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PATHWAYS TO 2035:

Expanding Non-Federal Climate Leadership in the United States

Technical Appendix

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1 Overview of GCAM-USA-CGS

Our analysis uses a version of the open-source Global Change Analysis Model (GCAM) to estimate the aggregate impact of federal and non-federal climate policies and actions on economy-wide emissions reductions in the United States. Specifically, we use GCAM-USA, a state-level version of GCAM. We refer to the version of GCAM-USA used in this study as GCAM-USA-CGS.

GCAM is an integrated assessment model (IAM) of the energy, land, water, climate, and socioeconomic systems. The global version of GCAM groups the world's countries into 32 geopolitical regions with representation of the energy and socioeconomic systems for each region. The United States is one of the 32 regions. GCAM represents the global climate system and uses 235 water basins and 384 land regions to represent global water and land systems. GCAM tracks emissions and sinks of carbon dioxide (CO_2), 16 other GHGs, and several air pollutants.

The state-level version of GCAM used in this analysis, GCAM-USA, disaggregates the U.S. energy and economy components into 50 states and the District of Columbia while maintaining the same level of detail as GCAM for water and land sectors. The energy system in GCAM-USA has representation of depletable primary energy sources, including coal, gas, oil, and uranium, in addition to renewable resources, including biomass, hydropower, solar, wind, and geothermal. Energy transformation processes like oil refining and electricity generation are represented at the state-level in GCAM-USA. These energy carriers, in turn, are used to deliver services to state-level end users in the buildings, transportation, and industrial sectors. The electric power sector includes representation of a range of electricity generation technologies, including those fueled by fossil fuels and bioenergy (with and without CCS), renewables, and nuclear.

GCAM-USA is a market equilibrium model. The model solves for equilibrium in each period by finding a set of market prices such that supplies and demands are equal to one another in all markets as model actors adjust the quantities of the commodities they demand and supply. GCAM operates in 5-year time-increments, with each new period starting from the conditions that emerged in the previous period, and with most technologies being vintaged such that a portion of existing stocks in each period carry over into future time periods.

GCAM-USA-CGS is based on the open-source release of GCAM-USA 8.2,[1] which is calibrated to historical outcomes through 2021 (the first simulation period is 2025). GCAM-USA-CGS has been updated for the purposes of this study to reflect changes such as the most recent estimates of future renewable energy costs.[2] The model is also calibrated to the latest non-CO_2 marginal abatement cost curves from the U.S. Environmental Protection Agency (EPA).[3]

2 Modeling approach

2.1 Core scenarios

The *Current Policies* scenario includes changes to the Inflation Reduction Act and Bipartisan Infrastructure Law under the recently passed One Big Beautiful Bill Act and the removal of the California waiver, which allowed states to set their own vehicle emissions standards. The Environmental Protection Agency's regulations on tailpipe emissions and fossil fuel power plants are assumed to be repealed. States and other non-federal actors continue to implement key existing policies, including renewable portfolio standards and building energy efficiency resource standards.

The *Enhanced Ambition (Low)* scenario assumes that climate-leading states strengthen their climate actions, and non-leading states adopt less ambitious climate actions at a slower pace. Table 2 includes a list of enhanced non-federal actions in this scenario.

The *Enhanced Ambition (High)* scenario assumes that in addition to the climate-leading states, non-leading states also adopt high-ambition policies driven by various approaches, including strong bottom-up climate leadership from local governments, bold business commitments and investments in clean energy technologies, and regional spillover impacts. This scenario still maintains some level of differentiation in ambition level across states. This scenario also includes re-engagement on climate policy from the federal government after 2028, including tax credits for renewable energy, regulations on fossil fuel power plants, tailpipe emissions standards, and more.

All scenarios include top-down and bottom-up policy representation, with the latter building on previously developed methodology for aggregating non-federal actions to the state-level for implementation in GCAM-USA.[4–8] Detailed modeling assumptions for representation in GCAM-USA-CGS for these and all other policies in these scenarios are shown in Section 3.3.

2.2 Policy representation

Policy representation in our modeled scenarios builds upon bottom-up aggregation tools and data analysis to evaluate and quantify the impacts of policies and climate actions in isolation and within specific sectors. Throughout, we took care to avoid potential double counting of potential emissions reduction drivers from nested governance levels. We then used this information in GCAM-USA-CGS to estimate the economy-wide implications of associated policies. We use a modeling approach consistent with previous analyses, including Accelerating America's Pledge (2019), An All-In Climate Strategy Can Cut U.S. Emissions by 50% by 2030 (2021), Blueprint 2030 (2021), An All-In Pathway to 2030 (2023), and Toward 2035 (2024).[4–7,9–11]

All modeled policies in GCAM-USA-CGS are implemented at the state and/or national levels. Policies and actions from city governments, businesses, and institutions are assumed to be embedded within or supportive of the state and/or national level policy representation in the model, and therefore not explicitly modeled to remove risk of double counting potential emissions reductions. Descriptions of policy representation in GCAM-USA-CGS can be found in Tables S2-S6.

Model parameters in GCAM-USA-CGS were varied according to information from our bottom-up aggregation analysis or they were changed directly for policy drivers where bottom-up aggregation was either not feasible or not necessary in the case of small-scale potential impacts. The purpose of this analysis is to assess the national emissions reduction potential in the United States for the policies modeled in our scenarios. Accordingly, non-federal policies and actions are only modeled to the extent that doing so would have a meaningful impact on the national-level emissions outcome.

