Energy & Climate

Taking Stock 2025: Technical Appendix

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Ben King (bking@rhg.com), Hannah Kolus (hkolus@rhg.com), Michael Gaffney (mgaffney@rhg.com), Anna van Brummen (avanbrummen@rhg.com), Nathan Pastorek (npastorek@rhg.com), John Larsen (jwlarsen@rhg.com)

This document provides additional detail on the methods and data sources used in Rhodium Group's Taking Stock 2025 report. Direct access to all energy and emissions results from our Taking Stock 2025 baselines—including results broken down by gas and sector for all 50 US states through 2040—is available via the ClimateDeck. All historical greenhouse gas (GHG) emissions and removal estimates (1990-2023) come directly from the Environmental Protection Agency (EPA) Greenhouse Gas Inventory. Like the EPA inventory, all gases are reported in carbon dioxide (CO2)-equivalent emissions based on the Intergovernmental Panel on Climate Change (IPCC) 5th Assessment Report (AR5) 100-year global warming potential (GWP) values. To model potential future emissions and policy scenarios, we use RHG-NEMS, a modified version of the detailed National Energy Modeling System used by the Energy Information Administration (EIA) to produce the Annual Energy Outlook 2025 (AEO2025) and maintained by Rhodium Group. We expand on this model to project all six GHGs targeted for reduction under the Kyoto Protocol.

Energy market, technology, and economic assumptions

To construct our national Taking Stock GHG emissions projections range, we revised multiple energy market, technology cost, policy, and behavioral assumptions in RHG-NEMS to be consistent with the most recent research and to reflect the range of market and economic uncertainties. We update these assumptions each year to reflect the best available data and information. More granular data for many of these inputs are included on the ClimateDeck.

Unless otherwise stated below, we use EIA's AEO2025 Reference case assumptions in our Taking Stock projections.

RHG-NEMS inputs that are consistent across the emissions outlook

We make several revisions to input assumptions beyond EIA's AEO2025 Reference case that are consistent across our Taking Stock emissions range. The key revisions are described below.

ANNOUNCED POWER PLANT RETIREMENTS AND ADDITIONS

We incorporate all announced coal and nuclear power plant retirements through 2040. We also include plant openings that have at least begun the regulatory approval process from the EIA's April 2025 preliminary electric generator inventory (EIA Form 860M).

DATA CENTER DEMAND

RHG-NEMS generates projections for demand for electricity from a number of end uses endogenously, including electric vehicles and building electrification, which then flow through to the model's power sector decisions. EIA reports modest demand growth from data centers from its AEO2025, but recent analyses widely anticipate large growth driven by the recent explosion of energy-intensive AI activity or the AI-driven expansion in demand that will play out over the next decade at least. Since Taking Stock 2024, estimates of data center demand growth have meaningfully increased. To capture this shift, we update the demand growth from AEO2025 with increased electricity demand from data centers in all three baseline emissions scenarios. Based on our review of external analyst projections for where demand could be heading, we developed a growth pathway in which data center demand increases by 93% above 2024 levels in 2030 and by 229% in 2040.

NATURAL GAS TURBINE CONSTRAINTS

Anticipated significant growth in data center demand has prompted developers to rush to build extra capacity into their resource planning. Additionally, the rise of hyperscale facilities that have large energy requirements means that developers must deploy considerable amounts of generating capacity at once to service data centers. For instance, the Louisiana Public Service Commission just approved 2.2 gigawatts of gas-powered generators for what will become the largest Meta data center in the world. The frenzy of activity around gas capacity development for data centers has driven a years-long backlog for gas turbines in the US, as demand outpaces supply. Three companies dominate US gas turbine manufacturing capacity: GE Vernova, Siemens Energy, and Mitsubishi Power. All three of these companies have reported long delivery times for new orders, with GE Vernova announcing in May that new orders would be delivered in late 2028 at the earliest and Mitsubishi Power's CEO stating in July that 2029 orders were already selling out.

We take a conservative approach to reflecting these supply constraints in RHG-NEMS across all scenarios. We explicitly include all planned gas turbine capacity as reported in EIA's April 2025 preliminary electric generator inventory, and we only allow unplanned gas turbine additions starting in 2029. We do not apply any future constraints on annual gas turbine deployment, though modeled additions reflect only moderate increases from historic levels of annual deployment. While some reports suggest that capital costs for new gas turbine orders have nearly doubled in some cases amid the supply crunch, we do not increase gas turbine capital costs in RHG-NEMS due to the current variation in price impacts, lack of definitive data, and the uncertainty of how price impacts will evolve over the next decade.

Sources of uncertainty

To construct the full range of emission projections in Taking Stock, we considered three key sources of uncertainty:

- **Economic growth:** We use two different projections of US gross domestic product (GDP) growth in TS2025: a baseline growth rate and a high growth rate.

