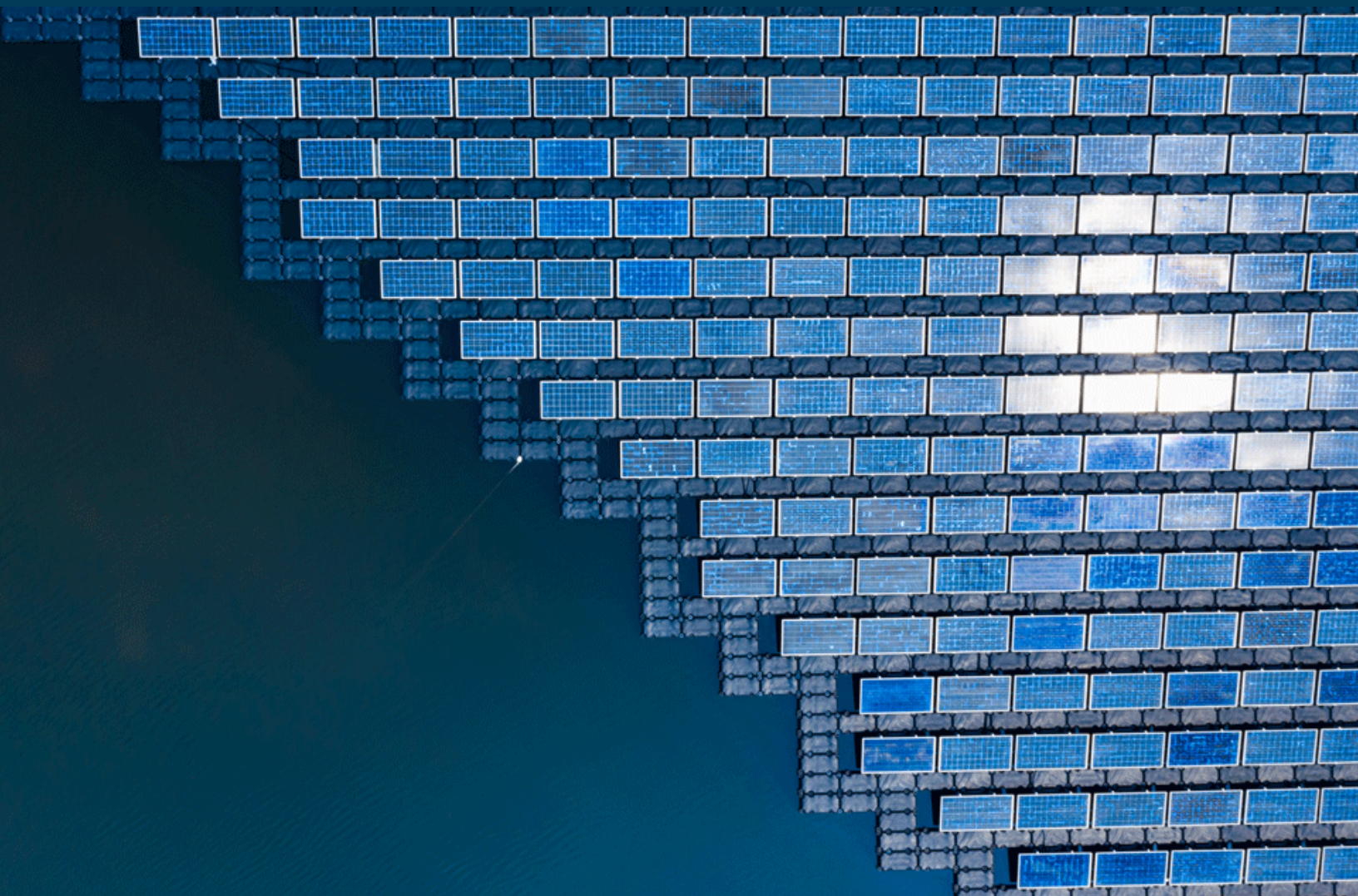
Rhodium Group

November 5, 2026

Authors:
Mahmoud Mobir
Shweta Movalia
Hannah Pitt
Alfredo Rivera
Emma Rutkowski
Kate Larsen

Rhodium Climate Outlook 2026: Probabilistic Global Emissions and Energy Baseline Projections



What is the world on track for?

In today's uncertain world, it is increasingly difficult to understand what the next few years, let alone the next few decades, will bring for global decarbonization. Assessing the likely pace and scale of continued progress in decarbonizing the global economy over the coming years is a challenge, but despite significant uncertainties, there are clear signals that renewable power and electric vehicles will continue to transform the global energy system. Renewables accounted for 86% of global power capacity additions in 2025, and one in four new cars sold worldwide was electric. These technologies offer increasingly competitive alternatives to fossil fuels. Displacing fossil fuels in other sectors like heavy industry, aviation, and shipping has proved more difficult, but emerging technologies that address some of these hard-to-abate sectors of the economy are increasingly ready for commercialization in a growing number of markets.

A baseline for assessing further action

Understanding what the world and nations are on track for today is a critical starting point for charting a path to where we need to go from here to avoid the worst impacts of climate change. To date, the global community has largely relied on models to project global greenhouse gas (GHG) emissions pathways to assess the necessary ambition of global and national emissions pledges and illustrate how the economy would need to adjust to achieve those targets. Now, a much wider array of actors is trying to understand how the economy will transform as the global energy transition continues to unfold and how they can accelerate that progress even further.

To meet this need, the Rhodium Climate Outlook (RCO) provides a shared baseline of energy, emissions, and temperature projections for use by a wide range of global stakeholders to assess where we are and what additional progress is needed, including:

- Probabilistic global and regional emissions and energy projections that capture uncertainty in economic and population growth, oil and gas prices, and clean energy technology costs.
- Econometrically based policy projections based on real-world evidence of country-level policy drivers to construct a baseline projection of how policy is likely to evolve going forward, absent a major acceleration from current trajectories.
- Emissions projections for all greenhouse gases, not just CO_2.
- Probabilistic temperature projections derived directly from our emissions projections but including climate system uncertainty as well.

The Rhodium Climate Outlook is produced using an integrated modeling platform that combines these critical features: Rhodium's Global Energy Model (RHG-GEM). RHG-GEM captures uncertainty in economic and population growth, coal, oil, and natural gas prices, and clean energy technology costs under likely policy evolution (see the Technical Appendix for more detail).

The result is our **RCO Baseline**, which provides probabilistic GHG emissions and energy outcome ranges based on the most up-to-date outlook for key drivers through the end of the century. This RCO Baseline illustrates what the world is likely on track for, absent a

major acceleration in the pace of climate policy ambition or accelerated innovation and investment in emerging technologies beyond their current trajectory. It is the starting point for assessing what additional action is needed to go above and beyond what the world is already on track to achieve, and specifically:

- What regions and sectors of the economy are making the most progress in the clean energy, low-GHG transition, and what are the potential barriers to further progress;
- Which regions and sectors are falling behind, and where is an acceleration of policy, investment, and deployment most needed;
- Where expected cost reductions in mature clean technologies don't go far enough to deploy at scale in regions with slow-to-evolve climate policy;
- How the emergence of new technologies that are nearing maturity can further reduce emissions; and
- Where additional technology innovation is most needed, and where new technologies would have the largest impact on future GHG emissions.

Key findings

In this year's outlook, we find that clean electricity makes substantial progress, but slower change in other sectors limits the decline in global emissions. The following sections examine that contrast, including what growing electrification means for power demand and the evolving sectoral and geographic landscape of global emissions in the decades ahead. Key findings include:

- **Global emissions decline modestly despite a transitioning energy system, with mean warming expected to reach 2.9°C in 2100.** Mean GHG emissions reach 47.4 gigatons of CO_2e in 2050, a reduction of 10% from today's levels, with a likely range (covering roughly two-thirds of modeled outcomes) of 42.0–52.7 gigatons CO_2e. Global emissions progress begins to stall after mid-century, however, as rising industrial emissions offset some of the reductions from the power sector. The likely range of global temperature rise is 2.3–3.4°C by the end of the century.
- **The share of global emissions shifts away from China and OECD economies.** Together, China and OECD economies account for 37% of global emissions in 2050 on average, a significant drop from their current share of 54%. Emissions growth in India, Africa, and other non-OECD countries in Asia offsets part of the reductions in these regions.
- **Cleaner power expands with rising electricity demand.** Wind and solar generation grow to over seven times today's levels by 2050 (from 5,500 TWh in 2025 to a mean of 39,300 TWh in 2050), while fossil generation is expected to fall by 23% on average.

- **Electric demand from buildings drives overall load growth in most of the world, while data centers drive rising US demand.** Electricity's share of end-use energy rises from 21% today to 28% by 2035 on average, falling short of the global target of 35% electrification by 2035, which was announced as part of the COP31 Action Agenda. Demand in buildings, including for cooling, contributes 60% of the expected increase by 2035. In the US, we project that data centers account for 62–77% of gross electricity demand growth from 2025 to 2030.
- **Industry continues to be the highest-emitting sector with little change, but declining steel emissions are a bright spot.** Growth in chemicals, refining, and other industries offsets emission reductions in steel and other subsectors. Industry, currently the highest-emitting sector, remains the largest source of emissions in 2050, at 15.6 gigatons CO_2e on average.
- **Emissions from the transport sector remain high, even while electric vehicles (EVs) gain market share.** Electric light-duty vehicles reach 40% of new sales in 2030 on average (likely range 35–45%) and 71% in 2050 (62–80%). However, slow fleet turnover keeps emissions from cars and trucks high, while aviation and shipping emissions continue to rise.