3 Modeling assumptions

3.1 Core model assumptions

The results of this study depend on many assumptions about how the U.S. and the world might evolve in the future. This study uses a set of core assumptions for drivers including economic growth, population

growth, fossil fuel prices, technology costs, and data center electricity demand (Table S1). Our core assumptions draw from a set of data sources that are referenced in other parts of this appendix, for example, U.S. Energy Information Agency's (EIA) Annual Energy Outlook (AEO),[12] National Renewable Energy Lab's Annual Technology Baseline,[2] and the Electric Power Research Institute (EPRI).[13]

The EPRI data used on data center load growth rates are based on public estimates of historical and current load levels, as well as varying assumptions about future industry growth, such as the extent of efficiency breakthroughs and saturation of service demand.[13,14] The data do not take into account transmission constraints and assume that future data center load growth is concentrated in emerging and already established markets. Uncertainty remains around current data center load and how technology and efficiency rates will improve in the future, and these extrapolated projections rely heavily on current assumptions about data center technology and demand. While there are few state-level datasets available, compared to other national data, the EPRI scenarios encompass a representative range of current national data center growth projections. Other growth forecasts include both bottom-up, top-down, and extrapolation models from national laboratories, private consulting firms, and utilities.[14]

Table S1. Core modeling assumptions in GCAM-USA-CGS [13]

Drivers	Scenario assumptions
Economic Growth	Overall gross domestic product (GDP) increases by 1.68% per year on average from 2022 through 2035, based on EIA's AEO Reference case.
Population Growth	Population grows by 0.46% per year on average from 2022 through 2035, based on EIA's AEO Reference case.
Fuel Prices	Gas price is assumed to increase at an average rate of 1.3% per year from 2022 through 2035, which is consistent with EIA's AEO Reference case. Oil price is assumed to increase at an average rate of 2.5% per year from 2022 through 2035, which is consistent with EIA's AEO Reference case.
Technology Costs	Technology costs are updated with the National Renewable Energy Laboratory (NREL) Annual Technology Baseline 2024 Moderate Scenario assumptions.
Data Center Electricity Demand	The medium scenario is based on a 2024 EPRI study, which assumes an average 12% annual growth rate from 2023 to 2030. Projections from 2030-2035 are linearly extrapolated from the medium scenario.

Offshore wind constraints

Due to substantial barriers to deployment, including pauses on project leasing, increased regulatory uncertainty, and market volatility,[15] we constrain the amount of offshore wind coming online by 2035. New offshore wind capacity is limited to fully permitted projects, assuming that those without permits would not be able to complete construction by 2035.[16]

Natural gas supply chain limitations

As a result of recent supply chain constraints, major companies have announced delivery backlogs for natural gas turbines, with GE and GE Vernova stating that gas turbines would not be delivered until late 2028 at the earliest.[17] To account for the impact of this natural gas turbines supply chain limitation,

we constrain new natural gas capacity to roughly reflect only planned additions from the U.S. Energy Information Administration between model years 2025 and 2030.[18] We assume that manufacturers are able to increase new capacity from natural gas by up to that same amount between model years 2030 and 2035.

3.2 State tiering system

3.2.1 Overview of methodology

State-level climate action in the United States varies considerably. For example, some states aim to achieve 100% clean energy generation by 2040, while others have less ambitious targets, and some lack these targets altogether.[19,20] To account for the varying levels of policy adoption, we developed a new methodology to categorize states into three tiers based on their propensity to adopt high-ambition climate action.

In each sector, state tiers are determined based on the strength of current state climate policy, progress in emissions reductions, local climate policies, and climate commitments. Tier 1 states have been leading the way on climate action, and are assumed to adopt a full range of climate policies under high-ambition policy scenarios. Tier 2 states have some policies in place but tend to move more slowly than Tier 1 states. Thus, they are assumed to adopt some level of climate ambition in high ambition scenarios, though not at the same level or on the same timeline as Tier 1 states. Tier 3 states have taken limited steps to advance climate action and are assumed to take few additional policy actions.

Across tiers, our policy assumptions differ by the stringency of the policy target or the speed of policy uptake. For example, EV sales targets vary in the speed of uptake: Tier 1 states achieve 100% EV sales by 2038, while Tier 2 states achieve this target by 2041, and Tier 3 states achieve it by 2044. On the other hand, RPS implementation is based on differences in the target itself: Tier 1 states set an RPS of 65% in 2035, which falls to 50% for Tier 2 states, and 20% for Tier 3 states. Targets for the different tiers are estimated based on high-achieving states in each tier. See Tables S2-S6 for details on policy assumptions and the level of adoption for each tier.

3.2.2 Components of the state tiering index

In order to determine each state's tier, we first created an index to score the states. A weighted score for each state was calculated using four metrics: state-level climate policy, emissions trends, local climate policy score, and the climate commitment score. State-level climate policy is given the most weight (60%) as it is assumed to be the most indicative of future policy action; this is followed by emissions trend (20%), local climate policy (10%) and climate commitment (10%) (Figure S1).

