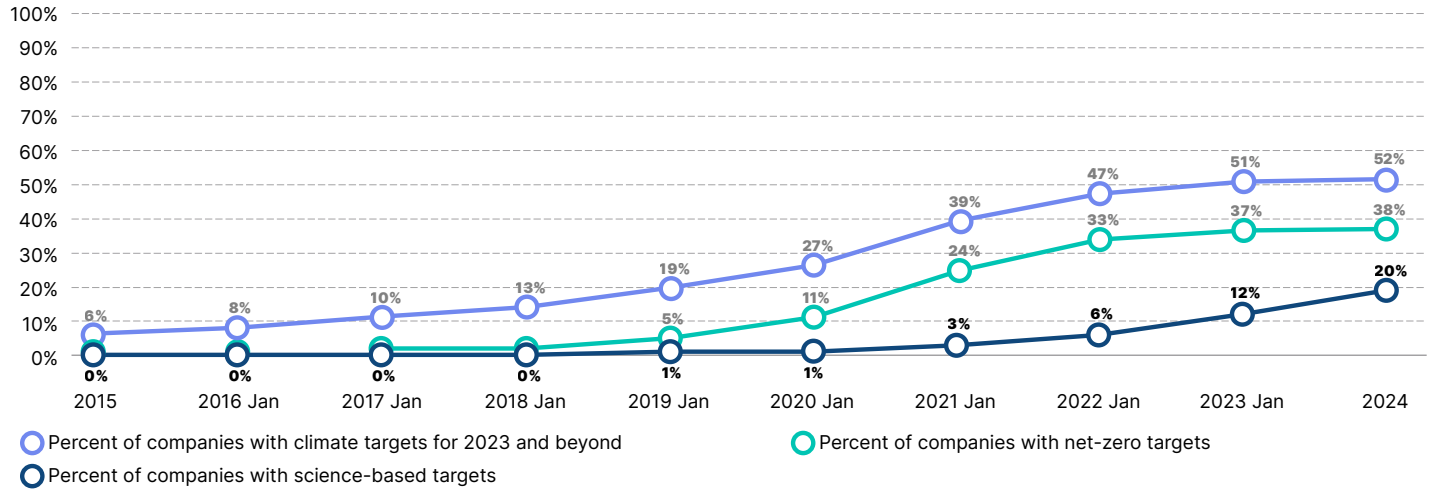
Source: MSCI Carbon Markets, data as of March 29, 2024

Assessing climate progress of listed companies

More companies are setting science-based climate targets

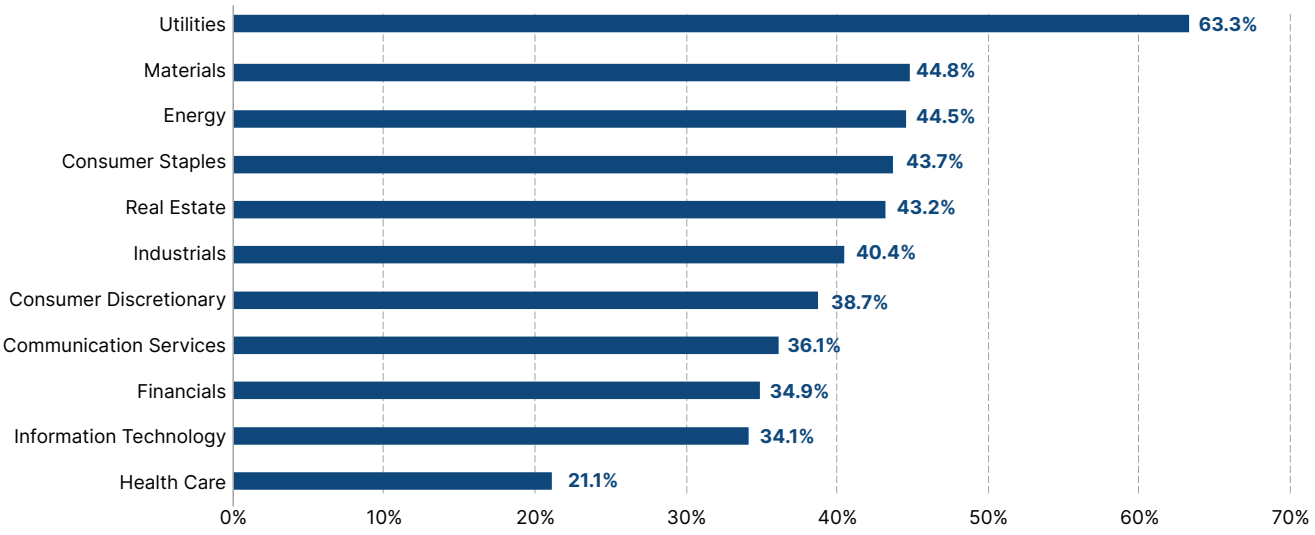
More companies are setting science-based climate targets. One-fifth of listed companies have published a target that would reduce all of their financially relevant greenhouse gas emissions to net-zero in line with the corporate net-zero standard developed by the Science Based Targets initiative (SBTi), as of Jan. 31, 2024, up eight percentage points from a year earlier.[49] Thirty-eight percent of companies have set a target that aspires to reduce emissions to net-zero (though not necessarily in line with SBTi's standard), up about one percentage point over the same period. Overall, more than half (52%) of listed companies have published a climate target, roughly unchanged from a year ago. (Exhibit 14).

Exhibit 14: Share of listed companies with climate targets by target type



Source: MSCI ESG Research, data as of Jan. 31, 2024

Exhibit 15: Percentage of companies with self-declared net-zero targets by GICS® sector



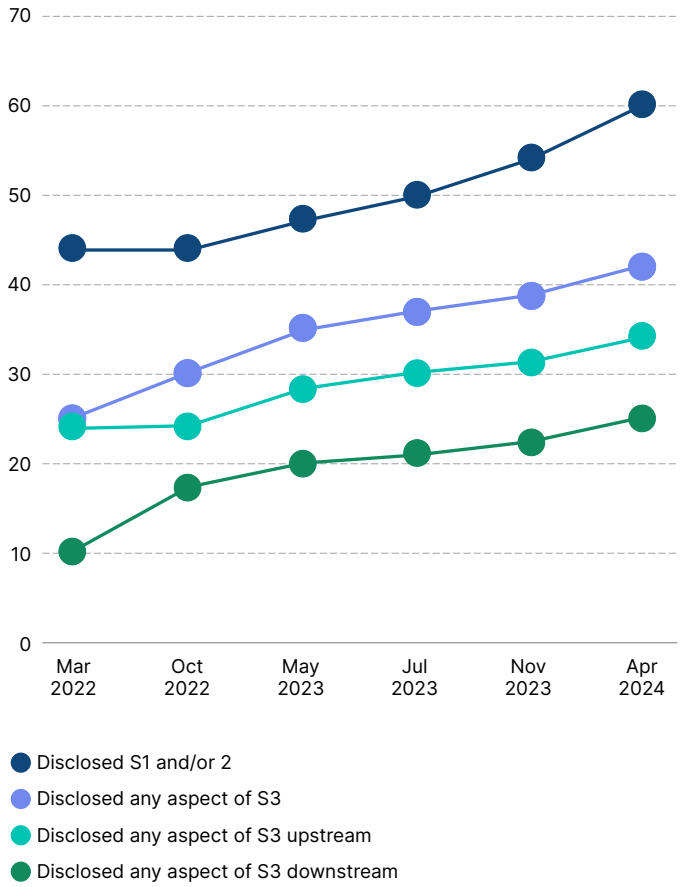
Source: MSCI ESG Research, data as of Jan. 31, 2024

