Rhodium Group

Taking Stock 2025

Energy & Climate

September 10, 2025

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Executive summary

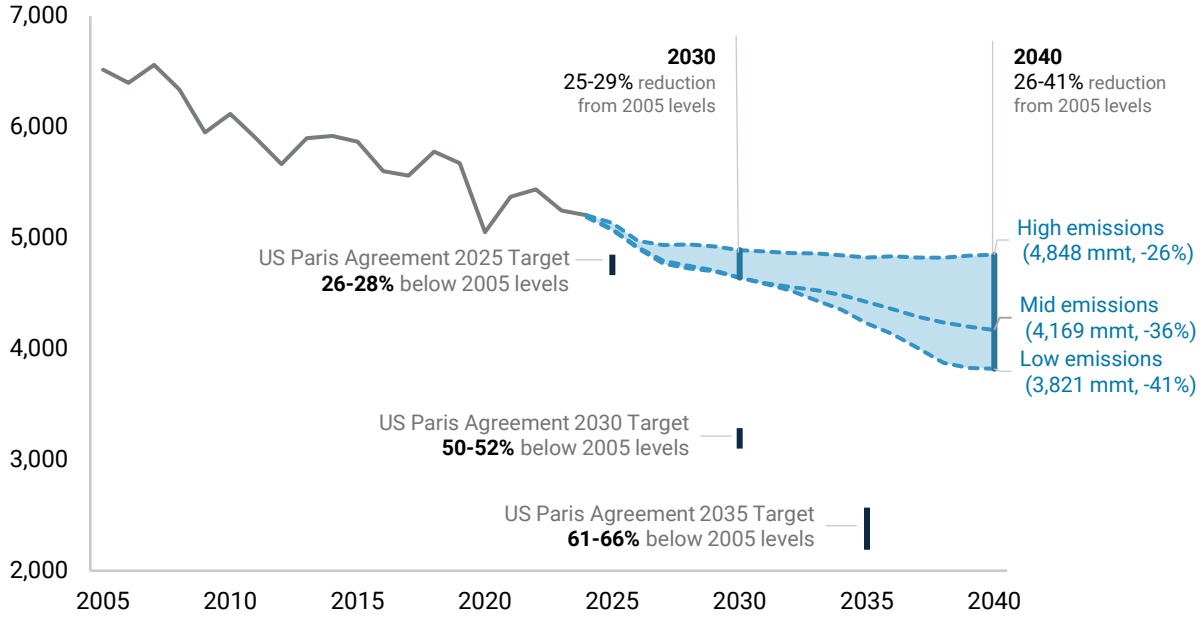
The first seven months of the second Trump administration and 119th Congress have seen the most abrupt shift in energy and climate policy in recent memory. After the Biden administration adopted meaningful policies to drive decarbonization, Congress and the White House are now enacting a policy regime that is openly hostile to wind, solar, and electric vehicles and seeks to promote increased fossil fuel production and use.

In this year's Taking Stock report—Rhodium Group's annual independent outlook of the evolution of the US energy system and greenhouse gas (GHG) emissions under current policy—we find the US is on track to reduce GHG emissions by 26-41% in 2040 relative to 2005 levels. On the way to 2040, we estimate GHG emissions levels will decline 26-35% in 2035, a meaningful shift from our 2024 report, which showed a steeper decline of 38-56% by that point. Emissions outcomes vary due to a range of expectations for economic growth, future fossil fuel prices, and clean energy cost and performance trends, which we combine to create low, mid, and high emissions scenarios. In the high emissions scenario, the most pessimistic outlook on decarbonization, the pace of decarbonization more than halves through 2040, with annual average GHG reductions of 0.4% from 2025 through 2040 compared to 1.1% from 2005 through 2024. In the mid and low emissions scenarios, the pace of decarbonization accelerates instead, with annual average reductions of 1.4% and 1.9% through 2040, respectively, representing a 22% and 70% acceleration, compared with the pace of the last two decades.

FIGURE ES1

US greenhouse gas emissions under current policy

Net million metric tons (mmt) of CO_2-equivalent (CO_2-e)



Source: Rhodium Group

Note: The high, mid, and low ranges reflect uncertainty around future fossil fuel prices, economic growth, clean energy technology costs, and growth in liquified natural gas (LNG) export capacity.

Key sectoral shifts underpin these topline findings:

The **power sector** emits 15-43% fewer GHGs in 2040 compared to 2024 levels, even as electricity demand grows faster than at any point this century. Renewables grow substantially in all three emissions scenarios through 2030 to claim the expiring clean electricity tax credits, but deployment diverges after that. The coal fleet shrinks by 55-75% compared to 2024 levels, but the mix of technologies that replace this capacity and meet growing load depends on fossil fuel prices and clean technology costs. In the low and mid cases, renewables outcompete gas, and emissions continue to decline through 2040. In the high emissions scenarios, gas contributes more generation to the grid than in 2024 or 2030, and power sector GHG emissions increase by 8% from 2030 through 2040.

Transportation sector emissions decline more modestly, by 8-20% in 2040 compared to 2024 levels, with zero-emissions vehicle (ZEV) sales shares increasing in the light (LDV), medium (MDV), and heavy-duty (HDV) fleets. Falling battery prices and strengthening consumer sentiment push ZEV LDV sales shares up to 19-43% by 2040, double to quadruple 2024 levels.

Domestic **oil and gas production** is increasingly aimed at export markets, given relatively modest changes in their domestic consumption. Liquified natural gas exports increase by 94-150% in 2040 compared to 2024 levels. Net exports of crude oil and other liquid fuels vary widely across emissions scenarios, flipping to net imports in the low emissions case and increasing by more than 600% in the high emissions case in 2040 compared to 2024 net export levels. **Industrial emissions**, mostly tied to oil and gas production, processing, and transportation, decline 4% in 2040 from 2024 levels in the low emissions scenario and increase 3-15% higher in the mid and high cases.

Environmental Protection Agency (EPA) Administrator Lee Zeldin has identified 31 regulatory policies for reconsideration, including greenhouse gas standards for power plants, on-road vehicles, and oil and gas operations. EPA has already proposed a repeal of the power plant standards, and a draft rule repealing vehicle standards is under review at the Office of Management and Budget. As such, we assume these major EPA regulations are removed in our baseline current policy modeling.

To illustrate the potential impacts of these regulations, we produce sensitivities of our three main emissions scenarios that retain these polices and restore EPA's waivers to California, enabling them to set their own vehicle standards. These "no rollbacks" cases have 2040 emissions outcomes that are 600-800 million metric tons (mmt) lower than our baseline current policy cases, roughly equivalent to total emissions in 2024 from California, Florida, and Michigan combined, resulting in GHG emissions declining to 35-53% below 2005 levels in 2040. The power sector is meaningfully cleaner, with no uncontrolled coal plants (i.e., those without carbon capture) remaining on the system in 2040 and more renewables filling in that capacity and meeting new demand. Passenger vehicle and freight fleets are also made up of substantially larger shares of ZEVs by the 2040s without regulatory rollbacks.

The outcomes we report throughout Taking Stock this year are subject to considerable uncertainty, including an incredibly dynamic policy environment and persistent non-cost barriers to clean energy deployment. These factors will continue to shape how the energy system and GHG emissions evolve in the coming years.

CHAPTER 1

A new outlook for US emissions

The early 2020s saw a few years of substantial climate and clean energy policies, anchored by the Infrastructure Investment and Jobs Act (IIJA), Inflation Reduction Act (IRA), and GHG regulations by EPA that would meaningfully transform the power and on-road transportation sectors. But the US is now embarking on a very different policy pathway under President Trump and a unified Republican Congress. The effects of these policy shifts are compounded by rapid growth in electricity demand driven predominantly by the growth in large AI data centers, a weakening macroeconomic outlook, and an increasingly export-driven fossil fuel sector to yield meaningfully different projections for the US energy system and GHG emissions.

Rapidly changing policy environment

Given the pace of the first seven months of the second Trump administration and 119th Congress, a complete review of all policy actions affecting the energy system and GHG emissions would be a monumental report. Instead, we provide a quick look at the most impactful and discussed policy moves over this period, broken down between executive and legislative actions. We discuss the specifics of how we model these policies in Chapter 2 and provide a detailed list of all policies we consider "on the books" as of July 15, 2025, in the Technical Appendix.

EXECUTIVE ORDERS AND REGULATORY ACTIONS

The Trump White House set the tone on day one of the new administration by issuing a slew of executive orders (EOs) that caused immediate whiplash in the energy and climate policy world. These orders directed withdrawal from the Paris Agreement, paused disbursement of congressionally appropriated funding from the IRA, deleted the Biden-era social cost of carbon, and declared a "national energy emergency" deemed to be caused by "the harmful and shortsighted policies of the previous administration." This shift in priorities and the resulting actions from across the executive branch created a very different policy landscape than the one we assessed when preparing Taking Stock 2024.

Since Inauguration Day, the White House has issued an ever-growing list of EOs directing agencies to implement an agenda focused on promoting largely fossil energy resources and restricting variable renewables like wind and solar, framed in terms of grid stability, national security, and getting energy prices under control (Table 1). These EOs instruct cabinet agencies to exercise emergency authorities to speed the buildout of domestic energy resources (excluding wind and solar); to expedite completion of all authorized energy infrastructure projects, environmental reviews under the National Environmental Policy Act, and approvals of liquified natural gas (LNG) export terminals; and to use a host of authorities to promote domestic coal mining and US coal exports and to support coal as an energy source. They also prioritize developing new nuclear reactors, setting a target to bring three new reactors to criticality by July 4, 2026.

TABLE 1
Select executive orders relating to climate or energy issued during the Trump administration

Executive Order #	Date Signed	Title
14156	1/20/25	Declaring a National Energy Emergency
14153	1/20/25	Unleashing Alaska's Extraordinary Resource Potential
14154	1/20/25	Unleashing American Energy
14162	1/20/25	Putting America First in International Environmental Agreements
14192	1/31/25	Unleashing Prosperity Through Deregulation
14260	4/8/25	Protecting American Energy From State Overreach
14261	4/8/25	Reinvigorating America's Beautiful Clean Coal Industry
14299	5/23/25	Deploying Advanced Nuclear Reactor Technologies for National Security
14300	5/23/25	Ordering the Reform of the Nuclear Regulatory Commission
14301	5/23/25	Reforming Nuclear Reactor Testing at the Department of Energy
14302	5/23/25	Reinvigorating the Nuclear Industrial Base
14315	7/7/25	Ending Market Distorting Subsidies for Unreliable, Foreign-Controlled Energy Sources

At least some of these EOs have had material impacts. For instance, Secretary of Energy Chris Wright has cited the energy emergency and coal EOs in issuing 202(c) orders to direct several coal plants to continue running this summer. More consequential actions have come from other agencies. EPA Administrator Lee Zeldin published a list of 31 "deregulatory actions" his agency would pursue, which largely consists of reconsideration of major EPA regulations adopted during the Biden administration—GHG standards for existing coal plants and new gas plants, tailpipe regulations for passenger vehicles and freight trucks, and methane emissions regulations on oil and gas operations chief among them. EPA has made progress on these actions: The power plant regulation repeal has already been proposed in the Federal Register, and the vehicle regulations repeal is under review at the Office of Information and Regulatory Affairs. Further, EPA has proposed eliminating the 2009 endangerment finding that established a legal framework for regulating GHGs.