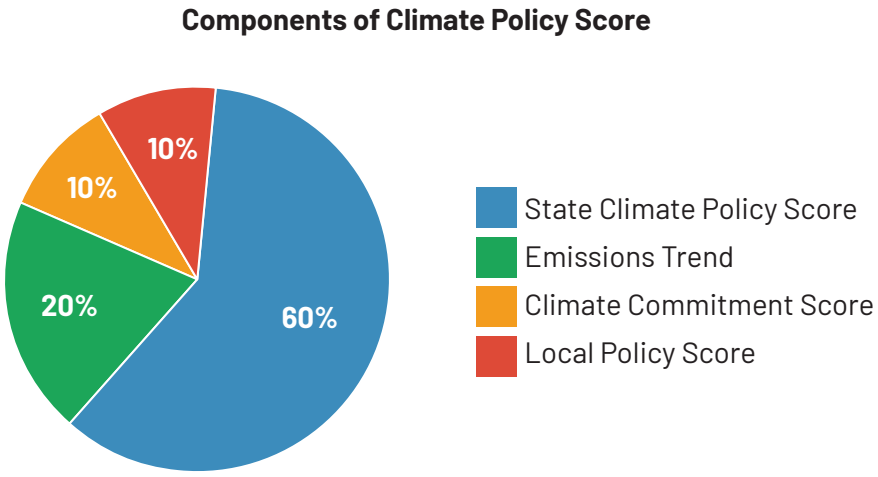

Figure S1: A visual representation of the state tiering index design with the weights of each component.

State Climate Policy Score (60%)

The state climate policy score carries the most weight in the index, and is calculated by assessing both the presence and ambition of different policies in each state. We used a comprehensive list of existing state-level policies by sector developed by ClimateXChange State Climate Policy Dashboard, and complemented it with additional data collection on industry and land use sector policies.[21] We defined ambition ranges for each existing policy, scoring them from 1 to 3, where 1 reflects low ambition and 3 reflects high ambition. We then calculated a score for each state and sector by multiplying the Presence (1 or 0) by the policy's ambition score (1 to 3), summing all the individual policy scores. This allows us to capture sector-wide policy performance.

Emissions Trend (20%)

Emissions trends for each state are evaluated as a proxy for policy implementation as well as non-policy drivers that reduce emissions. This score is calculated by taking the average yearly rate of change of net greenhouse gas emissions from 2005 to 2022. The emissions data were obtained from the EPA's Inventory of U.S. GHG and Sinks: 1990-2022.[22]

Local Climate Policy (10%)

The local climate policy score evaluates cities that make up a significant share of the state's GHG emissions and are adopting ambitious climate measures. We identified cities that make up more than a 2.5% share of the state's GHG emissions, using the Vulcan dataset.[23] These cities are scored based on the existence of climate action plans, sustainable transportation policies, building codes that are stricter than the state's building code, sustainable procurement policies, clean energy targets, and waste reduction goals. If a state has multiple cities that meet the GHG emissions criteria, their policy scores are weighted based on their share of the state's GHG emissions and then aggregated as the final local climate policy score.

Climate Commitment (10%)

The climate commitment score measures other commitments to climate action on top of state-level sectoral climate policies. States are scored based on the presence of a state-level GHG reduction target, a climate action plan, climate-focused offices and staff, and their membership in climate coalitions, including the U.S. Climate Alliance, the Under2Coalition, the Powering Past Coal Alliance, the Medium- and Heavy-Duty (MHD) Zero Emission Vehicle (ZEV) Deployment Support MOU, the State Buy Clean Partnership, and the State Modern Grid Deployment Initiative.[24-28]

3.2.2 Sectoral tiers

To determine the tiers for each sector, the different components mentioned above are normalized and aggregated into a final index score. An economy-wide score was also calculated by aggregating each state's index scores across sectors, weighted by the percentage of GHG emissions coming from each sector. The k-means clustering method was then applied to the final index score, categorizing the states into three groups based on the distribution of the scores. We also varied the weights used for each index component to check the robustness of our results.

A full list of states categorized into Tier 1, Tier 2, and Tier 3 by sector are listed below. It is important to caveat that states with strong policies in one area but not other areas may be categorized under Tier 2 or 3, given that they are evaluated comprehensively across sectors in this index. Additionally, states that are advancing the clean energy transition as a result of market forces and other non-policy drivers (e.g. high shares of renewable energy in Texas) are not likely to be ranked highly in this index, given the focus on policy drivers and their ability to drive future ambitious action.

Electricity

- **Tier 1 states:** California, Colorado, the District of Columbia, Hawaii, Maine, Maryland, Massachusetts, Minnesota, New Jersey, New York, and Washington
- **Tier 2 states**: Arizona, Connecticut, Delaware, Illinois, Michigan, Nevada, New Hampshire, New Mexico, North Carolina, Ohio, Oregon, Rhode Island, Vermont, Virginia, and Wisconsin
- **Tier 3 states:** Alabama, Alaska, Arkansas, Florida, Georgia, Idaho, Indiana, Iowa, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Montana, Nebraska, North Dakota, Oklahoma, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Utah, West Virginia, and Wyoming

Buildings

- **Tier 1 states:** California, Colorado, Connecticut, the District of Columbia, Illinois, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, Rhode Island, Vermont, and Washington
- **Tier 2 states**: Delaware, Hawaii, Louisiana, Michigan, Minnesota, Nevada, New Hampshire, New Mexico, North Carolina, Pennsylvania, Texas, Virginia, and Wisconsin
- **Tier 3 states:** Alabama, Alaska, Arizona, Arkansas, Florida, Georgia, Idaho, Indiana, Iowa, Kansas, Kentucky, Mississippi, Missouri, Montana, Nebraska, North Dakota, Ohio, Oklahoma, South Carolina, South Dakota, Tennessee, Utah, West Virginia, and Wyoming

