2023 Central New Mexico Community-Scale Greenhouse Gas Inventory

Prepared for: The Central New Mexico Comprehensive Climate Action Plan

By: Lotus Engineering and Sustainability

CONTENTS

INTRODUCTION

Six community-scale greenhouse gas emissions inventories were completed for the Central New Mexico region for the calendar year 2023. This includes an inventory for the activities occurring within each of the major local government boundaries - Bernalillo, Sandoval, Torrance, and Valencia Counties, and the City of Albuquerque - and one for the entire Metro Statistical Area (MSA) - the sum of all four county inventories. All inventories are compliant with the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories. The MSA inventory is covered in the following sections.

Background

Data from various sectors were either measured or estimated for the calendar year 2023. Emissions were calculated for stationary energy (emissions associated with generating electricity; or energy generation as part of manufacturing and construction activities); transportation; fugitive emissions (unintentional and undesirable emission, leakage or discharge of gases or vapors from pressure-containing equipment or facilities and components inside plants such as valves and piping); waste and wastewater; industrial processes and product use; and agriculture, forestry, and other land uses. The greenhouse gases included in the inventory cover carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), nitrogen trifluoride (NF_3), and hydrofluorocarbons. The following section includes descriptions of sources, methodology, and results from the greenhouse gas emissions inventory. See Table 1 below for a list of all emission sectors and individual emission sources.

Table 1. Description of GHG emissions sources included in the 2023 MSA GHG Inventory.

Sector	Description
Stationary Energy	Electricity generation. ● Public Service Company of New Mexico. ● Jemez Mountains Electric Cooperative. ● Socorro Electric Co-op (data pulled from the EPA's 861 form). ● Continental Divide Electric Co-op (data pulled from the EPA's 861 form). ● Central New Mexico Electric Co-op (data pulled from the EPA's 861 form). Natural gas. ● New Mexico Gas Company. ● National Renewable Energy Laboratory's State and Local Planning for Energy (NREL SLOPE) tool. Propane. ● Usage data from Ferrellgas Staff also estimated usage data for other local propane providers and wood used in wood stoves for this sector. Stationary diesel data could not be collected. Transmission and distribution losses were estimated from electricity generation data from the U.S. Energy Information Administration (EIA).
Transportation	Data for fossil fuel vehicles, electric vehicles, gas-powered and electric public transit buses, commuter rail, commercial railway activity, jet fuel and aviation gas for airplanes, and fuel usage for off-road vehicles and equipment are included in this sector. It does not include aviation from the US Department of Defense's Kirtland Air Force Base.
Fugitive Emissions from Natural Gas	Fugitive emissions from natural gas leaks are accounted for in this sector. There is no oil and gas extraction activity within the inventory boundary.
Waste and Wastewater	This sector accounts for emissions from landfilled waste and compost, fugitive and process emissions from wastewater treatment, and emissions from septic tanks.
Industrial Processes and Product Use.	Refrigerant leakage from commercial and residential air conditioning systems, as well as emissions from industrial facilities (such as cement plants, power plants and refineries, and data centers) are included in this sector.

Agriculture, Forestry, and Other Land Uses	The agriculture, forestry, and other land uses sector includes emissions from livestock, emissions from urea fertilization and manure, and emissions from soil fertilizers and chemicals. Carbon emissions and removals from forests and urban trees are also included in this sector.

Inventory Methodology and Sources

The Albuquerque MSA greenhouse gas emissions inventory includes emissions data from the City of Albuquerque, as well as the counties that make up the MSA: Bernalillo County, Sandoval County, Torrance County, and Valencia County. The Global Protocol for Community-scale Greenhouse Gas Emissions Inventories provides a transparent and consistent greenhouse gas accounting methodology for reporting community greenhouse gas emissions from carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, and other greenhouse gases. The global warming potentials (GWPs) selected for this inventory are IPCC AR5 100-year GWPs.

Stationary energy

Stationary energy primarily includes electricity and heating fuels used in buildings. Other fuels such as propane, stationary diesel, and wood are also included. The Public Service Company of New Mexico is the primary electricity provider in the MSA, and New Mexico Natural Gas Company is the primary natural gas provider. Electricity and natural gas usage data were provided directly by the utilities in most cases. Additional electricity data was provided by Jemez Mountains Electric Cooperative. As noted in Table D1, data from three electric cooperatives could not be collected, so data from the EPA's 861 forms were used to estimate electricity usage. Staff calculated transmission and distribution losses using state-specific data from the U.S. EIA.

Additionally, natural gas data were unable to be collected for Torrance County, so staff used NREL's SLOPE tool to estimate usage. Additional activity data for commercial propane were provided by FerrellGas. Residential propane usage was estimated using data from the US Census American Community Survey (ACS) and the EIA RECs 2020 survey. Activity data from wood used for home heating were also estimated using the US Census ACS.

