New Mexico Greenhouse Gas Emissions Inventory and Forecast

2021 Emissions Inventory and 2030-2050 Forecast

Release Date: December 2024

Energy+Environmental Economics

This update to New Mexico's greenhouse gas emissions inventory and forecast was prepared by Energy and Environmental Economics Inc. for the Center for New Energy Economy at Colorado State University.

Sharad Bharadwaj, Tory Clark, Rawley Loken, Disha Trivedi

Energy and Environmental Economics, Inc. (E3)
44 Montgomery Street, Suite 1500
San Francisco, CA 94104

Project Contact: Sharad Bharadwaj

sharad@ethree.com

Table of Contents

Table of Figures

Table of Tables

Introduction

This technical study provides data and metrics to help New Mexico analyze the scope of statewide greenhouse gas (GHG) emissions and target policies to further reduce emissions. The study was commissioned by Colorado State University's Center for the New Energy Economy (CNEE) at the request of the state. E3 coordinated with the New Mexico Energy, Minerals, and Natural Resources Department (EMNRD) and the New Mexico Environment Department (NMED) to complete the study.

This study estimates GHG emissions for the 2005 baseline year and for 2021, the most recent year for which data are available for most source categories. A prior GHG inventory study was prepared by E3 for New Mexico in 2020, but since the completion of this prior study there have been a variety of data and methodology updates to estimating emissions, including the completion of state-specific oil and gas emissions inventories by the consulting firm ERG. Therefore, this study includes updated emissions for 2005 in addition to a refreshed benchmark for 2021.[1] In addition to estimates of historical GHG emissions, this study produces estimates of future emissions under two scenarios:

+ Reference, or Current Policy: includes effects of emissions reductions from recently enacted and pending federal and statewide policies; and
+ Mitigation: includes emission reductions from additional policies as necessary to achieve the state's 2030 economywide GHG target

[1] Energy and Environmental Economics Inc., "New Mexico Greenhouse Gas Emissions Inventory and Forecast."

Emissions Inventory

This section gives an overview of the sectors within the New Mexico GHG Inventory, with estimates of 2005 and 2021 emissions. This study used the best available data to estimate historical emissions, and used emissions accounting protocols consistent with the Environmental Protection Agency (EPA) national inventory: these include using 100-year global warming potential (GWP) to calculate carbon dioxide equivalent ($CO2_e$) emissions, and using emissions factors sourced from the EPA.[2] A broad range of data sources is included and detailed data sources are described in more detail in the sections that follow. In brief, key data sources include:

- Environmental Protection Agency (EPA) State Inventory Tool (SIT): a spreadsheet tool developed by EPA which is designed to help states develop GHG emissions inventories. This is published and revised periodically, so this study used the most recent version of EPA SIT available as of February, 2024.[3]
- EPA National Inventory of GHG Emissions and Sinks: a comprehensive database of national GHG emissions sources and sinks, with granularity by sector, subsector, gas, and state, produced by EPA and submitted to the United Nations in accordance with the Paris Agreement.[4] The latest vintage of this report was published online on April 11, 2024.
- Energy Information Agency (EIA) State Energy Data System (SEDS): a set of data series which EIA publishes that contains estimates of energy consumption by sector and state. This is published and revised periodically, so this study used the most recent version of EIA SEDS available as of February, 2024.[5]
- Eastern Research Group (ERG) New Mexico Oil and Gas Greenhouse Gas inventory and forecast of oil and gas emissions and production within New Mexico. ERG prepared detailed estimates of GHG emissions associated with oil and gas production within the state, including estimates of historical emissions in 2005 and 2020, as well as estimates for how emissions would change in 2025 and 2030, driven by various state and federal policies.[6]

This section of the report also provides explanations of the methodology used to estimate GHG emissions in each sector of the inventory. A summary of the emissions calculation methodology by sector is provided in Table 1, with emissions estimate by sector for 2005 and 2021 provided in Figure 1 and Table 2.

---

[2] Global warming potential is a measure of how much energy a GHG will absorb over a given period, relative to carbon dioxide; by definition carbon dioxide has a global warming potential of one. The United States primarily uses the 100-year global warming potential to measure the relative impact of different GHGs.

[3] U.S. Environmental Protection Agency, "State Inventory and Projection Tool."

[4] U.S. Environmental Protection Agency, "Inventory of U.S. Greenhouse Gas Emissions and Sinks."

[5] US Energy Information Administration, "State Energy Data System 2021 Consumption Technical Notes."

[6] Eastern Research Group, "New Mexico Oil and Gas Greenhouse Gas Emissions Inventory for Year 2005"; Eastern Research Group, "New Mexico Oil and Gas Greenhouse Gas Emissions Inventory for Year 2020."

Table 1. Emissions and calculation methodology by sector, 2005 and 2021

Sector	2005 calculation method	2021 calculation method
Electricity generation	E3 calculation based on emissions data for in-state generators. Data sources include EPA and EIA	
Transportation	EPA 1990-2022 National GHG Inventory data, for NM [April 2024]	EPA 1990-2022 National GHG Inventory data, for NM [April 2024]
Residential		
Commercial		
Industrial (non-oil-and-gas fuel combustion)	Direct EPA State Inventory Tool outputs (not including fossil fuel industry fuel consumption)	
Industrial processes (Non-combustion emissions from non-oil-and-gas industry)	EPA 1990-2022 National GHG Inventory data, for NM [April 2024]	
Agriculture	EPA 1990-2022 National GHG Inventory data, for NM [April 2024]	
Coal mining & abandoned mines		
Waste		
Natural & working lands*		
Oil & gas (fugitive emissions)	ERG oil and gas industry GHG inventory**	
Oil & gas (fuel combustion)		

**Due to significant data uncertainty around the size of the natural land use sources and sinks in the state, throughout this report we provide emissions using a "gross" framework, which includes emissions from all sectors excluding the natural and working lands sector, while providing current best estimates of natural and working lands emissions for reference.*
***ERG oil and gas industry GHG inventory data were available for 2005 and 2020. To estimate 2021, the 2020 emissions were scaled using emissions factors specific to production stages. See the oil and gas inventory section for more details.*

Figure 1. Gross statewide annual emissions, 2005 and 2021 (MMT CO2e)

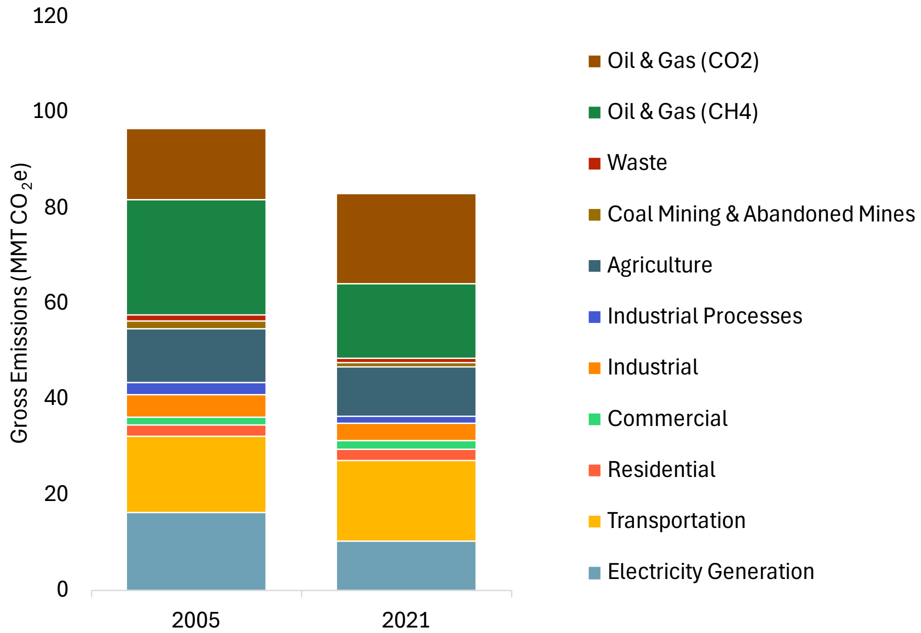


Table 2. Statewide annual emissions, 2005 and 2021

Sector	2005 (MMT CO_2e)	2021 (MMT CO_2e)
Electricity Generation	16.33	10.31
Transportation*	15.85	16.77
Diesel	*5.07*	*7.44*
Jet Fuel	*0.95*	*0.47*
Gasoline	*8.27*	*8.30*
Others	*1.56*	*0.56*
Residential	2.37	2.36
Commercial	1.70	1.79
Industrial	4.68	3.63
Industrial Processes (Non-Combustion Emissions)	2.53	1.48
Agriculture	11.15	10.25
Agricultural Soil Management (N_2O)	*5.95*	*5.22*
Field Burning of Agricultural Residues	*0.00*	*0.00*
Enteric Fermentation	*3.51*	*3.58*
Manure Management	*1.67*	*1.41*
Others	*0.01*	*0.04*
Coal Mining & Abandoned Mines	1.69	0.93
Waste	1.32	1.06
Oil & Gas (Fugitive Emissions)	24.02	15.47
Oil & Gas (Fuel Combustion)	14.80	18.92
Total (gross emissions)	96.44	82.97
Natural & Working Lands**	9.57	2.95

** The National GHG Inventory dataset used to source the data for transportation related emissions does not include a breakout of transport related emissions by fuel. To construct the estimates for diesel, jet fuel, and gasoline we use fuel sale estimates from the EIA State Energy Data System and emissions factors from the EIA.*

***Due to significant data uncertainty around the size of the natural land use sources and sinks in the state, throughout this report we provide emissions using a "gross" framework, which includes emissions from all sectors excluding the natural and working lands sector, while providing current best estimates of natural and working lands emissions for reference.*

Residential and Commercial Buildings

This inventory attributes direct emissions from energy consumed in buildings to the residential or commercial sector.[7] Emissions from residential and commercial buildings are associated with fuel combustion on-site, primarily from natural gas and propane burned for space heating, water heating and cooking. Emissions associated with electricity consumption in buildings are attributed to the electricity sector.

To calculate emissions for residential and commercial buildings, E3 relied on the latest available EPA National GHG Inventory (published in April 2024); this report includes state specific data, and thus is appropriate to use for estimating New Mexico's historical emissions.[8] These data were used to calculate emissions for 2005 and 2021.