Global emissions decline modestly despite a transitioning energy system

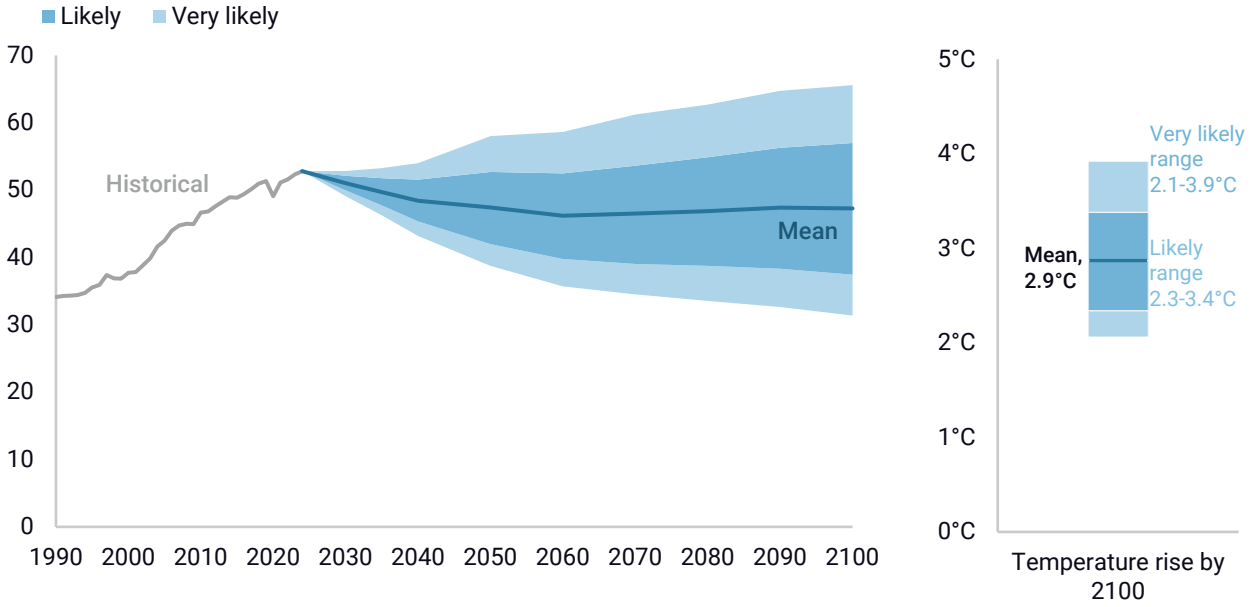
In our 2026 outlook, global greenhouse gas emissions are projected to decline only modestly by mid-century in the mean projection. From a peak of 52.8 gigatons CO_2e in 2024, emissions are expected to fall to 47.4 gigatons in 2050, a reduction of 10% from 2024 levels (likely range of 42.0 to 52.7 gigatons, a 0.2-21% reduction) (Figure 1).

The decline begins to lose momentum after mid-century, however. Mean emissions reach about 46.2 gigatons CO_2e in 2060 (13% below 2024 levels) before rising to 47.3 gigatons in 2100 (10% below 2024 levels). After 2060, power emissions continue to fall, but that improvement is outweighed by emissions growth from industry. The likely range widens to 37.4–57.0 gigatons by 2100 (29% below to 8% above 2024 levels), and the very likely range (90% probability) to 31.4–65.6 gigatons (41% below to 24% above 2024 levels). The broader late-century range underscores how much the long-term outcome depends on economic and technological developments that remain uncertain.

FIGURE 1

Global emissions decline modestly over the century

Net greenhouse gas emissions, including removals (gigatons CO_2e), and temperature rise in 2100 (degrees C above 1850–1900)

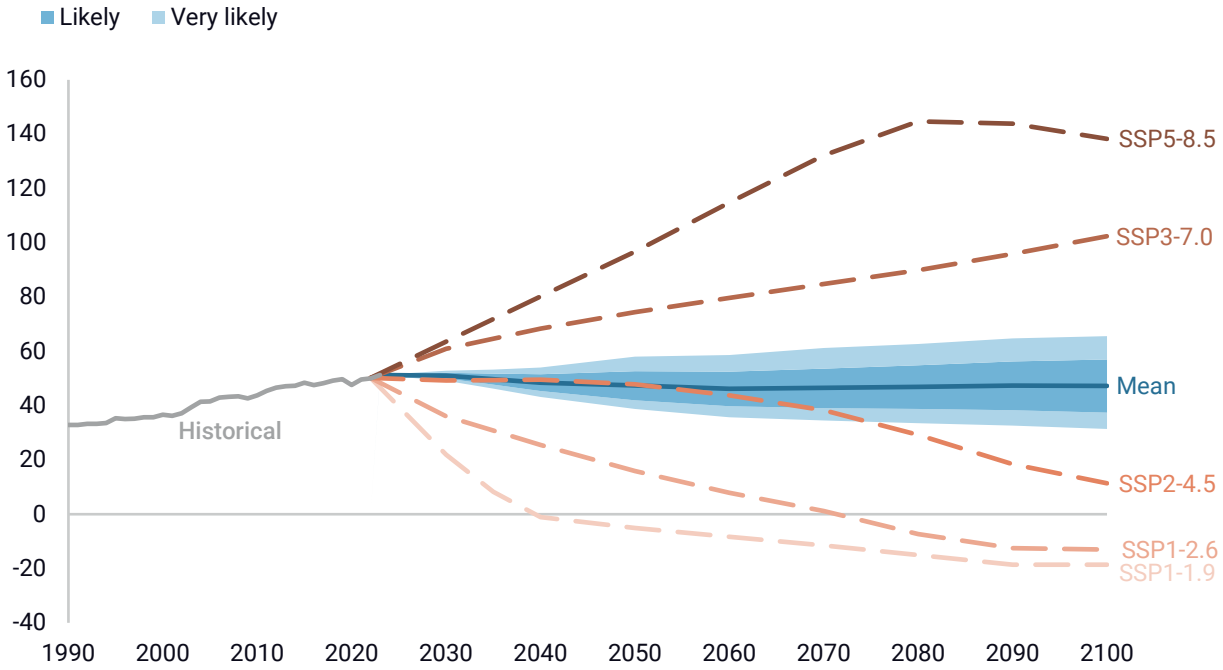


Source: Rhodium Climate Outlook. Note: Likely ranges (P17–P83) cover 67% of modeled outcomes; very likely ranges (P05–P95) cover 90%.

Over a decade ago, the Intergovernmental Panel on Climate Change (IPCC) projected that, without stronger climate action, global temperatures could rise between 2.5°C and 7.8°C by 2100 (including climate uncertainty). Since that time, advances in policy and technology have significantly improved the global temperature outlook. In our RCO Baseline, we now project a very likely range of 2.1°C to 3.9°C by the end of the century, with a likely range of 2.3°C to 3.4°C and an average outcome of 2.9°C (Figure 1). While the world has likely avoided the dire predictions of a decade ago, if current trends persist, the probability of limiting warming below 2°C before the end of the century—the Paris Agreement target—remains below 5%. Achieving that goal will require a much faster pace of policy action and technological deployment.

Even when accounting for a wide range of potential futures—including socioeconomic trends, fossil fuel prices, clean energy costs, and climate policy—the RCO Baseline projects a much narrower range of emissions than those used by global climate modelers to simulate future changes in temperature, precipitation, and other climate variables. Compared with the illustrative Shared Socioeconomic Pathways (SSPs), the RCO shows how the surge in clean technology deployment over the past decade has restrained emissions growth significantly, relative to projections made just a decade ago (Figure 2).

FIGURE 2
Current global emissions path avoids most extreme climate change scenarios
Net greenhouse gas emissions, including removals (gigatons CO_2e)



Source: Rhodium Climate Outlook, IIASA SSP Database. Note: SSP emissions are adjusted to match national inventory-reported emissions for comparability with Rhodium Group's historical and projected emissions. Following IPCC conventions, this report uses very likely to indicate a 90% probability of occurring and likely to indicate a 67% probability.

Emissions shift away from China and OECD economies

The small decline in global emissions masks a much larger change in the geographic distribution of those reductions. OECD economies accounted for 45% of global emissions in 2000, compared with China's 12%. By 2024, their shares were almost equal, at 28% and 26%, respectively. China alone accounted for 61% of the net global increase from 2000 to 2024. But looking ahead, China's emissions are expected to decline rapidly, with OECD economies' emissions continuing their more moderate rate of decline through mid-century. As a result, the bulk of future emissions growth becomes concentrated in the rest of the world. Together, China and the OECD are projected to account for 37% of global emissions in 2050 on average, down from 54% in 2024 (Figure 3).