- **Energy markets:** We consider a range of energy market variables that shape emissions outcomes, including natural gas and oil resource availability and prices. New this year, we also include two different pathways for planned liquid natural gas (LNG) export capacity.

- **Technology cost and performance:** We estimate ranges for key technology cost and performance variables, including capital and operating costs for clean electricity generators, battery costs for light-duty electric vehicles, and capital costs for industrial point-source carbon capture retrofits.

For each of these sources of uncertainty, we defined a mid, low, and high case to reflect a range of potential market and technology cost outcomes (Table 1). To create our low emissions scenario, we combine high oil and gas prices with the lowest projections of clean technology capital costs, baseline economic growth, and planned LNG export capacity reflecting under-construction facilities. Our high emissions scenario is the reverse, combining low oil and gas prices with high-cost clean technologies, high economic growth, and a broader range of planned LNG export facilities. The mid emissions scenario generally adopts more moderate trajectories for these factors. In the following sections, we describe the key assumptions that vary across our estimated emissions range and underlying data sources.

TABLE 1

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

TS2025 Scenarios	Low emissions	Mid emissions	High emissions
Economic growth	Baseline	Baseline	High
Oil and natural gas prices	High	Mid	Low
Planned LNG export capacity	Under construction	Under construction	Under construction or permitted
Clean technology costs	Low	Mid	High

RHG-NEMS inputs that vary to capture macroeconomic uncertainty

We reviewed a range of macroeconomic projections from government institutions, non-governmental organizations, and the financial sector including economic growth, inflation, and federal funds rates. Based on these forecasts, we selected two forecasts to bound economic expectations in our emissions scenarios.

Under baseline economic conditions, used in our mid and low emissions scenarios, GDP growth averages 2.1% annually through 2029 before falling to 1.7% for the following decade. The latest CBO projections see slightly lower GDP growth in the near term, at 1.8% average annual growth through 2029, but align with our baseline from 2030 to 2040 at 1.7%.

Under higher economic growth assumptions, used in our high emissions scenario, GDP growth is elevated through the end of the decade at 2.7% annual average growth before falling to 2.1% through 2040. Across the 2025 to 2040 projection period, GDP grows at 2.3% annually, consistent with observed average annual GDP growth from 2010 to today (2.4%).

Economic conditions alone play an important role in future emissions pathways. Household disposable income influences factors like vehicle purchasing decisions, vehicle miles traveled, and home energy consumption. Industrial output, a key component of GDP, is also positively correlated with emissions. In our testing, we found that a shift from baseline to high economic growth while holding all other inputs constant yields an emissions increase of about 200 million metric tons per year by 2035 (roughly equivalent to half of today's emissions from freight trucks). On the other hand, any surprise shocks that push GDP down can also decrease emissions, though such shocks are not captured in this framework.

IMPACTS OF TARIFFS

Shortly after assuming office, the Trump administration began threatening—and sometimes imposing—sweeping tariffs on specific goods (e.g., steel, aluminum, automobiles) and on other countries, including some of the US's closest trading partners. The country-specific tariffs that went into effect on April 5, termed "reciprocal" tariffs by the Trump administration, applied a minimum 10% tariff on all countries and further increased tariff rates depending on US trading dynamics with each country. While these specific tariffs are currently paused for some of our most important trading partners (e.g., Canada, Mexico), they could be reinstated at any time, and a number of other tariffs remain in place. Perhaps the only part of US tariff policy that we can be certain of is continued uncertainty.

Most of the macroeconomic projections that we reviewed did not incorporate impacts of tariffs, either because they were released prior to tariff implementation or because tariff policy was too uncertain to represent in modeling. However, the few sources that did account for tariffs in their projections found significant reductions in GDP growth relative to a scenario without these new tariffs, with GDP growth rates averaging 1.3%-1.4% while tariffs were in effect. Recent data supports these modeling results: Federal Reserve Chair Jerome Powell announced on August 22 that real GDP growth in the first half of 2025 slowed to 1.2%, roughly half the pace of growth in 2024.