Transportation

Emissions associated with the transportation sector within New Mexico are also calculated by attributing direct emissions from energy consumed in motor vehicles and other transportation sources. The EPA National GHG Inventory data provides estimates for GHG emissions from mobile sources and categorizes transportation CO_2 emissions as coming from petroleum-based fuels (gasoline, diesel, jet fuel, etc.) as well as from natural gas powered vehicles and equipment. This method accounts for greenhouse gas emissions associated with combustion of all gasoline and diesel sold within the state. E3 did not perform any adjustments to account for either fuel sold in-state but used to drive miles outside the state or fuel sold outside state boundaries but consumed by drivers within the state. This is a standard approach to estimating transportation emissions within states, so this method is used here.

Some state inventories only include aviation emissions associated with domestic or intra-state air travel,[9] while others include GHG emissions associated with all jet fuel sold within the state. This method takes the latter approach, where emissions from all jet fuel sold within the state are counted within the state's inventory. Aviation is a minor part of the transportation emissions within New Mexico and thus this assumption is not likely to significantly change results.

Oil and Gas

To estimate greenhouse gas emissions from the oil and gas sector, this analysis relies primarily on two oil and gas inventory and forecast reports produced by ERG. The ERG reports include estimates

[7] This inventory relies on SIT and SEDS data on energy consumption by sector; SEDS uses a variety of survey data to estimate energy consumption by sector, defining the residential sector as including living quarters for private households, while the commercial sector consists of service-providing facilities and equipment of businesses, governments, and other private and public organizations, including institutional living quarters.

[8] U.S. Environmental Protection Agency, "Inventory of U.S. Greenhouse Gas Emissions and Sinks."

[9] For example California considers intra-state travel, New York estimates non-international travel, Washington considers all aviation fuel sold within state.

for GHG production from the oil and gas sector in New Mexico in 2005 and 2020. To estimate emissions in 2021, we scale the 2020 estimates sourced from ERG. The ERG dataset includes estimates of GHG emissions in the oil and gas sector by segment. This data, for 2005 and 2020, is reproduced in Table 3, below. Note that due to rounding of individual emissions source segments, the sub-totals for each segment may not match the sum of the sources within that segmentation, especially for methane (CH_4) emissions which have a high GWP factor and are more sensitive to rounding differences.

Table 3. Oil and Gas sector emissions for 2005 and 2020 by segment, source, and gas.

Segment	Emissions Source	CH4 Emissions in 2005 [MMT CO2e]	CO2 Emissions in 2005 [MMT CO2e]	CH4 Emissions in 2020 [MMT CO2e]	CO2 Emissions in 2020 [MMT CO2e]
Production	Pneumatic Controllers	4,784,276	28,711	3,620,848	23,129
	Equipment Leaks	5,126,268	5,328	5,205,200	5,346
	Reciprocating Compressors	8,400	45	36,484	244
	Pneumatic Pumps	16,968	32	56,308	187
	Liquids Unloading	2,819,852	4,918	632,072	3,203
	Completions and Workovers	1,402,576	31,822	142,548	626,348
	Dehydrators	58,688	1,609	23,856	120,230
	Tanks	345,156	14,219	168,952	198,700
	Associated Gas	339,192	13,740	102,228	695,755
	Miscellaneous Venting/Flaring	3,833,900	160,618	88,676	725,225
	Mud Degassing	98,476	249	230,832	588
	Tank Unloading	1,092	1	6,916	5
	Produced Water	36,764	27	235,200	173
	Combustion	237,664	2,700,045	308,952	4,437,587
	TOTAL	19,109,272	2,961,364	10,859,072	6,836,720
Gathering and Boosting	Centrifugal Compressors	10,108	11	10,528	13
	Combustion	1,190,980	4,774,257	1,521,688	5,772,935
	Dehydrators	100,828	3,508	196	33,517
	Equipment Leaks	264,460	275	262,080	217
	Pneumatic Controllers	320,684	2,051	275,352	1,670
	Miscellaneous Venting/Flaring	535,836	21,438	17,752	200,967
	Pneumatic Pumps	32,592	202	32,956	196
	Reciprocating Compressors	581,952	605	577,808	488
	Equipment Blowdowns	95,004	771	96,432	581
	Tanks	256,928	10,168	480,004	44,399

	Acid Gas Removal Units	0	40,029	0	97,632
	Pipeline Blowdowns	1,344	2	3,304	4
	Pipeline Leaks	148,428	2,746	250,320	5,785
	TOTAL	3,539,144	4,856,063	3,528,364	6,158,405
Processing	Acid Gas Removal Units	0	2,866,814	0	1,949,741
	Dehydrators	3,500	1,972	1,036	16,686
	Equipment Blowdowns	15,204	54	118,832	183
	Equipment Leaks	21,896	56	13,720	125
	Flaring	26,908	195,147	34,104	246,710
	Centrifugal Compressors	196,924	891	31,808	37
	Reciprocating Compressors	103,208	809	77,560	149
	Pneumatic Controllers	2,408	10	2,968	13
	Combustion	356,104	3,226,165	257,852	2,339,343
	TOTAL	726,152	6,291,918	537,880	4,552,987
Transmission	Pneumatic Controllers	11,592	13	3,780	4
	Centrifugal Compressors	50,288	45	65,268	51
	Reciprocating Compressors	140,196	136	44,212	31
	Flaring	0	0	28	387
	Equipment Blowdowns	112,952	176	44,940	46
	Equipment Leaks	23,296	26	6,916	7
	Transmission Storage Tanks	24,220	18	5,180	5
	Combustion	58,856	647,113	53,508	588,285
	Pipeline Blowdowns	173,068	185	101,976	105
	Pipeline Leaks	1,960	2	1,960	2
	TOTAL	596,428	647,714	327,740	588,922
Underground Natural Gas Storage	Dehydrators	728	1	728	1
	Equipment Blowdowns	4,704	5	4,704	5
	Equipment Leaks	3,976	4	3,976	4
	Flaring	196	696	196	696
	Metering and Regulating Equipment	12,264	13	12,264	13
	Pneumatic Controllers	2,800	3	2,800	3
	Reciprocating Compressors	16,744	18	16,744	18

	Storage Wells	1,848	2	1,848	2
	Combustion	3,696	39,600	3,696	39,600
	TOTAL	46,956	40,342	46,956	40,342

To estimate emissions for 2021, we apply different factors for each segment to scale 2020 emissions estimate to 2021. The scaling factors, sources for scaling factors, and 2020 and 2021 emissions are detailed in the Table 4.[10] Note this methodology includes an estimate of emissions from both fuel combustion and fugitive emissions associated with oil and gas activities. While the total amount of emissions from fugitive sources is smaller than from fuel combustion in terms of tons per gas, the high global warming potential of these fugitive emissions (primarily methane) means that fugitive emissions are a significant source of total GHG emissions in units of CO_2 equivalent.

Table 4. New Mexico oil and gas emissions in 2020, and scaling factors for 2020->2021 emissions estimation

Segment	2020 Emissions (ERG Inventory) [MMT CO_2e]	Scaling Factor	Sources for Scaling Factor	Scaling Value for 2020 -> 2021	2021 Emissions Estimate [MMT CO_2e]
Production	17.70	Active Well Count	New Mexico Oil Conservation Division Well Statistics	1.00	17.75
Gathering and Boosting	9.69	Active Well Count	New Mexico Oil Conservation Division Well Statistics	1.00	9.72
Processing	5.09	Gas Production	EIA New Mexico Natural Gas Production	1.14	5.78
Transmission	0.92	Gas Production	EIA New Mexico Natural Gas Production	1.14	1.04
Underground NG Storage	0.09	Constant	Constant	1.00	0.09

Industrial (fuel combustion emissions from non-oil-and-gas industries)

The largest industry within New Mexico is the oil and gas sector. All emissions from the oil and gas sector (from energy combustion and fugitive emissions) are calculated separately in this analysis. This section discusses emissions from fuel combustion for all non-oil-and-gas industries. A significant share of natural gas fuel use which EIA categorizes as industrial is used as lease fuel or plant fuel for oil and gas operations The emissions associated with these natural gas end uses are

[10] New Mexico Energy, Minerals, and Natural Resources Department, "OCD Statistics"; "New Mexico Natural Gas Gross Withdrawals and Production."

categorized within the oil and gas sector in this inventory. Statewide data from federal sources such as the National GHG Inventory and the EPA SIT report industrial emissions inclusive of oil and gas and other sectors, so to estimate non-oil-and-gas industrial emissions in New Mexico we exclude estimates of the share of oil and gas emissions which are embedded in those data sources. The reason we do not use those data sources for the overall oil and gas sector emissions is they are less geographically granular and precise than the state specific ERG dataset. To do this, we use data from the EIA Natural Gas Annual report to calculate the share of industrial natural gas use reported to EIA which is lease and plant fuel, which we assume to be used for oil and gas production.[11] The method is summarized below:

1. Use the EPA SIT to calculate industrial emissions for coal, petroleum, and natural gas in New Mexico.[12]
2. Use EIA Natural Gas Annual report data to estimate the share of natural gas emissions which are used by the fossil fuel industry and exclude these emissions.
    a. The assumption is these emissions are captured in the ERG oil and gas inventory dataset, so we exclude them here to avoid double counting these emissions.

The EIA categorizes natural gas used by pipeline and distribution system operators (such as pipeline gas consumed within compressor stations) within the Transportation sector. As the 2005 and 2021 GHG inventories use EIA and EPA data, and the EPA SIT tool relies on EIA data for energy use by sector, to maintain consistency in this report E3 also categorizes natural gas used by pipeline and distribution system operators as within the Transportation sector.