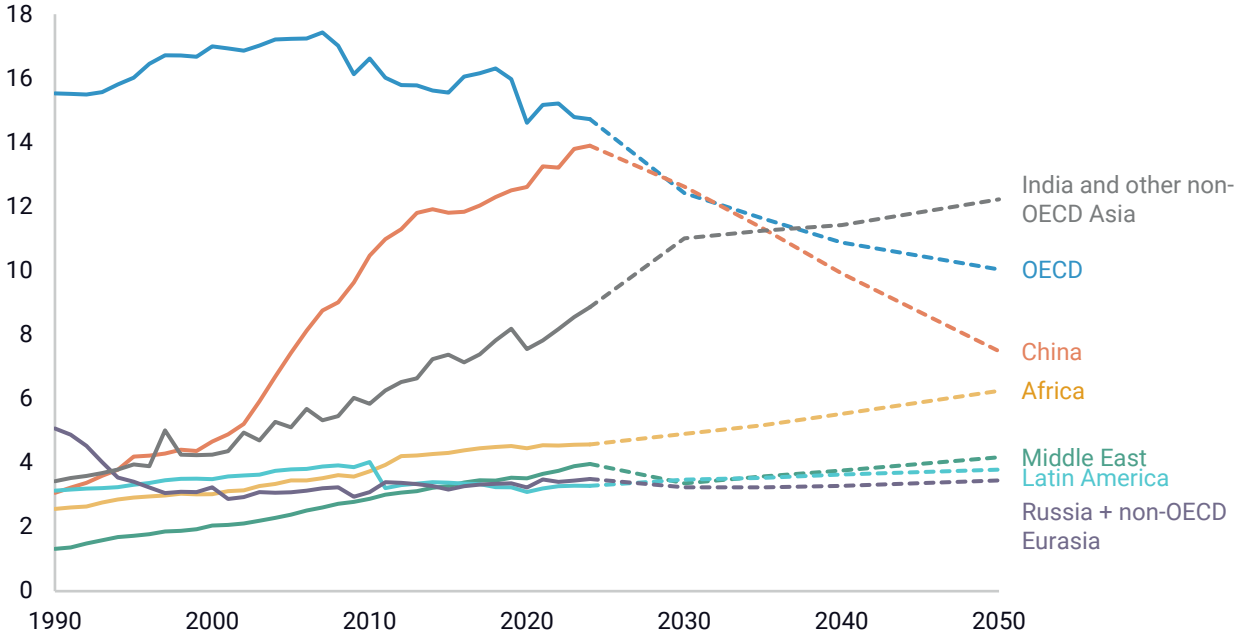
China and OECD countries are expected to cut emissions over the coming decades even as their electricity demand rises steeply. In our outlook, both China and the OECD generate substantially more electricity by 2050, but wind, solar, and other low-carbon sources replace a growing share of fossil-fuel generation. In China, that change reverses the emissions effect of decades of coal-led power expansion and delivers most of the reduction in China's total emissions, from 13.9 gigatons CO_2e in 2024 to a mean of 7.5 in 2050 (likely range 6.1–8.6 gigatons), a 46% reduction. In the OECD, where energy systems and vehicle markets are more mature, cleaner power is accompanied by lower direct emissions from transport and buildings. Existing clean-technology adoption and its continued development reduce the emissions associated with economic activity, bringing

OECD-wide emissions from 14.7 gigatons in 2024 to a mean of 10.0 in 2050 (likely range 8.9–11.1 gigatons), a 32% reduction.

FIGURE 3

Emissions shift away from China and the OECD

Net greenhouse gas emissions, including removals by region (gigatons CO_2e)



Source: Rhodium Climate Outlook. Note: These outcomes represent the average emissions outcome across our projection range. Historical GHG emissions data through 2024 are reported here, followed by projected values for 2030, 2040, and 2050, with unmodeled trend lines connecting historical and projected values.

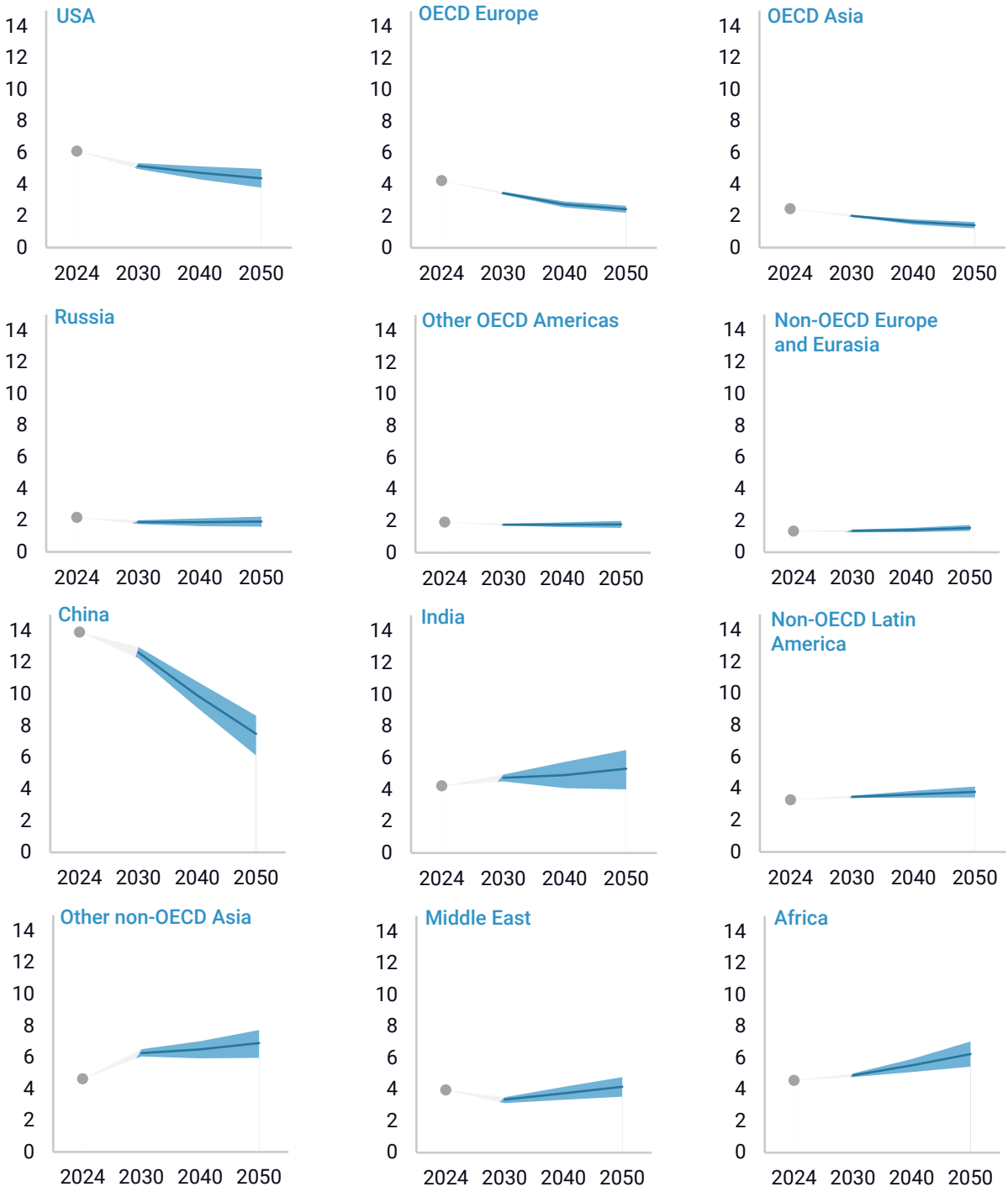
The balance is different in economies where rising incomes and expanding populations increase the need for housing, mobility, infrastructure, and manufactured goods. India, Africa, and other non-OECD countries in Asia account for much of the emissions increase outside of China and the OECD. Clean technologies expand in these regions too, but more of their deployment serves additional energy needs rather than replacing existing fossil use. Across all regions outside of China and the OECD, mean emissions rise from 24.2 gigatons in 2024 to 29.9 in 2050, a 24% increase.

India's emissions rise by 26% from 2024 to 2050 (likely range –5% to 54%), Africa's by 37% (19% to 54%), and the Middle East's by 5% (–11% to 21%) in the mean projection (Figure 4). This growth does not negate the emissions reduction progress in China and the OECD, but it absorbs much of their reduction. Given where we expect the largest share of economic growth and development to occur in the coming decades, the global GHG emissions outlook increasingly depends on how growing economies meet new demand for energy.

FIGURE 4

Emissions rise in emerging and developing economies as China and OECD emissions fall

Net greenhouse gas emissions, including removals (gigatons CO_2e), likely range (67% probability)



Source: Rhodium Climate Outlook. Note: The blue range represents the likely (67% chance) emissions outcome across our projection range, line indicates projected mean. Historical GHG emissions data through 2024 are reported here, followed by projected values for 2030, 2040, and 2050, with unmodeled grey range connecting historical and projected values.

Global power sector emissions fall, while emissions from industry remain stubbornly high

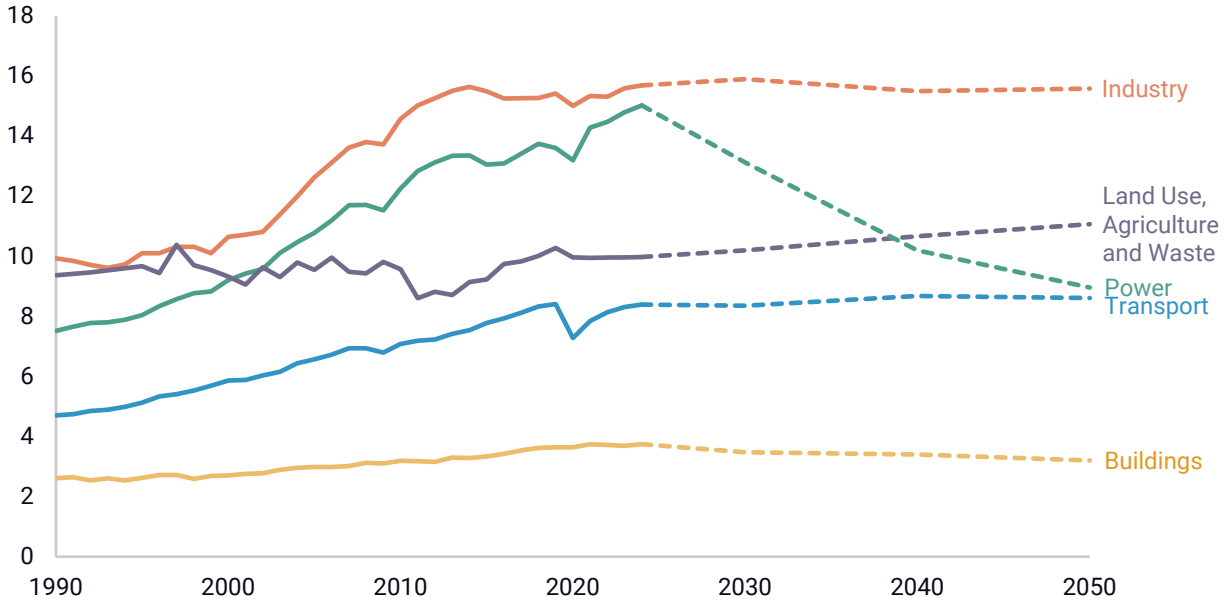
Turning to the sector level, global emissions from all major sectors have either grown or fluctuated around a long-term average over the past three decades. In our outlook, emissions from some sectors peak and decline. However, we anticipate progress across sectors will be uneven. The industry and power sectors were the two largest sources of global emissions in 2024, at 15.7 and 15.0 gigatons, respectively. They follow very different paths in our outlook. Power benefits from established, increasingly competitive wind and solar technologies, together with storage and other low-carbon sources. Many industrial processes still rely on fuels and chemical reactions for which low-emission alternatives are less widely deployed (Figure 5).