Transportation

- **Tier 1 states:** California, Colorado, Connecticut, the District of Columbia, Maryland, Massachusetts, New Jersey, New York, Oregon, Rhode Island, and Washington
- **Tier 2 states**: Delaware, Hawaii, Illinois, Maine, Michigan, Minnesota, Nevada, New Mexico, Pennsylvania, Vermont, and Virginia
- **Tier 3 states:** Alabama, Alaska, Arizona, Arkansas, Florida, Georgia, Idaho, Indiana, Iowa, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Montana, Nebraska, New Hampshire, North Carolina,

North Dakota, Ohio, Oklahoma, South Carolina, South Dakota, Tennessee, Texas, Utah, West Virginia, Wisconsin, and Wyoming

Industry

- **Tier 1 states:** California, Colorado, Maryland, Massachusetts, New York, Oregon, and Washington
- **Tier 2 states**: Connecticut, Hawaii, Illinois, Maine, Nevada, New Jersey, New Mexico, North Caroline, Pennsylvania, Rhode Island, Vermont, and Virginia
- **Tier 3 states:** Alabama, Alaska, Arizona, Arkansas, Delaware, Florida, Georgia, Idaho, Indiana, Iowa, Kansas, Kentucky, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, New Hampshire, North Dakota, Ohio, Oklahoma, South Carolina, South Dakota, Tennessee, Texas, Utah, West Virginia, Wisconsin, and Wyoming

Land use

- **Tier 1 states:** California, Colorado, Maryland, New Mexico, New York, and Washington
- **Tier 2 states**: the District of Columbia, Hawaii, Illinois, Louisiana, Maine, Massachusetts, Michigan, Minnesota, Nevada, New Jersey, North Carolina, Oregon, Pennsylvania, Rhode Island, Texas, Vermont, and Wisconsin
- **Tier 3 states:** Alabama, Alaska, Arizona, Arkansas, Connecticut, Delaware, Florida, Georgia, Idaho, Indiana, Iowa, Kansas, Kentucky, Mississippi, Missouri, Montana, Nebraska, New Hampshire, North Dakota, Ohio, Oklahoma, South Carolina, South Dakota, Tennessee, Texas, Utah, Virginia, West Virginia, and Wyoming

Economy-wide tiers

- **Tier 1 states:** California, Colorado, the District of Columbia, Maryland, Massachusetts, New Jersey, New York, Oregon, Rhode Island, and Washington
- **Tier 2 states**: Connecticut, Delaware, Hawaii, Illinois, Maine, Michigan, Minnesota, Nevada, New Mexico, North Carolina, Pennsylvania, Vermont, and Virginia
- **Tier 3 states:** Alabama, Alaska, Arizona, Arkansas, Florida, Georgia, Idaho, Indiana, Iowa, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Montana, Nebraska, New Hampshire, North Dakota, Ohio, Oklahoma, South Carolina, South Dakota, Tennessee, Texas, Utah, West Virginia, Wisconsin, and Wyoming

3.3 Modeling Assumptions

In this section, the modeling assumptions are provided in tables that identify the type of policy (federal vs. non-federal), the specific portion of the policy (where relevant), and a description of the assumptions. The policies and actions included in this analysis are current as of July 2025. Policies and actions introduced or modified after July 2025 are not included in this analysis For additional information on the modeling of provisions in effect before January 2025, please refer to our past report *Toward 2035: Forging a High-Ambition U.S. Climate Pathway*.[11]

3.3.1 Current Policies

Federal assumptions
This scenario includes the IRA and BIL provisions rolled back under the One Big Beautiful Bill Act, along with rollbacks on federal regulations for fossil fuel-fired power plants, tailpipe emissions, and oil and gas methane. Detailed assumptions are described in Tables S2.

Table S2. Federal assumptions by sector under *Current Policies*

Sector	Policy Type	Provision/Policy	Modeling Adjustment
Electricity	IRA	Sections 13701 & 13702: New clean electricity PTC and ITC	Rolled back after 2025
		Section 13302: Residential clean energy credit	Rolled back after 2025
		Section 13015: PTC for existing nuclear	No change, continues through 2033
		Section 50144: Energy infrastructure reinvestment financing	Rolled back after 2025
		Section 13104 – 45Q: Extension of credits for captured CO_2	Rolled back after 2025 due to termination of the greenhouse gas reporting program, which would make this credit difficult to claim.[29]
	Regulations	CAA section 111(b) Standards for New Stationary Combustion Turbines	Rolled back after 2025
		CAA section 111(d) Emission Guidelines for Existing Fossil Fuel-Fired Sources	Rolled back after 2025
Transportation	IRA	Section 13401 – 30D: Clean vehicle credit	Rolled back after 2025
		Section 13404: Alternative refueling property credit	Rolled back after 2026
		Section 13403 – 45W: Commercial clean vehicle credit	Rolled back after 2025
		Sections 45Z: Clean fuel production credit	Extended through 2030
	BIL	Section 11401 and 11403: Grants from charging and fueling infrastructure, Carbon reduction program, and National Electric Vehicle Formula Program	Rolled back after 2025
		Section 11115 and 11403: Congestion mitigation and air quality improvement program, and Carbon reduction program	Rolled back after 2025
		Sections 71101 and 30018: Clean school bus program and Grants for buses and bus facilities	Rolled back after 2025
	Regulations	CAFE standards for LDVs	Rolled back after 2025
		GHG emissions standards for freight trucks	Rolled back 2025