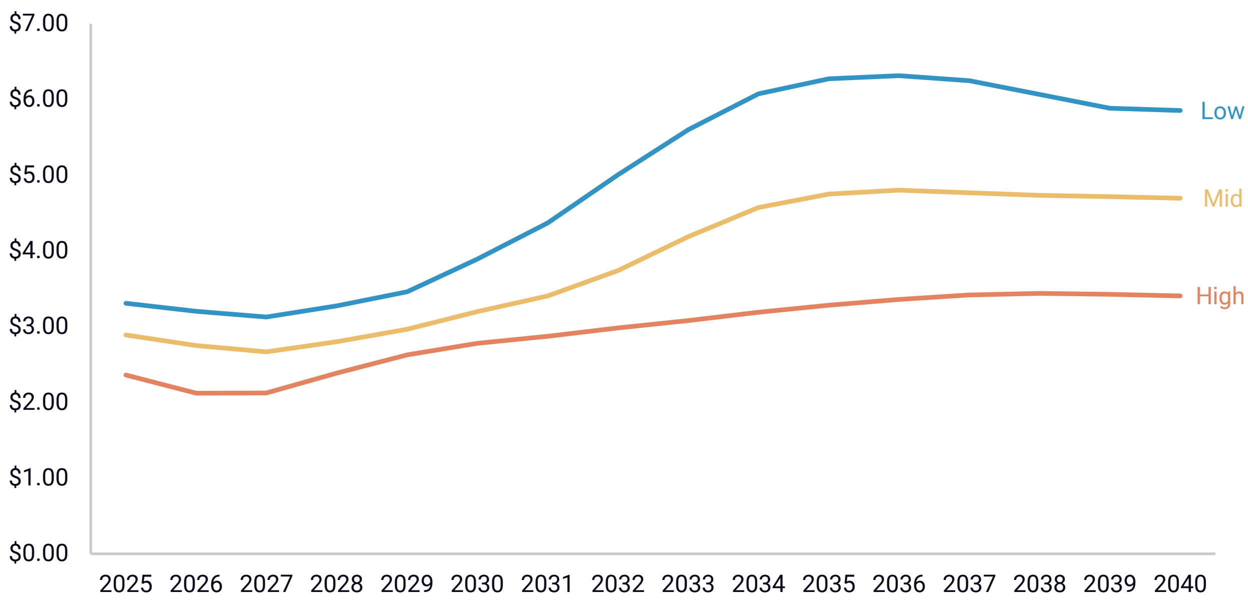
We expect that the most direct and significant impacts of tariffs on US energy consumption will come from reductions in industrial activity. To capture this, we incorporate tariff impacts into our scenarios by reducing industrial output in the short term. In all scenarios, we assume that tariffs will remain in place, or cause enough uncertainty that markets respond as if they are in effect, through 2029. In the mid and low emissions scenarios, which use baseline economic conditions, we reduce industrial output from 2025 to 2029 to match levels in the 2025 Annual Energy Outlook's (AEO's) Low Economic Growth scenario. That scenario projects 1.4% average annual GDP growth over the period—in line with estimates of GDP growth under tariffs. From 2030 on, we assume that tariffs are no longer in effect, and industrial output resumes its baseline growth rate. This results in 1.5-4% lower industrial output in 2040 relative to a scenario with no tariffs. In the high emissions scenario, which assumes high economic growth, we follow the same methodology but reduce industrial output from 2025 to 2029 to align with industrial output under baseline economic growth rather than low economic growth. From 2030 on, we allow industrial output to return to the high growth rate.

RHG-NEMS inputs that vary to capture energy market uncertainty

OIL AND GAS PRICES

We use three sets of energy market conditions to build our emissions scenarios. In the lowest price projection, natural gas prices at Henry Hub average $2.40/MMBtu through 2030 and increase to an average of $3.10/MMBtu from 2031 to 2035, continuing some of the lowest annual average prices in recent history. Prices rebound to $3.40/MMBtu in the late 2030s. Brent crude prices remain relatively flat across the projection period, averaging $72/barrel or just under the historical average over the last decade. These prices represent robust growth of US oil and gas production through 2040.