By 2050, we find that power emissions are expected to fall by 6.1 gigatons, or 40% below 2024 levels, on average, dropping to 9.0 gigatons. Power's share of global emissions falls from about 28% in 2024 to 19% in 2050, moving it from the second largest to third largest source. Direct emissions from buildings also decline by 14% from 2024 levels, from 3.7 to 3.2 gigatons, as improvements in equipment and a growing role for electricity reduce direct fuel use. Transport moves in the opposite direction, however, rising by 3%, from 8.4 to 8.6 gigatons in our mean projection, as cleaner vehicles do not fully offset growth in road travel, aviation, and shipping. These divergent sectoral outcomes leave a much smaller reduction in total emissions than the power transition alone would suggest.

FIGURE 5

The power sector delivers the largest emission reductions

Net greenhouse gas emissions, including removals, by sector (gigatons CO_2e)



Source: Rhodium Climate Outlook. Note: Historical estimates through 2024 and projected means through 2050.

In 2050, industry remains the largest source of emissions, at 15.6 gigatons on average after removals, with a likely range of 13.4–17.7 gigatons (Figure 6). This is essentially flat relative to 2024, a decline of about 0.1 gigaton (0.7%). Reductions in emissions from steel, cement, and non-metallic minerals are offset by increases elsewhere. Land use,

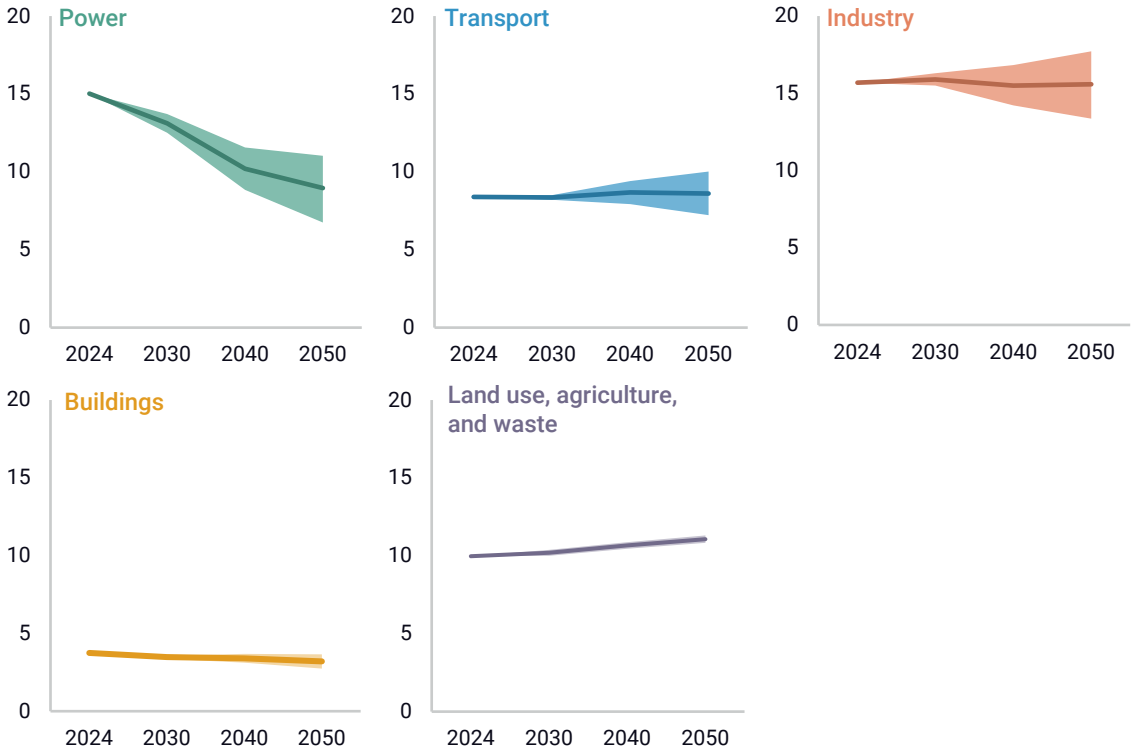
agriculture, and waste emissions also rise, from 10.0 gigatons in 2024 to 11.1 under our mean projection. Most of the increase comes from agriculture, with a smaller increase from waste and a slight decline in land-use emissions.

In many ways, the electrification of more end uses links these sectoral trends. The rising electrification of vehicles and equipment in buildings, industry, and agriculture shifts energy use away from direct combustion and toward the grid. Under the RCO methodology, electricity-related emissions are captured in the power sector totals and are not reflected in the other end-use sectors. The simultaneous expansion and decarbonization of electricity will continue to support reductions in direct fuel use across sectors but leave emissions from industrial and agricultural processes and other non-energy sources to be addressed separately. Below, we provide a more detailed look at these sectoral trends.

FIGURE 6

Industrial emissions remain high as power emissions fall

Net greenhouse gas emissions, including removals by sector (gigatons CO_2e), likely range (67% probability)



Source: Rhodium Climate Outlook. Note: Historical 2024 estimates and projected mean ranges through 2050.

Rising clean generation cuts emissions from power despite rising electricity demand

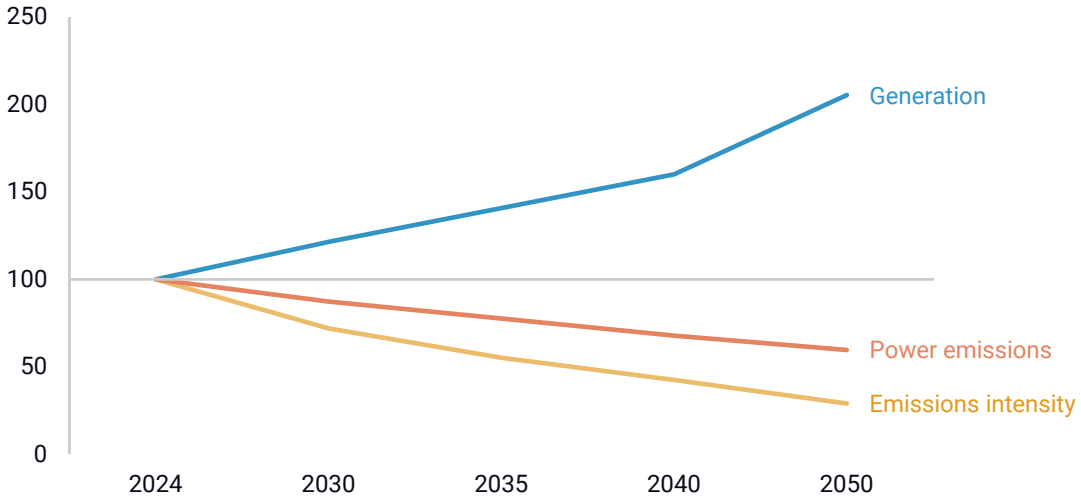
With the rise of electrification and digitalization of the global economy, it is becoming increasingly clear that a vast, interconnected and resilient electric power system and its supporting infrastructure will be essential to achieving continued economic growth and to further the clean energy transition. Global electricity generation has been rising steadily,

growing 108% from 2000 to 2025. By 2050, we project that global power generation likely grows an additional 73–133% above 2024 levels (105% on average), driven by the electrification of transportation, industry, and buildings, along with rising demand from space cooling, data centers, and AI. Despite that high growth, the emissions intensity of electric power falls by 71% on average, from 483 to 140 metric tons of CO_2e per GWh. That reduction more than offsets the 105% increase in generation, reducing total global power emissions by 40% by 2050 (Figure 7). Below, we dig into the trends driving these results.