49 Includes targets approved by SBTi or pending with the initiative

Greenhouse gas emissions reporting

Nearly 60% of listed companies disclosed their Scope 1 and/or Scope 2 emissions as of Jan. 31, 2024, an increase of roughly 16 percentage points in two years (Exhibit 16). Forty-two percent of companies reported at least some of their Scope 3 emissions, a rise of nearly 17 percentage points over the same period.

Exhibit 16: Emissions disclosure rising



Source: MSCI ESG Research, data as of Jan. 31, 2024

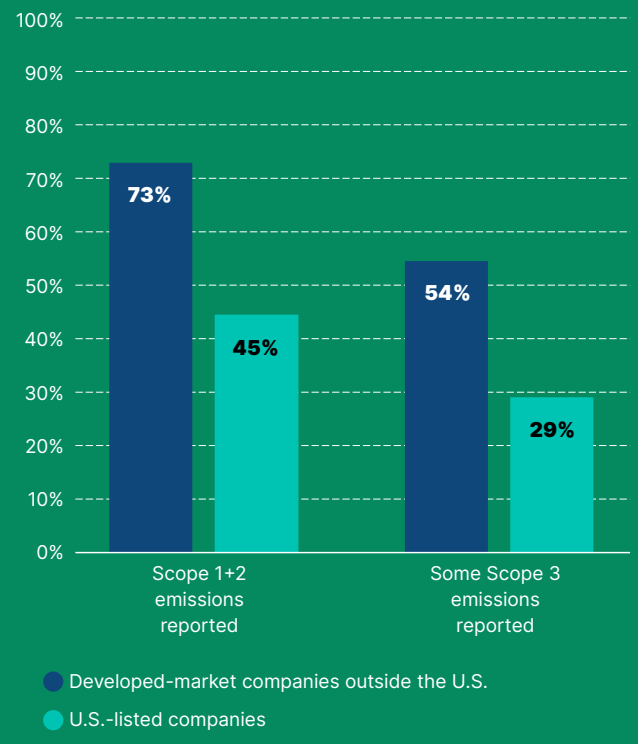
Narrowing a global disclosure gap?

The largest U.S.-listed companies will be required to publish their material Scope 1 and 2 GHG emissions and other climate-related financial information annually under rules adopted in March by the Securities and Exchange Commission (SEC).[50] The measures are designed to standardize disclosure of climate-related information available to investors.

The rules could help to narrow a global disclosure gap: Only 45% of U.S.-listed companies currently disclose their Scope 1 and 2 emissions, compared with 73% of listed firms in other developed markets (Exhibit 17). The rules also require disclosure of climate-related physical and transition risks that are reasonably likely to have a material impact on the company in the short or long term.

The requirement will not catch all companies off guard. A majority of U.S.-listed companies in emissions-intensive sectors like utilities, materials and energy are already disclosing their Scope 1 and 2 emissions, as are companies in consumer staples (Exhibit 18).

Exhibit 17: Emissions disclosure gap

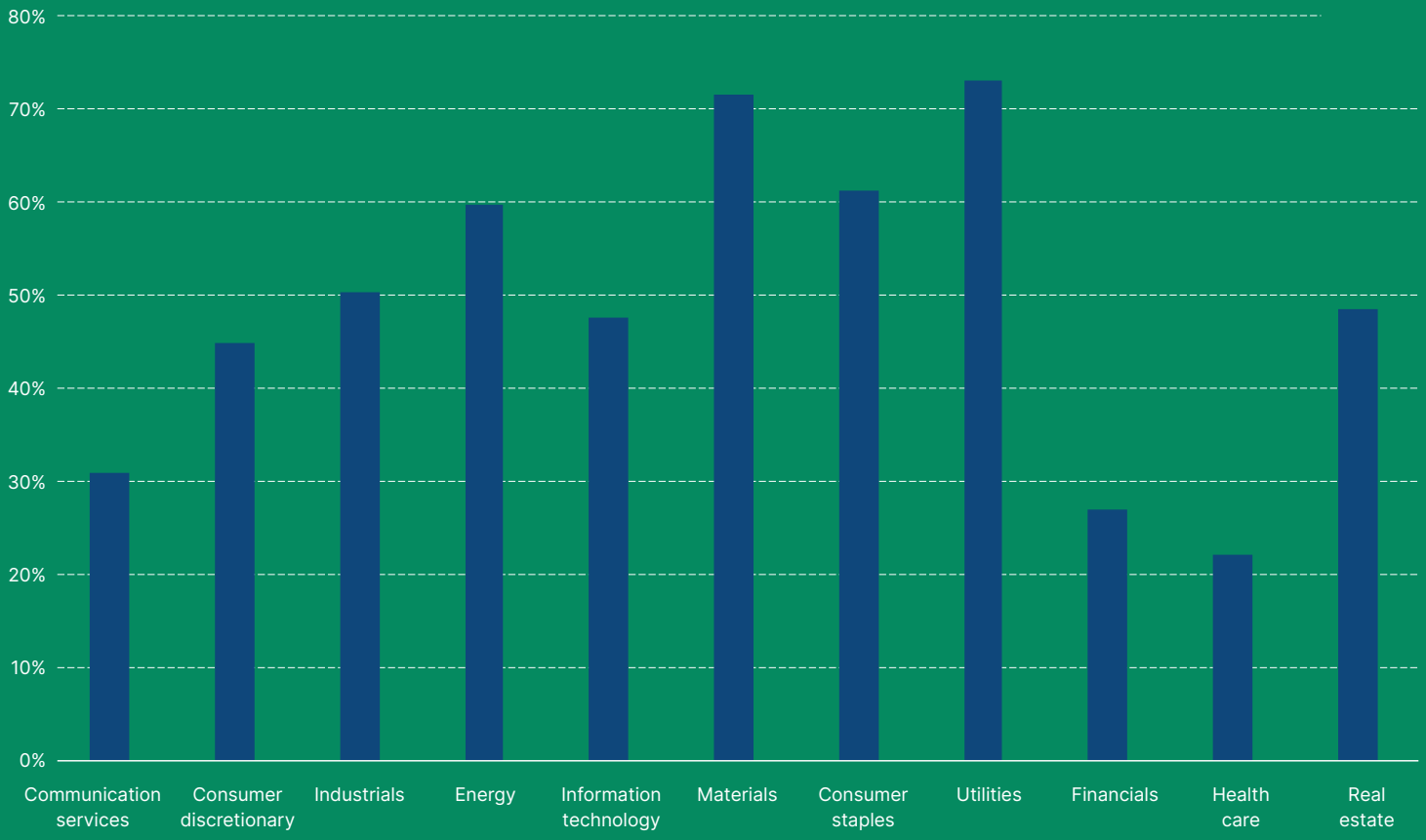


Source: MSCI ESG Research, data as of Jan. 31, 2024

50 "The Enhancement and Standardization of Climate-Related Disclosures for Investors," SEC, March 6, 2024. The SEC has stayed the rules pending judicial review. See, "Order Issuing Stay," SEC, April 4, 2024.