FIGURE 1
Natural gas spot price at Henry Hub
2024 dollars per million Btu

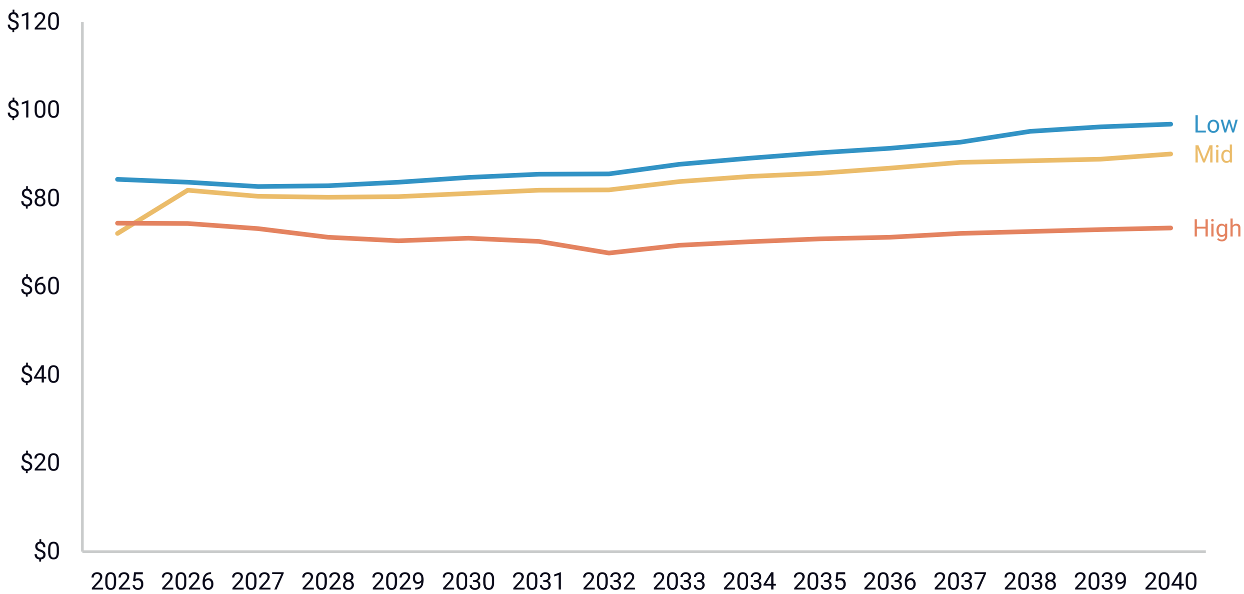


Source: Rhodium Group analysis, EIA

The mid fossil price projection sees Henry Hub prices stay steady at 2024 levels in the near term, averaging $2.90/MMBtu through 2030. Gas prices increase through the 2030s, averaging $4.10/MMBtu from 2031 to 2035 and $4.70/MMBtu in the late 2030s. Brent prices also increase through 2040, hovering around $80/barrel over the next five years before increasing to $84/barrel on average in the early 2030s and $89/barrel through the late 2030s. These prices represent roughly flat domestic oil production and moderate growth in gas production through 2040.

In the high fossil price projection, gas prices average $3.40/MMBtu through 2030, slightly lower than the EIA's August Short-Term Energy Outlook forecasts for 2025 and 2026. Gas prices increase to $5.50/MMBtu in the early 2030s and $6.00/MMBtu in the late 2030s. Brent prices average $84/barrel in the near-term, in line with prices over the last couple of years. Average Brent prices increase to $88/barrel in the early 2030s and $95/barrel in the late 2030s. These prices represent roughly flat domestic gas production and a decline in oil production through 2040, coupled with a doubling of LNG exports relative to today's levels.

FIGURE 2
Brent crude oil spot price
2024 dollars per barrel



Source: Rhodium Group analysis, EIA

PLANNED LNG EXPORT CAPACITY

The US is already the world's leading LNG exporter, with considerable export capacity under development. RHG-NEMS includes planned LNG export capacity that is already in the pipeline and models additional LNG export capacity expansions based on international demand for gas at the price of production plus transportation. In all scenarios, we update planned LNG export capacity with EIA's latest data on facilities that are either under construction or in the commissioning stage. To reflect the bull case for LNG growth, particularly in a high macroeconomic growth environment, we add more planned LNG capacity in our high emissions pathway to include 9.56 billion cubic feet of additional capacity. This includes projects that have secured all required export permits and offtake agreements for most of their capacity but have not yet made final investment decisions.

RHG-NEMS inputs that vary to capture clean technology cost and performance uncertainty

ELECTRIC GENERATING TECHNOLOGY COSTS

We use technology cost projections from the National Renewable Energy Laboratory's 2024 Annual Technology Baseline (ATB) for most of our utility-scale and distributed clean technology costs, as we did in Taking Stock 2024. We also constrain near-term deployment of these technologies in light of policy interventions, particularly from the Interior Department. We continue to include ATB 2024's starting (2030) costs for advanced and small nuclear reactors, though we allow RHG-NEMS to determine cost declines dynamically depending on deployment levels.

For battery storage, we use low, reference, and high costs from the EIA's Annual Energy Outlook (AEO) 2025 in the power sector. AEO 2025 significantly increases capital costs for storage relative to AEO 2023, the source we used for storage costs in Taking Stock 2024. Storage capital costs in 2025 are $250 per kilowatt (kW) higher than last year's assumptions in our high emissions scenario and a little over $600/kW higher in our mid and low emissions scenarios. For carbon capture technologies in the power sector, we use updated Rhodium Group estimates for central, low, and high costs that are based on a 2023 National Energy Technology Laboratory report. For unabated fossil generator costs, we rely on AEO 2025 reference case projections.

Granular utility-scale clean technology capital cost data are available on the ClimateDeck.