Interior Secretary Doug Burgum is another firm adherent to these executive orders, citing them in a number of actions. In accordance with an Inauguration Day EO, Interior's Bureau of Ocean Energy Management rescinded all designated Wind Energy Areas on the Outer Continental Shelf. Interior also instituted a new "energy density" test, adding complexity to leasing federal lands for wind or solar generation. All solar and wind activities that require federal oversight and approval by Interior—any of at least 69 listed actions—must also be submitted for final review by the Office of the Secretary. Interior also directed the developers of two offshore wind facilities to stop work on those projects.

Shortly after assuming office, the Trump administration began threatening—and sometimes imposing—sweeping tariffs on both specific goods (e.g., steel, aluminum, solar

panels) and on other countries. These tariffs impact the energy system and emissions in two different ways. First, the country-specific tariffs and tariffs on commodities like steel are likely to drive reductions in GDP growth relative to a scenario without these additional tariffs. We expect that the most direct and significant impacts of tariffs on US energy consumption will come from reductions in industrial activity. Second, direct tariffs on clean energy technologies will increase the cost of these products to domestic developers, making clean technologies less cost-competitive with fossil incumbents. For instance, new antidumping and countervailing duties set tariff rates as high as 3,400% on cells and panels imported from the four top supplier countries. Most of these tariffs stack on top of one another, quickly driving up costs and creating a complex environment for developers and domestic manufacturers importing solar and battery products, components, and materials. We unpack the tariffs and how we model them in greater detail in the Technical Appendix to this report.

BUDGET RECONCILIATION AND ENSUING EXECUTIVE ORDER

Despite the volume of policymaking from the executive branch, the single largest climate and energy policy action came in the federal legislative realm with passage of the fiscal year 2025 budget reconciliation bill, dubbed the "One Big Beautiful Bill Act." We've previously unpacked the final version of the law in detail, its implications for energy bills for consumers and industry, and the risk to record levels of clean energy manufacturing growth. The most substantial changes came to energy-related tax credits, shuffling expiration dates and instituting restrictions on how foreign entities of concern (FEOC) can engage with qualifying projects (Table 2 provides a very high-level summary). The law also includes substantial rescissions of climate and clean energy grant funding and Loan Programs Office credit subsidies enacted as part of the IRA.

TABLE 2
Major changes to tax credits from the budget reconciliation bill

Tax credit	Modifications	FEOC provisions
Clean electricity production and investment tax credits (45Y and 48E)	*Wind & solar:* end of 2027 placed-in-service deadline with exception for facilities that commence construction before July 4, 2026 *Storage & other zero-emitting technologies:* end of 2033 commence construction deadline, then credit value steps down Transferability and bonus credits retained	Taxpayer-level restrictions on prohibited foreign entities (PFE) from claiming the credit Increasingly stringent material assistance limitations on sourcing of components from PFEs
Advanced manufacturing production tax credit (45X)	*Wind components:* expires after 2027 *Solar and storage components:* phase down beginning 2030	

	Critical minerals: phase down beginning 2031	
Electric vehicle tax credits, alternative vehicle fueling tax credits (30D, 45W, 25E, 30C)	Generally repealed Sept. 30, 2025 (6/30/2026 for charging infrastructure)	N/A given credit expiration
Building efficiency tax credits (25C, 25D, 45L, 179D)	Repealed at the end of 2025 (residential) or June 30, 2026 (commercial deduction)	
Clean hydrogen production tax credit (45V)	2027 commence construction deadline	
Carbon sequestration tax credit (45Q)	Credit parity for utilization	Taxpayer-level restrictions on PFEs from claiming the credit
Biofuels tax credits (45Z)	Extended through 2029, removal of sustainable aviation fuel-specific credit	
Existing nuclear production tax credit (45U)	No changes	

Source: Rhodium Group compilation

Three days after the law's passage, President Trump issued another EO, "Ending Market Distorting Subsidies for Unreliable, Foreign-Controlled Energy Sources," seemingly to push the Secretary of Treasury to adopt a maximalist position on two highly negotiated provisions of the compromise bill that became law: the definition of "beginning of construction" as well as FEOC provisions. Both constituted efforts to further restrict wind and solar deployment. In response to this EO, the Treasury released guidance on the commence construction definition, eliminating one of two definitions that had been in place since 2013. As of the time of writing, the foreign entity guidance has not yet been issued.

Continued demand for clean energy resources, continued non-policy headwinds

Despite new policy challenges for clean energy, we find continued demand for clean technologies across the economy. The grid still gets cleaner, though far less than the levels of deployment we've found in Taking Stock reports over the past couple of years. Renewable resources remain economically competitive with natural gas, even without subsidies, on an unsubsidized basis in many parts of the country, findings we unpack in much greater detail below. They are also available: Wind, solar, and storage have made up 87% of all capacity additions to the grid since 2023 and represent 95% of capacity waiting in interconnection queues. Generationally high demand for electricity, largely from adding new data centers to the grid, necessitates adding any available capacity to the grid.

At the same time, renewable resources continue to face many of the same headwinds we identified last year. That interconnection queue—in which 95% of capacity is renewable—is still far too large, with years-long waits for new generators to be able to plug into the grid. In addition to federal permitting slowdowns, persistent local opposition, limited growth in transmission capacity, and inflationary pressures on installation costs all weigh on deployment.

Consumer and business adoption of zero-emissions vehicles, particularly electric vehicles (EVs), also continues to increase—though modestly in some cases. This reflects the lower total cost of ownership that EVs offer compared to gasoline vehicles for many vehicle types in many parts of the country and continuing consumer preference for other EV attributes.

In the rest of this report, we highlight where the energy system and emissions trajectory look meaningfully different than today and where existing trends toward clean technology adoption continue. In Chapter 2, we discuss our modeling approach. In Chapter 3, we unpack the results of this modeling, starting with a high-level look at economywide emissions before diving into discussions of key sectoral trends. In Chapter 4, we consider a set of sensitivities in which EPA does not finalize its proposed or anticipated regulatory actions, giving a sense of what is still at stake in those rules. Finally, in Chapter 5, we identify some key areas of focus over the next year.

CHAPTER 2

Bounding uncertainty in projections

We project the energy system and emissions impacts of current policies under a range of possible future trajectories for energy markets, technology, and the economy. Critically, we do not produce probabilistic forecasts but rather determine a range of possible outcomes using a combination of testing and modeler judgment. The ranges we report represent distinct emissions pathways rather than confidence intervals on a central estimate.

We provide emissions and energy system projections for three main current policy scenarios:

- Our **high emissions pathway** provides a reasonable upper bound on US emissions through 2040, combining the lowest projections of oil and gas prices with the most conservative cost declines for a range of clean technologies (including clean power, EVs, industrial decarbonization technologies, and direct air capture) and faster economic growth than the latest Congressional Budget Office (CBO) projections through 2035. This scenario also includes a broader range of planned LNG export facility additions.
- Our **low emissions pathway** provides a reasonable lower bound on US emissions through 2040, effectively the inverse scenario of our high emissions pathway. It combines the highest projections of oil and gas prices with the most aggressive cost declines and performance improvements for clean technologies. It also assumes economic growth aligned with the latest CBO projections and the completion of LNG export capacity currently under construction or in the commissioning stage per the latest Energy Information Administration (EIA) data.
- Our **mid emissions pathway** adopts more moderate trajectories for some of these factors. It assumes continued cost declines for clean technologies, but less aggressive declines than in our low emissions pathway, and sees oil and gas prices that roughly split the difference between prices in the low and high emissions pathways. It also assumes economic growth aligned with the latest CBO projections and planned LNG export capacity consistent with the latest EIA data on facilities under construction or in the commissioning stage.

We generally reflect current, "on-the-books" policy as of July 15, 2025, in this year's Taking Stock report. We also assume EPA finalizes the repeal of GHG standards for power plants; model year 2027 and later LDVs, MDVs, and HDVs; and oil and gas operations. EPA has already proposed overturning several of these regulations. These proposals aren't yet finalized and will likely face court challenges, but the administration has prioritized these deregulatory actions, and the courts have generally allowed them. As a result, we expect the finalized rules to hew very closely to complete rollback and believe it is appropriate to discuss energy system and climate trends accordingly. We also modeled a set of sensitivity scenarios in which these rollbacks do not occur. We unpack this modeling in detail in Chapter 4.

We provide more details on the policies, constituent inputs of these scenarios, and our modeling environment in the rest of this chapter, and we go into much greater detail in the Technical Appendix to this report.

Using RHG-NEMS

We use RHG-NEMS to quantify energy sector and emissions outcomes. RHG-NEMS is Rhodium Group's modified version of the National Energy Modeling System (NEMS), a model developed by the EIA to produce their AEOs. Rhodium Group maintains a version of NEMS that we modify from the EIA base version. As we do each year with base NEMS, in addition to changing many key inputs (as described above) and bringing the current policy representation up to date as of July 2025, we also vary key assumptions and algorithms in the model based on research and recent real-world observations.

We expand this version of NEMS to include all sectors of the US economy and coverage for all six greenhouse gases targeted for reduction under the Kyoto Protocol. We continue to use the latest land use, land use change, and forestry (LULUCF) projections from the US Fifth Biennial Report. Consistent with EPA's annual Inventory of Greenhouse Gas Emissions and Sinks and United Nations Framework Convention on Climate Change (UNFCCC) requirements, we use 100-year global warming potential (GWP) values from the IPCC Fifth Assessment Report (AR5). Finally, we downscale this data to provide state-level results for key metrics.