FIGURE 7

Cleaner generation cuts power emissions despite rising demand

Global electricity generation, power emissions, and emissions intensity, 2024 = 100, mean



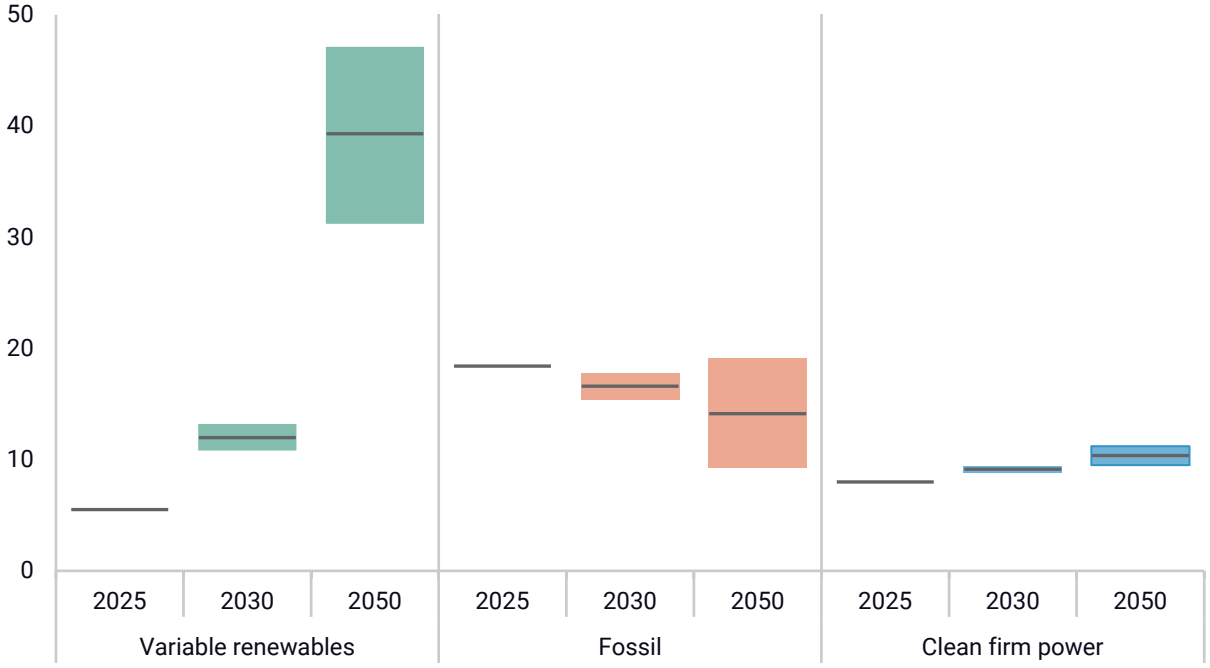
Source: Rhodium Climate Outlook, Clean Investment Monitor

Decades of policy and innovation have driven down the costs of solar, wind, and batteries, which have led to significant decarbonization of power generation. In 2025, wind and solar supplied 17% of global electricity, up from only about 5% a decade earlier. In our outlook, we see a continued shift to clean supply, replacing substantial amounts of fossil generation in the mix in the decades ahead as solar and wind supply most of the additional electric power output to meet growing global demand. Generation of variable renewable energy (VRE) rises from 5,500 TWh in 2025 to 39,300 TWh by 2050, roughly six to nine times the 2025 level. Other low-carbon sources, including hydro, nuclear, geothermal, and biomass, grow more slowly, from 8,000 to 10,400 TWh in the mean projection. Together, low-carbon generation expands by 36,200 TWh, while fossil generation falls by 4,300 TWh (or 23%) in our mean projections by 2050 (Figure 8).

FIGURE 8

Wind and solar grow faster than fossil and clean firm generation

Global electricity generation by source (thousand TWh), likely range (67% probability)



Source: Rhodium Climate Outlook, Clean Investment Monitor. Note: Historical estimates for 2025, projected means, and likely ranges through 2050.

The expansion of VRE generation also becomes much less concentrated geographically. Outside China and the OECD, wind and solar generation grows from just 900 TWh in 2025 to 12,500 TWh on average in 2050, approaching the levels projected across OECD economies in 2050 (13,300 TWh) and China's projected 2050 levels of 13,500 TWh. The rest of the world thus reaches a comparable scale of deployment from a much smaller starting point. But faster growth in overall electric demand means that less of that additional clean power supply is used to displace fossil generation, which sticks around longer to meet growing demand (Figure 9).

FIGURE 9

Renewables expand everywhere but displace more fossil power in China and the OECD

Electricity generation by source (thousand TWh), likely range (67% probability)

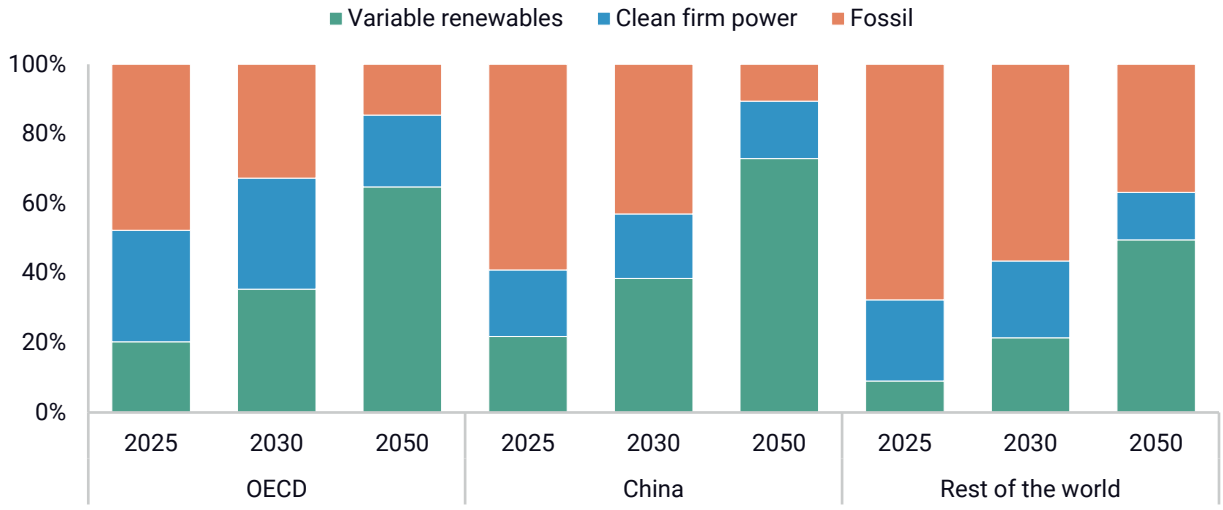


Source: Rhodium Climate Outlook, Clean Investment Monitor. Note: Historical estimates for 2025, projected means and likely ranges through 2050.

By 2050, low-carbon sources provide a majority of electricity in all three country groupings: 89% in China on average, 85% in the OECD, and 63% in the rest of the world. Wind and solar alone rise from 22% in 2025 to 73% in China, from 20% to 65% in the OECD, and from 9% to 50% in the rest of the world (Figure 10). Fossil generation falls by a mean 65% in China and 45% in the OECD but rises by 33% elsewhere as total demand expands. That increase is not inevitable: the likely range for the rest of the world spans a 14%

decline to an 81% increase in fossil output due to uncertainty in electricity demand growth and fuel and technology costs, compared with declines of 59–82% in China and 20–69% in the OECD.

FIGURE 10
By 2050, low-carbon sources supply over 80% of electricity in China and across OECD economies, compared with roughly 60% in the rest of the world
Percent share of annual electricity generation by source, mean projection



Source: Rhodium Climate Outlook, Clean Investment Monitor. Note: Historical estimates for 2025 and projected means in 2030 and 2050. Storage discharge excluded.

This larger role for wind and solar is accompanied by substantial storage deployment, which shifts electricity to periods when renewable output is lower. Mean global four-hour battery capacity rises from 89 GW in 2023 to about 3,240 GW in 2050, with a likely range of 2,270–4,210 GW. China reaches about 1,710 GW, up from 36 GW; the OECD reaches 880 GW, up from 52 GW; and the rest of the world reaches 650 GW, up from 2 GW.

Global electrification on track to reach 28% of total energy by 2035

Clean power can reduce emissions beyond the electricity sector as vehicles, buildings, and industry replace direct fossil-fuel use with electricity. As COP31 President, Türkiye announced the "35 by 35" Global Electrification Pledge and Action Agenda calling for increasing electricity's share of global final energy consumption to 35% by 2035.

Electricity supplied about 21% of reported global final energy in 2024. In our outlook, that share rises to 28% in 2035 on average, with a likely range of 27–29% absent additional action to drive current market trends and policy further than their current glide path. Closing that gap would require faster replacement of direct fuel use, alongside the expansion of clean power.

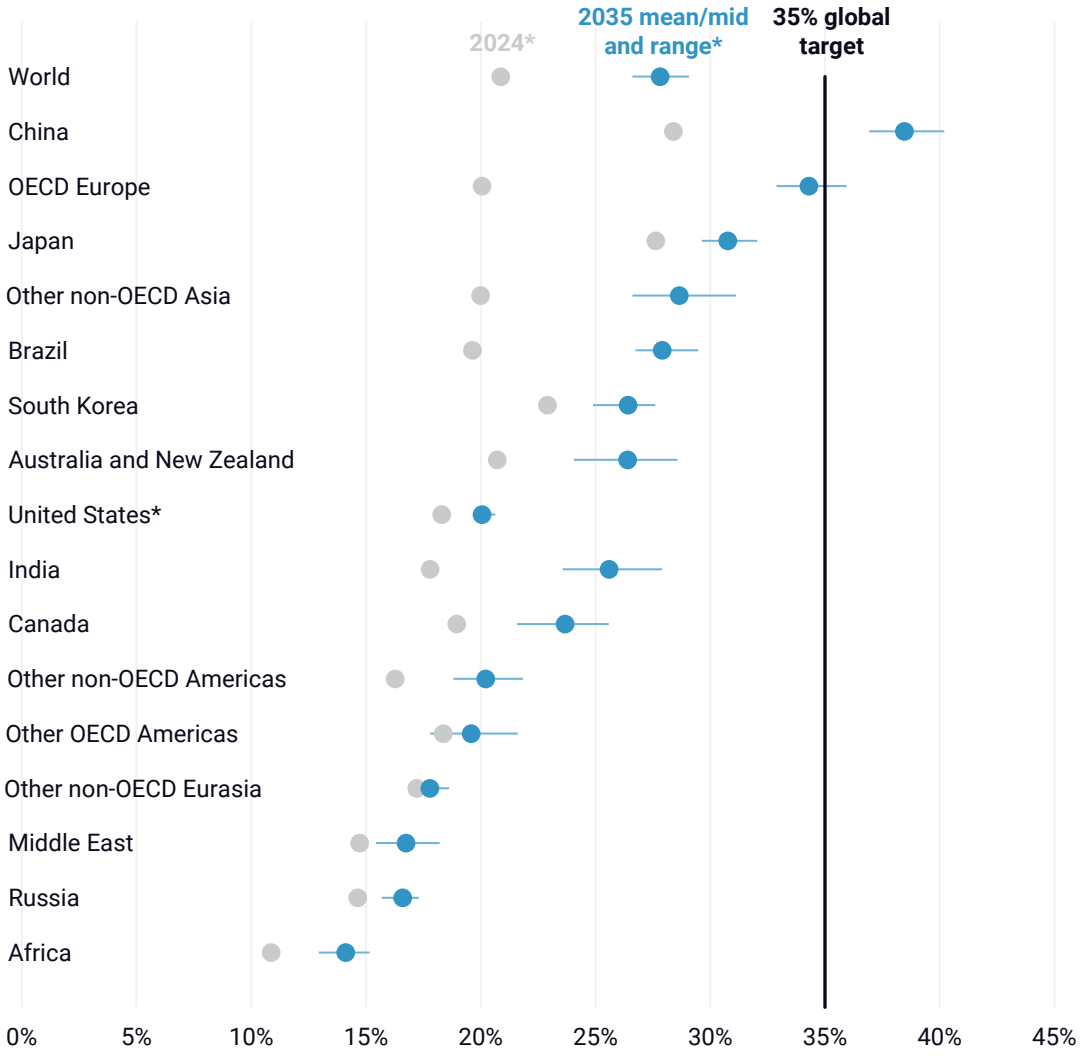
There is considerable regional variation in electrification shares, however (Figure 11). In our baseline, China and OECD countries in Europe reach the highest electrification shares by 2035, but their starting points shape the story. China is all but guaranteed to meet the goal, as its share rises from 28% to a likely range of 37–40%. OECD countries in Europe