Industrial Processes (non-combustion emissions from non-oil-and-gas industries)

E3 sourced data for emissions from industrial processes, excluding non-combustion emissions from the oil and gas sector, from EPA National GHG Inventory data for New Mexico.[13]

Agriculture, coal mining, waste, and wastewater

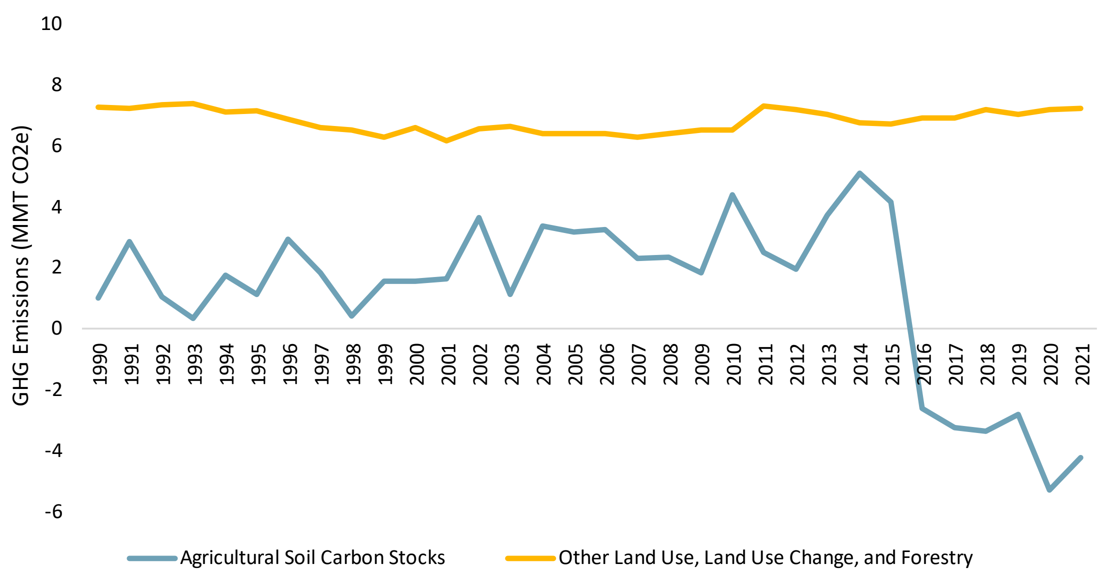
A variety of non-combustion emissions from agriculture, coal mining, waste, and wastewater are present in New Mexico. E3 used data from the EPA National GHG Inventory to estimate emissions from these sectors.[14]

[11] Energy Information Administration, "Natural Gas Annual."
[12] SIT is used here because the data format allows for easy exclusion of the oil and gas sector. Both SIT and National GHG Inventory use the same data sources for state-specific fossil fuel emissions so the choice of SIT vs National GHG Inventory data has no significant impact on emissions estimate.
[13] U.S. Environmental Protection Agency, "Inventory of U.S. Greenhouse Gas Emissions and Sinks."
[14] U.S. Environmental Protection Agency.

Natural and working lands

E3 sourced data for natural and working lands from the EPA National GHG Inventory to estimate emissions changes because of changes in natural and working lands sinks in the State. There are two caveats to keep in mind regarding this data source. On the role of wildfires, the default EPA data does not estimate emissions changes because of wildfires. This is consistent with the treatment of wildfire emissions in the prior New Mexico GHG Inventory report. New Mexico state agencies such as the EMNRD Forestry Division are taking actions to reduce the risk of wildfires in the state; these actions have a host of benefits not limited to climate benefits, such as ecosystem, human health, and air quality benefits. However, given the significant uncertainty in wildfire emissions we remain consistent with the National GHG Inventory and prior State GHG Inventory methodology in excluding wildfire emissions for the purpose of calculating baseline year emissions estimates in this report. Every year, the EPA makes methodology and data upgrades in its National GHG Inventory analysis. The latest EPA National GHG Inventory report has made an update to its treatment of soil carbon flux which resulted in significant decline in soil carbon flux for New Mexico from 2015 to 2016, as can be seen in Figure 2, below.

Figure 2. New Mexico Land Use, Land Use Change, and Forestry Emissions



EPA documentation for the changes made in the National GHG Inventory include data updates and modeling updates as described in the block quote below. Even accounting for improved data, it is unclear why there is a significant change in the soil carbon flux for New Mexico in 2016 and why that change proves relatively durable from 2016-2021; this trend is not clear in national estimates of GHG emissions from natural and working lands, so it will be important to revisit estimates of this sector as future modeling and data improvements are made.

Several improvements have been implemented in this Inventory leading to recalculations. These improvements included a) incorporating new USDA-NRCS NRI data through 2017; b) updated FIA data from 1990 to 2022 on biomass, dead wood and litter carbon stocks in woodlands for grassland remaining grassland; c) constraining manure N applications in the Tier 3 method at the state scale rather than the national scale; and d) re-calibrating the soil carbon module in the DayCent model using Bayesian methods[15]

Electricity Generation

To calculate emissions from electricity generation, E3 considered emissions from all in-state generating units over which the State of New Mexico has regulatory authority. The default EIA data on in-state generation and in-state emissions show higher generation and emissions levels than this analysis. This is because the EIA data include emissions and generation from the Four Corners power plant, which is a tribal source on the Navajo Nation. Four Corners is excluded in this analysis because it does not fall under state authority and most of the power from the plant is not consumed in New Mexico.

High quality historical data on dispatch of in-state and out-of-state plants for New Mexico electricity use requires additional research beyond the scope of this study. Therefore, the estimation of GHG emissions for this inventory is a production-based analysis that includes all emissions from in-state generation of electricity. Taking this simplified approach of relying on high quality historical data of in-state emissions is a reasonable approach since New Mexico is an electricity exporting state and this approach accounts for emissions from all fossil fuel electric generation in New Mexico. By comparison, New Mexico's Energy Transition Act (ETA) sets renewable energy standards based on retail sales of electricity to New Mexico customers. This is more of a consumption-based approach to standard setting in the electric power sector.

[15] U.S. Environmental Protection Agency, "Inventory of U.S. Greenhouse Gas Emissions and Sinks."

Table 5. Summary of generation, sales, and emissions data for 2005 and 2021

Category	Units	2005	2021
In-State Generation*	GWh	19,520	27,288
Retail Sales	GWh	20,639	25,394
NM-Associated Emissions	MMT CO2e	16.3	10.3
Notes and data sources: EIA in-state generation, retail sales data, ownership of out of state units from EIA Forms 906/920, 860, 923[16] Generation from in-state units from EPA Emissions & Generation Resource Integrated Database (eGRID) data[17] * Includes all units in the state, excluding Four Corners as that plant is on tribal lands			

[16] U.S. Energy Information Administration, "A Guide to EIA Electric Power Data."
[17] Abt Associates, "The Emissions & Generation Resource Integrated Database: Technical Support Document for eGRID with Year 2021 Data."

Emissions Forecast Methodology and Framework

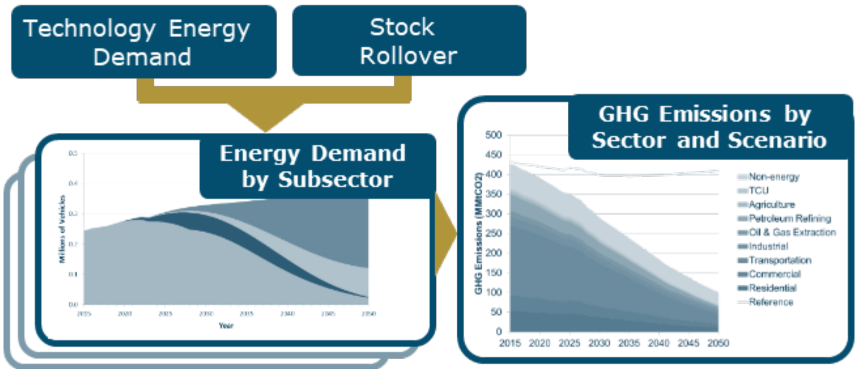
Model framework

To characterize economy-wide greenhouse gas emissions in New Mexico, E3 analyzed economy-wide decarbonization using the PATHWAYS model. E3's PATHWAYS model is an economy-wide representation of infrastructure, energy use, and emissions within a specified geography. E3 first developed PATHWAYS in 2008 to help policymakers, businesses, and other stakeholders analyze trajectories to achieving deep decarbonization of the economy, and the model has since been improved over time in projects analyzing jurisdictions across North America.[18]

E3 aligned the GHG emissions within the New Mexico PATHWAYS model with the inventory accounting methodology described previously in this report. In brief, this includes emissions associated with energy use in residential and commercial buildings, transportation, and industry; electricity generation from in-state generators; non-combustion emissions associated with industrial processes, agriculture, and waste processing; and emissions associated with oil and gas production and extraction.

E3 developed a PATHWAYS model of bottom-up energy and emissions within all sectors of the economy, benchmarked to the 2021 inventory described in the previous section, and developed economy-wide emissions scenarios through 2050. The PATHWAYS model characterizes bottom-up and user-defined emissions accounting scenarios to analyze questions around possible energy and climate policies. PATHWAYS includes both supply and demand sectors to capture interactions between the sectors, and the focus is on comparing user-defined policy and market adoption scenarios and to track physical accounting of energy flows within all sectors of the economy.

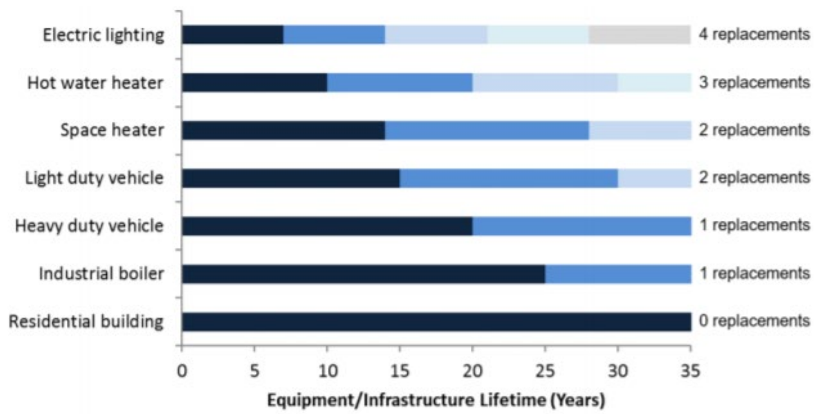
Figure 3. Illustration of PATHWAYS model framework



[18] Energy and Environmental Economics Inc., "California PATHWAYS Model Framework and Methods."

A key feature of PATHWAYS is a characterization of stock rollover in major equipment categories (specifically in buildings and transportation fleets). A stock rollover approach tracks infrastructure turnover of energy consuming device while accounting for changes in performance, such as improved efficiency over time. This tracks the time lag between changes in annual sales of new devices and change in device stocks over time explicitly. Different technologies will have different lifetimes, which are captured by this approach. For example, some technologies, such as lightbulbs, might have lifetimes of just a few years while others, such as building shell systems, might have lifetimes on the order of decades. By tracking these lifetimes, using PATHWAYS a user can determine the pace necessary to achieve economy-wide greenhouse gas emissions goals while capturing potential path dependencies.

Figure 4. Illustrative device lifetimes for stock rollover methodology in PATHWAYS



A second key feature of the PATHWAYS model is its ability to link sectors. This enables PATHWAYS to identify where aggressive action in one sector can enable emissions reductions elsewhere. For instance, the treatment of the electricity sector is explicitly tied to the carbon savings associated with electric vehicles.

Overview of emissions forecasting approaches

E3 used a variety of modeling approaches to forecast greenhouse gas emissions in each sector. Greenhouse gas emissions from consumption of fuel for energy demand were analyzed using either (1) stock rollover, in which an explicit accounting of rollover appliances and equipment were calculated and used to account for energy and GHG emissions; or (2) total energy by fuel, in which the total energy consumption was directly modeled.