CHAPTER 3

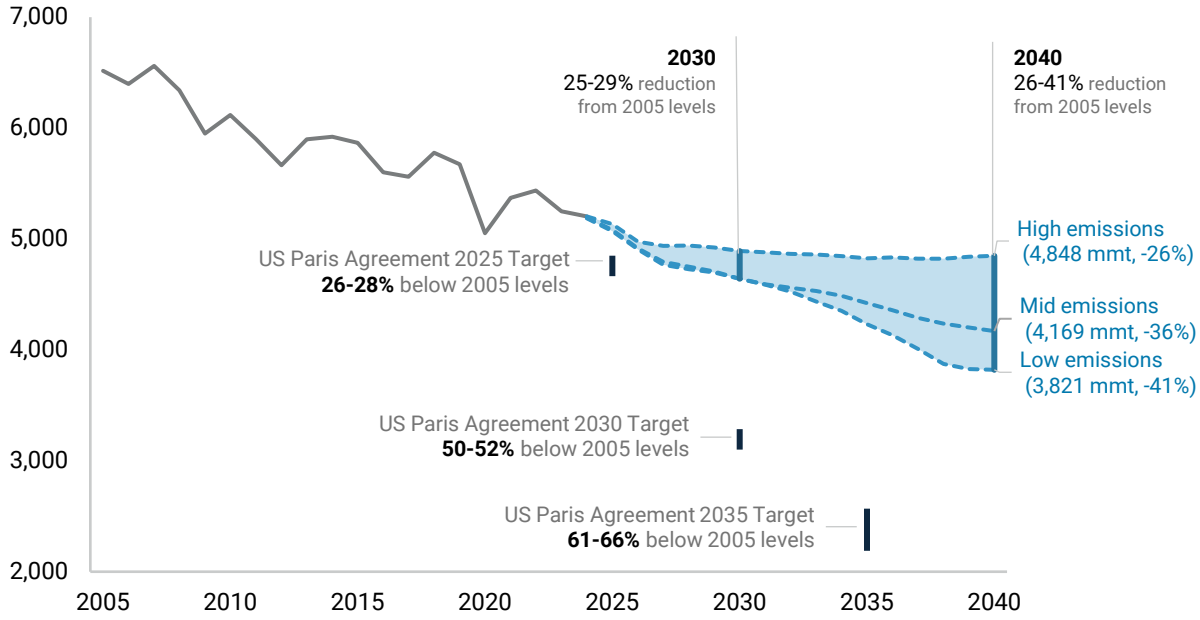
Emissions outlook and key sectoral trends

The US is on track for net GHG emissions of 3.8-4.8 gigatons (Gt) in 2040, representing a 26-41% reduction in emissions from 2005 levels. On the way to 2040, we estimate GHG emissions levels will decline to 4.2-4.8 Gt in 2035—a 26-35% reduction from 2005 (Figure 1).

FIGURE 1

US greenhouse gas emissions under current policy

Net million metric tons (mmt) of CO_2-equivalent (CO_2-e)



Source: Rhodium Group

Note: The high, mid, and low ranges reflect uncertainty around future fossil fuel prices, economic growth, clean energy technology costs, and growth in LNG export capacity.

In the high emissions scenario, emissions reductions continue for the next couple of years as planned clean energy investments continue to come online, but then flatten from the late 2020s through the mid-2030s, followed by several years of modest increases from 2035 through 2040. US emissions decreased by an average of 1.1% per year over the twenty years from 2005 through 2024. In our high emissions scenario, that rate of decarbonization is more than halved, with emissions decreasing by an average of 0.4% per year from 2025 through 2040.

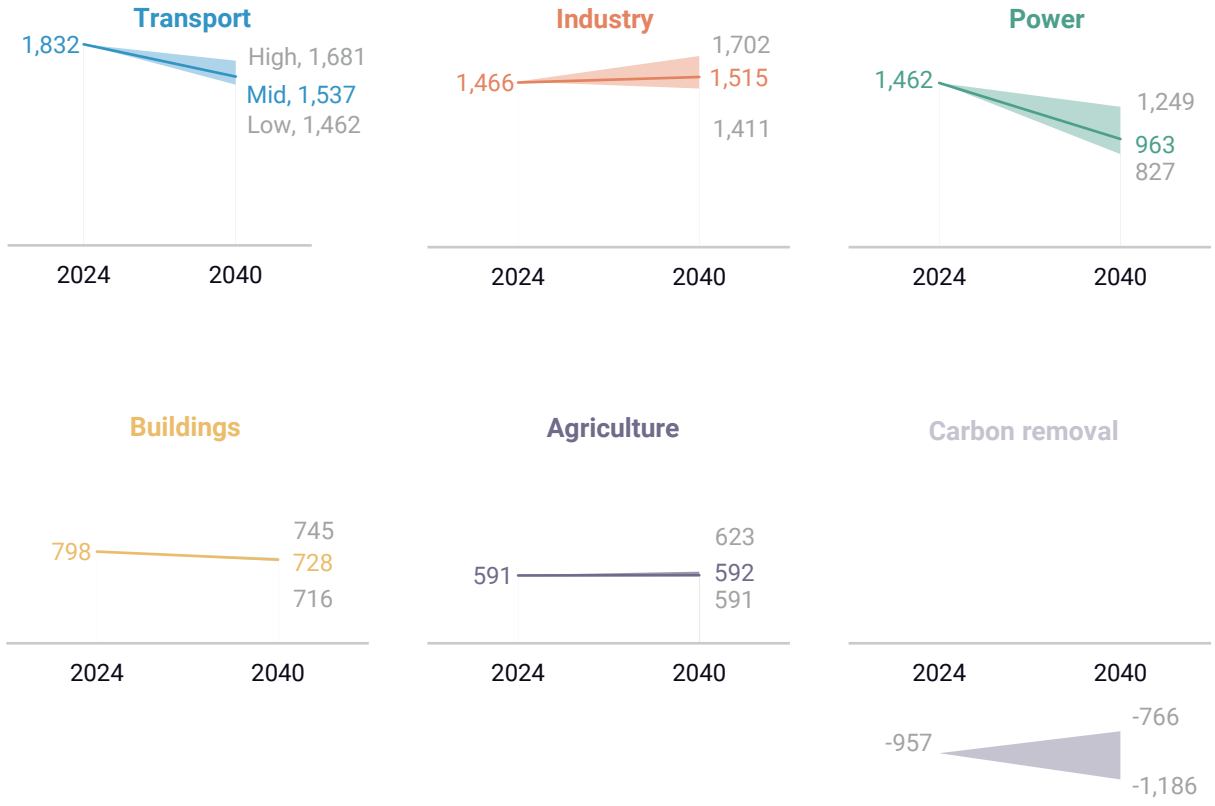
The mid and low scenarios show more meaningful and sustained decarbonization. In the mid case, emissions decline at an annual average of 1.4% from 2025 through 2040, 20% faster than the pace over the past two decades. In the low case, emissions decline 70% faster than the 2005-2024 annual rate, averaging declines of 1.9% per year through 2040.

Compared to Taking Stock 2024, this year's projections are higher. For comparison, we then estimated that the US was on track for a 38-56% decline in emissions in 2035 compared to 2005. Our projections this year represent a 0.8-1.2 Gt increase in expected GHG emissions in 2035 compared to last year.

Power, transport, and carbon removal sectors contribute most to emission declines

GHG emissions decline in the power, transport, and carbon removal sectors in all three emissions cases, though the pace of those declines varies substantially across the cases (Figure 2). For instance, power sector emissions could be nearly cut in half by 2040, as in our low emissions scenario, or decline by a more modest 200 mmt, a 13% drop, as in our high emissions scenario. Building sector emissions trend slightly downward while agricultural emissions increase modestly. Industrial emissions vary across scenarios, driven for the most part by the level of oil and gas production. We unpack the energy system and economic trends underpinning these sectoral outcomes in the remainder of this chapter.

FIGURE 2
US greenhouse gas emissions under current policy
Net million metric tons of CO_2-e



Source: Rhodium Group
Note: The high, mid, and low ranges reflect uncertainty around future fossil fuel prices, economic growth, clean energy technology costs, and growth in LNG export capacity.

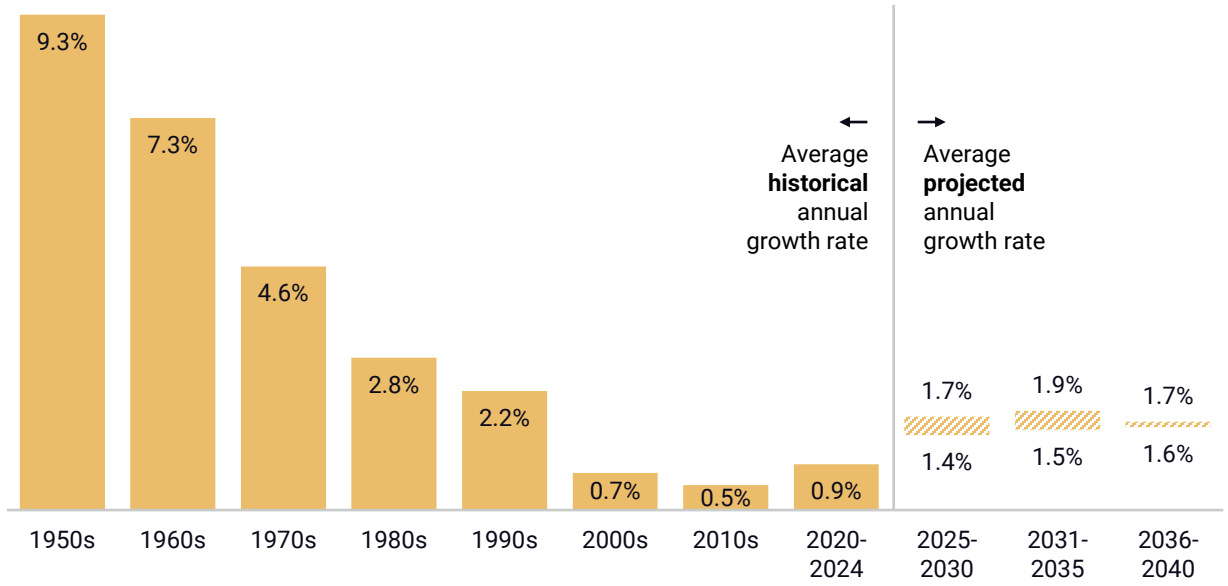
Carbon removal sector outcomes depend largely on assumptions around the carbon sink associated with land use, land use change, and forestry (LULUCF), with smaller impacts from deployment of direct air capture and point-source carbon capture on biogenic emissions at ethanol production facilities. Throughout this report, we report results using the high LULUCF pathway from the Fifth US Biennial Report. Under the report's low

LULUCF pathway, the carbon sink weakens to the point that the sector contributes to increasing net emissions from 2024 to 2040—though economywide emissions still decline (more modestly) under the low LULUCF pathway. Users can toggle between the low and high LULUCF pathways on ClimateDeck to further investigate this assumption's impact.

Power sector trends cleaner despite surging electricity demand

We project that electricity demand will increase faster from 2025 through 2040 than it has since the turn of the century (Figure 3). Since 2000, demand growth has averaged 0.6% annually, with a general pattern of declining growth rates over this window. Excluding growth in 2024, which marks the beginning of the current surge in demand, annual demand growth in the 2020s has so far averaged 0.3%. Against that backdrop, our projected increases in demand growth through 2040 mark a step change from where the US power grid has been over the past quarter century. We project electricity demand to grow 1.5%-1.7% over the next fifteen years, with sustained growth across that period.