Though the rules would not require companies to disclose their Scope 3 emissions, the disclosures they do mandate could equip investors with much more information about financially relevant climate risks. That's significant from a global perspective, as U.S.-listed companies represent roughly two-thirds (63%) of the total value of global equity markets.[51]

Exhibit 18: Scope 1 and 2 GHG emissions disclosure, US-listed firms by sector



Companies represented by the MSCI USA IMI Index. Sectors as defined by GICS®. The GICS® structure comprises 11 sectors, 24 industry groups, 69 industries and 158 sub-industries. Source: MSCI ESG Research, as of March 7, 2024.

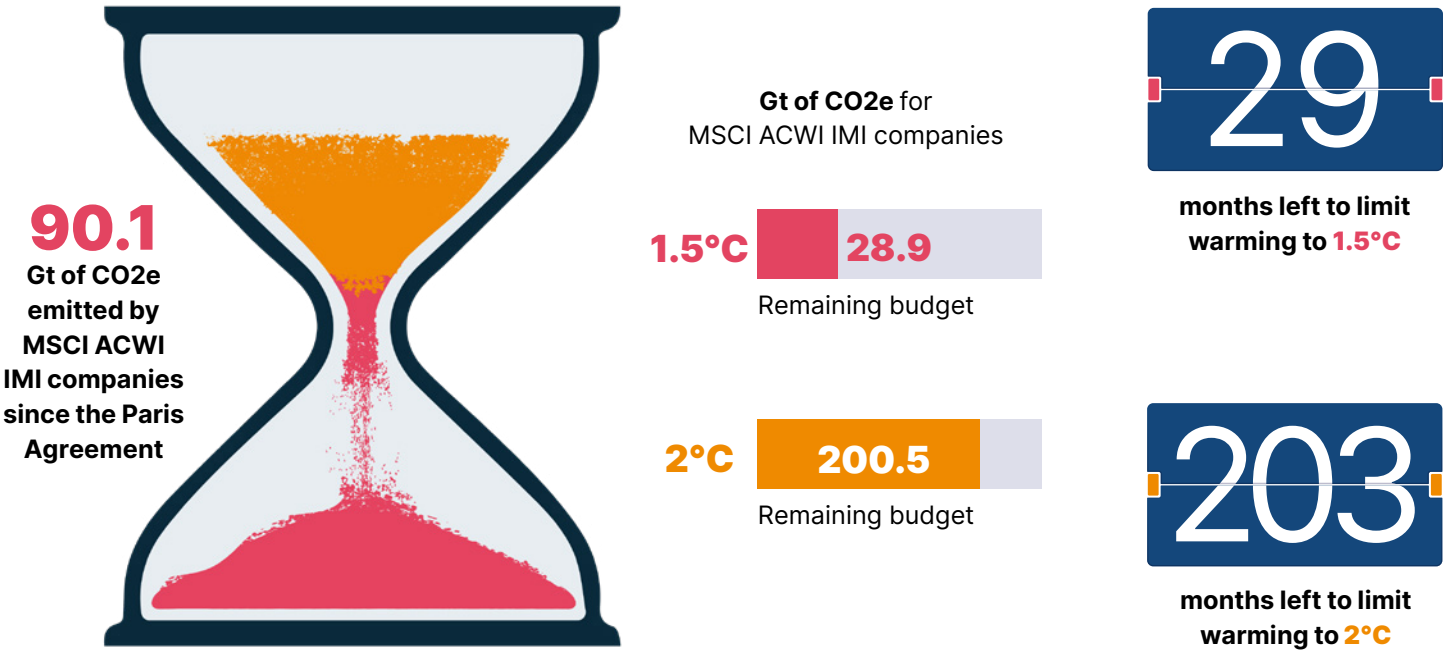
51 Based on country weights in the MSCI ACWI IMI, as of Feb. 29, 2024

Time remaining to rein in **the worst impacts of a warming climate**

Listed companies would deplete their share of the global carbon emissions budget for limiting temperature rise to 1.5°C by July 31, 2026, based on their Scope 1 emissions as of Feb. 29, 2024 (Exhibit 19). Note that this refers to the remaining emissions budget for listed companies and not global temperatures, which averaged between 1.35°C (2.43°F) and 1.54°C (2.77°F) above preindustrial levels last year.[52]

To limit warming to 1.5°C, companies would need to collectively cap future Scope 1 emissions at 28.9 gigatons (Gt) of CO_2e emissions by 2050. Without any change to their current emissions of roughly 11.8 Gt a year, companies would deplete their remaining emissions budget in 2 years, 5 months. To limit warming to 2°C, listed companies would need to collectively cap future Scope 1 emissions at 200 Gt of CO_2e by 2050. Without any change to their current emissions, companies would deplete their remaining emissions budget in 16 years, 11 months.

Exhibit 19



MSCI ESG Research, data as of Feb. 29, 2024

The hourglass and countdown clock show annual total Scope 1 emissions of MSCI ACWI IMI constituents (not index-weighted) based on listed companies' reported emissions data and MSCI estimates as of Jan. 31, 2024. Emissions for 2023 that companies haven't yet reported are based solely on MSCI estimates, given a lag in company reporting. The remaining future emissions budget to achieve a 1.5°C and 2°C warming scenario are calculated based on bottom-up estimates (sum of remaining emissions budget of all MSCI ACWI IMI constituents) as of Jan. 31, 2024.

52 See generally, "Global Temperature Report for 2023," Berkeley Earth, Jan. 12, 2024

Comparing global and listed-company GHG emissions

Scope 1 emissions of the world's listed companies represent about one-fifth of global GHG emissions (Exhibit 20). The chart below shows total estimated global GHG emissions and Scope 1 emissions (sum for all index constituents without index weighting) for the MSCI ACWI Investable Market Index (IMI), as of Feb. 29, 2024.