ELECTRIC VEHICLE BATTERY COSTS

We align our low battery cost pathway with the 2024 Transportation ATB mid electric vehicle battery cost assumptions. Our mid battery cost pathway assumes that battery prices decline at half the rate of the low pathway. Our high battery cost pathway assumes that battery prices are elevated through 2030 before tracking roughly double our low battery cost pathway through 2040.

INDUSTRIAL CARBON CAPTURE COSTS

We continue to rely on our Industrial Carbon Abatement Platform (ICAP) to assess economic opportunities for industrial point-source carbon capture retrofits and replacing existing steam methane reformers with electrolyzers for hydrogen production. Using ICAP, we project future carbon capture retrofits at existing industrial facilities under low, mid, and high-cost assumptions for CO2 capture, transportation, and storage. ICAP is integrated with the rest of RHG-NEMS such that industrial facilities see dynamic energy costs and expected revenue from CO2 sales. The AEO2025 edition of NEMS includes endogenous industrial carbon capture projections for a subset of subindustries available in RHG-ICAP. For this year, we remove the endogenous industrial carbon capture in RHG-NEMS and replace it with RHG-ICAP projections, though in future years we intend to integrate these assessments with EIA's new modules.

IMPACTS OF TARIFFS ON TECHNOLOGY COSTS

The uncertain nature of current US policy makes it impossible to fully capture the impact of tariffs in our technology cost assumptions. It's plausible that the balance of tariffs will generally increase costs across all technologies rather than differentially impact the cost of certain technologies significantly more than others. However, solar and batteries are more exposed to tariffs than other technologies due to the suite of tariffs specifically targeting their constituent components as well as the Southeast Asian countries whose supply chains they depend on.

In addition to "reciprocal" tariffs, solar faces new steep antidumping and countervailing duties (AD/CVD) that set tariff rates as high as 3,400% on cells and panels imported from the four top supplier countries. New investigations into India, Laos, and Indonesia could expand the reach of AD/CVD impacts. In September 2024, after a four-year review, the Biden administration doubled Section 301 tariffs on certain products imported from China including solar cells and panels, semiconductors, graphite and other critical minerals, electric vehicle batteries, and electric vehicles. While some products are currently excluded from these tariffs, those exclusions are set to expire at the end of August. The Trump administration has also expanded Section 232 tariffs to cover semi-finished copper products and copper-intensive derivative goods and has initiated investigations into materials important to solar and batteries, including graphite, lithium, and polysilicon.

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. The prospect of changing "reciprocal" tariffs add an extra layer of uncertainty. To reflect the impact of these tariffs in all scenarios, we increase the capital cost of utility-scale solar and storage technologies by 25% through 2029, before returning to the original capital cost trajectory in 2031. This approach assumes that tariffs will remain in place, or cause enough uncertainty that markets respond as though they're in effect, through 2029, but do not impact long-term capital costs.

Federal and state policy assumptions

Our scenarios include emission reductions from all actionable and quantifiable existing federal and state policies as of July 2025. To remain consistent with United Nations (UN) guidelines for reporting the impact of "current measures," we generally include only policies that have been finalized and adopted, though we note several exceptions below. We do not include aspirational goals or economy-wide targets that have not been solidified in specific, actionable policy, nor do we explicitly include specific city-level or corporate commitments.

On the federal regulatory level, we assume EPA finalizes the repeal of GHG standards for power plants; model year 2027 and later light-duty, medium-duty, and heavy-duty vehicles; 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 a complete rollback and believe it is appropriate to discuss energy system and climate trends accordingly.

Federal action is also shaping state climate and energy policy. Congress used the Congressional Review Act to revoke federal waivers that allowed California to set emissions standards for light-duty vehicles (LDVs) and trucks that were more stringent than national ones. As a result, Advanced Clean Cars 2 (ACC2) and Advanced Clean Trucks (ACT) can no longer be enforced in California or the 11 other states (plus DC) that adopted the regulations. California is challenging this decision in the courts, but will likely face a long uphill battle. We exclude both ACC2 and ACT from Taking Stock 2025.

We reflect all major climate and energy policy changes enacted via the Fiscal Year 2025 budget reconciliation bill, dubbed “One Big Beautiful Bill Act” (OBBBA). We list these policy changes in Table 2 of Taking Stock 2025.

We describe our policy assumptions in greater detail in the sections below.

CO_2 policies

CARBON PRICING: We include the Washington Cap-and-Invest Program, the California Cap-and-Trade Program, and the Regional Greenhouse Gas Initiative (RGGI), which prices electricity sector carbon emissions from 11 states. Carbon pricing policies that have not been finalized with clear, implementable milestones have not been included in our analysis. This includes the New York Cap-and-Invest Program, which was announced by Governor Hochul in January 2023 and directs policymakers to design an economy-wide Cap-and-Invest Program that establishes a declining cap on greenhouse gas emissions. We do not explicitly include the Oregon Climate Protection Program.