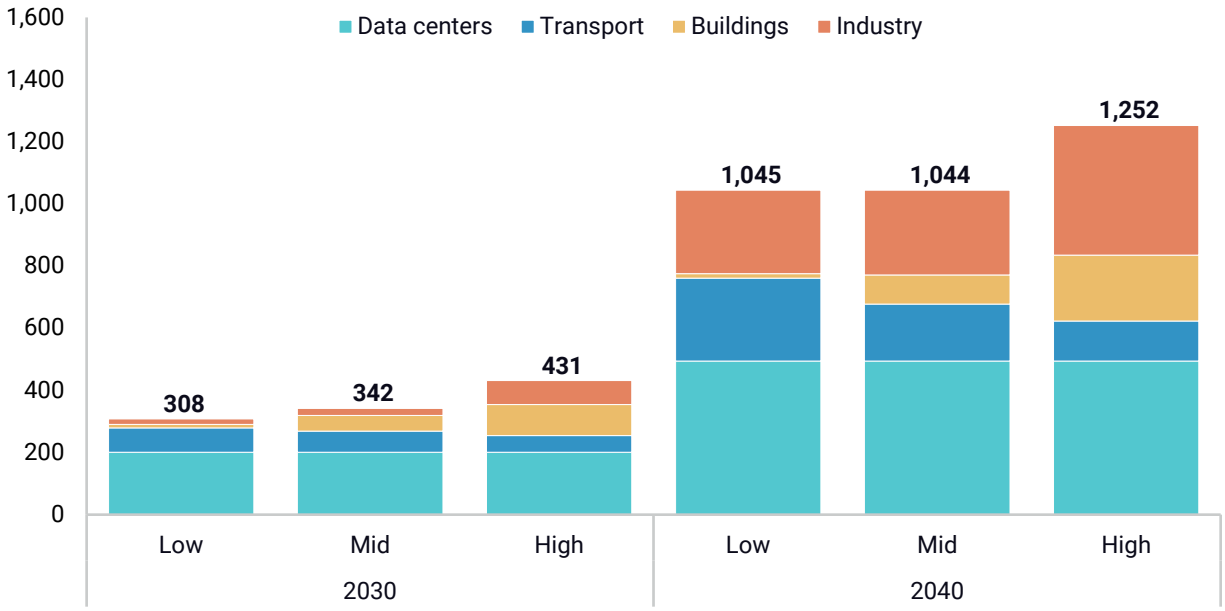
FIGURE 3
Evolution of electricity demand since the 1950s
Average annual percent growth



Source: Rhodium Group
Note: EIA Monthly Energy Review, Rhodium Group. Note: Ranges for future projections correspond to low and high emissions scenarios.

These growth rates are particularly sensitive to assumptions around electricity consumption at data centers. Our projections reflect substantial increases in power demand from data centers—nearly doubling by 2030 and more than tripling in 2040 relative to 2024 levels. Data centers account for 47-65% of electricity demand growth in 2030 and 44-59% in 2040 (Figure 4). In these scenarios, data centers make up 14% of *total* US electricity demand in 2040.

FIGURE 4
Sources of electricity demand growth from 2024 levels in 2030 and 2040
Billion kilowatt-hours



Source: Rhodium Group
Note: The high, mid, and low ranges reflect uncertainty around future fossil fuel prices, economic growth, clean energy technology costs, and growth in LNG export capacity.

There is considerable uncertainty around this outcome. Recent analyst projections for data center demand vary by plus or minus 80% of our assumed data center demand growth in 2040. We use a single assumed demand growth path for data centers to enable comparison across our emissions scenarios. If demand grows more slowly, our projections could be overstating future grid demand; if exponential growth for AI and associated power demand comes to fruition, we could be understating grid impacts. We plan to publish a note later this fall analyzing the effects of a wider range of potential data center demand pathways on the grid.

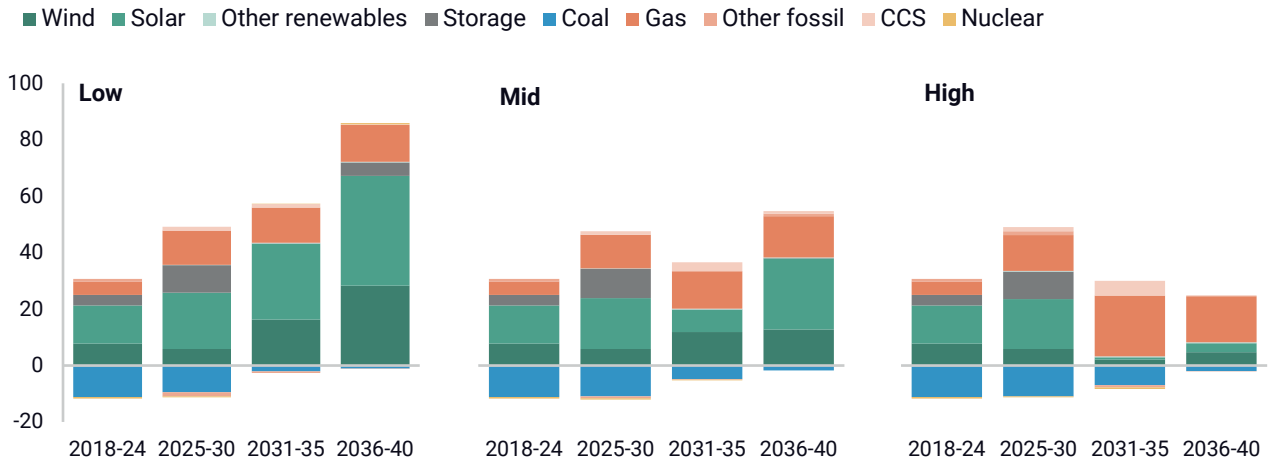
Currently, access to electricity is one of the major factors driving (or limiting) the growth of data centers. While we represent some frictions to grid capacity additions, an economywide energy system model isn't the best tool for characterizing the regionally granular decisions that underpin specific grid interconnection requests. Put another way, we generally assume power demand is met, subject to some broad assumptions around the buildout of new generating capacity. In practice, the ability for that capacity to come online may limit data center demand growth. Data center developers are also exploring behind-the-meter solutions to meet demand, which fall outside the power grid-level modeling we're discussing.

COAL CONTINUES ITS DECLINE ON THE GRID WHILE GAS AND RENEWABLES VIE TO FILL THE GAP AND MEET GROWING DEMAND

We find that power sector emissions fall 15-43% below 2024 levels by 2040, even with the meaningfully faster load growth discussed above. However, the pace and consistency of that decline vary considerably. It's useful to consider power sector evolution over the

next 15 years in two phases. Through 2030, power sector outcomes look broadly similar across all three emissions scenarios. Power sector emissions decline by 18-22% in 2030 compared to 2024. Renewables push to add substantial capacity to the grid before clean electricity tax credits expire, despite facing a range of policy and non-market headwinds discussed in Chapter 2. The grid averages 33-35 GW of new wind, solar, and storage capacity annually through 2030—about 10 GW higher than the average pace of additions since 2018 (Figure 5). Solar and storage installations are lower on average than the record highs set last year. Coal retirements continue at 10-11 GW per year, matching the pace of the first years of the 2020s. Gas deployment averages 12-13 GW per year, but is partially limited by turbine availability.

FIGURE 5
Average annual net capacity change (additions less retirements)
Gigawatts



Source: Rhodium Group
Note: The high, mid, and low ranges reflect uncertainty around future fossil fuel prices, economic growth, clean energy technology costs, and growth in LNG export capacity.

After 2030, the grid's trajectory diverges across the three scenarios. Emissions declines continue in the low and mid cases, while emissions actually increase by 8% from 2030 to 2040 in the high case. Coal plants continue to face challenging economics, leading to sustained retirements through 2040. The key to whether the sector sees modest or meaningful emissions reductions lies in the choice of technologies built to replace the diminishing coal capacity and meet expanding demand. This choice of technology buildout in the longer term depends strongly on natural gas price and technology cost assumptions across scenarios.

We project 45-77 GW of coal capacity will remain on the US power grid by 2040, a 55-75% reduction from today's capacity levels. Counterintuitively, the high emissions scenario sees the greatest magnitude of coal plant retirement: Wholesale natural gas prices average $2.40/MMBtu lower than in our low scenario, incentivizing new natural gas builds to replace existing, less efficient coal plants. The same dynamics allow natural gas to outcompete new renewable generation most of the time. In the low emissions scenario,

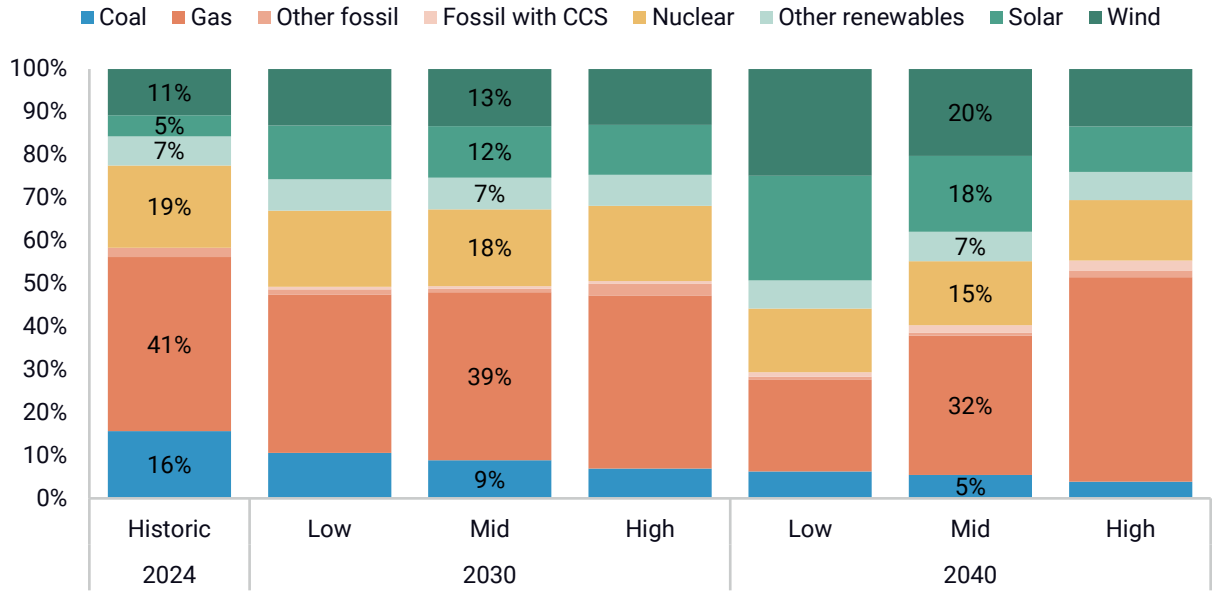
higher natural gas prices make gas less competitive with coal as the marginal generator, resulting in the fewest coal retirements.

As eligibility for clean electricity tax credits disappears through 2030, variable renewable energy deployment becomes further exposed to power market dynamics. In the low emissions scenario, continued cost declines for wind and solar lead those resources to outcompete gas and grow through 2040. By the late 2030s, both wind and solar exceed historical high levels of deployment for these resources on an annual average basis. In the high emissions scenario, cheaper gas and more expensive renewable technology costs result in anemic renewable growth, with average annual renewable builds falling to single-digit GWs after 2030. Storage deployment is also vulnerable to slowing variable renewable energy deployment. As demand grows and renewable buildout stalls, opportunities to capture curtailed variable renewable energy decrease. The expiration of the zero-emission nuclear power credit after 2032 leads to the retirement of 2-5 GW of nuclear capacity during the 2030s. In the low emissions scenario, we also see around 2 GW of new advanced nuclear added to the grid in the 2030s because of assumed declines in capital costs. Geothermal capacity also more than doubles to around 5 GW of total installed net summer capacity by 2040.