make a substantial gain, climbing 14 percentage points from 20% to 34%, with the likely range (33–36%) spanning the target. We see similar progress in other parts of non-OECD Asia, which rises from 20% to 29% in the coming decade. India alone is expected to rise from 18% to 26%. Other regions starting from a low base, like Africa, Russia, and the Middle East, see less progress in the coming decade, however. In the next section, we explore the sectoral trends driving the different regional outcomes we see here.

FIGURE 11

Global electrification falls short of 35% by 2035 target

Electricity percent share of reported final energy



Source: Rhodium Climate Outlook, Rhodium Group's Taking Stock 2026 (US). Note: The US shows purchased electricity / delivered energy, 2025 baseline, 2035 mid scenario and three-scenario min–max. Other regions show 2024 shares, 2035 means and 67% likely ranges. The 35% line is a reference to the global target of 35% electrification by 2035 in the COP31 Action Agenda.

The story of rising electrification rates is complex. In addition to rising electrification of end uses that have conventionally relied on fossil fuels, the rise of overall electric demand—driven by rising incomes and expanded electricity access, soaring cooling demand, and the emergence of power-hungry data centers—is also shifting the landscape for overall electrification rates and changing the importance of electric power as a core

driver of economic growth and prosperity worldwide. The next section examines these differences in absolute demand and where the additional electricity goes.

Rising power demand in buildings drives global electric load growth; data center boom primarily a US story

The expansion of data centers and artificial intelligence has brought renewed attention to soaring electricity demand, but the sources of growth differ considerably across regions. Rhodium Group's Taking Stock 2026 outlook for the US projects that data centers account for 62–77% of gross US electricity demand growth from 2025 to 2030. Globally, the picture is different: rising electricity use in homes, businesses, and transport contributes much more.

In our baseline, we project global electricity demand to rise by 46% between 2024 and 2035 on average (likely range of 37–54%). Demand from buildings—including demand for appliances, cooling, and heating but excluding data centers—contributes about 7,600 TWh of additional demand by 2035, or 60% of the mean increase of roughly 12,650 TWh. Power demand in buildings is expected to grow rapidly as rising incomes allow more households to acquire air conditioners and appliances, while expanding commercial activity increases electricity use in businesses. Warmer conditions further raise cooling requirements, partly offset by reduced heating needs. Our outlook incorporates Climate Impact Lab research to capture these opposing effects. Climate change is a significant driver of rising demand, but the broader expansion of electricity use also reflects economic development, equipment ownership, and the services that households and businesses consume.

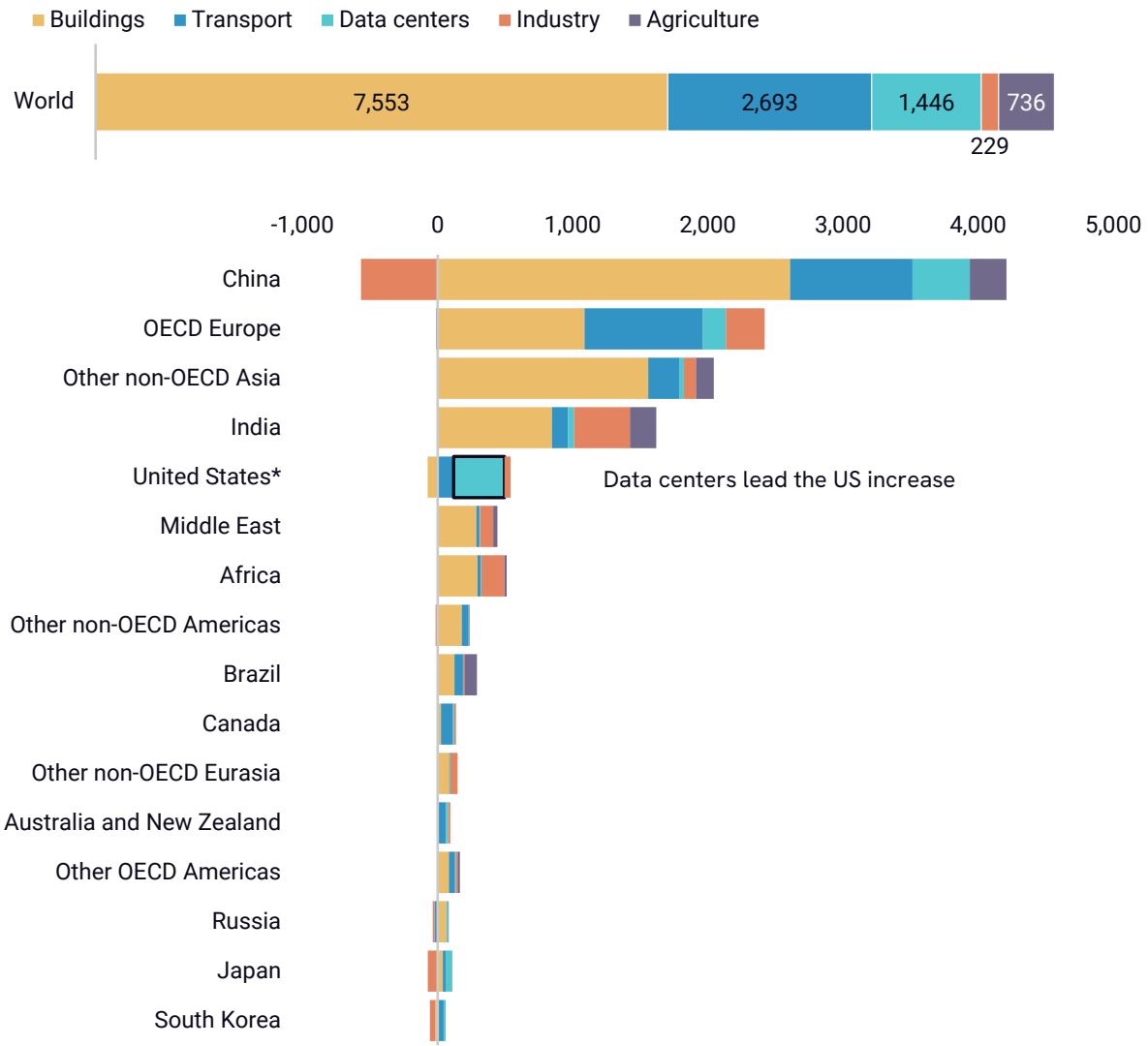
Industry starts from a very different position, using about 13,600 TWh in 2024, nearly half of reported electricity demand. Its 1.7% net increase from 2024 to 2035 combines growth in chemicals, steel, and electricity used to produce hydrogen with lower use in other industry and refining. The pattern also differs by region: India's industrial electricity demand increases by about 410 TWh, while China's falls by about 570 TWh from 2024. Taking Stock projects US industrial electricity demand, including agriculture, to rise by about 45 TWh from 2025 to 2035 in its mid scenario.

As we highlight in the following section, growing electrification of transport is expected to account for 2,700 TWh, or 21%, of the global increase in electricity demand from 2024 to 2035, driven largely by the replacement of gasoline- and diesel-powered vehicles with electric models. Data centers contribute another 1,450 TWh, or 11%, with their growth concentrated in a smaller set of markets. Agriculture accounts for about 740 TWh, or 6%, while industry contributes 230 TWh, or 2%.

FIGURE 12

Buildings lead global electricity growth while data centers drive US demand growth

Increase in electricity demand by sector (TWh), 2024–2035; US: 2025–2035, Taking Stock mid scenario



Source: Rhodium Climate Outlook, Rhodium Group's Taking Stock 2026 (US). Note: The US uses 2025–2035 changes in the Taking Stock 2026 mid scenario; Taking Stock industry includes agriculture. Other regions and the global total retain RCO 2024–2035 means. Regional bars therefore do not sum to the global total. Negative segments indicate declines.

Buildings lead demand growth in both China and India, but the region-specific drivers differ. China adds about 3,640 TWh by 2035, or 29% of the global increase, with buildings and transport together adding 3,510 TWh, reflecting wider use of electric equipment and faster vehicle electrification. Lower industrial electricity use offsets a portion of that growth in China, however. India's increase is smaller in absolute terms, about 1,620 TWh, but represents a doubling of demand in the course of just a decade. Buildings contribute 840 TWh, alongside increases in industry and agriculture as energy needs expand. Data centers remain a smaller driver in both: 12% of China's net increase and 3% of India's.