Exhibit 20: Global greenhouse gas emissions (Gt CO2e)

Historical greenhouse gas emissions [Gt C02e]	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024 (estimated)
Global greenhouse gas emissions*	51.7	51.8	51.9	53.5	55.3	59.1	55.6	58.6	59.7	59.8	59.8
MSCI ACWI IMI Scope 1**	10.4	10.2	9.6	10.2	11.4	11.4	10.4	11.6	11.8	11.8	11.8

Source: MSCI ESG Research, data as of Feb. 29, 2024

* Global emissions through the end of 2023 are based on annual UN Environment Programme reports. The estimate for 2024 reflects changes in emissions as reported by Carbon Monitor. Data reflects cumulative GHG emissions.

** MSCI ACWI IMI emissions for 2023 as reported by companies or estimated by MSCI, where not reported. Emissions for 2024 are estimated from changes in emissions as reported by Carbon Monitor.

A note on global and listed-company emissions reported in the MSCI Net-Zero Tracker

Global GHG emissions in the MSCI Net-Zero Tracker are based on the latest annual report by the United Nations Environment Programme.[53] Scope 1 emissions of listed companies (as represented by the MSCI ACWI IMI) are based on either data reported by companies or estimated by MSCI ESG Research where not reported.

We use data from Carbon Monitor, an international initiative that monitors global carbon emissions from the burning of fossil fuels and cement production, to extrapolate both global GHG emissions and listed-company emissions during the lag between corporate emissions reporting and the latest period.[54] Because Carbon Monitor updates its data daily, however, emissions estimates for any given period can and do change over time.

We estimated in the November 2023 edition of the MSCI Net-Zero Tracker that listed-company emissions would total 12.4 gigatons last year, based on data as of Aug. 31, 2023. We now report, however, that listed-company emissions for 2023 totaled roughly 11.8 Gt, based on data as of Feb. 29, 2024.

Similarly, we currently estimate that global GHG emissions will total roughly 59.8 Gt again this year, after estimating that such emissions would total 60.9 Gt in the November 2023 edition of the report.

The differences reflect changes in emissions reported by Carbon Monitor. Because we are extrapolating from the year that precedes our report, our estimate reflects the ebb and flow of emissions at a given point in time; whether we are extrapolating from a peak or a trough. Hence, our estimate may change depending on when we extrapolate from Carbon Monitor's data, changes in reported global or listed-company Scope 1 GHG emissions, or both.

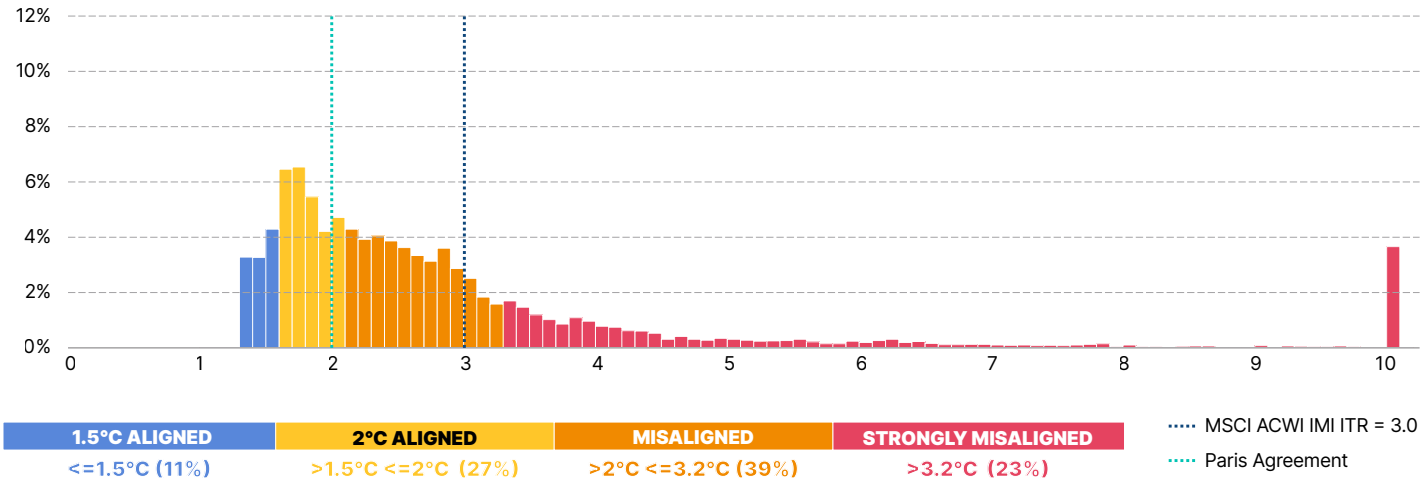
53 "Emissions Gap Report 2023," UN Environment Programme, Nov. 20, 2023

54 "Carbon Monitor, a near-real-time daily dataset of global CO_2 emission from fossil fuel and cement production," Nature, Nov. 9, 2020

Companies' decarbonization trajectories

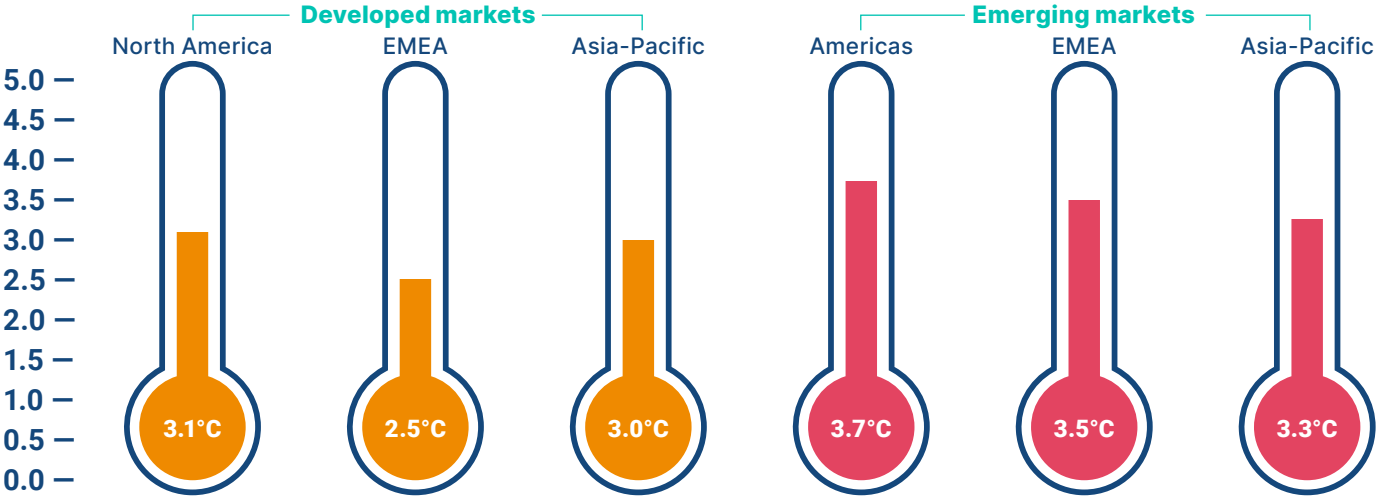
The world's listed companies are on a pathway to warm the planet by 3°C (5.4°F) by the end of the century, as indicated by their collective MSCI Implied Temperature Rise, a forward-looking climate impact metric that shows the warming potential of a financial asset based on its current greenhouse gas emissions and projected future decarbonization trajectory across all emissions scopes (Exhibit 21). Twenty-seven percent of companies are on track to keep warming 2°C or below while 11% are aligned with a 1.5°C temperature rise.