FIGURE 6

Power sector generation shares by fuel type

Percent of total generation



Source: Rhodium Group

Note: The high, mid, and low ranges reflect uncertainty around future fossil fuel prices, economic growth, clean energy technology costs, and growth in LNG export capacity.

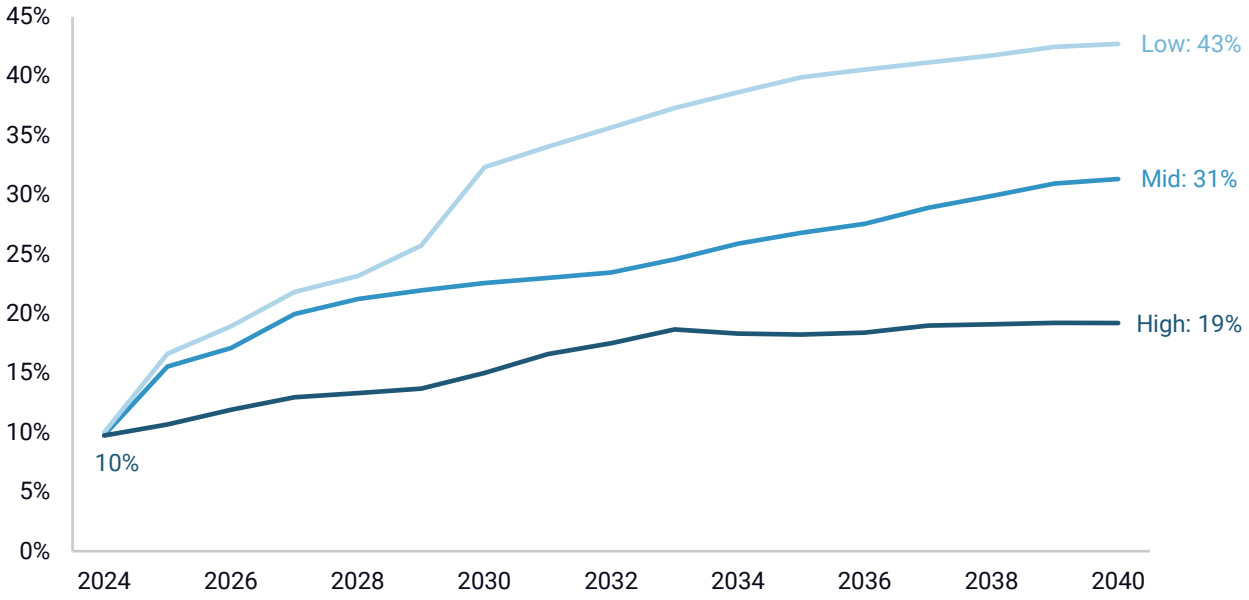
As a result of these capacity changes, zero-emitting resources account for 49-51% of generation in 2030 and 45%-71% in 2040 across our scenarios, up from 42% today (Figure 6). Across the board, lower levels of generation from a shrinking nuclear fleet lead to nuclear's share of total generation falling in 2040 compared to both 2024 and 2030. In the case of high emissions, renewable additions fail to keep pace with growing demand and the retirement of nuclear plants, and the share of clean generation shrinks in 2040 relative

to 2030. In the mid and low emissions scenarios, slower natural gas buildout results in a cleaner, more diverse grid in 2040 with renewables playing greater roles in meeting demand, thereby increasing total clean generation shares.

ZEV sales shares continue to increase, though at a slowing pace

Despite the expiration of EV tax credits in 2025 and the rollback of federal GHG regulations and state policies, we project electric and plug-in hybrid EVs to capture a growing share of the LDV market compared to today's levels. As a result, GHG emissions decline by 8-20% below 2024 levels in 2040. Without regulations, which tend to set a floor for ZEV sales shares, ZEV sales pathways have a wider range across emissions scenarios. Falling battery prices and strengthening consumer sentiment push ZEV's share of LDV sales up to 19-43% by 2040, double to quadruple 2024 levels (Figure 7).

FIGURE 7
Light-duty zero-emission vehicle sales shares
Percent of total light-duty vehicle sales



Source: Rhodium Group
Note: The high, mid, and low ranges reflect uncertainty around future fossil fuel prices, economic growth, clean energy technology costs, and growth in LNG export capacity.

Freight ZEV sales shares struggle to grow as steadily without policy drivers to push adoption. We project that freight ZEV sales shares reach 3-7% of the fleet by 2040. While this range represents progress from today's levels, it highlights the economic challenges that zero-emissions freight transport continues to face.

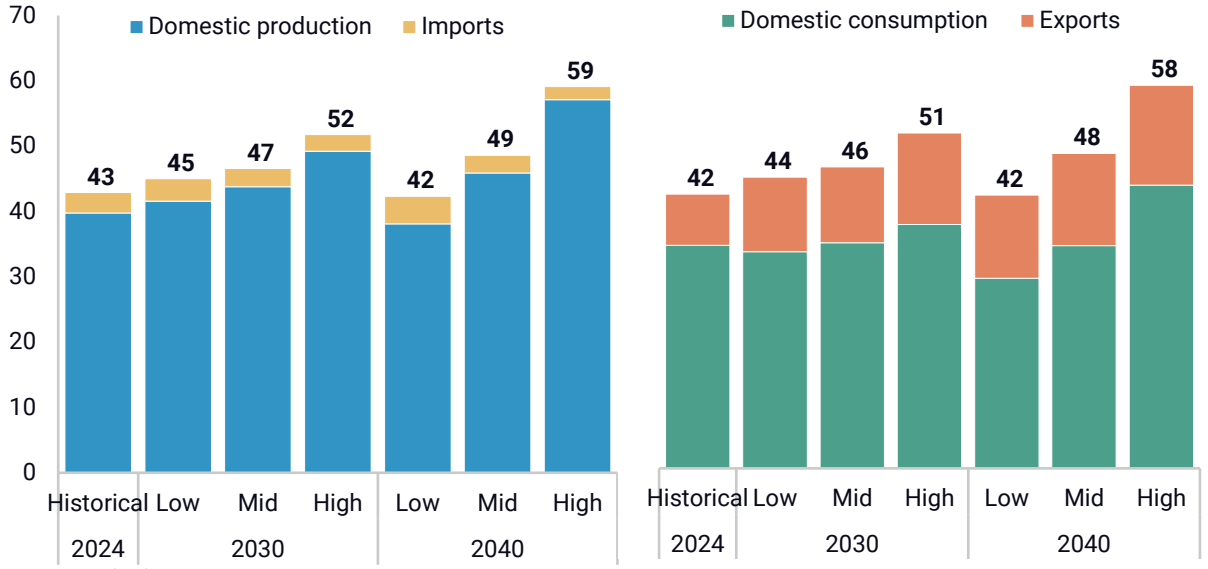
Fossil fuel production increasingly driven by trade

US production of oil, other petroleum products, and natural gas is primarily shaped by increasing net export of these fossil fuels rather than satisfying domestic demand over the next 15 years. Today, the US produces more natural gas than it consumes, and it has been a net petroleum exporter since 2020 (despite ongoing imports tied to refinery-specific needs). We generally project this trend to persist, with the US continuing as a net

natural gas exporter through 2040 in all scenarios and a net petroleum exporter in mid and high scenarios.

US natural gas production increases across most emissions scenarios—by 2030, output is 5-24% above 2024 levels, and by 2040 it is 15% higher in the mid case and 44% higher in the high case (Figure 8). In the low emissions scenario, domestic production drops by 4% compared to 2024 levels in 2040. Domestic gas consumption stays flat or drops from 2024 levels in both 2030 and 2040 in the low and mid emissions scenarios, but increases by 9% in 2030 and 27% in 2040 in the high emissions scenario.

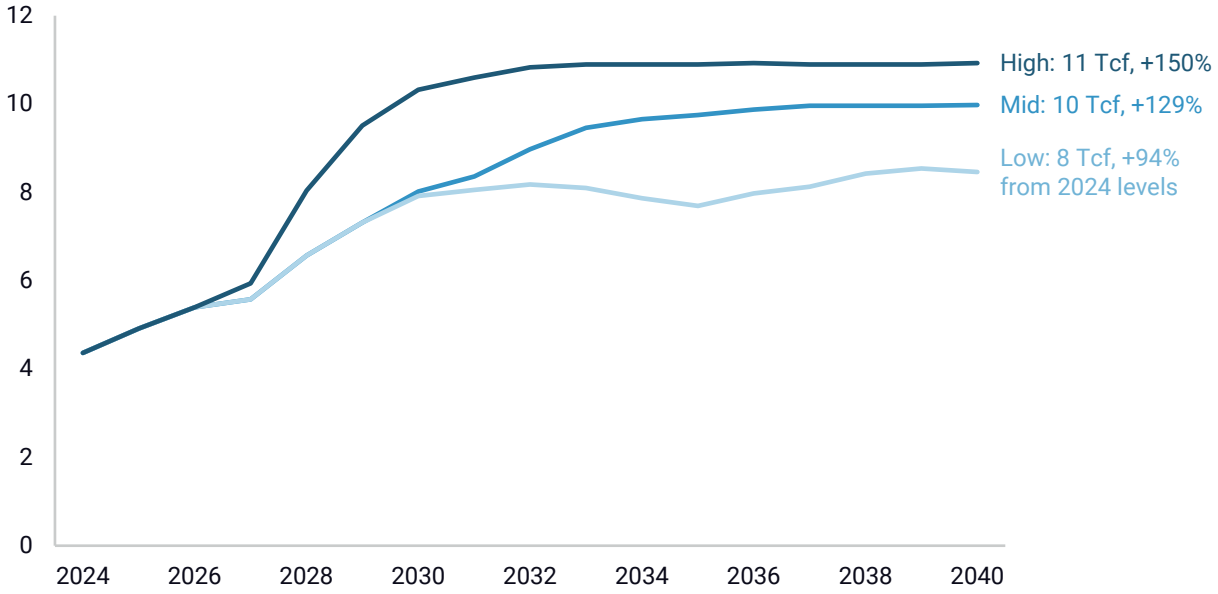
FIGURE 8
Natural gas supply and use in 2030 and 2040
Quadrillion BTU



Source: Rhodium Group
Note: The high, mid, and low ranges reflect uncertainty around future fossil fuel prices, economic growth, clean energy technology costs, and growth in LNG export capacity.