The US has a different balance. In Taking Stock's mid scenario, data centers add about 380 TWh from 2025 to 2035, or 81% of the net increase of about 465 TWh. Transport adds

about 120 TWh and industry, including agriculture, adds about 45 TWh, while buildings, excluding data centers, use about 75 TWh less electricity. Data centers consequently dominate the US demand increase.

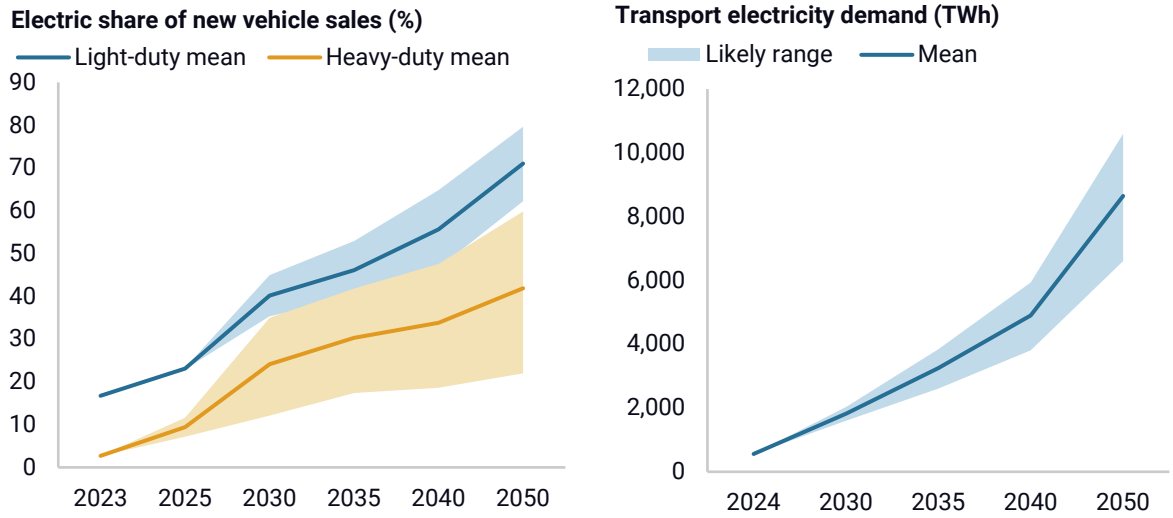
In OECD countries in Europe, buildings and transport account for about 1,960 TWh, or 82%, of the increase. Vehicle emissions standards drive electric vehicle adoption, and in buildings, rising demand for air conditioning adds cooling load (buildings overall add about 1,090 TWh, or 45% of the region's net increase), while electric heating shifts demand away from heating fuels. Heat pumps require less energy per unit of heat than resistance heating, and warmer weather reduces heating needs, so these changes do not translate one-for-one into electricity growth. Together, buildings and transport nevertheless add far more demand than data centers.

Electric vehicle sales rise rapidly, but slow fleet turnover keeps transport emissions stubbornly high

Electric vehicles are already changing new-car markets. EVs made up one-quarter of global new-car sales in 2025, marking a rapid scale-up, bringing EV shares of the global passenger vehicle fleet to a record 5%. In our outlook, the electric share of global light-duty vehicle sales reaches 40% in 2030 on average (35–45% likely range) and 71% in 2050 (62–80% likely range). Electrification proceeds more slowly in heavy-duty vehicles: their electric sales share rises from 3% in 2023 to 24% in 2030 on average, and 42% in 2050 (22–60% likely range) (Figure 13).

That uptake makes transport a substantial new source of electricity demand even before it delivers large reductions in the sector's total emissions. Mean transport electricity use rises from an estimated 558 TWh in 2024 to 1,822 TWh in 2030 and 8,648 TWh in 2050 (6,610–10,598 TWh likely range) (Figure 13).

FIGURE 13
Electric vehicles gain market share and raise electricity demand
Mean and likely range (67% probability)

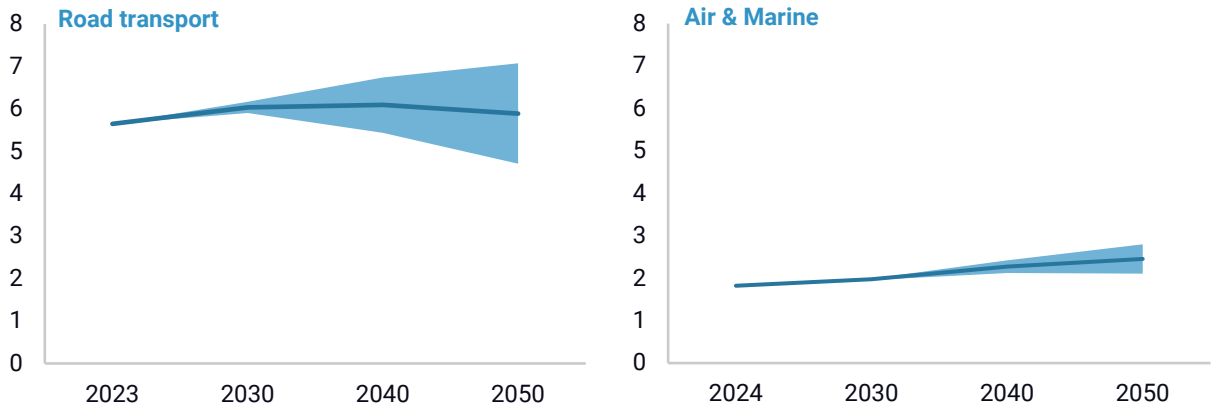


Source: Rhodium Climate Outlook, Clean Investment Monitor. Note: Light- and heavy-duty electric vehicle sales, including battery-electric and plug-in hybrid vehicles. Total transport electricity demand includes other transport.

The impact on GHG emissions is slower than the change in sales, however, as stock turnover takes time. Existing combustion vehicles remain in use, and rising road travel demand offsets some of the gains from cleaner new vehicles. As a result, projected emissions from cars and trucks remain relatively flat through mid-century, rising from 5.6 gigatons CO_2e in 2023 to 5.9 gigatons in 2050 (4.7–7.1 gigatons likely range) (Figure 14). Within road transport, heavy-duty emissions fall by 18% on average, from 2.8 gigatons in 2023 to 2.3 in 2050, but light-duty emissions remain above their historical level in the mean projection.

Aviation accounts for most of the increase in total transport emissions through 2050. By mid-century, aviation emissions rise from an estimated 1.1 gigatons in 2024 to 1.5 as demand grows and low-emission fuels displace only a small fraction (10–15% by 2050) of conventional jet fuel, absent a scale-up in policy ambition. Shipping emissions rise from 0.7 gigatons in 2024 to around 1.0 in 2050. Together, aviation and shipping rise by 35%, from 1.8 gigatons in 2024 to 2.5, with a likely range of 2.1–2.8 gigatons. Their share of transport emissions rises from about 22% in 2024 to 29% in 2050. Their trajectory contrasts with the much greater potential for direct electrification in road vehicles.

FIGURE 14
Aviation drives most of the increase in transport emissions
Direct greenhouse gas emissions by transport mode (gigatons CO_2e), likely range (67% probability)



Source: Rhodium Climate Outlook

Declining steel emissions a bright spot as industrial emissions remain high

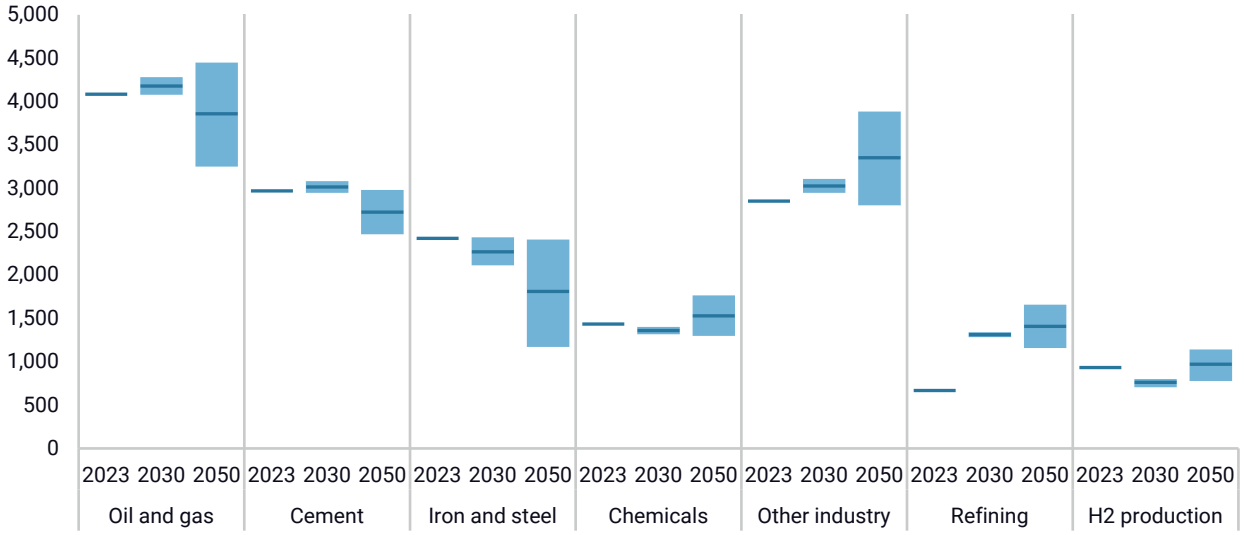
While mature, cost-effective technologies exist today to decarbonize vast swaths of the power and transport sectors, opportunities to transition the industrial sector remain limited. The industrial sector covers a large swath of the global economy, including manufacturing and industrial processes involved in producing iron, steel, cement, chemicals, and fuels. While we see some progress in the electrification of industry, a large share of the industrial processes that generate GHG emissions cannot be replaced by electricity. In our outlook, industrial emissions remain relatively flat through mid-century despite limited progress in iron, steel, and cement production, driven largely by demographic change and the application of a handful of mature technologies.