Exhibit 21: Projected warming of the world's listed companies (MSCI Implied Temperature Rise in °C)



Source: MSCI ESG Research, data as of Feb. 29, 2024

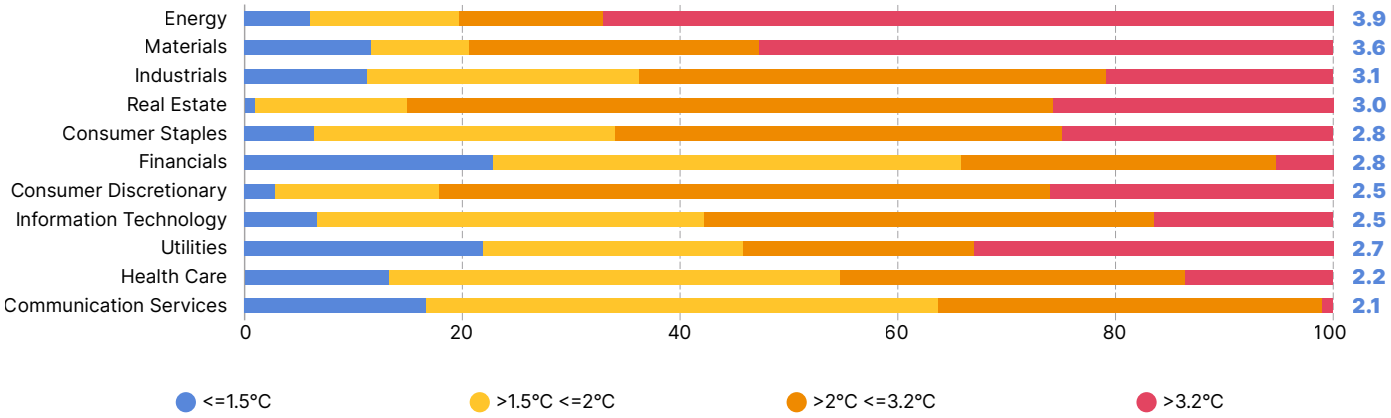
Exhibit 22: Projected warming of listed companies by region (MSCI Implied Temperature Rise in °C)



Source: MSCI ESG Research, data as of Feb. 29, 2024, based on data in the following regional indexes: MSCI North America Investable Market Index, the MSCI Europe and Middle East Index, the MSCI Pacific Investable Market Index, the MSCI Emerging Markets Latin America Index, the MSCI Emerging Markets EMEA Investable Market Index, and the MSCI Emerging Markets Asia Index

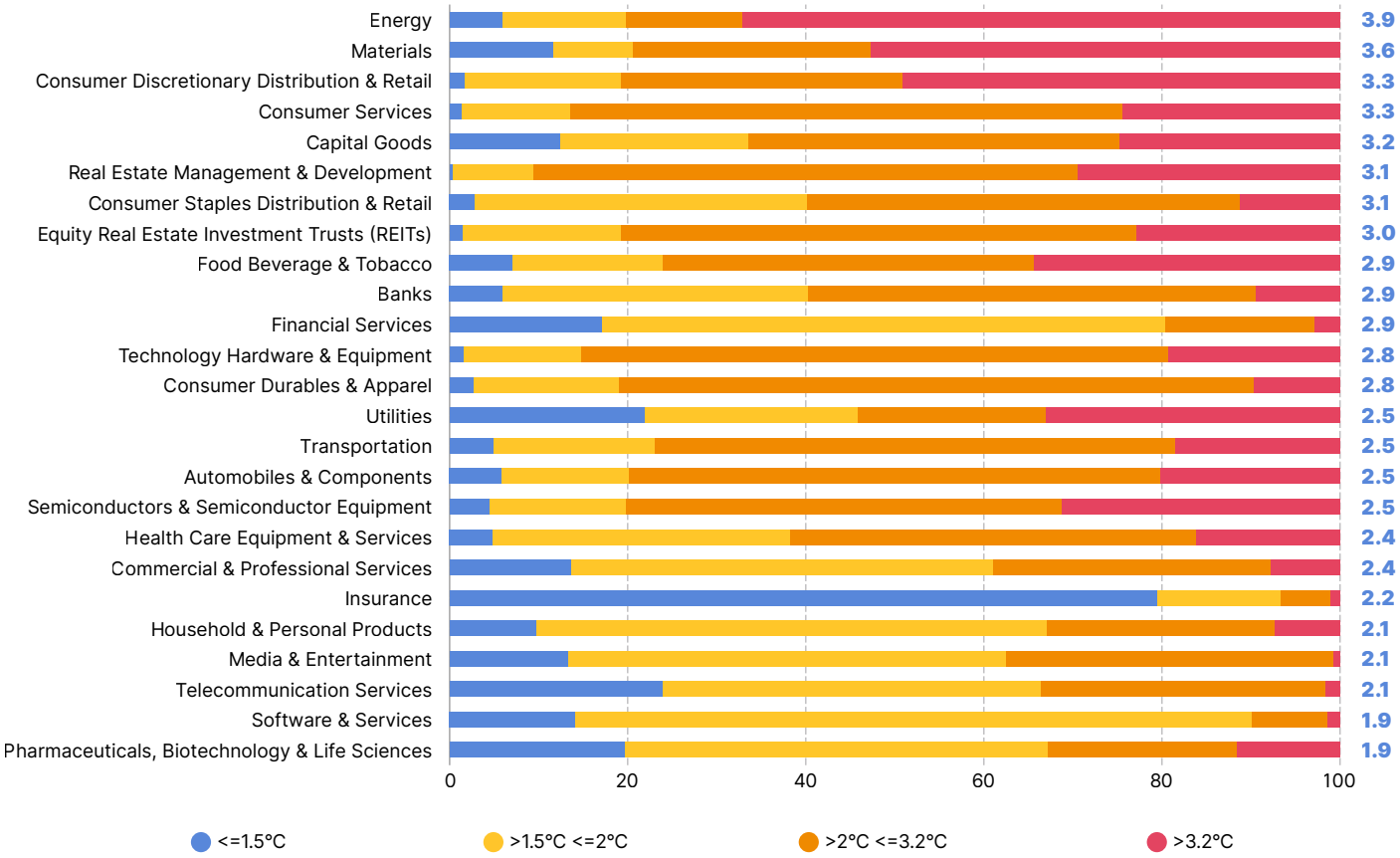
Every sector and industry group contains companies whose emissions trajectories align with global climate goals (Exhibits 23 and 24). The contribution of emissions-intensive sectors such as energy, materials and industrials to global warming highlights the importance for investors and financial institutions of identifying companies in those sectors that are taking action to reduce their emissions in line with interim net-zero targets and investing in climate solutions.