The level of domestic gas production is heavily influenced by how much is exported, increasingly via LNG export terminals. LNG exports increase substantially through the early 2030s before stabilizing through 2040 across all scenarios, with export levels 94-150% higher than 2024 (Figure 9). In the mid and high emissions scenarios, LNG export terminals operate at effectively 100% capacity utilization rates through 2040, indicating sufficient international demand to absorb US exports at the cost of gas production plus transportation. This holds true in the high emissions scenario, even with the addition of LNG export facilities that have been fully permitted but not yet started construction—a 122% increase in planned capacity buildout over the low and mid emissions cases. In the low emissions case, export facilities sustain near 100% capacity utilization through 2031 before declining to a 94% utilization rate over the rest of the 2030s. Over this later portion of the analysis window, wholesale gas prices at Henry Hub increase substantially, averaging $5.92/MMBtu from 2032 through 2040, cutting into the economic competitiveness of US gas globally.

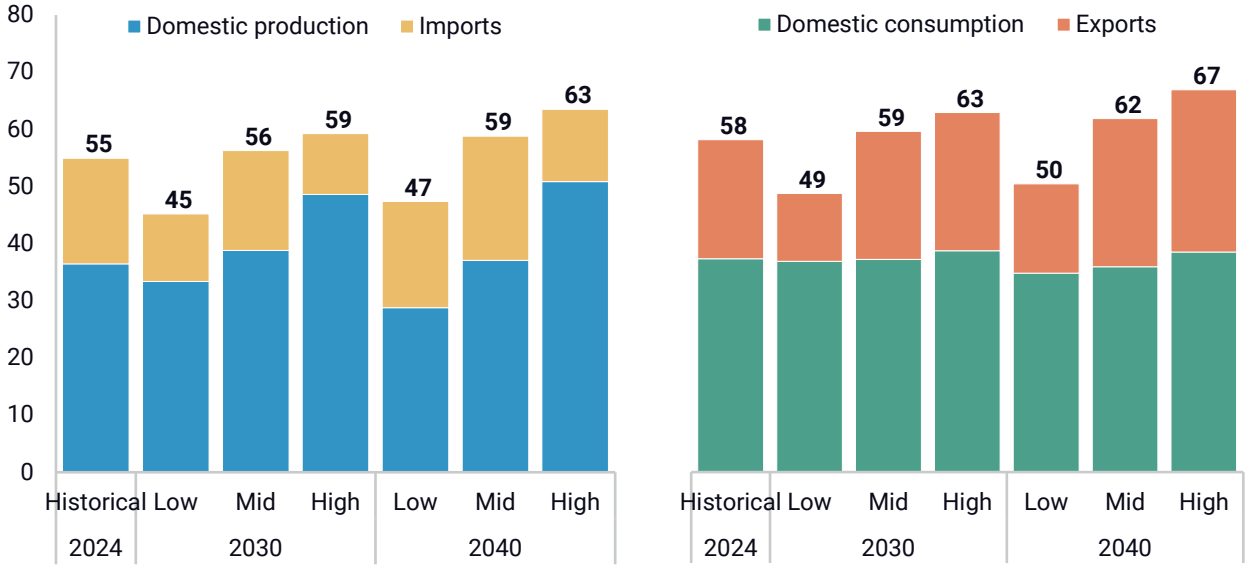
FIGURE 9
Liquified natural gas exports
Trillion cubic feet



Source: Rhodium Group
Note: The high, mid, and low ranges reflect uncertainty around future fossil fuel prices, economic growth, clean energy technology costs, and growth in LNG export capacity.

International trade has an even bigger effect on US production of oil and other liquid fuels. Domestic consumption varies little, mostly due to the slow electrification of the vehicle fleet. Across the economy, domestic demand for liquid fuels increases by 1-5% in 2030 compared to 2024 levels and changes by -5% to +5% in 2040 (Figure 10). Domestic production levels vary widely across scenarios, from a 21% decrease relative to 2024 levels in 2040 in the low emissions case to a 40% increase in 2040 in the high emissions case. The level of net exports mostly causes this variation in production.

FIGURE 10
Crude oil and other liquid fuels supply and use in 2030 and 2040
Quadrillion BTU

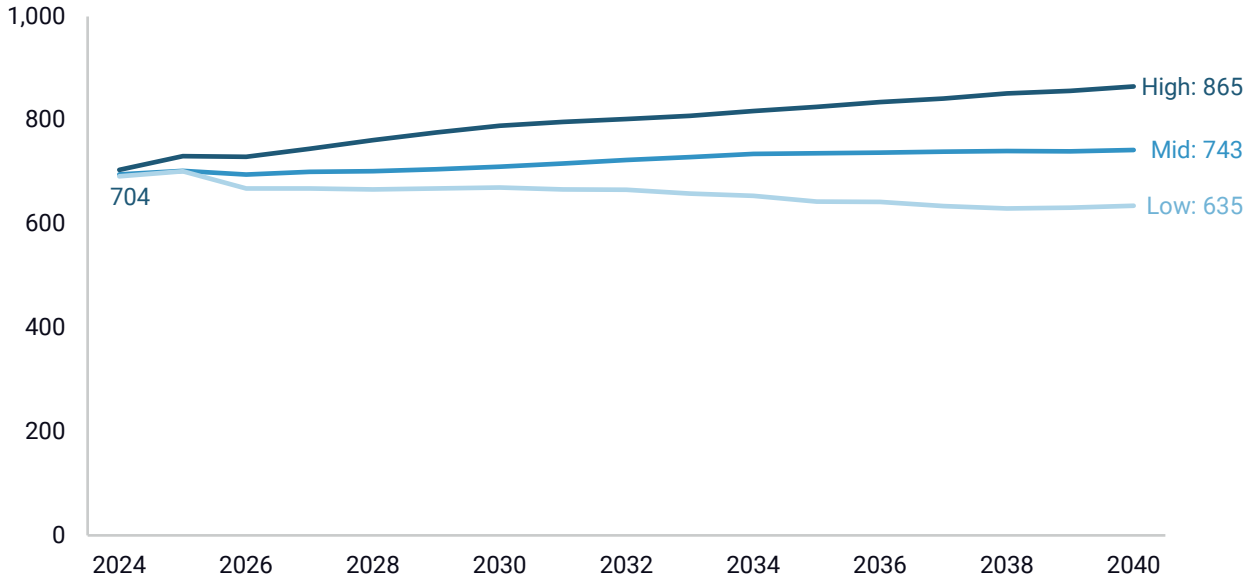


Source: Rhodium Group
Note: The high, mid, and low ranges reflect uncertainty around future fossil fuel prices, economic growth, clean energy technology costs, and growth in LNG export capacity. Includes crude oil, lease condensates, and natural gas plant liquids.

Industrial emissions heavily driven by oil and gas production

Industrial emissions levels in 2040 show wide variation, with a 291 mmt gap between the low and high emissions scenarios in 2040. Only the power sector has a larger variation in 2040 emissions outcomes. Two factors determine the level of industrial emissions. Most significantly, GHG emissions from oil and gas production, transportation, and processing track closely with domestic oil and gas production levels without EPA regulations—from an 8% decrease in the low emissions scenario relative to 2024 to a 22% increase in the high emissions scenario (Figure 11). Emissions from oil and gas account for 73% and 100% of total industrial emissions increases in the mid and high scenarios, respectively, and 88% of the decrease in the low emissions scenario.

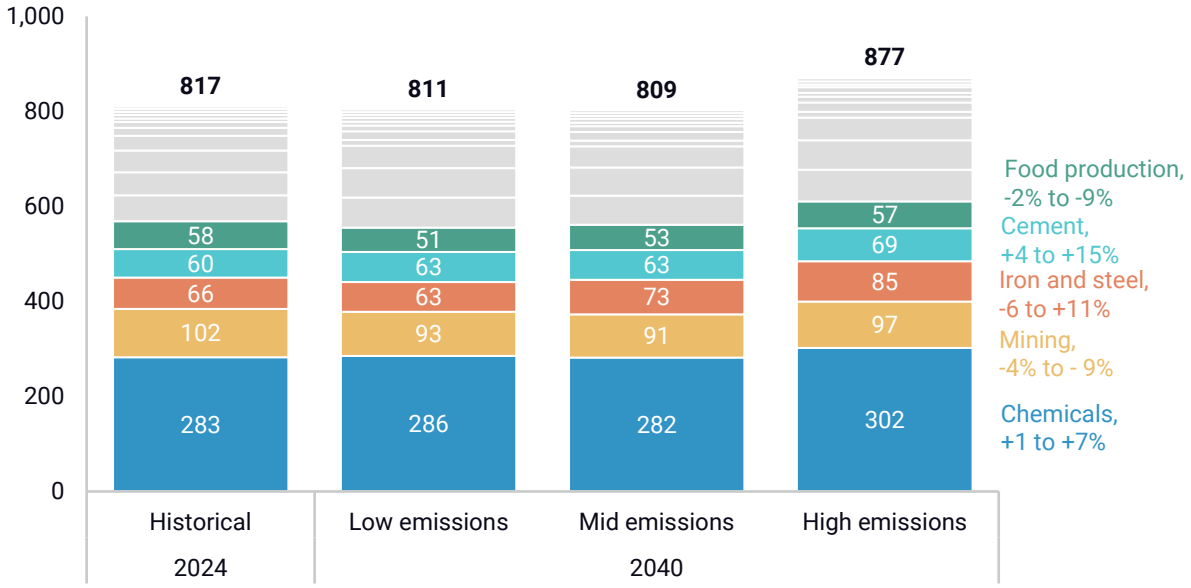
FIGURE 11
GHG emissions from oil and gas production, processing, and transportation
Net million metric tons (mmt) of CO_2-equivalent (CO_2-e)



Source: Rhodium Group
Note: The high, mid, and low ranges reflect uncertainty around future fossil fuel prices, economic growth, clean energy technology costs, and growth in LNG export capacity.

Industrial emissions outside of oil and gas remain essentially flat, with 1% decreases in the low and mid scenarios in 2040 compared to 2024 and a 7% increase in the high scenario (Figure 12). Without meaningful industrial decarbonization policies, these industrial emissions are largely a function of the total output from these industries and price competition between fuel options, where applicable. We also estimate 13-56 mmt of point-source carbon capture retrofit capacity deployed in industry in 2040. The largest sources of emissions increases come in chemical production, iron and steelmaking, fossil fuel use in building construction, and agriculture.