In calculating energy demands, E3 benchmarked energy consumption within New Mexico to state level data from the EIA SEDS, which reports fuel consumption by economic sector and fuel in each state.[19] E3 performed a bottom-up based accounting of the appliances and vehicles in the state and

[19] US Energy Information Administration, "State Energy Data System 2021 Consumption Technical Notes."

relied on a variety of federal data on appliance and vehicle efficiencies, as well as usage patterns, to benchmark residential; commercial; and transportation energy demands. The stock rollover approach was used when quality infrastructure data were available from public data sources; otherwise E3 used a total energy approach, in which there is no explicit turnover calculations within the modeling framework.

For other sectors in which energy demand were not specified, E3 input the GHG emissions directly in each year, but adjusted these to account for the effects of various policies, such as waste and ozone pre-cursor reductions for oil and gas.

Table 6. New Mexico PATHWAYS emissions forecast methodology by sector

<table>
<tr><th>Sector</th><th>Emissions forecast methodology</th></tr>
<tr><td>Electricity Generation</td><td>Estimate effects of electric sector policies on total generation requirement. Calculate emissions rate of electricity generation required to be in line with state policy targets. Apply emissions rate to forecasts of statewide load to estimate total emissions for electricity consumed in state.</td></tr>
<tr><td>Transportation</td><td rowspan="4">Use combination of stock rollover and total energy approaches to estimate demand for various fuels and estimate emissions from these fuels. This approach considers the reduced emissions from electrification or efficiency, as well as the increased load these measures might create.</td></tr>
<tr><td>Residential</td></tr>
<tr><td>Commercial</td></tr>
<tr><td>Industrial (non-oil-and-gas fuel combustion)</td></tr>
<tr><td>Industrial Processes (Non-combustion emissions)</td><td>Hydrofluorocarbon (HFC) emissions reductions modeled, but other non-combustion emissions held constant over time</td></tr>
<tr><td>Agriculture</td><td>Hold flat in Current Policy scenario, with reductions in Mitigation scenario as described in Table 7</td></tr>
<tr><td>Waste</td><td rowspan="2">Hold flat in Current Policy scenario, with scenario-dependent reductions in Mitigation scenario as described in Table 7</td></tr>
<tr><td>Natural & Working Lands</td></tr>
<tr><td>Oil & Gas (Fugitive Emissions)</td><td rowspan="2">ERG Oil and Gas GHG forecast for 2025 and 2030, with estimated effects of NSPS and additional mitigation from EPA and New Mexico methane rules. In the Mitigation case, additional oil and gas mitigation was assumed, as required to hit the State’s 45% by 2030 economywide greenhouse gas emissions target.</td></tr>
<tr><td>Oil & Gas (Fuel Combustion)</td></tr>
</table>

Emissions forecast for oil and gas, electricity generation

Oil and gas

Forecasting emissions from oil and gas extraction is difficult as total emissions are closely related to production levels, which can be highly variable on an annual or even monthly basis. This analysis relies on data from the ERG Oil and Gas GHG Projections, which estimated oil and gas production and associated emissions for 2025 and 2030. This analysis did not account for the most recent federal policies of the EPA’s Methane Emissions Reduction Program, such as Subpart OOOOb and

OOOOc, and therefore this analysis is likely to conservatively overestimate future GHG emissions associated with oil and gas production in New Mexico.[20]

Electricity generation

Electrification is a core decarbonization strategy modeled in both scenarios. While this report estimates emissions from electricity generation considering load growth and the state's clean electricity targets, E3 did not run a detailed capacity expansion and electricity dispatch model for this analysis. E3 calculated forecasted electricity generation emissions by assuming a share of electricity consumption as zero-carbon, in line with state policies such as the Energy Transition Act, and applied an emissions factor consistent with a modern natural gas combined cycle plant for the remaining non-carbon-free electricity. This emissions intensity was then applied to electricity consumption as calculated by performing the bottom-up energy demand forecast, as described in the prior sections. This is meant to be a relatively simple, first pass approach to performing electric emissions forecast. This is not a substitute for the level of rigor necessary in performing an integrated system plan; such an assessment requires significantly more detail on both economics and reliability assessments of various resources.

Scenario development

This study includes analysis of two statewide emissions trajectory scenarios through 2050.

- **Reference or Current Policy (current policies):** a scenario showing the effect of currently passed and anticipated emissions reductions measures based on the directives of existing state and federal policies. These include but are not limited to the Energy Transition Act and efficient building codes; advanced clean cars and clean trucks; HFC measures, and a regulatory framework to reduce emissions from the oil and gas sector.
- **Mitigation Scenario (deep decarbonization):** a scenario that represents the scale of effort necessary to achieve the state's 2030 carbon target, with a level of effort in each sector commensurate with similar deep decarbonization analyses performed in other states. This scenario includes electrification of most space and water heating within buildings, as well as electrifying most light-duty vehicles. The modeling also includes increased adoption of electric and hydrogen vehicles in medium-duty vehicles (MDVs) and heavy-duty vehicles (HDVs), and industrial electrification of feasible industrial processes. This scenario is not meant to reflect a specific action plan for the state, but rather representative pathways that highlight the scale of transformation necessary to reach decarbonization goals.

[20] Eastern Research Group, "New Mexico Oil and Gas Greenhouse Gas Emissions Inventory for Year 2020."

Table 7. Key assumptions for PATHWAYS measures by scenario

Sector	Strategy	Expressed as	Current Policy	Mitigation
Buildings	Building Shell Efficiency	Efficient shell sales share*	100% of new and retrofit building shells meet IECC 2018 building codes	*Same as Current Policy*
	Building Electrification	Electric heat pump sales share	14% heat pump sales by 2030, 48% by 2050 (consistent with EPA analysis of electrification effects of Inflation Reduction Act)	15% sales of heat pumps for space heating and water heating by 2027; 100% by 2030
	Appliance Efficiency (non-HVAC)	Efficient appliance sales share	100% efficient sales for lighting by 2030; 100% efficient sales for all appliances by 2030	*Current Policy*
Industry	Efficiency	Efficiency increase relative to baseline projection	None	15% by 2030, 20% by 2050
Transportation	Corporate Average Fuel Economy (CAFE) Standards	Light Duty Vehicle (LDV) fuel economy	CAFE extension (MY2021-2026 extension)	*Same as Current Policy*
	Smart Growth	LDV VMT reduction relative to Current Policy**	None	15% reductions by 2030 (consistent with New Mexico Priority Climate Action Plan)[21]
	Vehicle Electrification	Zero Emission Vehicle (ZEV) sales share	LDV ZEV sales consistent with Advanced Clean Cars II and Advanced Clean Trucks: 82% LDV Sales by 2031	Continued growth in LDV EV Sales: 100% by 2035
Zero Emissions Fuels***	Biofuels Blend	Share of conventional fuel use met with biofuels	10% ethanol blend by volume (equivalent to 7% ethanol blend by energy) for gasoline	Fuels blended as needed to meet New Mexico Low Carbon Fuel Standard after including reductions associated with ZEV sales: 20% reductions in carbon intensity of fuels by 2030; 30% by 2040

[21] New Mexico Environment Department and New Mexico Energy, Minerals and Natural Resources Department, "New Mexico Priority Climate Action Plan."

Clean Electricity	Clean Electricity Generation	Share of renewable/zero-emission generation	50% RPS by 2030; 100% clean electricity by 2045	60% RPS by 2030, 100% clean electricity by 2045
Non-combustion (Industrial Processes, Agriculture, Waste)	Industrial Processes	Hydrofluorocarbon (HFC) reductions	17% reduction by 2030; 29% by 2050 (based on downscaling of EPA SNAP rules)	30% reduction by 2030; 85% by 2050 (phase down in line with Kigali Amendment)[22]
	Natural and Working Lands	Reduction in forest/soil emissions	None	*Same as Current Policy*
	Waste	Methane emissions captured	None	40% reduction in landfills and wastewater management emissions by 2050
	Agriculture	Methane and nitrous oxide reductions	None	*Same as Current Policy*
Oil and Gas	Equipment improvements	Reduced fuel combustion and methane emissions	Reductions consistent with data from ERG 2025 and 2030 emissions forecast: 18% reductions relative to 2021 levels by 2030	Further ambition in oil and gas sector GHG emissions reductions as needed to meet State targets: 56% reductions relative to 2021 levels by 2030

[22] U.S. Environmental Protection Agency, “Recent International Developments under the Montreal Protocol.”

Emissions Forecast Results

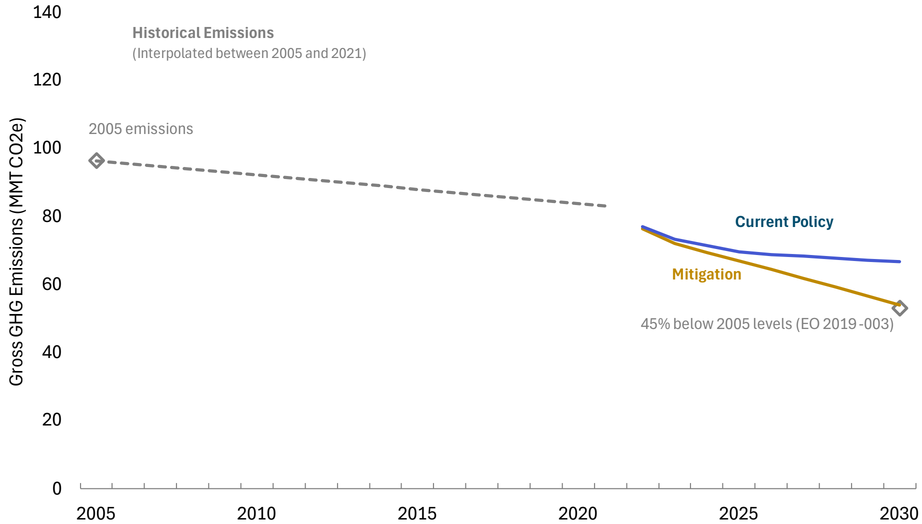
This section includes results of the economy-wide emissions forecasting analysis, through 2030 and through 2050.

Results through 2030

Due to significant uncertainty in the level of emissions from the natural and working lands sector, the Mitigation scenario was tuned to hit the state target of 45% below 2005 levels by 2030 for all sectors excluding the natural and working lands sector.

Figure 5 shows annual economy-wide emissions for two scenarios through 2030, as well as a marker showing the 45% below 2005 by 2030 target set by EO 2019-003.[23] The Current Policy scenario achieves significant emissions reductions, and even further reductions are achieved in the Mitigation case relative to the Current Policy. The Current Policy scenario sees a significant decrease in emissions, achieving 31% reduction in gross emissions levels (all sectors excluding natural and working lands) by 2030 relative to 2005. The Mitigation scenario achieves 45% reductions for that same time period.