Exhibit 23: Implied Temperature Rise by GICS® sector



Source: MSCI ESG Research, data as of Feb. 29, 2024

Exhibit 24: Implied Temperature Rise by GICS® industry group



Source: MSCI ESG Research, data as of Feb. 29, 2024

Projecting companies' decarbonization pathways

Readers will note that the world's listed companies align with warming of 3°C (5.4°F), a half-degree warmer than we reported in the November 2023 edition of this report.[55] The dispersion of temperature alignment has changed as well. Thirty-eight percent of listed companies aligned with warming of 2°C or below while 11% align with 1.5°C, compared with 55% and 19% of companies, respectively, in our November report.

The warmer estimated temperatures reflect the latest update to MSCI's Implied Temperature Rise (ITR), a forward-looking climate-impact metric designed to extrapolate the estimated rise in average global temperatures that would result if the global economy over- or underspent its remaining carbon budget like the company or investment portfolio in question (Exhibit 25).

The update includes stricter and more granular parameters that tend to reduce the number of companies projected to align with global climate thresholds compared with the prior model. For example, the updated metric no longer takes company climate commitments at face value but instead adjusts companies' projected emissions for each emissions scope based on, among others, whether the company has published climate targets with a sufficient level of detail to be assessed. This contributes to higher projected emissions (and hence a higher ITR) for companies that fail to make progress toward targets they have set. Similarly, for companies that have emitted significantly more GHG emissions than prescribed by their decarbonization pathways, updated company budgets lead to higher ITRs, all other parameters equal. The updated metric also aligns with sector-specific 1.5°C decarbonization pathways developed by the Network of Central Banks and Supervisors for Greening the Financial System (NGFS) and brings the time for reaching net-zero forward to 2050 (from 2070).

MSCI ESG Research developed and implemented the enhancements based on the latest guidance for measuring portfolio alignment published by the Glasgow Financial Alliance for Net Zero (GFANZ) and extensive consultations with institutional investors that use the metric.[56] Please see **our overview of the latest model** for a summary of enhancements and how the model compares with its predecessor.

Exhibit 25: Alignment of listed companies with key climate thresholds

Source: MSCI ESG Research, based on MSCI ACWI IMI data as of Feb. 29, 2024 and Aug. 31, 2023, respectively

55 "The MSCI Net-Zero Tracker," MSCI Sustainability Institute, November 2023

56 See, "Measuring Portfolio Alignment: Driving Enhancement, Convergence, and Adoption." GFANZ, August 2022. MSCI ESG Research incorporates such recommendations when it believes they reflect the views of investors broadly and can contribute to metrics' incorporating industry practice. MSCI clients have had access to the latest Implied Temperature Rise model since last year.

The 20 listed companies **with the largest carbon footprints**

Exhibit 26

Company	Country	Total carbon emissions [million tons of CO2e]*	Scope 1 emissions [million tons of CO2e]	Scope 2 emissions [million tons of CO2e]	Scope 3 emissions [million tons of CO2e]	Does the company have a self-declared net-zero target ?	Has the company set a science-based target
Saudi Arabian Oil Company	Saudi Arabia	2523.4	234.2	19.5	2269.7	Yes	No
PetroChina Company Limited	China	1287.3	119.7	40.9	1126.7	Yes	No
Exxon Mobil Corporation	U.S.	1184.5	109.0	7.0	1068.5	Yes	No
Coal India Ltd.	India	1162.2	1.2	3.8	1157.2	No	No
China Petroleum & Chemical Corporation	China	1002.4	137.7	24.1	840.6	Carbon neutral	No
Chevron Corporatoin	U.S.	822.0	53.0	4.0	765.0	Yes	No
Shell PLC	U.K	790.8	82.0	8.0	700.8	Yes	No
China Shenhua Energy Company Limited	China	759.0	172.4	4.0	582.6	Yes	No
BP P.L.C.	U.K	681.0	33.9	1.6	645.5	Yes	No
SAIC Motor Corporation Limited	China	632.8	1.7	3.0	628.1	No	No
BHP Group Limited	Australia	538.7	9.2	3.1	526.4	Yes	No
Equinor ASA	Norway	506.3	11.4	0.1	494.8	Yes	No

Company	Country	Total carbon emissions [million tons of CO2e]*	Scope 1 emissions [million tons of CO2e]	Scope 2 emissions [million tons of CO2e]	Scope 3 emissions [million tons of CO2e]	Does the company have a self-declared net-zero target ?	Has the company set a science-based target
Porsche Automobil Holding SE	Germany	503.3	2.4	1.1	499.8	Yes	Yes
Volkswagen Aktiengesellschaft	Germany	488.2	4.5	2.1	481.7	Yes	Yes
Toyota Motor Corporation	Japan	476.6	2.4	3.8	470.4	Yes	Yes
Marathon Petroleum Corporation	U.S.	473.8	33.7	6.7	433.4	No	No
Dongfeng Motor Group Company Limited	China	458.0	0.4	1.3	456.3	Carbon neutral	No
Huaneng Power International , Inc.	China	455.6	410.8	0.2	44.5	No	No
Vale S.A.	Brazil	452.1	8.6	0.6	442.9	Yes	No
General Electric Company	U.S.	451.9	0.7	1.0	450.3	Yes	No

Source: MSCI ESG Research, data as of Jan. 31, 2024.

* Sum of reported or estimated Scope 1 and 2 emissions plus Scope 3 emissions estimates. If a company does not report its Scope 1 and 2 carbon emissions data, MSCI ESG Research estimates each scope separately based on either the company's previously reported emissions data or, if none, the carbon emissions intensity of the company's production or industry segments. We estimate Scope 3 emissions for all companies in our coverage based on company-specific information that considers both the revenue intensity of emissions and production data, in line with the Greenhouse Gas Protocol framework. For more information, please see: "MSCI Climate Change Metrics Methodology and Definition" and "Scope 3 Carbon Emissions Estimation Methodology," MSCI ESG Research.

Conclusion

The commitments agreed to at COP28 are now center stage in the climate transition. Achieving them will require rapid increases globally in both renewable energy capacity and energy efficiency. An orderly transition to a clean-energy economy will require both public and private investment at more than double today's already record level, as well as policy designed to improve predictability while clearing barriers to decarbonization.