ELECTRIC POWER: Taking Stock 2025 excludes EPA’s standards regulating carbon pollution from existing coal-fired and new gas-fired power plants promulgated under the Clean Air Act sections 111(d) and 111(b). We also exclude EPA’s final rule to strengthen and update the Mercury and Air Toxics Standards for Power Plants. We represent EPA’s 2021 update to the Cross-State Air Pollution Rule that revised emissions budgets through 2024, but we exclude EPA’s 2023 “Good Neighbor” plan because the Supreme Court issued a stay on implementation in June 2024. We include the Civil Nuclear Credit enacted as part of the Infrastructure Investment and Jobs Act (IIJA). All Inflation Reduction Act (IRA) tax credits reflect adjustments to timeframe and eligibility requirements implemented via OBBBA this year. We include a list of state-level Renewable Portfolio Standards (RPS), Clean Energy Standards (CES), and zero-emission credit programs in Table 1. We continue to exclude state offshore wind mandates due to persistent timeline delays and now the suite of federal actions levied against offshore wind development.

TRANSPORTATION: In the transportation sector, we include harmonized EPA and National Highway Traffic Safety Administration’s CAFE standards for LDVs through model year 2026. We no longer include EPA’s multi-pollutant emissions standards for model years 2027 and later for LDVs and medium-duty vehicles (MDVs) or EPA’s Phase 3 standards for heavy-duty vehicles (HDVs) in our baselines. All IRA tax credits for clean vehicles, clean fuel production, sustainable aviation fuel, and clean hydrogen production have been adjusted to reflect OBBBA updates. We also include the federal Renewable Fuels Standard requirements.

At the state level, we include vehicle emission standards and zero-emission vehicle (ZEV) mandates for California and 15 states that follow California’s tighter standards (Advanced

Clean Cars I) under Section 177 of the Clean Air Act (S177 states). We exclude ACC2 regulations previously adopted in CA and 12 other S177 states that required 100% light-duty ZEV sales by 2035. We also exclude ACT regulations (requiring 40%-75% zero-emission truck sales, depending on truck weight class, by 2035) in CA and the 10 additional states that previously adopted them. We include the California, Oregon, and Washington low-carbon fuel standards as well as California's Innovative Clean Transit regulation (requiring 100% zero-emission bus sales by 2040). State ZEV commitments with no underlying regulatory policy are not included in our modeling.

INDUSTRY AND BUILDINGS: We include current federal minimum energy conservation standards for appliances and equipment, as well as the IRA's tax credits and rebates for residential and commercial energy efficiency and clean energy expenditures in accordance with OBBBA implementation changes. We also include the tax credits for carbon dioxide sequestration (45Q), clean hydrogen production, and clean fuel production. State energy efficiency programs are implicitly captured in RHG-NEMS electric demand projections. We also capture the impacts of federal investment in clean hydrogen and direct air capture hubs that were funded as part of the IIJA.

Non-CO_2 policies

METHANE: We assume emission reductions from EPA's 2016 updated NSPS and emission guidelines for methane from municipal solid waste landfills rules are delayed—with enforcement starting in 2021 rather than 2016—to reflect EPA's update to the Obama-era rule. The following state policies are also reflected: oil and gas standards in 10 states and California's landfill methane control measures from 2010 and updated in 2017. All estimates associated with federal and state oil and gas rules are based on modeled estimates from the Clean Air Task Force that align with oil and gas production from each of our scenarios. For landfills, we used emission reduction estimates from EPA and California's Air Resources Board.

HYDROFLUOROCARBONS (HFCS): All our scenarios assume a phasedown in the production and consumption of HFCs in line with EPA's final rule to phase down HFCs, issued September 2021.

Federal and state policies included in Taking Stock 2025 baselines

FEDERAL POLICY

*Includes modifications defined in the Fiscal Year 2025 budget reconciliation bill (OBBBA)

Power sector
- Clean electricity tax credits*
- Tax credit direct pay provisions and transferability
- Zero-emitting nuclear production tax credit*
- USDA assistance for rural electric cooperatives
- Tax credit for carbon oxide sequestration (45Q)*
- CCS demonstration and pilot projects
- Civil Nuclear Credit Program
- Cross-State Air Pollution Rules (CSAPR)
- Mercury and Air Toxics Standards (MATS)

- New Source Review (NSR)

Transportation
- New clean vehicle tax credit*
- New clean commercial vehicle tax credit*
- EV charging infrastructure grants*
- Clean fuels tax credit*
- Clean hydrogen production tax credit (45V)*
- Sustainable aviation fuel credit*
- Renewable Fuel Standards (RFS)
- MY2024-2026 Corporate Average Fuel Economy Standards
- GHG and fuel consumption standards for heavy-duty vehicles, Phase 2
- Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards
- Tier 3 Motor Vehicle Emission and Fuel Standards Program
- International Convention for the Prevention of Pollution from Ships (MARPOL) Annex VI