Figure 5. Current Policy and Mitigation case emissions forecast through 2030 (gross emissions)



New Mexico saw a significant decrease in emissions from 2005 to 2021, driven primarily by declines in power sector and oil and gas sector emissions. In the power sector, further reductions occurred between 2021 and 2023 du to the decommissioning of the San Juan coal fired power generating station. Additional reductions have also occurred since 2021 in the oil and gas sector due to ongoing

[23] The 45% by 2030 target calculated here is relative to the 2005 emissions inventory as shown in Table 2.

implementation of state and federal regulations. Achieving further power generation emissions reductions will require balancing cost and reliability of decarbonized power as demand grows from various new loads, including electric vehicles, heat pumps, data centers, industrial sources and the oil and gas sector.

This study shows a relatively moderate decrease in oil and gas emissions from 2005 to 2021, despite the significant growth in oil and gas production in the state. Between 2021 and 2030, in the Current Policy scenario we forecast a moderate decrease in emissions, due to the expected impacts of regulatory programs like the EPA New Source Performance Standards (NSPS); federal off-road diesel engine tier standards; and state oil and gas methane rules. These emissions forecasts are sourced from the ERG 2025 and 2030 emissions forecast.[24] This forecast assumes changes to production and associated emissions through 2030. Due to the uncertainties of forecasting future production, E3 held these oil and gas production and emissions values constant after 2030. In the Mitigation scenario, we assume further decrease in oil and gas sector emissions as needed to hit an economywide 45% by 2030 gross GHG target. This requires assuming the oil and gas sector achieves 56% reductions in oil and gas emissions in 2030 relative to 2021. In this analysis, these emissions reductions are shown as coming in equal proportion from both further methane reductions and further CO2 reductions. However, it is possible that additional mitigation may be more likely or more feasible in either reduced methane or in reduced combustion, so the incremental oil and gas related reductions split is not meant to be policy prescriptive Here, we simply note that an additional 11 MMT of CO2e in GHG emissions reductions in oil and gas, relative to the already significant GHG reductions achieved in Current Policy by 2030, are necessary for the state to achieve a 45% by 2030 gross target, along with the reductions estimated in the mitigation scenario for other sectors.

In addition to the oil and gas sector, significant emissions reductions are attributed to Current Policy scenario policies, as well as further emissions reductions in the Mitigation scenario, across the residential, commercial, transportation, and power generation sectors. Note the specific policies included within the Mitigation scenario are detailed in Table 7, above. This Mitigation scenario includes aggressive mitigation policies broadly consistent with the level of effort seen in other states with similar economy-wide mitigation targets. These include measures such as building and transportation electrification, low-carbon fuels, significant energy efficiency and conservation measures.[25] The Mitigation scenario included in this report is meant to provide a sense of scale for what sorts of policies might be necessary to achieve economywide decarbonization, but is not a least-cost optimization or a specific action plan for the State.

Table 8 shows the growth in electricity sales in the Current Policy and Mitigation scenarios through 2030. Note this is a forecast of electricity sales, not of generation; this figure does not include the effects of transmission and distribution losses. A sophisticated capacity expansion, electricity dispatch, and electric reliability model was not run for this analysis.

[24] Eastern Research Group Inc., "New Mexico Oil and Gas Sector 2025 and 2030 Emissions Forecast."

[25] California Air Resources Board, "California's 2017 Climate Change Scoping Plan"; Energy and Environmental Economics Inc., "Pathways to Deep Decarbonization in New York State"; Mahone et al., "Deep Decarbonization in a High Renewables Future: Updated Results from the California PATHWAYS Model."

Table 8. Electricity sales by sector, Current Policy and Mitigation scenarios: 2021-2030 (Units: TWh)

Scenario	Sector	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Current Policy	Residential	7.09	7.03	6.97	6.84	6.95	6.93	6.91	6.91	6.90	6.90
Current Policy	Commercial	9.09	9.07	9.04	9.02	9.03	9.04	9.05	9.07	9.09	9.09
Current Policy	Industry	9.73	9.76	9.79	9.82	9.85	9.88	9.90	9.93	9.96	9.98
Current Policy	Transportation	0.11	0.16	0.25	0.37	0.52	0.70	0.92	1.16	1.44	1.75
Mitigation	Residential	7.09	7.03	6.97	6.85	6.96	6.94	6.93	6.95	6.99	7.05
Mitigation	Commercial	9.09	9.07	9.04	9.02	9.03	9.04	9.06	9.09	9.12	9.15
Mitigation	Industry	9.73	9.76	9.79	9.82	9.85	9.88	9.90	9.93	9.96	9.98
Mitigation	Transportation	0.11	0.16	0.25	0.37	0.52	0.70	0.92	1.16	1.43	1.74

Figure 6 and Figure 7 highlight the impact of energy efficiency and electrification technologies on energy demand. The Current Policy and Mitigation scenarios include significant energy efficiency and electrification measures, as well as a shift towards low carbon fuels as the Mitigation scenario includes use of renewable diesel as a strategy to decarbonize transportation fuels.

Figure 6. Economywide annual energy demand by fuel, excluding oil and gas: sectors: 2021 and 2030

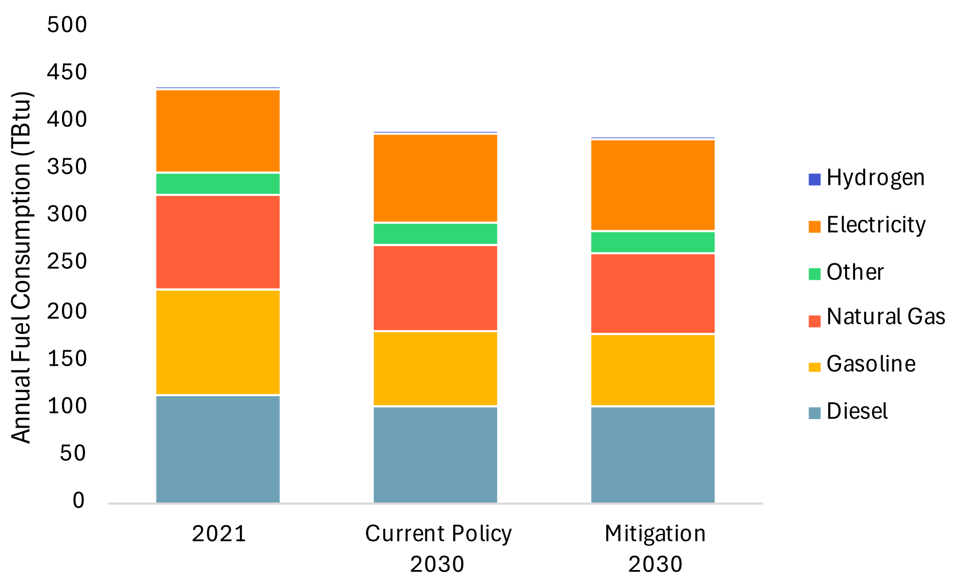


Figure 7. Economywide annual energy demand by fuel, excluding oil and gas: sectors: 2021 and 2030

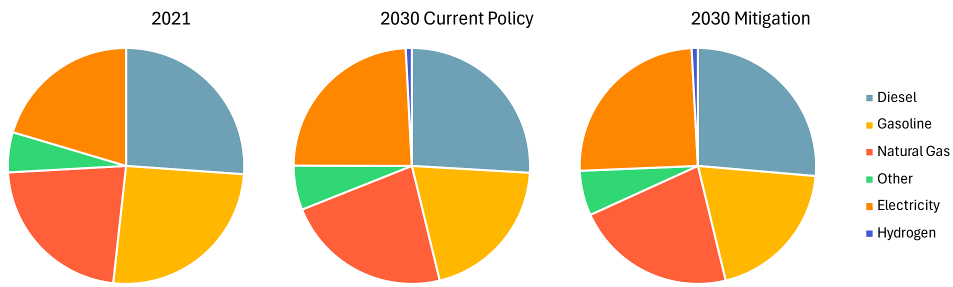


Figure 8 and Table 9 provide a comparison of gross emissions by sector in 2030 compared to 2005 and 2021.

Figure 8. Economywide emissions: 2005, 2021, 2030 emissions by sector (gross emissions)