FIGURE 12
Industrial sector emissions from non-oil and gas sources
Net million metric tons (mmt) of CO_2-equivalent (CO_2-e)

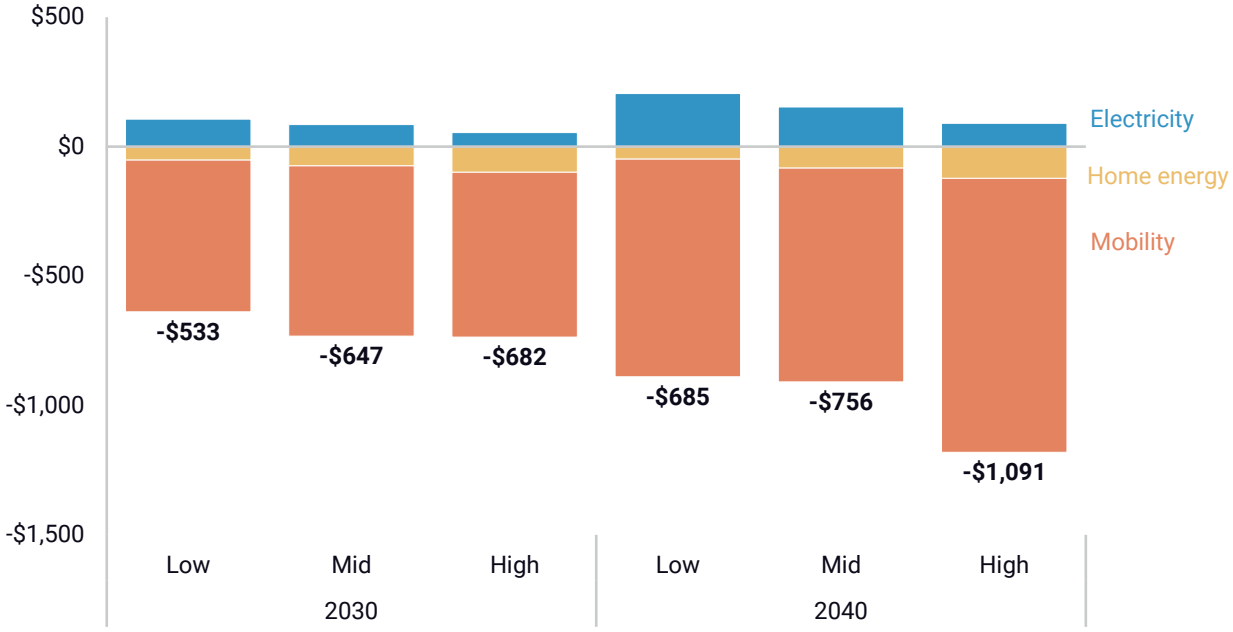


Source: Rhodium Group
Note: The high, mid, and low ranges reflect uncertainty around future fossil fuel prices, economic growth, clean energy technology costs, and growth in LNG export capacity. These figures include combustion and process emissions, but not emissions from electricity use in these industries.

Household energy bills decline

In line with the past three years of Taking Stock, household energy expenditures continue to show declines, but the decreases are substantially smaller in this outlook. We noted earlier this year that revisions to tax policy and regulations could increase costs for households compared to no change in policy. With those policy revisions in place, we find that cost declines are slower than we projected in prior years. We estimate that average annual household energy bills decline by $533-682 (9-12%) in 2030 and by $685-$1,091 (12-18%) in 2040 compared to average bills in 2024 (Figure 13).

FIGURE 13
Change in household energy costs from 2024 to 2030 and 2040
2024 dollars



Source: Rhodium Group
Note: The high, mid, and low ranges reflect uncertainty around future fossil fuel prices, economic growth, clean energy technology costs, and growth in LNG export capacity.

Lower spending on mobility fuels, which encompasses gasoline, diesel, and electricity for EV charging, accounts for 87-92% of bill savings in 2030 and 90-95% in 2040. There are a few reasons for this. First, the number of EVs on the road increases in all scenarios, and because electric motors are efficient and electricity is a cheaper fuel than gasoline on a per-mile basis, this lowers bills. Motor gasoline prices also fall 10-17% in 2030 compared to 2024 levels. Price declines then slow, declining 3-4% between 2030 and 2040 in the low and mid emissions cases. However, they persist in the high case, which sees gasoline prices decline another 15% over the decade. We estimate that residential electricity bills will increase by $57-106 (3-6%) in 2030 and by $90-205 (5-11%) in 2040 compared to 2024. Increases in household energy efficiency somewhat offset higher electricity rates through this window. As discussed in the next chapter, retaining regulatory policies would lead to lower overall bills.

CHAPTER 4

Impacts of regulatory rollbacks

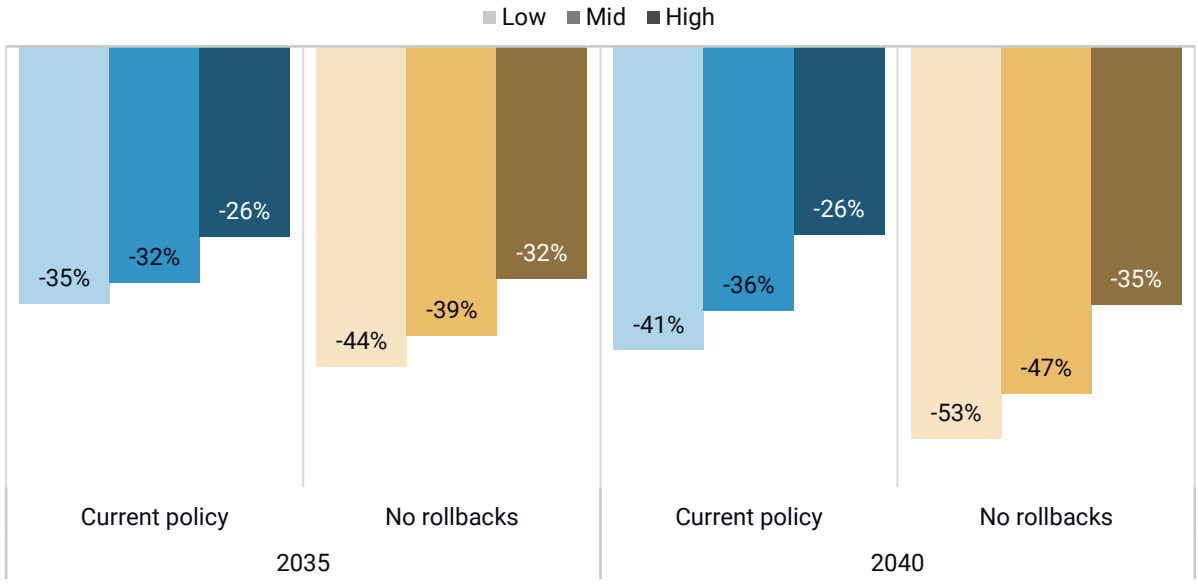
The current policy scenarios in Chapter 3 reflect a future in which major Biden-era regulations are rolled back. Specifically, we project how the US energy system would evolve if all major EPA regulations identified in Administrator Zeldin's list of 31 deregulatory actions discussed in Chapter 1 were rolled back. It's also informative, however, to consider a world where pending regulatory actions are not adopted and Biden-era regulations remain in place. While this "no rollbacks" policy scenario is unlikely, it provides crucial insights about the stakes of the regulatory moves under consideration.

The no rollbacks policy scenario builds from the current policy low, mid, and high emissions baselines discussed in Chapter 3 and restores a suite of policies: GHG standards and emissions guidelines for new gas and existing coal plants; emissions standards for model year 2027 and later LDVs, MDVs, and HDVs; emissions standards for new and existing oil and gas operations; updates to the Mercury and Air Toxics Standards (MATS) for power plants; and the waiver enabling California to establish the Advanced Clean Cars 2 (ACC2) and Advanced Clean Trucks (ACT) programs.

Emissions are lower with no regulatory rollbacks

Under the current policy baseline discussed in Chapter 3, the US economy is on track to reduce emissions by 26-42% from 2005 levels in 2040. Without regulatory rollbacks, US GHGs decline 35-53% from 2005 levels in 2040 (Figure 14), decreasing by an additional 600-800 mmt compared to current policy.

FIGURE 14
Change in US greenhouse gas emissions from 2005 levels
Percent change



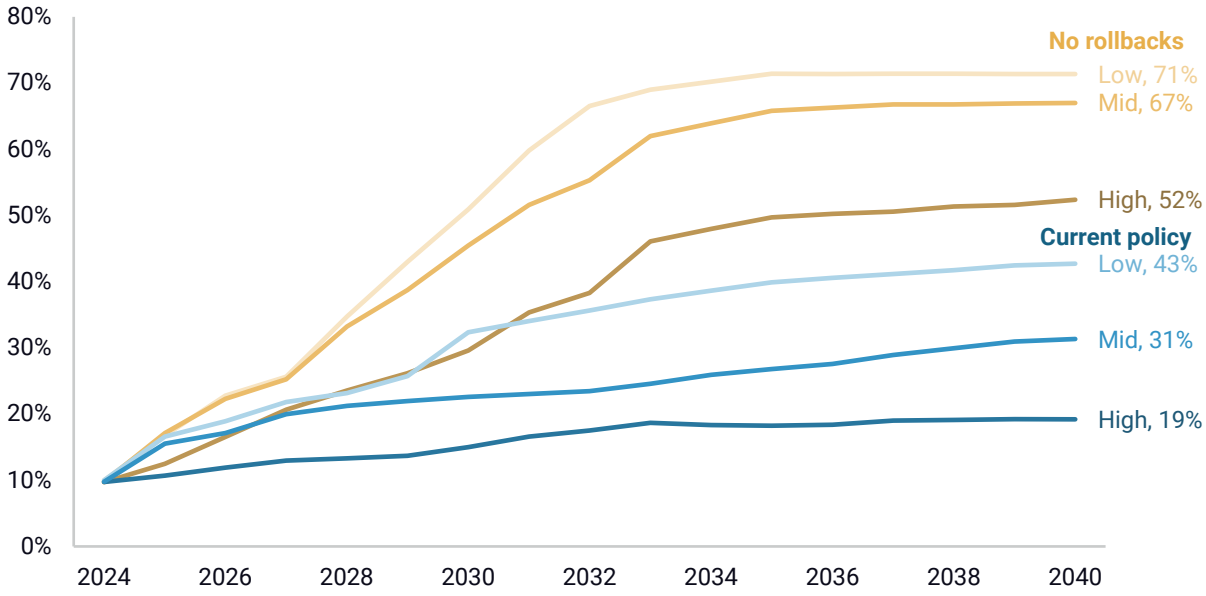
Source: Rhodium Group
Note: The high, mid, and low ranges reflect uncertainty around future fossil fuel prices, economic growth, clean energy technology costs, and growth in LNG export capacity.

Retaining transportation regulations packs the biggest punch in the mid and high emissions scenarios, driving 43-44% of emissions abatement in this counterfactual world due to increased ZEV sales. Conversely, keeping power sector regulations plays the largest role in the low emissions scenario, accounting for 47% of abatement, as more expensive gas prices drive higher levels of renewable generation to replace retiring coal generation. Oil and gas methane regulations rank third in this no rollbacks modeling, delivering 17-25% of emissions reductions, proportional to the level of oil and gas production in each emissions scenario.

Keeping tailpipe regulations raises the floor for LDV ZEV sales

With EPA's GHG standards for LDVs and California's ACC2 program kept in place, ZEV sales shares increase to 52-71% of light-duty vehicles in 2040, more than doubling sales shares relative to current policy (Figure 15). Notably, even the lowest ZEV sales trajectory when regulations are retained exceeds the highest ZEV sales trajectory under current policy. Regulations also spur earlier adoption of ZEVs. By 2033—the year the EPA tailpipe standards stop ramping upwards—ZEV sales under no rollbacks already approach the levels that would otherwise not be achieved until 2040. Retaining federal GHG standards for MDVs and HDVs, as well as California's ACT program, yields higher levels of freight ZEV sales as well.