Companies, meanwhile, are accelerating their adoption of climate targets, with an increase in the number of such targets that align with science-based net-zero pathways. Disclosure rules finalized recently by the SEC could equip investors with more information about climate target setting by U.S.-listed companies and help to narrow a global disclosure gap. The acceleration of climate target-setting by companies could also increase the urgency of capital-market participants to boost the integrity and transparency of voluntary carbon markets, such that high-integrity carbon credits can provide a legitimate avenue to help meet interim climate targets and offset residual emissions.

Still, the data shows that the world is not on track to tackle the climate problem. The decarbonization trajectories of the world's publicly listed companies places them on a path to warm the planet by 3°C (5.4°F) above pre-industrial levels this century. The aggregate GHG emissions of publicly listed companies have continued to rise since the pandemic, yet those emissions would need to peak next year and fall by roughly 7% annually between now and 2030 to avoid the worst effects of global warming.

Key terms

Carbon budget: The amount of greenhouse gas that society can release into the atmosphere before breaching key temperature thresholds.

Carbon credit: A unit representing the avoidance or removal of 1 tonne of CO_2e, created by an activity or set of activities in relation to a counterfactual baseline that considers what emissions would be but for the activity or activities.

Carbon dioxide equivalent (CO_2e): Greenhouse gas emissions with the same global warming potential as 1 metric tonne of carbon.

Carbon emissions revenue intensity: Greenhouse gas emissions in metric tons that a company emits to generate every USD 1 million of revenue.

Carbon Engineering: Projects that remove and store carbon dioxide emissions from the atmosphere and into materials that do not create or increase biomass carbon stocks.

Energy Efficiency: Projects that reduce CO_2 emissions by decreasing the energy needed by equipment (either domestic or industrial), energy systems, and single power generation units.

Financed emissions: Greenhouse gas emissions associated with investments, loans and insurance.

Fuel Switch: Projects that change the energy source within an energy system or its individual beneficiaries (such as power plants and vehicles) without adding or removing any installed capacity.

GICS®: The global industry classification standard jointly developed by MSCI Inc. and S&P Global Market Intelligence. The GICS® structure comprises 11 sectors, 24 industry groups, 69 industries and 158 sub-industries.

Gigaton [Gt]: 1 billion tons (of emissions).

Implied Temperature Rise: A forward-looking climate impact metric that estimates the increase in average global temperature that would occur this century if the economy were to overshoot or undershoot the global carbon budget by the same amount as the company or investment portfolio in question.

Jurisdictional REDD+: Projects that reduce carbon dioxide emissions through the avoidance of deforestation on a national or subnational scale.

Megaton [Mt]: 1 million tons (of emissions).

MSCI ACWI Investable Market Index (MSCI ACWI IMI): Captures large-, mid- and small-cap listed companies across 23 developed markets and 27 emerging market countries. With 9,033 constituents, the index covers approximately 99% of the global equity investment opportunity set, as of March 29, 2024.

Nature Restoration: Projects that increase GHG sequestration into the biosphere by restoring living biomass and soils towards their pre-disturbance state. Includes most emissions "removals" alongside carbon engineering.

Non-CO_2 gases: Projects that primarily reduce greenhouse gas emissions other than carbon dioxide (notably methane), including landfills, waste treatment systems and fugitive emissions.

REDD+ (Reducing emissions from deforestation in developing countries plus): Projects that reduce carbon dioxide emissions through the avoidance of deforestation, either planned or unplanned.

Remaining emissions budget: A company's future GHG emissions budget, in tons of CO_2e, for limiting warming this century to 1.5°C or 2°C above preindustrial levels.

Renewable Energy: The installation of new power generation capacity that uses carbon-free energy sources.

Science Based Targets initiative: A nonprofit organization established by CDP, the U.N. Global Compact, the World Resources Institute, the U.N. and the World Wildlife Foundation to assess corporate climate targets.

Scope 1 emissions: Listed companies' direct greenhouse gas emissions in tons of CO_2e.

Scope 2 emissions: Listed companies' greenhouse gas emissions from electricity use in tons of $C0_2e$.

Scope 3 emissions: Listed companies' indirect greenhouse gas emissions in tons of CO_2e from their upstream supply chain, emissions inherent in products and services or emissions from portfolio companies.

Target comprehensiveness: Percentage of listed companies' Scopes 1, 2 and 3 emissions covered by emissions reporting or target setting.

About the MSCI Sustainability Institute

The MSCI Sustainability Institute is on a mission to drive progress by capital markets to create sustainable value and tackle global challenges such as climate change. Our mission mirrors our belief that capital markets can help to build a better future for all of us.

We aim to foster alignment of data, analysis, policy, and practice. We do this by drawing upon MSCI's experience and expertise in the investment industry to curate data and analysis, support scholarship and advance knowledge that helps practitioners, academics and policymakers fine-tune their approaches for maximum effectiveness. For more information and to engage with us, visit msci-institute.com.

To learn more, please visit **msci-institiute.com**.

About MSCI ESG Research Products and Services

MSCI ESG Research products and services are provided by MSCI ESG Research LLC, and are designed to provide in-depth research, ratings and analysis of environmental, social and governance-related business practices to companies worldwide. ESG ratings, data and analysis from MSCI ESG Research LLC. are also used in the construction of the MSCI ESG Indexes. MSCI ESG Research LLC is a Registered Investment Adviser under the Investment Advisers Act of 1940 and a subsidiary of MSCI Inc.

To learn more, please visit **www.msci.com**.

Acknowledgements

The MSCI Sustainability Institute thanks the colleagues who contributed to this report: Umar Ashfaq, Brian Browdie, Anthony Chan, Peter Fegelman, James Griffiths, Jamie Lambert, Linda-Eling Lee, Julia Giguere-Morello, Calum MacDougall, Mariela Martinez, Amanda Michaud, Antonios Panagiotopoulos, Jamie Saunders, Drashti Shah, Florian Sommer, Guy Turner, Sylvain Vanston, and Kenji Watanabe.

If you would like to discuss this report, please contact the MSCI Sustainability Institute.

Notice and disclaimer

This document and all of the information contained in it, including without limitation all text, data, graphs, charts (collectively, the "Information") is the property of MSCI Inc. or its subsidiaries (collectively, "MSCI"), or MSCI's licensors, direct or indirect suppliers or any third party involved in making or compiling any Information (collectively, with MSCI, the "Information Providers") and is provided for informational purposes only. The Information may not be modified, reverse-engineered, reproduced or redisseminated in whole or in part without prior written permission from MSCI. All rights in the Information are reserved by MSCI and/or its Information Providers.

The Information may not be used to create derivative works or to verify or correct other data or information. For example (but without limitation), the Information may not be used to create indexes, databases, risk models, analytics, software, or in connection with the issuing, offering, sponsoring, managing or marketing of any securities, portfolios, financial products or other investment vehicles utilizing or based on, linked to, tracking or otherwise derived from the Information or any other MSCI data, information, products or services.