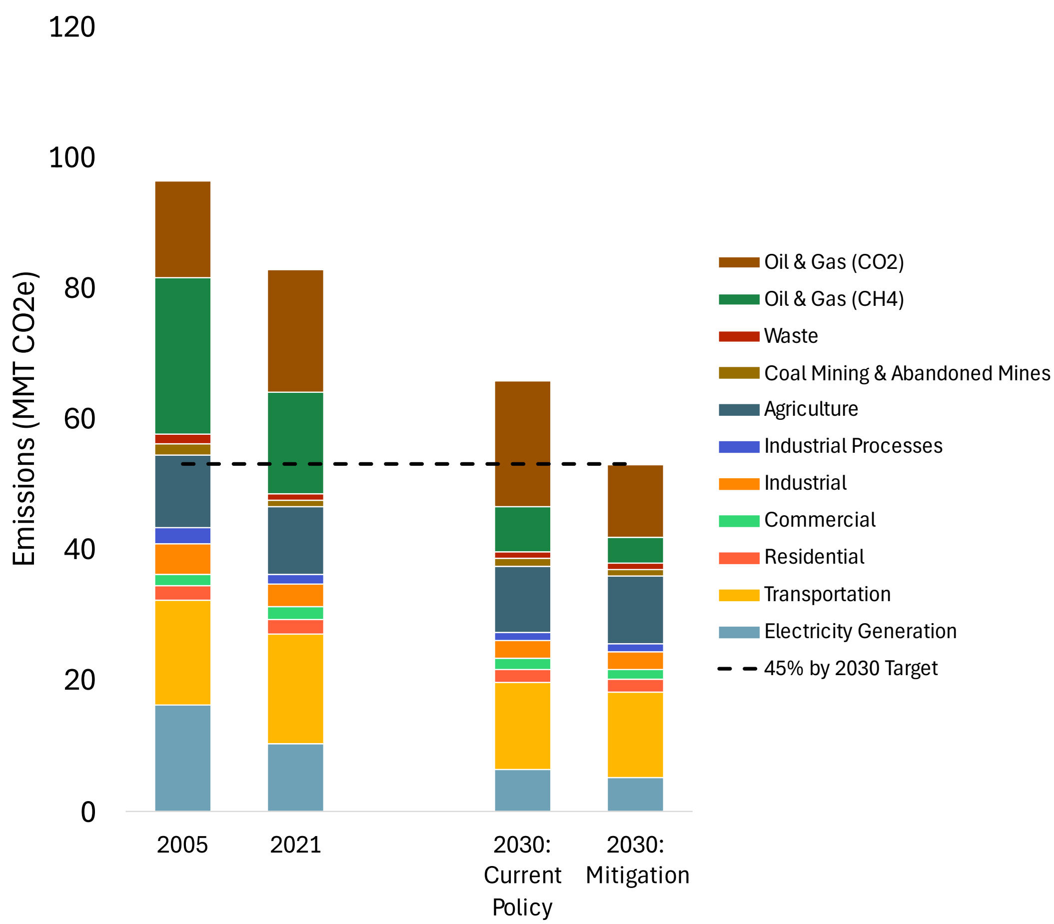


Table 9. Economywide emissions: 2005, 2021, 2030 emissions by sector

Sector	2005 (MMT CO2e)	2021 (MMT CO2e)	2030 Current Policy (MMT CO2e)	2030 Mitigation (MMT CO2e)
Electricity Generation	16.33	10.31	6.40	5.28
Transportation	15.85	16.77	13.22	12.96
Diesel	*5.07*	*7.44*	*6.66*	*6064*
Jet Fuel	*0.95*	*0.47*	*0.52*	*0.52*
Gasoline	*8.27*	*8.30*	*5.42*	*5.18*
Others	*1.56*	*0.56*	*0.6*	*0.61*
Residential	2.37	2.36	2.17	1.99
Commercial	1.70	1.79	1.53	1.43
Industrial	4.68	3.63	2.82	2.82
Industrial Processes	2.53	1.48	1.24	1.24
Agriculture	11.15	10.25	10.21	10.21
Agricultural Soil Management (N_2O)	*5.95*	*5.22*	*4.64*	*4.64*
Field Burning of Agricultural Residues	*0.00*	*0.00*	*0.00*	*0.00*
Enteric Fermentation	*3.51*	*3.58*	*4.01*	*4.01*
Manure Management	*1.67*	*1.41*	*1.52*	*1.52*
Others	*0.01*	*0.04*	*0.04*	*0.04*
Coal Mining & Abandoned Mines	1.69	0.93	1.02	1.02
Waste	1.32	1.06	1.16	1.03
Oil & Gas (CH4)	24.02	15.47	6.76	3.92
Oil & Gas (CO2)	14.80	18.92	19.24	11.16
Total (gross)	**96.4**	**83.0**	**65.7**	**53.0**
Natural & Working Lands	9.57	2.95	2.98	2.98

Results through 2050

Economy-wide emissions results

Figure 9 shows annual economy-wide emissions for the scenarios through 2050. The Current Policy and Mitigation scenarios both see continued emissions reductions through 2050. The Current Policy scenario achieves a 46% reductions in gross emissions by 2050 relative to 2005; the Mitigation scenario achieves 62% reductions by 2050 relative to 2005. As described in the section above, significant emissions reductions are attributed to Current Policy scenario policies, as well as further emissions reductions in the Mitigation scenario. The Mitigation scenario included in this report is meant to provide a sense of scale for what sorts of policies might be necessary to achieve economywide decarbonization, but is not meant to be prescriptive. Note the specific policies included within the Mitigation scenario are described in Table 7, above. This Mitigation scenario includes aggressive mitigation policies such as building and transportation electrification, low-carbon fuels, significant energy efficiency and conservation measures.

Figure 9. Current Policy and Mitigation case emissions forecast through 2050 (gross emissions)

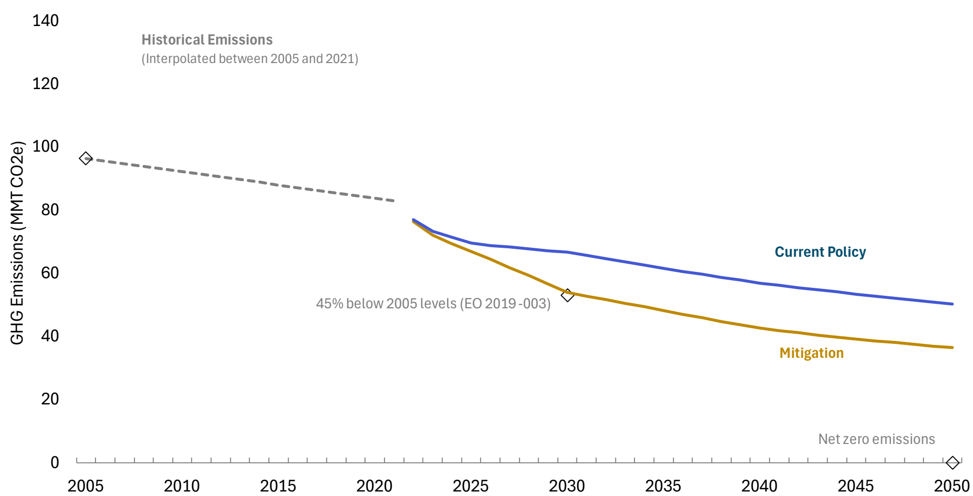


Figure 10 shows the emissions modeled for the oil and gas sector through 2050. Beyond 2030 E3 assumed no change in oil production, emissions intensity of production, or in fugitive methane emissions. This results in a constant oil and gas GHG emissions beyond 2030. This is unlikely to play out, but without reliable forecasts of oil and gas production estimates it is difficult to estimate oil and gas emissions so far into the future. As described previously, the Mitigation scenario shows the level of additional GHG reductions in the oil and gas sector as needed to hit an economy-wide 45% target The mix of GHG reductions attributed to CO2 vs CH4 reductions are not meant to be prescriptive in this analysis and are not meant to indicate the relative level of effort required to achieve incremental reductions in these sub-sectors.

Figure 10. Oil & Gas sector emissions reductions through 2050

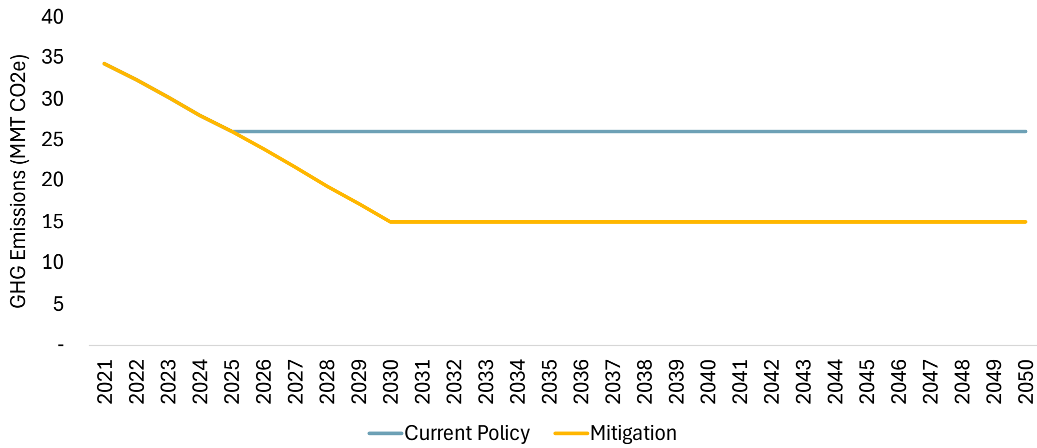


Table 10 shows the growth in electricity sales in the Current Policy and Mitigation scenarios through 2050. Note the ETA requires investor-owned utilities to deliver 80% renewable energy generation by 2040, and 100% carbon-free (not necessarily renewable) by 2045, while rural co-ops must meet this target by 2050.[26]. A full capacity expansion and electricity dispatch model was outside the scope of this analysis, so E3 do not comment explicitly on the reliability or least cost pathways of achieving deeply decarbonized electricity generation. Numerous studies have been undertaken to identify challenges and solutions for decarbonization of the electricity generation sector.[27] These studies are not reviewed here but note that the accounting methodology E3 used in forecasting emissions for electricity generation in this study is agnostic as to the source of decarbonized electricity. New carbon-free resources could include wind, solar, battery storage, nuclear power, fossil units with carbon capture and storage (CCS), hydrogen, or renewable natural gas. Other more detailed analyses have found that at very high levels of renewable electricity, some form of firm dispatchable capacity is required to maintain a reliable and cost-effective electricity system.[28]

[26] New Mexico Interagency Climate Change Task Force, "New Mexico Climate Strategy: Initial Recommendations and Status Update."

[27] Ribera and Sachs, "Pathways to Deep Decarbonization"; Mahone et al., "Deep Decarbonization in a High Renewables Future: Updated Results from the California PATHWAYS Model"; Energy and Environmental Economics Inc., "Pathways to Deep Decarbonization in New York State"; Jenkins, Luke, and Thernstrom, "Getting to Zero Carbon Emissions in the Electric Power Sector."

[28] Public Service New Mexico, "2023 Integrated Resource Plan."

Table 10. Electricity sales by sector, Current Policy and Mitigation scenarios: 2021 -2050 (snapshot years). Units: TWh

Scenario	Sector	2021	2025	2030	2035	2040	2045	2050
Current Policy	Residential	7.09	6.95	6.90	6.96	7.07	7.22	7.38
Current Policy	Commercial	9.09	9.03	9.09	9.12	9.16	9.20	9.29
Current Policy	Industry	9.73	9.85	9.98	10.09	10.19	10.26	10.32
Current Policy	Transportation	0.11	0.52	1.75	3.63	5.34	6.58	7.43
Mitigation	Residential	7.09	6.96	7.05	7.44	7.83	8.16	8.37
Mitigation	Commercial	9.09	9.03	9.15	9.28	9.43	9.60	9.79
Mitigation	Industry	9.73	9.85	9.98	10.09	10.19	10.26	10.32
Mitigation	Transportation	0.11	0.52	1.74	3.64	5.62	7.25	8.41

Figure 11 and Table 11 provide a comparison of emissions by sector in 2050 compared to 2005 and 2021.