FIGURE 15
Light-duty zero-emissions vehicle sales shares
Percent of total light-duty vehicle sales



Source: Rhodium Group
Note: The high, mid, and low ranges reflect uncertainty around future fossil fuel prices, economic growth, clean energy technology costs, and growth in LNG export capacity.

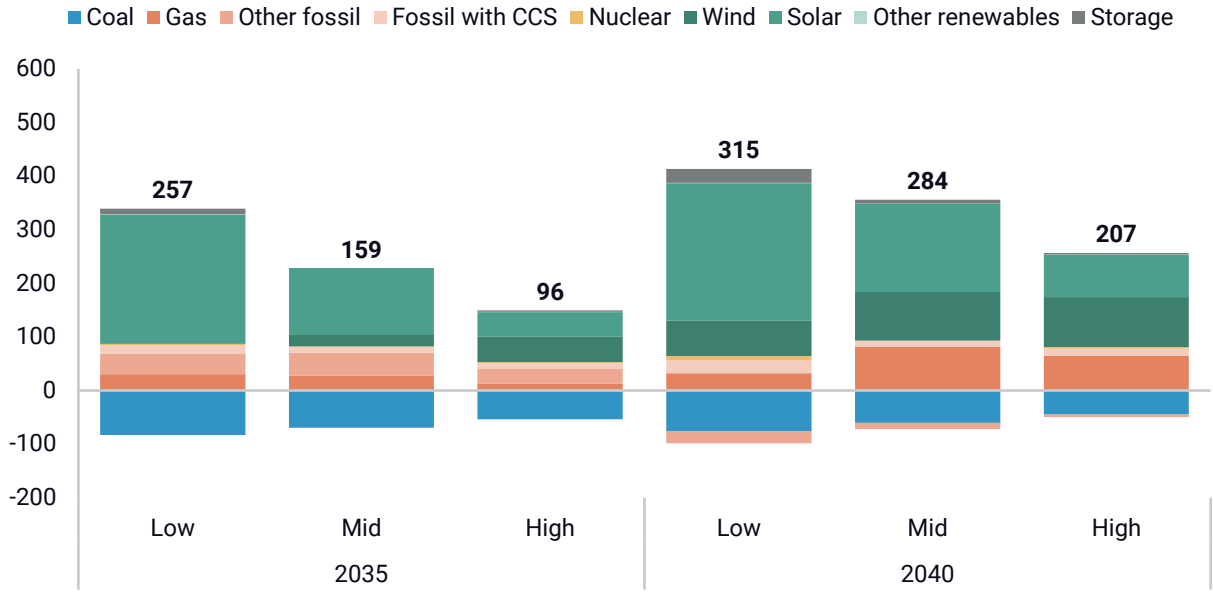
With regulations driving higher EV adoption, consumers spend less on gasoline and diesel and more on electricity for vehicle charging. On average, mobility fuel savings exceed added electricity costs, lowering household energy expenditures. By 2040, average annual household energy bills could fall by $42-248 relative to current policy, representing a 1-

5% decrease in energy expenditures. These findings align with our previous analysis of policy developments over the last few months.

Power plant regulations displace coal capacity and boost renewables and gas

EPA's GHG standards for power plants, if retained, push the grid to retire all unabated coal by 2040 (Figure 16). To comply with the retained regulations, 9 GW of coal plants retrofit with carbon capture (CCS) in the late 2020s and early 2030s and remain operational in 2040, but most of these retrofitted plants would retire once their respective 12-year 45Q payment window ends.

FIGURE 16
Change in capacity from keeping regulations in place, relative to current policy
Gigawatts



Source: Rhodium Group
Note: The high, mid, and low ranges reflect uncertainty around future fossil fuel prices, economic growth, clean energy technology costs, and growth in LNG export capacity. Other fossil includes coal plants that cofire with 40% natural gas and coal plants that have converted to natural gas-firing. Coal plant capacity conversions are counted as both negative coal capacity and positive other fossil capacity.

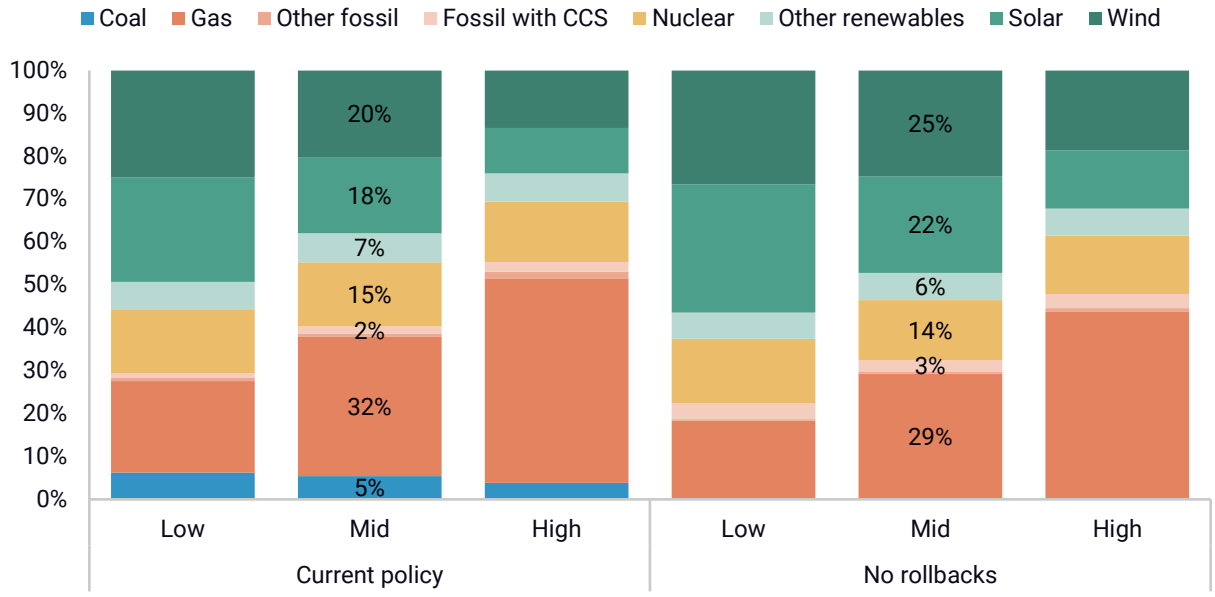
Retiring coal capacity and higher levels of electricity demand from more EVs on the road provide an opportunity for renewables and gas. The majority of additional capacity in the no rollbacks cases comes from solar and wind. Solar capacity rises 165-256 GW above current policy by 2040, while wind capacity grows by 66-93 GW. Gas capacity also gets a boost from retaining the regulations, increasing by 32-81 GW from current policy in 2040. Nearly all of this gas growth could come from combustion turbines that run infrequently and consequently would not need to change their operations to meet power plant regulations. Combustion turbines deploy both to meet higher load and provide reliability resources alongside growing shares of renewable capacity. New gas with carbon capture also increases modestly in the low and mid scenarios.

Zero-emitting generation reaches 52-78% of generation in 2040 in the no rollbacks case, 7 to 8 percentage points higher than their share under current policy (Figure 17). This growth is largely driven by increasing generation from wind and solar. Gas generation shares fall modestly (3-4 percentage points) as new natural gas combined cycle plants run less, while combustion turbines could make up an increasing share of total gas capacity. The amount of generation coming from fossil with CCS also increases by 1-3 percentage points with the regulations retained.

FIGURE 17

Power sector generation shares by fuel type in 2040

Percent of total generation



Source: Rhodium Group

Note: The high, mid, and low ranges reflect uncertainty around future fossil fuel prices, economic growth, clean energy technology costs, and growth in LNG export capacity.

CHAPTER 5

What's next?

The first seven months of the second Trump administration and 119th Congress have rapidly shifted energy and climate policy. We anticipate that they are a guidepost for what to expect over the next few years. While Congress will not face down another large, must-pass budget reconciliation bill that hinges on a signature Trump promise—extension of the 2017 Tax Cuts and Jobs Act changes to the tax code—there will still be opportunities to advance the Trump administration's policy agenda. We expect continued robust debate around appropriations for Department of Energy programs focused on future clean energy technologies where the US seeks to maintain global leadership. There are also indications that committee leadership may work on a permitting reform package, though it would require Democratic votes to pass under current Senate rules.

We also expect the executive branch to remain active. EPA will certainly work to finalize proposed regulations, repeal power plant GHG standards, overturn the endangerment finding, and push forward on new regulatory changes. The Interior and Treasury departments are likely to continue executing on President Trump's vision of constraining wind and solar deployment. The Commerce Department will continue to develop tariff policies to pursue the president's preferred outcomes on a number of different economic and non-economic fronts. And all of these actions from all agencies will then be litigated in court. The number of EOs issued by the White House also shows no sign of slowing down.

We'll be watching to see how rapidly increasing power sector demand interacts with real and imposed constraints on capacity deployment. Burgeoning capacity demand may create pressure for reforms in interconnection and other market policies. In transportation, consumer demand and economics may increase the amount of EVs on the road—or US manufacturers may revert to a more gasoline-heavy fleet strategy. Meanwhile, ever-shifting global trade dynamics and conflicts are likely to play an increasing role in determining US oil and gas production and setting the course for industrial emissions.

Access the data

TABLE 3
US GHG emissions under emissions scenarios
Million metric tons of CO_2-e

Gas	2005	2024	2030	2035	2040
Carbon dioxide	6,118	4,896	4,532 to 4,724	4,248 to 4,712	3,932 to 4,785
Methane	788	694	657 to 720	641 to 733	631 to 758
Nitrous oxide	425	383	371 to 377	365 to 373	359 to 371
HFCs	124	172	120	98	67

Other F-Gases	31	15	16	17	18
Gross GHG emissions	7,486	6,161	5,696 to 5,956	5,370 to 5,943	5,007 to 6,000
Carbon removal*	-969	-957	-1,066 to -1,070	-1,109 to -1,141	-1,152 to -1,186
Net GHG emissions	6,517	5,203	4,627 to 4,891	4,230 to 4,824	3,812 to 4,848
Change from 2005	0%	-20%	-25% to -29%	-26% to -35%	-26% to -41%

Source: Rhodium Group. Columns represent the minimum and maximum annual net US emissions given likely energy market, policy, and carbon removal outcomes. *Includes Land Use, Land Use Change, and Forestry (LULUCF) from the high sequestration scenario and carbon capture and sequestration.

We've provided a national look at trends in this report, but RHG-NEMS also produces state-level estimates for GHG emissions and key energy sector outcomes. Direct access to those results for our three main emissions scenarios is available via the ClimateDeck. The ClimateDeck equips users with comprehensive datasets, unique and responsive insights, and a robust set of tools for tracking pathways to climate targets and understanding the emissions and economic implications of major international, national, and state developments. All of this data is available for exploration and download from our interactive data visualization platform. For access, contact 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.

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Acknowledgments

The authors would like to thank Jaspreet Sohal, Ian Hutchinson, and Hannah Hess for their helpful review and contributions.

Disclosures

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