Industry and buildings
- Clean hydrogen production tax credit (45V)*
- Clean fuel production tax credit*
- Building efficiency tax credits*
- Building electrification and efficiency grants*
- Federal investments in clean hydrogen and direct air capture hubs in IIJA

Hydrofluorocarbons (HFCs)
- EPA's final rule to phase down HFCs

Methane
- Orphaned mine and well remediation
- Updated onshore and offshore oil and gas royalty rates*
- EPA municipal solid waste landfill methane rule

Carbon removal
- Tax credit for carbon dioxide sequestration (45Q)*

STATE POLICY

Power sector
Relevant states

- Renewable portfolio standard (RPS) and clean electricity standard (CES)
  AZ CA CO CT DC DE HI IL LA MA MD ME MI MN NC NE NH NJ NM NV NY OH OR PA RI TX VA VT WA WI
- Nuclear zero-emission credit (ZEC) programs
  IL NJ NY

Transportation
Relevant states

- California LDV GHG standards or ZEV mandate (Advanced Clean Cars I regulation)
  CA CO CT ME MD MA MN NJ NM NV NY OR RI VA VT WA
- State electric, hybrid, and alternative-fuel vehicle tax and other incentives
  CA CO CT DE DC IL MA MD ME MN NJ NY OR PA RI VT WA
- Low-Carbon Fuel Standard (LCFS)
  CA OR WA
- Zero-emission bus mandate
  CA

Industry and buildings
Relevant states

- Energy Efficiency Resource Standards (EERS)
  AK AZ CA CO CT DC HI IA IL LA MA MD ME MI MN MO MS NC NH NV NJ NM NY OR PA RI TX UT VA VT WA WI

Methane
Relevant states

- State oil and gas standards
  CA CO MA MD NM NY OH PA UT WY
- Landfill methane regulation (LMR) and SB1383 agricultural methane targets
  CA

Carbon pricing
Relevant states

- Cap and trade program
  CA WA
- Regional Greenhouse Gas Initiative (RGGI)
  CT DE ME MD MA NH NJ NY PA RI VT

No Rollbacks sensitivity scenarios

Because EPA's major regulatory actions are not yet finalized and represent significant policy reversals with substantial energy and emissions impacts, we also modeled a set of sensitivity scenarios in which these rollbacks do not occur. In these No Rollbacks scenarios, we assume EPA's proposed regulatory actions are *not* adopted, and Biden-era EPA policies are instead retained. We also assume that EPA waivers allowing California to regulate tailpipe emissions are restored, enabling states to enforce ACC2 and ACT. Several states had pushed back the starting years for ACC2 implementation, prior to congressional rescission, and we reflect those later implementation dates in our sensitivity scenarios.

Starting from the low, mid, and high emissions pathways assumptions, we layered on the following policies to build our No Rollbacks scenarios:

- 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 MATS for power plants
- California's ACC2 and ACT

Additional federal and state policies included in the No Rollbacks scenarios

FEDERAL POLICY

Power sector

- New Source Performance Standards for Greenhouse Gas Emissions From New, Modified, and Reconstructed Fossil Fuel-Fired Electric Generating Units; Emission Guidelines for Greenhouse Gas Emissions From Existing Fossil Fuel-Fired Electric Generating Units; and Repeal of the Affordable Clean Energy Rule
- May 2024 update to Mercury and Air Toxics Standards for Power Plants

Transportation

- Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles
- GHG and fuel consumption standards for heavy-duty vehicles, Phase 3

Methane

- Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources

STATE POLICY

Transportation
Relevant states

- California Advanced Clean Cars 2 regulation
  CA CO DC DE MA MD NM NJ NY OR RI VT WA
- California Advanced Clean Trucks regulation
  CA CO MA MD NJ NM NY OR RI WA VT

Projection and 50-state downscaling methodology

Carbon dioxide emissions

Projected CO2 emissions from all energy use in RHG-NEMS are inconsistent with EPA's accounting conventions for CO2 from fossil-fuel combustion in its GHG inventory. To address this inconsistency, we make the following adjustments to RHG-NEMS output to generate a forecast for CO2 from fossil-fuel combustion:

- **INTERNATIONAL BUNKER FUELS:** Emissions from fuel combustion by ships and airplanes that depart from or arrive in the US from international destinations are not included in EPA's inventory of total US emissions nor are they counted in US climate targets. However, they are included in RHG-NEMS CO2 output. We subtract these emissions from our projections.