Over the coming decades, we expect to see declining emissions from iron and steel production, falling from 2.4 gigatons CO_2e in 2023 to 1.8 in 2050 on average (a 25% drop) (Figure 15). We see a continued diversification of the overall fuel mix used in iron and steel production, with coal consumption falling by 31%, while electricity use rises 24%, and natural gas use increases by 53%. This is consistent with a shift away from coal-based production, rather than an equivalent decline in all steelmaking. Cement and non-metallic mineral emissions fall a more modest 8% by 2050, from 3.0 to 2.7 gigatons, as continued material demand and process emissions leave less scope for reductions through fuel switching alone.

FIGURE 15

Lower steel emissions are offset by growth elsewhere in industry

Industrial greenhouse gas emissions by subsector (million metric tons of CO_2e), likely range (67% probability)



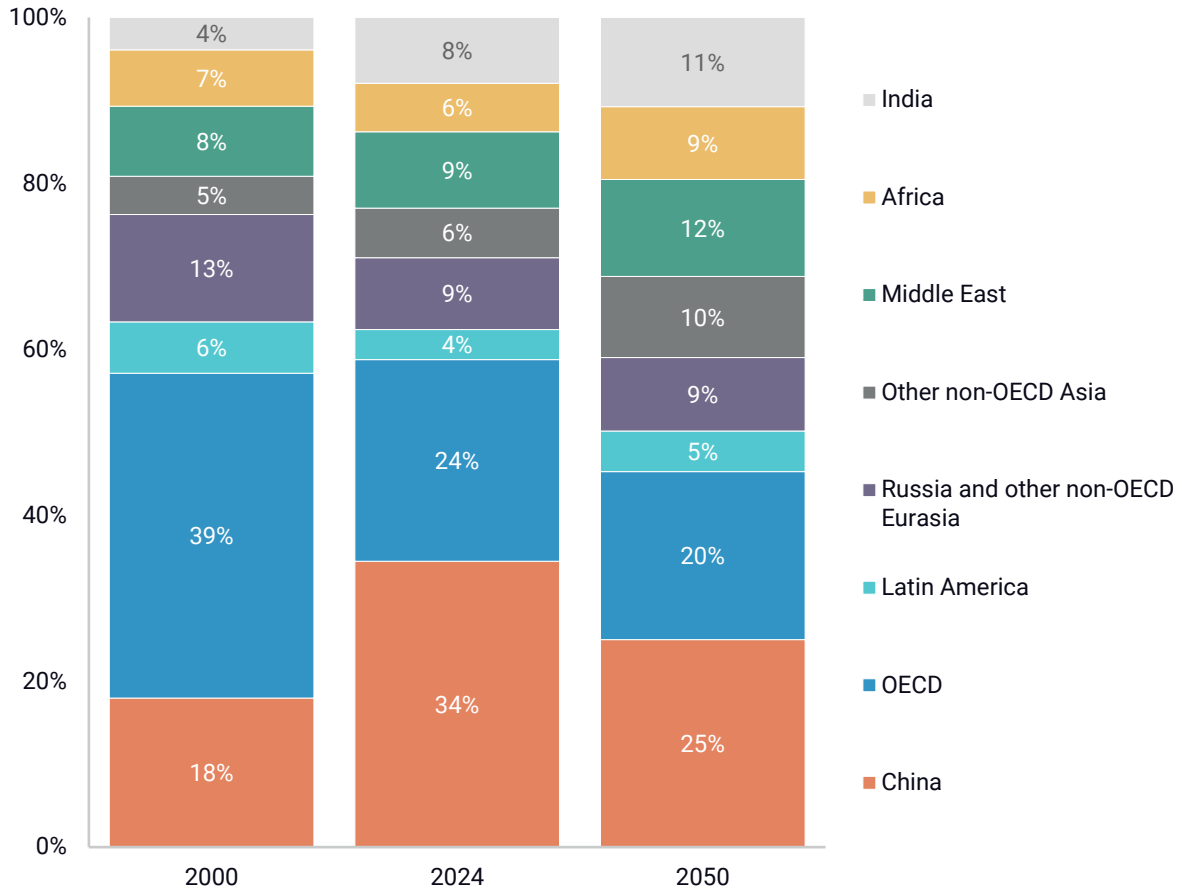
Source: Rhodium Climate Outlook. Note: Historical levels for 2023, projected means, and likely ranges in 2030 and 2050. Subsector totals exclude carbon removals. Oil and gas includes coal-mining methane.

These emission reductions are offset by rising emissions across other industrial subsectors, however. Other-industry emissions—including paper and pulp, food production, and non-ferrous metals—rise 18% by mid-century from 2.9 to 3.4 gigatons, chemicals from 1.4 to 1.5 gigatons, and emissions from refining are expected to double (rising from 0.7 to 1.4 gigatons) in the next 25 years on average. Despite a likely decline in emissions from oil and gas production and coal-mining methane (with a 6% drop on average), together they remain the largest industrial source of emissions and could even increase in some pathways.

We also find that the geographic distribution of industrial emissions changes over the coming decades. China's industrial emissions fall considerably by mid-century, dropping 28% on average, from 5.4 gigatons in 2024 to 3.9 in 2050, driven by structural population changes and the underway transition to a developed economy. We see the inverse of this occurring across India, Africa, and the Middle East, which together see emissions rise 36% on average, from 3.6 gigatons in 2024 to 4.9 by mid-century. Those three regions account for 31% of industrial emissions in 2050, up from 23% in 2024; China's share falls from 34% to 25% (Figure 16). Growth in these markets offsets much of the reduction in emissions

from China. The choices made when adding new production capacity will increasingly determine whether industrial emissions decline in absolute terms, rather than simply moving their center of growth.

FIGURE 16
India, Africa, and the Middle East account for more industrial emissions
Percent share of industrial greenhouse gas emissions by region



Source: Rhodium Climate Outlook

Conclusion

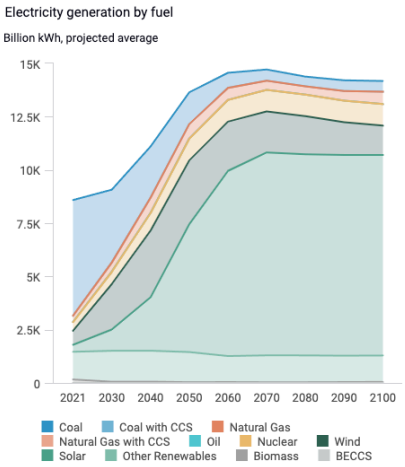
Each year, the Rhodium Climate Outlook provides an updated look at what the world is on track for in terms of energy use, emissions, and temperature rise, given a wide range of developments with impacts on key drivers. As we narrow down uncertainty, add emerging technologies that have reached sufficient maturity, and incorporate new policies as they are adopted, we hope to see the outlook for global emissions and temperature rise improve. In the years ahead, the RCO will continue to be an important barometer to assess what really matters, where the world must focus more attention, and how our efforts are paying off.

Access RCO data on ClimateDeck

All of the underlying data from the RCO is available on ClimateDeck, our free interactive data platform that enables you to explore global and US 50-state greenhouse gas (GHG) emissions data and projections and energy market outlooks.

Unlock insights with Rhodium Climate Outlook data

Dive into the Rhodium Climate Outlook dashboards on ClimateDeck to answer your global and regional climate-related questions. Whether you are analyzing emissions trends, forecasting energy market shifts, or assessing the potential for emerging climate technologies, ClimateDeck offers the tools to customize your analysis. ClimateDeck equips users with comprehensive datasets, unique and responsive insights, and a robust set of tools. Users are empowered to track pathways to climate targets and understand the implications of major developments at the international, national, and state levels.



Explore, customize, and share

All of the underlying data from the Rhodium Climate Outlook is available to explore and download from ClimateDeck. Use its intuitive interface to tailor data visualizations by adjusting inputs such as timeframe, geography, sector, greenhouse gas, and uncertainty ranges. The adjustable datasets can be exported as production-ready visualizations and CSV files to seamlessly integrate into your work. Incorporate ClimateDeck data in your own analysis and external publications, with attribution to Rhodium Group. Access the full suite of Rhodium Climate Outlook data for free at climatedeck.rhg.com.

About Rhodium Group

Rhodium Group is an independent research provider with deep expertise in policy and economic analysis. We help decision-makers in both the public and private sectors navigate global challenges through objective, original, and data-driven research and insights. Our key areas of expertise are China's economy and policy dynamics, and global climate change and energy systems. More information is available at www.rhg.com.

Acknowledgments

Funding for the Rhodium Climate Outlook is provided by Breakthrough Energy and Sequoia Climate Foundation as part of their support for ClimateDeck. The authors would like to acknowledge the contributions of Rhodium team members that supported this work, including Jaspreet Sohal, Maggie Young, and Kelly McCusker.

Disclosures

This material was produced by Rhodium Group LLC for use by the recipient only. No part of the content may be copied, photocopied, or duplicated in any form by any means or redistributed without the prior written consent of Rhodium Group. Our publications are intended to provide clients with general background research on important global developments and a framework for making informed decisions. Our research is based on current public information that we consider reliable, but we do not represent it as accurate or complete. The information in this publication is not intended as investment advice and it should not be relied on as such.

© 2026 Rhodium Group LLC, 5 Columbus Circle, New York, NY 10019. All rights reserved.

New York | California | Washington, DC | Paris

Website: **www.rhg.com**

Rhodium Group