Figure 11. Economywide emissions: 2005, 2021, 2030, 2050 emissions by sector (all sectors)

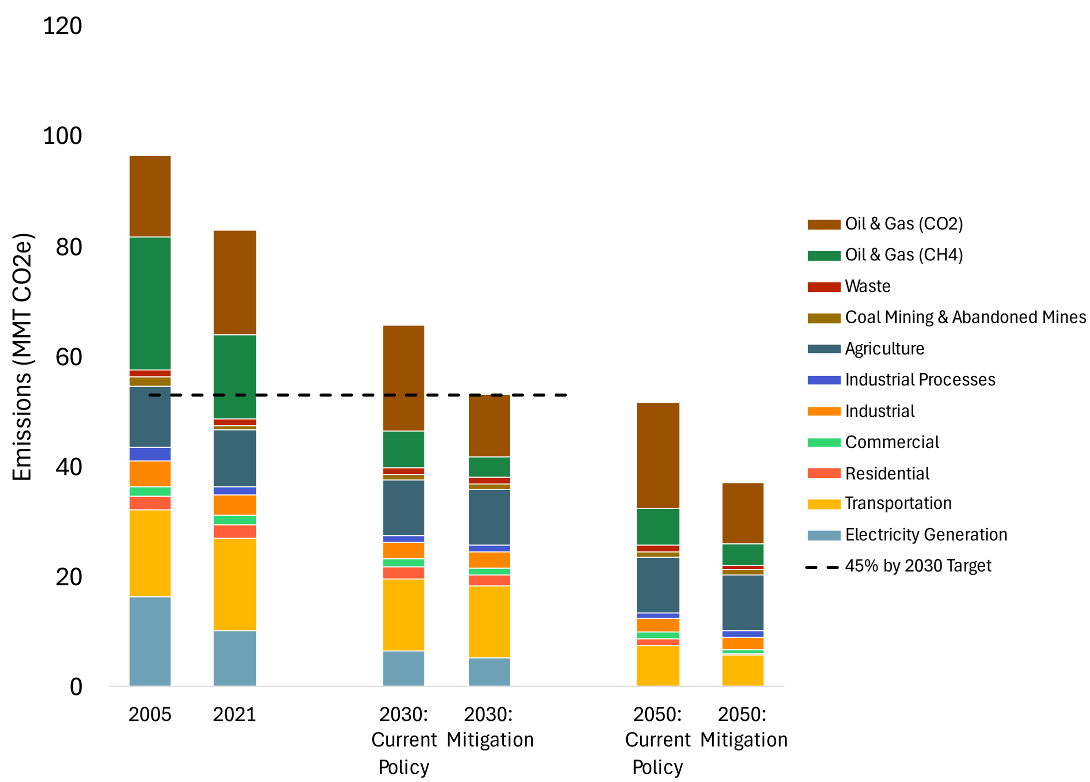


Table 11. Economywide emissions: 2005, 2021, 2050 emissions by sector

Sector	2005 (MMT $CO2_e$)	2021 (MMT $CO2_e$)	2050 Current Policy (MMT $CO2_e$)	2050 Mitigation (MMT $CO2_e$)
Electricity Generation	16.33	10.31	-	-
Transportation	15.85	16.77	7.37	5.87
Diesel	*5.07*	*7.44*	*4.77*	*4.12*
Jet Fuel	*0.95*	*0.47*	*0.71*	*0.71*
Gasoline	*8.27*	*8.30*	*1.32*	*0.49*
Others	*1.56*	*0.56*	*0.58*	*0.55*
Residential	2.37	2.36	1.29	0.23
Commercial	1.70	1.79	1.41	0.70
Industrial	4.68	3.63	2.25	2.25
Industrial Processes	2.53	1.48	1.04	1.04
Agriculture	11.15	10.25	10.21	10.21
Agricultural Soil Management (N_2O)	*5.95*	*5.22*	*4.64*	*4.64*
Field Burning of Agricultural Residues	*0.00*	*0.00*	*0.00*	*0.00*
Enteric Fermentation	*3.51*	*3.58*	*4.01*	*4.01*
Manure Management	*1.67*	*1.41*	*1.52*	*1.52*
Others	*0.01*	*0.04*	*0.04*	*0.04*
Coal Mining & Abandoned Mines	1.69	0.93	1.00	1.00
Waste	1.32	1.06	1.16	0.74
Oil & Gas (CH4)	24.02	15.47	6.76	3.92
Oil & Gas (CO2)	14.80	18.92	19.24	11.16
Total (gross)	**96.4**	**83.0**	**51.7**	**37.1**
Natural and Working Lands	9.57	2.95	2.98	2.98

Figure 12 shows the impact of energy efficiency measures in the Current Policy and Mitigation scenarios by 2050. Both scenarios show significant decrease in overall energy demand due to the paired effects of increased energy efficiency measures, as well as the fuel switching of various fossil fuel demands (such as space heating and vehicles) to electricity. Electric vehicles and heat pump space heaters are significantly more efficient than the fossil replacements, reaching efficiencies of three times or more relative to their counterparts, and therefore electrification of fossil energy demands acts as an efficiency measure.

Figure 12. Economywide annual energy demand by fuel, no oil and gas: 2021 and 2050

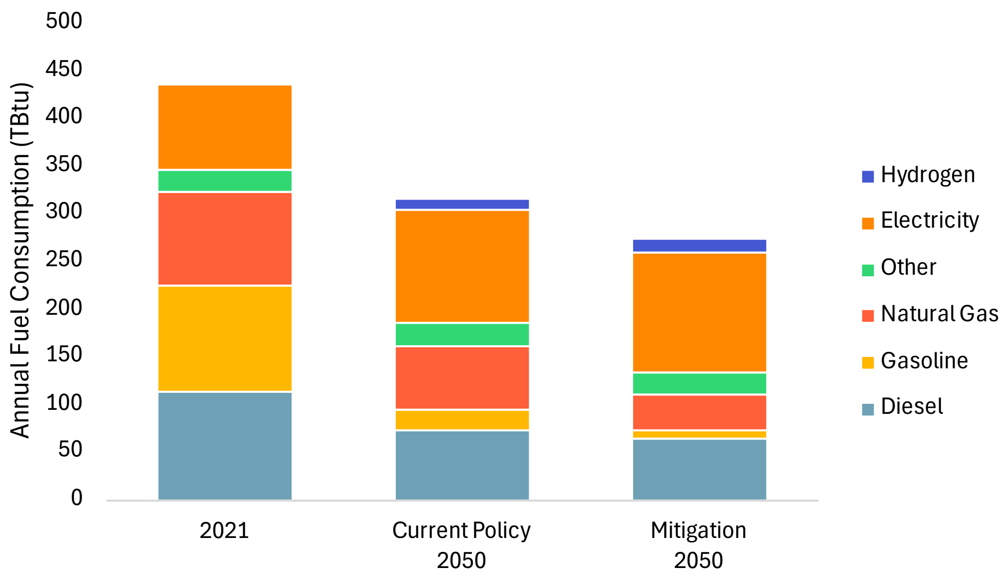
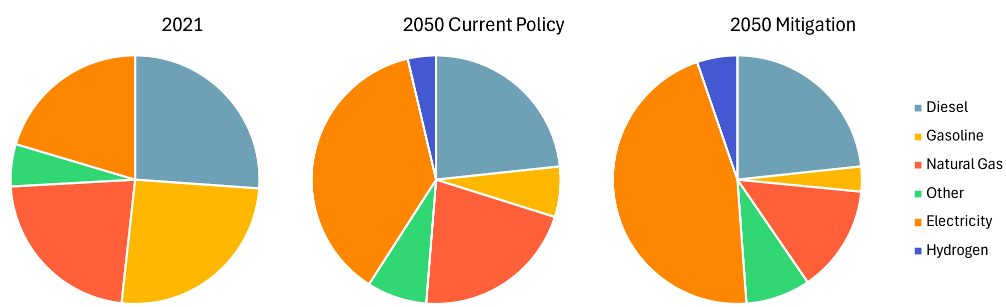


Figure 13. Economywide annual energy demand by fuel, no oil and gas: 2021 and 2050



Conclusion

This report has estimated greenhouse gas emissions in New Mexico for 2005 and 2021 and has produced an analysis of emissions in the state for 2030 and 2050 under two scenarios: one scenario representing federal and state energy and climate policies (Current Policy), and one illustrative scenario representing deep decarbonization measures (Mitigation). Key conclusions are discussed below.

Despite improved methodology, Oil and gas production dominates New Mexico's emissions portfolio. The size of the oil and gas sector in New Mexico make data collection and verification a challenge, however it is consistent that the oil and gas sector is the largest source of greenhouse gas emissions in New Mexico. Further study is needed to identify strategies to reduce emissions associated with up-stream and mid-stream oil and gas production, including decreasing fuel consumption through electrification and further limiting methane leakage. Federal and state action in the oil and gas sector, or lack thereof, can produce significant swings in oil and gas production and emissions forecasts. While this analysis does not account for the most recent federal actions, it is likely that oil and gas will remain the largest source of greenhouse gas emissions in New Mexico, and that further action will be needed in this sector to meet the state's climate goals.

Current policies are key to moving towards deep decarbonization targets economywide. Since Governor Lujan-Grisham signed EO 2019-003, the State has implemented numerous policies that move the state significantly closer to achieving its 2030 carbon target. Key existing policies such as - the New Mexico ETA and federal IRA in the electricity sector; Advanced Clean Cars, Advanced Clean Trucks, the Clean Transportation Fuels Standard, incentives for zero-emission vehicles and charging infrastructure in the transportation sector; more stringent building codes; HFC reductions; and the methane waste and volatile organic compound rules reducing emissions in the oil and gas sector drive significant decarbonization.

Existing statewide policies are not sufficient to meet 2030 carbon goals, and additional policy action is necessary. Although current policies put the State on a path to achieving significant carbon reductions by 2030, the Current Policy scenario does not achieve the 2030 carbon target. Additional action in vehicle electrification, building efficiency and electrification, advanced biofuels, the agriculture sector, and oil and gas sector are needed to achieve a 45% reduction relative to 2005 levels.

To achieve further deep decarbonization beyond the 45% by 2030 target, aggressive action must be pursued across all sectors. The Mitigation scenario illustrates ambitious and broad decarbonization measures across the economy, including electrification and energy efficiency in buildings and industry; electric vehicles in transportation; advanced renewable biofuel usage; full decarbonization of the electricity generation sector by 2050; and significant land use emissions reductions. With these measures in place, the Mitigation scenario achieves further decreases in economywide emissions by 2050. However, other sources of emissions remain, primarily from oil and gas combustion and methane emissions; industrial process and waste emissions; natural and working lands; and agriculture.

The state needs to intensify and accelerate mitigation measures which are in place to be on a pathway to economy-wide deep decarbonization. This could include measures such as earlier saturation of electric vehicles, early retirement of fossil fuel consuming equipment, pursuing further building shell weatherization, or increasing VMT reductions due to further densification or mass transit.

While New Mexico has a challenge in achieving deep decarbonization, current state policies show the potential to significantly reduce greenhouse gas emissions in the state. By continuing to expand these state policies and pursue more aggressive mitigation across the economy, New Mexico is well positioned to move towards deep decarbonization targets economywide.