- **INDUSTRIAL NON-ENERGY USE OF FUELS:** Fossil fuels are used as feedstocks in the manufacture of a variety of products, such as steel and chemicals. Generally, EPA accounts for CO2 emissions generated by consumption of these feedstocks in the industrial processes categories of the GHG inventory, not under fossil-fuel combustion CO2. We subtract CO2 emissions from non-energy uses of CO2 from our fossil-fuel combustion projections and account for non-energy use of fuels and feedstocks elsewhere.

- **TRANSPORTATION NON-ENERGY USE OF FUELS:** A small amount of petroleum fuel used in the transportation sector (largely for lubricants) is not combusted but generates CO2 emissions through its usage. We subtract this amount from projections of petroleum CO2 emissions in the transportation sector and account for them elsewhere as non-energy use of fuels.

RHG-NEMS does not provide an Intergovernmental Panel on Climate Change (IPCC) consistent projection output for non-fossil fuel consumption CO2 emissions from activities such as non-energy use of fuels and industrial processes. We applied the following methods to project non-fossil fuel combustion CO2 emissions:

- **INVENTORY CATEGORIES WITH EMISSIONS BELOW 25 MILLION METRIC TONS (MMT):** We extrapolate historical trends from EPA's latest GHG inventory in line with EPA's GHG projection guidance.

- **INVENTORY CATEGORIES WITH EMISSIONS ABOVE 25 MMT:** We follow EPA's latest guidance, scaling inventory data based on category-appropriate RHG-NEMS output. For example, recent historical CO2 emissions from natural gas systems are scaled based on the projected change in dry natural gas production available at the play level from RHG-NEMS. This allows for non-combustion CO2 emissions to change in line with changes in the economic and technology assumptions we make to account for uncertainty in our projections.

Non-CO2 and land use emissions and removals

All projections of non-CO2 emissions (i.e., methane, nitrous oxide, hydrofluorocarbons, perfluorocarbon, and sulfur hexafluoride) follow the same general approach as we take in projecting CO2 emissions from non-fossil fuel combustion sources. Inventory categories with emissions less than 25 mmt CO2e are extrapolated based on recent historical trends. Inventory categories with emissions more than 25 mmt CO2e are scaled based on appropriate outputs from RHG-NEMS where possible. In some instances, such as agriculture, there are no appropriate outputs from RHG-NEMS to scale emissions. In these instances, we use alternative public projections such as the US Department of Agriculture (USDA)'s long-term projections. Additional modifications are made to reflect the impact of state and federal policies as discussed above.

Historical emissions and removals from land use, land-use change, and forestry (LULUCF) come directly from the 2023 EPA GHG inventory. Projected trends come from the high sequestration scenario from the 2022 Fifth Biennial Report of the United States (the most recent set of federal projections) calibrated to align with EPA's 2023 inventory. For emissions of N_2O and CH_4 from LULUCF, we assume 2023 emissions from LULUCF remain constant through 2040, following the approach used in the 2022 Biennial Report.

Downscaling national emissions projections to the state level

RHG-NEMS forecasts fuel consumption by sector at various levels of geographical aggregation, which is then downscaled to the state level using state-level activity data. For the power sector, generation-based emissions are taken directly from RHG-NEMS, which reports individual plant-level emissions. NEMS builds new fossil fuel-fired plants to meet electricity demand, and those plants and their respective emissions are attributed to individual states within an electricity market region based on historical trends. We estimate generation-based power emissions based on the production of electricity within a state, a portion of which may be exported outside the state. We also estimate power sector emissions associated with the consumption of electricity within a state, accounting for the carbon intensity of the generation that produced that electricity.

Projections of fuel consumption by other end-use sectors, including industry, buildings (a combination of the residential and commercial sectors), and transportation, are downscaled to the state level from nine census-level regions. In the building sector, we apportion census-level GHG emissions to constituent states using each state's share of historical fuel consumption. In the transportation sector, we use historical demand to allocate fuel consumption by mode in each census region between constituent states. For example, we use the historical share of vehicle miles traveled for LDV fuel demand, and truck ton-miles for freight fuel demand. For industry, we use EPA's Facility Level Information on Greenhouse Gases Tool (FLIGHT) as weights to apportion census region GHG emissions to constituent states for large industrial facilities, and total value-added as weights to apportion census region fuel consumption for smaller facilities.

For non-fossil fuel combustion CO_2 emissions at the state level, all other GHG emissions, and LULUCF emissions and removals, we use activity data from RHG-NEMS where available. For example, methane emissions from fossil fuel production are downscaled based on production output from RHG-NEMS, which is available by fuel basin/play and can be attributed to individual states. In cases where there are no appropriate outputs from RHG-NEMS, we draw on other sources of activity data, including FLIGHT, the EIA, and USDA.