Sector	Policy Type	Provision/Policy	Modeling Adjustment
Buildings	IRA	Section 13303: Energy efficient commercial building deduction	Rolled back after 2026
		Sections 13301 – 25C, 13304, and 50121: Energy efficient home improvement credit, Energy efficient home credit, and Home energy efficiency credit	Rolled back after 2025
		Section 51022: High-efficiency home rebate program	No change, continues through 2031
Industry	IRA	Section 13104 – 45Q: Extension of credits for captured CO_2	Rolled back after 2025 due to termination of the greenhouse gas reporting program, which would make this credit difficult to claim.[29]
		Section 13204 – 45V: Production credit for clean hydrogen	Rolled back after 2027
		Section 13501 – 48C: Manufacturing investment tax credit for advanced energy projects	Rolled back after 2025
		Section 50161: Advanced industrial facilities deployment program	Rolled back after 2025
Methane	IRA	Section 60113: Methane emissions reduction program	Rolled back after 2025
	Regulations	EPA standards for oil and gas methane	Rolled back after 2025
Other	AIM Act	HFC phasedown	National HFC phasedown is implemented consistent with the American Innovation and Manufacturing (AIM) Act.
	IRA and BIL	Land use, land-use change and forestry (LULUCF)	Rolled back after 2025, using the 'Absent Climate-Smart Policies' scenario from a previous CGS report on lands.[30]

Non-federal assumptions
Existing non-federal policies are assumed to continue, including renewable portfolio standards, cap and trade policies, ZEV incentives, energy efficiency resource standards, and methane regulations. Due to the removal of the California waiver, ZEV sales mandates and targets are rolled back after 2025. Detailed assumptions are described in Tables S3.

Table S3. Non-federal assumptions by sector under *Current Policies*

Sector	Policy	Modeling Assumption
Electricity	Renewable portfolio standards	Current state-level RPS targets are modeled.
	Cap and trade	The Regional Greenhouse Gas Initiative (RGGI) is modeled as a 50% reduction in power sector emissions below 2020 levels by 2035 in participating states. Additionally, cap and trade targets for California and Washington are modeled.
	Coal phase-out	Scheduled retirements of coal-fired capacity are modeled through 2035.
Transportation	LDV ZEV sales mandates and targets	Rolled back after 2025
	Freight truck ZEV sales mandates and targets	Rolled back after 2025
	LDV ZEV incentives	Major existing incentives for LDV ZEVs at the state-, utility-, and district levels from the Alternative Fuels Data Center are modeled at the state level as reductions in per-vehicle capital cost. Altogether, these are equivalent to a national average capital cost reduction for LDV EVs of $826 per vehicle.
Buildings	Energy efficiency standards (EERS)	Current state-level EERS were modeled by reducing state-level building service demands.
Methane	Methane incentives and regulations	Non-federal actors are incentivized to reduce methane emissions reductions achievable at a cost of $0/tCO2e or below on the EPA's MAC curves.

3.3.2 Enhanced Ambition (Low)

Federal assumptions
This scenario uses the same federal assumptions as those listed under *Current Policies* in Table S2.

Non-federal assumptions
This scenario assumes that Tier 1 states adopt the most ambitious climate actions across sectors based upon existing or proposed policies. Tier 2 states adopt similar policies but with a less stringent target or at a slower pace. Tier 3 states have limited policy uptake, but increase their ambition in some areas. Modeled policies include clean electricity standards, LDV electrification policies, vehicle miles traveled reduction policies, zero-emission appliance standards, cement CCS targets, oil and gas methane regulations, and more. Detailed assumptions are described in Table S4.

With the California waiver removed, states lose the ability to set their own vehicle emissions standards to mandate EV sales. In place of this, we assume that a combination of other non-federal actions, including clean car coalitions, transport emissions reduction targets, low carbon fuel standards, automaker

commitments, collectively helps states achieve what is equivalent to a delayed implementation of the targets under Advanced Clean Cars II (ACC II) and Advanced Clean Trucks (ACT). These specific policies are not modeled explicitly but instead modeled through delayed implementation of the ACC II and ACT targets.

Table S4. Modeled non-federal policies in the *Enhanced Ambition (Low)* scenario, with policy actions differentiated by tier.