The user of the Information assumes the entire risk of any use it may make or permit to be made of the Information. NONE OF THE INFORMATION PROVIDERS MAKES ANY EXPRESS OR IMPLIED WARRANTIES OR REPRESENTATIONS WITH RESPECT TO THE INFORMATION (OR THE RESULTS TO BE OBTAINED BY THE USE THEREOF), AND TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, EACH INFORMATION PROVIDER EXPRESSLY DISCLAIMS ALL IMPLIED WARRANTIES (INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF ORIGINALITY, ACCURACY, TIMELINESS, NON-INFRINGEMENT, COMPLETENESS, MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE) WITH RESPECT TO ANY OF THE INFORMATION.

Without limiting any of the foregoing and to the maximum extent permitted by applicable law, in no event shall any Information Provider have any liability regarding any of the Information for any direct, indirect, special, punitive, consequential (including lost profits) or any other damages even if notified of the possibility of such damages. The foregoing shall not exclude or limit any liability that may not by applicable law be excluded or limited, including without limitation (as applicable), any liability for death or personal injury to the extent that such injury results from the negligence or willful default of itself, its servants, agents or sub-contractors.

Information containing any historical information, data or analysis should not be taken as an indication or guarantee of any future performance, analysis, forecast or prediction. Past performance does not guarantee future results.

The Information may include "Signals," defined as quantitative attributes or the product of methods or formulas that describe or are derived from calculations using historical data. Neither these Signals nor any description of historical data are intended to provide investment advice or a recommendation to make (or refrain from making) any investment decision or asset allocation and should not be relied upon as such. Signals are inherently backward-looking because of their use of historical data, and they are not intended to predict the future. The relevance, correlations and accuracy of Signals frequently will change materially.

The Information should not be relied on and is not a substitute for the skill, judgment and experience of the user, its management, employees, advisors and/or clients when making investment and other business decisions. All Information is impersonal and not tailored to the needs of any person, entity or group of persons.

None of the Information constitutes an offer to sell (or a solicitation of an offer to buy), any security, financial product or other investment vehicle or any trading strategy.

It is not possible to invest directly in an index. Exposure to an asset class or trading strategy or other category represented by an index is only available through third party investable instruments (if any) based on that index. MSCI does not issue, sponsor, endorse, market, offer, review or otherwise express any opinion regarding any fund, ETF, derivative or other security, investment, financial product or trading strategy that is based on, linked to or seeks to provide an investment return related to the performance of any MSCI index (collectively, "Index Linked Investments"). MSCI makes no assurance that any Index Linked Investments will accurately track index performance or provide positive investment returns. MSCI Inc. is not an investment adviser or fiduciary and MSCI makes no representation regarding the advisability of investing in any Index Linked Investments.

Index returns do not represent the results of actual trading of investible assets/securities. MSCI maintains and calculates indexes, but does not manage actual assets. The calculation of indexes and index returns may deviate from the stated methodology. Index returns do not reflect payment of any sales charges or fees an investor may pay to purchase the securities underlying the index or Index Linked Investments. The imposition of these fees and charges would cause the performance of an Index Linked Investment to be different than the MSCI index performance.

The Information may contain back tested data. Back-tested performance is not actual performance, but is hypothetical. There are frequently material differences between back tested performance results and actual results subsequently achieved by any investment strategy.

Constituents of MSCI equity indexes are listed companies, which are included in or excluded from the indexes according to the application of the relevant index methodologies. Accordingly, constituents in MSCI equity indexes may include MSCI Inc., clients of MSCI or suppliers to MSCI. Inclusion of a security within an MSCI index is not a recommendation by MSCI to buy, sell, or hold such security, nor is it considered to be investment advice.

Data and information produced by various affiliates of MSCI Inc., including MSCI ESG Research LLC and Barra LLC, may be used in calculating certain MSCI indexes. More information can be found in the relevant index methodologies on www.msci.com.

MSCI receives compensation in connection with licensing its indexes to third parties. MSCI Inc.'s revenue includes fees based on assets in Index Linked Investments. Information can be found in MSCI Inc.'s company filings on the Investor Relations section of msci.com.

MSCI ESG Research LLC is a Registered Investment Adviser under the Investment Advisers Act of 1940 and a subsidiary of MSCI Inc. Neither MSCI nor any of its products or services recommends, endorses, approves or otherwise expresses any opinion regarding any issuer, securities, financial products or instruments or trading strategies and MSCI's products or services are not a recommendation to make (or refrain from making) any kind of investment decision and may not be relied on as such, provided that applicable products or services from MSCI ESG Research may constitute investment advice. MSCI ESG Research materials, including materials utilized in any MSCI ESG Indexes or other products, have not been submitted to, nor received approval from, the United States Securities and Exchange Commission or any other regulatory body. MSCI ESG and climate ratings, research and data are produced by MSCI ESG Research LLC, a subsidiary of MSCI Inc. MSCI ESG Indexes, Analytics and Real Estate are products of MSCI Inc. that utilize information from MSCI ESG Research LLC. MSCI Indexes are administered by MSCI Limited (UK).

Please note that the issuers mentioned in MSCI ESG Research materials sometimes have commercial relationships with MSCI ESG Research and/or MSCI Inc. (collectively, "MSCI") and that these relationships create potential conflicts of interest. In some cases, the issuers or their affiliates purchase research or other products or services from one or more MSCI affiliates. In other cases, MSCI ESG Research rates financial products such as mutual funds or ETFs that are managed by MSCI's clients or their affiliates, or are based on MSCI Inc. Indexes. In addition, constituents in MSCI Inc. equity indexes include companies that subscribe to MSCI products or services. In some cases, MSCI clients pay fees based in whole or part on the assets they manage. MSCI ESG Research has taken a number of steps to mitigate potential conflicts of interest and safeguard the integrity and independence of its research and ratings. More information about these conflict mitigation measures is available in our Form ADV, available at https://adviserinfo.sec.gov/firm/summary/169222.

Any use of or access to products, services or information of MSCI requires a license from MSCI. MSCI, Barra, RiskMetrics, IPD and other MSCI brands and product names are the trademarks, service marks, or registered trademarks of MSCI or its subsidiaries in the United States and other jurisdictions. The Global Industry Classification Standard (GICS) was developed by and is the exclusive property of MSCI and S&P Global Market Intelligence. "Global Industry Classification Standard (GICS)" is a service mark of MSCI and S&P Global Market Intelligence.

MIFID2/MIFIR notice: MSCI ESG Research LLC does not distribute or act as an intermediary for financial instruments or structured deposits, nor does it deal on its own account, provide execution services for others or manage client accounts. No MSCI ESG Research product or service supports, promotes or is intended to support or promote any such activity. MSCI ESG Research is an independent provider of ESG data.

Privacy notice: For information about how MSCI collects and uses personal data, please refer to our Privacy Notice at https://www.msci.com/privacy-pledge.

©2024 MSCI Inc. All rights reserved | CBR0424