Bibliography

Abt Associates. "The Emissions & Generation Resource Integrated Database: Technical Support Document for eGRID with Year 2021 Data." Washington, DC: Clean Air Markets Division, Office of Atmospheric Programs, U.S. Environmental Protection Agency, January 2024. https://www.epa.gov/system/files/documents/2024-01/egrid2022_technical_guide.pdf.

California Air Resources Board. "California's 2017 Climate Change Scoping Plan." Sacramento, CA: California Air Resources Board, 2017.

Eastern Research Group. "New Mexico Oil and Gas Greenhouse Gas Emissions Inventory for Year 2005." New Mexico Environment Department, March 1, 2024.

———. "New Mexico Oil and Gas Greenhouse Gas Emissions Inventory for Year 2020." New Mexico Environment Department, Colorado State University Center for the New Energy Economy, August 31, 2022.

Eastern Research Group Inc. "New Mexico Oil and Gas Sector 2025 and 2030 Emissions Forecast." New Mexico Climate Change Bureau, n.d. https://www.env.nm.gov/climate-change-bureau/.

Energy and Environmental Economics Inc. "California PATHWAYS Model Framework and Methods." California Air Resources Board, 2017.

———. "New Mexico Greenhouse Gas Emissions Inventory and Forecast," October 27, 2020. https://cnee.colostate.edu/wp-content/uploads/2021/01/New-Mexico-GHG-Inventory-and-Forecast-Report_2020-10-27_final.pdf.

———. "Pathways to Deep Decarbonization in New York State." San Francisco, CA: Energy and Environmental Economics, Inc., 2020.

Energy Information Administration. "Natural Gas Annual." Energy Information Administration, n.d. https://www.eia.gov/naturalgas/annual/.

Jenkins, Jesse D., Max Luke, and Samuel Thernstrom. "Getting to Zero Carbon Emissions in the Electric Power Sector." *Joule* 2, no. 12 (2018): 2498–2510. https://doi.org/10.1016/j.joule.2018.11.013.

Mahone, Amber, Zachary Subin, Jenya Kahn-Lang, Douglas Allen, Vivian Li, Gerritt De Moor, Nancy Ryan, and Snuller Price. "Deep Decarbonization in a High Renewables Future: Updated Results from the California PATHWAYS Model." San Francisco, CA: California Energy Commission, 2018.

New Mexico Energy, Minerals, and Natural Resources Department. "OCD Statistics." Oil Conservation. Accessed June 14, 2024. https://www.emnrd.nm.gov/ocd/ocd-data/statistics/.

New Mexico Environment Department, and New Mexico Energy, Minerals and Natural Resources Department. "New Mexico Priority Climate Action Plan." Environmental Protection Agency, n.d. https://www.epa.gov/system/files/documents/2024-03/new-mexico-priority-climate-action-plan.pdf.

New Mexico Interagency Climate Change Task Force. "New Mexico Climate Strategy: Initial Recommendations and Status Update," 2019.

"New Mexico Natural Gas Gross Withdrawals and Production." Accessed June 14, 2024. https://www.eia.gov/dnav/ng/NG_PROD_SUM_DC_SNM_MMCF_A.htm.

Public Service New Mexico. "2023 Integrated Resource Plan," n.d. https://www.pnmforwardtogether.com/assets/uploads/PNM-2023-IRP-Report-corrected-2023-12-18.pdf.

Ribera, Teresa, and Jeffrey Sachs. "Pathways to Deep Decarbonization," 2015.

U.S. Energy Information Administration. "A Guide to EIA Electric Power Data." Washington, DC: U.S. Energy Information Administration, 2018.

US Energy Information Administration. “State Energy Data System 2021 Consumption Technical Notes.” Washington, DC: U.S. Energy Information Administration, June 23, 2023. https://www.eia.gov/state/seds/sep_use/notes/use_technotes.pdf.

U.S. Environmental Protection Agency. “Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2022.” Reports and Assessments, April 11, 2024. https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2022.

———. “Recent International Developments under the Montreal Protocol.” Accessed August 20, 2020. https://www.epa.gov/ozone-layer-protection/recent-international-developments-under-montreal-protocol.

———. “State Inventory and Projection Tool.” Microsoft Excel. Washington, DC: State Energy and Environment Program, U.S. Environmental Protection Agency, March 8, 2024. https://www.epa.gov/statelocalenergy/download-state-inventory-and-projection-tool.

Appendix A. Data Tables

Table 12. Data Underlying Figure 2: Historical LULUCF Emissions

Emissions (MMT CO2e)	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020	2021
Industrial Processes (Non-Combustion Emissions)	1.6	2.2	2.5	2.5	2.0	1.8	1.6	1.4	1.4	1.3	1.5	1.5
Agriculture	9.2	10.0	10.4	11.1	11.3	10.8	10.3	11.0	10.7	10.6	10.1	10.2
Coal Mining & Abandoned Mines	0.2	0.3	0.2	1.7	2.2	1.5	1.1	1.0	0.8	0.8	0.4	0.9
Waste	0.8	1.2	1.3	1.3	0.8	1.0	1.1	1.2	1.2	1.2	1.1	1.1
Natural & Working Lands	8.3	8.3	8.1	9.6	10.9	10.9	4.3	3.7	3.8	4.2	1.9	2.9

Table 13. Data Underlying Figures 9/11: Gross Emissions (Snapshot Years)

GHG Emissions (MMT CO2e)	2005	2021	2025	2030	2035	2040	2045	2050
Historical Emissions	96	83						
Current Policy			68	66	61	57	54	52
Mitigation			68	53	47	42	39	37

Table 14. Data Underlying Figure 6: 2030 Energy Demand Compared to 2021 (excluding O&G Sector).

Energy Demand (TBtu)	2021	Current Policy 2030	Mitigation 2030
Diesel	113.77	101.71	101.28
Gasoline	111.51	79.53	76.19
Natural Gas	97.45	89.23	84.39
Other	23.90	23.83	23.61
Electricity	88.77	94.60	95.26
Hydrogen	0.00	3.27	3.27

Table 15. Data Underlying Figure 13: 2050 Energy Demand Compared to 2021 (excluding O&G Sector)

Energy Demand (TBtu)	2021	Current Policy 2050	Mitigation 2050
Diesel	113.77	73.45	63.85
Gasoline	111.51	20.66	8.91
Natural Gas	97.45	67.49	38.08
Other	23.90	24.57	22.99
Electricity	88.77	117.44	125.84
Hydrogen	0.00	11.56	14.37

Table 16. Data Underlying Figure 3: Oil and Gas Sector GHG Emissions

GHG Emissions (MMT CO2e)	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031- 2050
Current Policy	34.39	32.29	30.20	28.10	26.00	26.00	26.00	26.00	26.00	26.00	26.00
Mitigation	34.39	32.29	30.20	28.10	26.00	23.82	21.63	19.45	17.26	15.08	5.08

Table 17. Energy Demand by Sector and Fuel, Snapshot Years (Current Policy) [Units: TBtu]

Scenario	Sector	Fuel	2021	2025	2030	2035	2040	2045	2050
Current Policy	Residential	Diesel	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Gasoline	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Natural Gas	40.5	37.9	35.2	31.8	28.0	24.2	20.7
		Other	3.3	3.0	2.9	2.6	2.4	2.1	1.8
		Electricity	24.2	23.7	23.5	23.7	24.1	24.6	25.2
		Hydrogen	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Commercial	Diesel	1.1	1.1	1.1	1.1	1.0	1.0	1.0
		Gasoline	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Natural Gas	27.8	27.7	27.4	26.9	26.4	25.8	25.3
		Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Electricity	31.0	30.8	31.0	31.1	31.2	31.4	31.7
		Hydrogen	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Industry	Diesel	12.1	11.5	10.8	10.1	9.5	8.8	8.2
		Gasoline	2.7	2.6	2.5	2.3	2.2	2.1	1.9
		Natural Gas	17.7	16.7	15.5	14.3	13.2	12.1	11.1
		Other	14.1	13.8	13.5	13.3	13.1	12.9	12.8
		Electricity	33.2	33.6	34.1	34.4	34.8	35.0	35.2
		Hydrogen	0.0	0.3	0.7	1.1	1.5	1.8	2.2
	Transportation	Diesel	100.6	96.5	89.8	81.9	74.7	68.8	64.3
		Gasoline	108.8	98.6	77.1	52.7	34.6	24.1	18.7
		Natural Gas	11.5	11.4	11.2	11.0	10.8	10.7	10.5
		Other	6.5	6.9	7.4	8.0	8.6	9.3	10.0
		Electricity	0.4	1.8	6.0	12.4	18.2	22.5	25.4
		Hydrogen	0.0	0.9	2.6	4.6	6.4	8.0	9.4

Table 18. Energy Demand by Sector and Fuel, Snapshot Years (Mitigation) [Units: TBtu]

Scenario	Sector	Fuel	2021	2025	2030	2035	2040	2045	2050
Mitigation	Residential	Diesel	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Gasoline	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Natural Gas	40.5	37.7	32.2	22.3	13.5	7.4	4.0
		Other	3.3	3.0	2.7	1.9	1.2	0.6	0.2
		Electricity	24.2	23.7	24.1	25.4	26.7	27.8	28.6
		Hydrogen	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Commercial	Diesel	1.1	1.1	1.0	0.7	0.5	0.3	0.1
		Gasoline	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Natural Gas	27.8	27.7	25.6	21.5	17.8	15.0	13.0
		Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Electricity	31.0	30.8	31.2	31.7	32.2	32.8	33.4
		Hydrogen	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Industry	Diesel	12.1	11.5	10.8	10.1	9.5	8.8	8.2
		Gasoline	2.7	2.6	2.5	2.3	2.2	2.1	1.9
		Natural Gas	17.7	16.7	15.5	14.3	13.2	12.1	11.1
		Other	14.1	13.8	13.5	13.3	13.1	12.9	12.8
		Electricity	33.2	33.6	34.1	34.4	34.8	35.0	35.2
		Hydrogen	0.0	0.3	0.7	1.1	1.5	1.8	2.2
	Transportation	Diesel	100.6	96.4	89.5	80.9	71.8	62.9	55.5
		Gasoline	108.8	96.7	73.7	47.7	27.2	14.2	7.0
		Natural Gas	11.5	11.4	11.2	10.9	10.6	10.3	10.1
		Other	6.5	6.9	7.4	8.0	8.6	9.3	10.0
		Electricity	0.4	1.8	5.9	12.4	19.2	24.7	28.7
		Hydrogen	0.0	0.9	2.6	4.8	7.2	9.9	12.2