Sector	Policy	Tier 1 Ambition Level	Tier 2 Ambition Level	Tier 3 Ambition Level
Electricity	Renewable portfolio standards	65% by 2035	50% by 2035	20% by 2035
	Clean electricity standards	80% by 2035	-	-
	Coal phaseout policies	2030 phaseout	2035 phaseout	2040 phaseout
Transportation	LDV electrification policies (e.g. clean car coalitions, emissions reduction targets, low carbon fuel standards, automaker commitments, and more)	100% EV sales by 2038	100% EV sales by 2041	100% EV sales by 2044
	M/HDV electrification policies (e.g. clean car coalitions, emissions reduction targets, low carbon fuel standards, automaker commitments, and more)	EV sales equivalent to California's Advanced Clean Trucks targets with a 3-year delay	-	-
	Bus electrification targets	100% electrification of new bus sales in 2030	100% electrification of new bus sales in 2035	100% electrification of new bus sales in 2040
	Vehicle miles traveled reduction policies	1.25% annual VMT per capita reductions by 2035	0.75% annual VMT per capita reductions by 2035	-
	Low carbon fuel standards	20% in 2030, 25% in 2035	-	-
Buildings	Enhanced energy efficiency resource standards	4% annual efficiency savings by 2030		
	Zero-emission appliance standards	100% electric heating and water heating sales by 2035	100% electric heating and water heating sales by 2040	
	Zero-emission construction standards	100% new electric construction by 2035		
Industry	Cement CCS targets	CCS capability for 40% of cement produced by 2035	CCS capability for 20% of cement produced by 2035	CCS capability for 10% of cement produced by 2035

Sector	Policy	Tier 1 Ambition Level	Tier 2 Ambition Level	Tier 3 Ambition Level
Methane	Oil and gas methane regulations	Reductions achievable at a cost of $60/tCO2e or below on the EPA's MAC curves by 2035	Reductions achievable at a cost of $30/tCO2e or below on the EPA's MAC curves by 2035	Reductions achievable at a cost of $0/tCO2e or below on the EPA's MAC curves
	Agricultural methane policies	Reductions achievable at a cost of $0/tCO2e or below on the EPA's MAC curves by 2035		
	Landfill waste methane regulations	Reductions achievable at a cost of $60/tCO2e or below on the EPA's MAC curves by 2035	Reductions achievable at a cost of $40/tCO2e or below on the EPA's MAC curves by 2035	Reductions achievable at a cost of $20/tCO2e or below on the EPA's MAC curves by 2035
	Enhanced waste diversion efforts	60% reduction in landfill waste by 2035	40% reduction in landfill waste by 2035	20% reduction in landfill waste by 2035
Other	HFC regulations	Adopt Significant New Alternatives Policy (SNAP) and Refrigerant Management Programs (RMP) programs		
	Expanded funding for wildfire mitigation, tree planting, conservation and health soils	Assume $42 billion in investments in climate-smart policies resulting from enhanced state-level action, based on the 'Current Policies' scenario from a previous CGS report on lands.[30]		

3.3.3 Enhanced Ambition (High)

Federal re-engagement

This scenario assumes that the federal government re-engages on climate policy after 2028. Policies similar to the IRA and previously finalized EPA regulations are assumed to be re-instated, as well as some additional policies on refineries and direct air capture. However, the design of investment strategies, regulations, and legislation may look different than what is included here. Some of the regulations, for instance, may instead be approached as incentives instead of requirements due to political feasibility. Detailed assumptions are described in Table S5.

Table S5. New policies modeled under federal re-engagement

Sector	Policy	Modeling Assumption
Electricity, Transportation, Buildings, Industry, Lands	Tax credits and investments	Tax credits and rebates similar to those under the IRA are reinstated by 2030.
Electricity	CAA section 111(b) Standards for New Stationary Combustion Turbines	Reinstated by 2030, requiring at least 90% CCS for any new natural gas turbines with a capacity factor higher than 40%
Transportation	Tailpipe emissions standards for LDVs	Reinstated by 2030 to help states achieve 100% EV sales by 2038
	CAFE standards and GHG standards for LDVs	Reinstated by 2030 such that new vehicles achieve the same internal combustion engine efficiency improvement from 2030-2035 as they would have under 2025-2030
	GHG emissions standards for freight trucks	Reinstated by 2030 such that new vehicles achieve the same internal combustion engine efficiency improvement from 2030-2035 as they would have under 2025-2030
Methane	Oil and gas methane regulations	Reinstated by 2030 such that reductions identified on the EPA's MAC curves as achievable at a cost of $60/tCO2e or below are achieved by 2035
	Coal methane regulations	Introduced by 2030, delivering emissions reductions achievable at a cost of $60/tCO2e or below on the EPA's MAC curves by 2035
	Agricultural methane regulations and incentives	Introduced by 2030, delivering emissions reductions achievable at a cost of achievable at a cost of $30/tCO2e or below on the EPA's MAC curves by 2035
Industry	Standards on oil refineries	Introduced after 2030, requiring CCS capabilities for 25% of oil by 2035
	Direct air carbon capture and storage (DACCS) incentives	Results in 12 $MtCO_2$ removals by 2035. This level of removal is consistent with announced DACCS facilities in the United States.[31]
Lands	Expanded funding for wildfire mitigation, tree planting, conservation and health soils	Assume $160 billion in investments in climate-smart policies resulting from enhanced federal and state-level action, based on the 'Enhanced Ambition' scenario from a previous CGS report on lands.[30]

New non-federal and federal assumptions

Along with federal re-engagement, the *Enhanced Ambition (High)* scenario assumes expanded non-federal action across the United States. All states accelerate their actions and adopt high-ambition policies: Tier 1 states continue to implement the policies under *Enhanced Ambition (Low)*. Tier 2 states accelerate their actions and implement Tier 1 policies. Tier 3 states also ramp up their ambition, implementing Tier 2 policies. Certain policies, such as EV sales targets and oil and gas methane regulations, are further boosted by federal incentives and regulations.

Table S6. Modeled policies in the *Enhanced Ambition (High)* scenario, which also includes the impacts of federal-engagement after 2028.

Sector	Policy Type	Tier 1 Ambition Level	Tier 2 Ambition Level	Tier 3 Ambition Level
Electricity	Renewable portfolio standards	65% by 2035		50% by 2035
	Clean electricity standards	80% by 2035		-
	Coal phaseout policies	2030 phaseout		2035 phaseout
Transport	LDV electrification policies to help achieve targets under Advanced Clean Cars II, including federal tax credits + regulations	100% EV sales by 2038		
	M/HDV electrification policies to help achieve targets under Advanced Clean Trucks, including federal tax credits + regulations	EV sales equivalent to California's Advanced Clean Trucks targets with a 3-year delay		
	Bus electrification targets	100% electrification of new bus sales in 2035.		100% electrification of new bus sales in 2040.
	Vehicle miles traveled reduction policies	1.25% annual VMT per capita reductions by 2035		0.75% annual VMT per capita reductions by 2035
	Low carbon fuel standards	20% in 2030, 25% in 2035		-
Buildings	Enhanced energy efficiency resource standards	4% annual efficiency savings by 2030		
	Zero-emission appliance standards	100% electric heating and water heating sales by 2035		100% electric heating and water heating sales by 2040
	Zero-emission construction standards	100% new electric construction by 2035		
Industry	Cement CCS targets	CCS capability for 40% of cement produced by 2035		CCS capability for 20% of cement produced by 2035.
Methane	Oil and gas methane regulations	Deliver emissions reductions achievable at a cost of $60/tCO2e or below on the EPA's MAC curves by 2035. A methane intensity standard of 0.2% is also achieved by 2035.		
	Landfill methane capture regulations	Deliver emissions reductions achievable at a cost of $60/tCO2e or below on the EPA's MAC curves by 2035		Deliver emissions reductions achievable at a cost of $40/tCO2e or below on the EPA's MAC curves by 2035
	Enhanced waste diversion efforts	60% reduction in landfill waste by 2035		40% reduction in landfill waste by 2035
Other	HFC regulations	Adopt Significant New Alternatives Policy (SNAP) and Refrigerant Management Programs (RMP) programs.		-

4 Emissions results

4.1 Emissions reductions by sector

In the *Current Policies* scenario, economy-wide GHG emissions are reduced to 35% below 2005 levels by 2035. In the *Enhanced Ambition (Low)* and *Enhanced Ambition (High)* scenarios, we find that subnational climate strategy has the potential to deliver a 44% to 56% reduction by 2035, respectively. A sector-by-sector breakdown of the emissions results is shown in Table S7.

Table S7. Emissions results by sector (Methane's AR5 100-year GWP of 28 is used in this table).

Sector/GHG	Emissions 2005 ($MMTCO_2e$)	Emissions 2021 ($MMTCO_2e$)	Emissions 2035 ($MMTCO_2e$)			Change relative from 2005 to 2035 (%)		
			Current Policies	*Enhanced Ambition (Low)*	*Enhanced Ambition (High)*	*Current Policies*	*Enhanced Ambition (Low)*	*Enhanced Ambition (High)*
Electricity CO_2	2,413	1,553	917	692	386	-62%	-71%	-84%
Transport CO_2	1,869	1,762	1,369	1,302	1,182	-27%	-30%	-37%
Industry CO_2	1,188	1,111	1,107	1,041	973	-7%	-12%	-18%
Buildings CO_2	586	556	501	433	388	-15%	-26%	-34%
Other CO_2	71	38	31	28	25	-56%	-60%	-65%
CH_4	858	783	756	679	527	-12%	-21%	-39%
N_2O	436	412	408	407	406	-6%	-7%	-7%
F-Gases	156	200	117	109	111	-25%	-30%	-29%
Direct Air Capture	0	0	0	0	-12	0%	0%	N/A
Land sink	-1,041	-1,044	-974	-1,081	-1,115	-6%	4%	7%
Net GHG Total	**6,536**	**5,371**	**4,231**	**3,610**	**2,869**	**35%**	**44%**	**56%**

4.2 Comparison with other studies

Other recent studies have also attempted to quantify the impact of federal rollbacks on U.S. net GHG emissions trajectories. The Rhodium Group projects that, under current policy rollbacks, U.S. emissions will decline by 26–35% by 2035 relative to 2005 levels.[32] Similarly, ZERO Lab's Rapid Energy Policy Evaluation and Analysis Toolkit (REPEAT) estimates a 25% reduction in 2035 under a policy scenario that incorporates the final version of The One Big Beautiful Bill Act (OBBBA).[33] By comparison, the *Current Policies* scenario in this report projects a 35% reduction in GHG emissions by 2035, which is sits on the high end of the range. This could be attributed to differences in modeled policies and underlying modeling assumptions.

5 Sensitivity analysis

In addition to the core scenarios presented in the main report, we assessed emissions projections by varying assumptions on a few important drivers, including GDP, population growth, oil and gas prices, solar and wind costs (Table S8). The "high emissions reduction" sensitivity includes the high assumption for GDP and population, the low assumption for oil and gas prices, and the high assumption for wind and solar capital costs. The "low emissions reduction" sensitivity includes the low assumption for GDP and population, the high assumption for oil and gas prices, and the low assumption for wind and solar capital costs.

After running these sensitivities, the *Enhanced Ambition (High)* scenario has a range of 52%-63% GHG emissions reductions below 2005 levels in 2035, and the *Enhanced Ambition (Low)* scenario has a range of 40%-52% reductions in 2035. In comparison, *Current Policies* scenario has a sensitivity range of 28%-44% in 2035 (Figure S2).

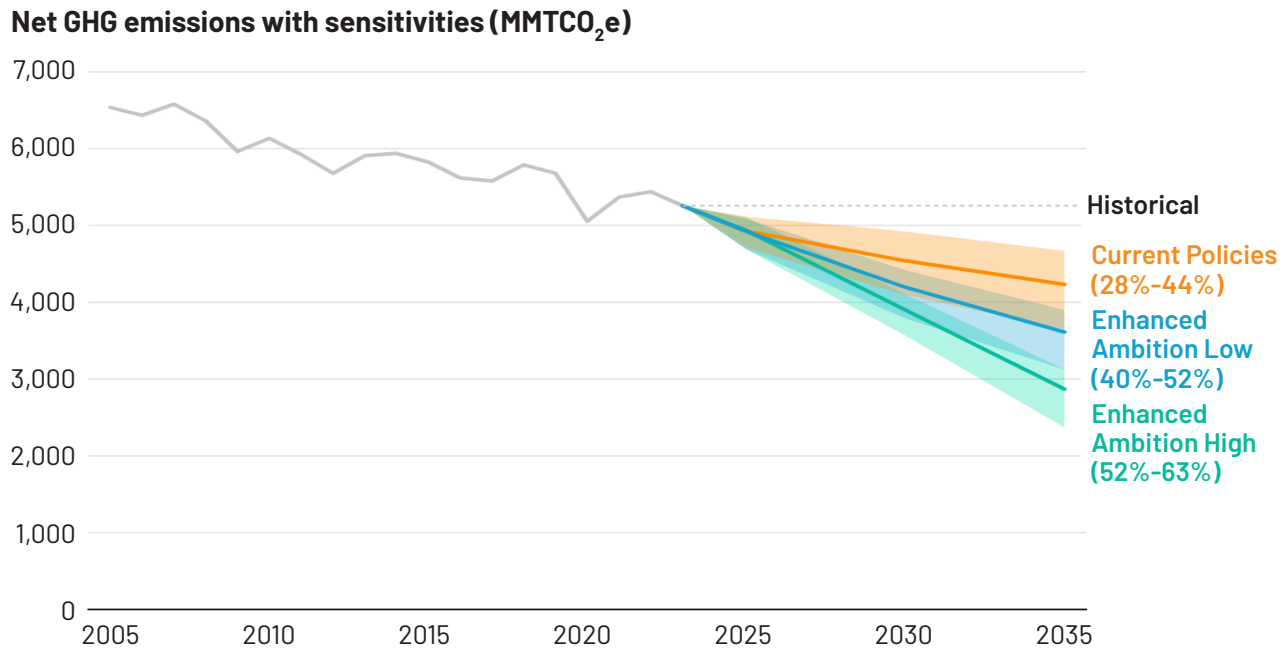

Figure S2. Net greenhouse gas emissions in 2035, in units of $MMTCO_2e$. Historical data through 2023 is taken from the latest Environmental Protection Agency inventory, which uses the 100-year global warming potential to convert non-CO_2 gases into CO_2 equivalents.[34] Accounting for sensitivities in GDP, population, oil and gas prices, and solar and wind costs, the *Enhanced Ambition (High)* scenario achieves a range of 52-63% GHG emissions reductions below 2005 levels in 2035. The *Enhanced Ambition (Low)* scenario achieves 40-52% emissions reductions in 2035. The *Current Policies* scenario reduces emissions by 28-44% in 2035.

Table S8. Assumptions under sensitivity scenarios

Driver	Core Assumptions	Sensitivities
GDP	GDP is assumed to grow by 1.68% per year on average from 2022 through 2035.	**High**: GDP is assumed to grow by 2.12% per year on average through 2035. **Low:** GDP grows by 1.08% per year on average through 2035.
Population	Population is assumed to grow by 0.46% per year on average from 2022 through 2035.	**High**: Grows by 0.66% per year on average through 2035. **Low:** Grows by 0.34% per year on average through 2035.
Fuel prices	Gas prices are assumed to increase at an average rate of 1.3% per year from 2021 through 2035.	**High:** Gas prices are assumed to increase at an average rate of 4.3% per year from 2021 through 2035. **Low:** Gas prices are assumed to decrease at an average rate of 0.01% per year from 2021 through 2035.
	Oil prices are assumed to increase at an average rate of 2.5% per year between 2021 and 2035.	**High:** Oil prices are assumed to increase at an average rate of 8.4% per year through 2035. **Low:** Oil prices are assumed to decrease at an average rate of 0.3% per year through 2035.
Solar power	Utility solar PV capital costs are assumed to decrease by 44% from 2022 to 2035.	**High:** Utility solar PV capital costs are assumed to decrease by 55% in 2035. **Low:** Utility solar PV capital costs are assumed to decrease by 27% in 2035.
Wind power	Land-based wind and offshore wind capital costs are assumed to decrease by 21% and 45%, respectively, from 2022 to 2035	**High:** Land-based wind and offshore wind capital costs are assumed to decrease by 26% and 47%, respectively, in 2035.. **Low:** Land-based wind and offshore wind capital costs are assumed to decrease by 9% and 47%, respectively, in 2035.

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