Transportation

Emissions for gasoline, diesel, and ethanol vehicles were calculated using vehicle-miles traveled (the amount of travel for all vehicles in a geographic region over an annual period) data from the Mid-Regional Council of Governments (MRCOG); vehicle type breakdowns from the EPA's State Inventory Tool; and vehicle registration data from the New Mexico Motor Vehicle Division. The Atlas EValuate NM Dashboard was used to find electric vehicle data. Transit data for regional fixed routes, dial-a-ride services, and the NM Rail Runner Express were provided by the Rio Metro Regional Transportation District.

The City of Albuquerque provided additional data for transit services specific to the city (ABQ Ride, ART, and Sun Van). The US EPA's National Emissions Inventory provided railway activity data, as well as fuel usage data for off-road vehicles and equipment. Aviation data were provided directly by Albuquerque International Sunport, which is the largest airport in the MSA. Data from the Federal Aviation Administration and the Airport Carbon Emissions and Reporting Tool were used to estimate activity data for a smaller airport in the MSA, Double Eagle Airport. Data from other smaller airports were unavailable.

Fugitive emissions from natural gas leakage

Fugitive emissions data were calculated based on the activity data provided by natural gas utilities. According to the New Mexico Oil Conservation Division, there are no active oil and gas extraction areas within the boundary for this inventory. The only fugitive emissions calculated in this inventory are those that result from natural gas leakage.

Waste and wastewater

The EPA's Facility Level Information on Greenhouse Gases Tool (FLIGHT) provided landfill emissions data for three landfills in the inventory boundary: Cerro Colorado Landfill, Rio Rancho Municipal Landfill, and Sandoval County Landfill. For the Estancia Valley Landfill, data was provided directly by the landfill. Data were unable to be collected for Valencia County Landfill and Southwest Construction and Demolition. Waste data for the City of Albuquerque was provided by the city. Wastewater data were provided directly by the two main wastewater treatment facilities in the region. It was assumed that the remainder of the population in the MSA was served by septic systems.

Industrial processes and product use

Square footage data from each county were used to estimate leakage from residential and commercial air conditioning systems. Square footage data were sourced from Google Environmental Insights Explorer and NREL's SLOPE tool. Industrial facility data from EPA's FLIGHT were used to estimate industrial process emissions.

Agriculture, forestry, and other land uses

The EPA's State Inventory Tool Agricultural Module and the U.S. Department of Agriculture 2022 Agricultural Census were used to calculate emissions from agriculture and land use. The Land Emissions and Removals Navigator (LEARN) tool was used to calculate carbon emissions and removals from forests and urban trees.

INVENTORY RESULTS

Albuquerque MSA's greenhouse gas emissions totaled 10,485,164 metric tons of carbon dioxide equivalent ($MTCO_2e$) in 2023. The total net carbon removed from the atmosphere by trees and forests, or "removals," totaled 482,096 $MTCO_2e$. Subtracting the removals from the total carbon emissions leaves 10,003,068 $MTCO_2e$, representing the Climate Pollution Reduction Grant planning area's net greenhouse gas emissions for 2023.

Table 2. Albuquerque MSA Total GHG Inventory Emissions by Sector ($MTCO_2e$).

Sector	Base Year (2023)	Most Recent Inventory Year (2023)
Commercial and Residential Buildings	4,443,603	4,443,603
Electricity Generation	Included Elsewhere (IE)	IE
Transportation	4,659,838	4,659,838
Industry	529,928	529,928
Agriculture	348,803	348,803
Natural and Working Lands	-482,096	-482,096
Waste and Materials Management	502,992	502,992
Total Emissions	10,485,164	10,485,164
Total Net Emissions	10,003,068	10,003,068

Table 3. Greenhouse Gas Emissions for MSA by Gas, Sector, and Total.

Sector	$MTCO_2$	$MTCH_4$	MTN_2O	MTHFC	$MTCO_2e$
Commercial and Residential Buildings	4,070,608	3,029	24	173	4,443,603
Electricity Generation	IE	IE	IE	IE	IE
Transportation	4,600,411	251	75	0	4,659,838
Industry	422,582	295	51	6	529,928
Agriculture	589	9,771	282	0	348,803
Natural and Working Lands	-482,096	0	0	0	-482,096
Waste and Materials Management	0	17,870	10	0	502,992
Total Emissions	9,094,190	31,215	442	179	10,485,164
Total Net Emissions	8,612,094	31,215	442	179	10,003,068

Table 4. Total Emissions by Jurisdiction.

Boundary	Total emissions ($MTCO_2e$)	Removals ($MTCO_2e$)	Net emissions ($MTCO_2e$)
City of Albuquerque	5,530,317	-7,091	5,530,317
Bernalillo County	7,401,735	-55,112	7,346,623
Sandoval County	1,586,227	-111,269	1,474,958
Torrance County	777,674	-297,204	480,470
Valencia County	719,528	-18,511	701,017
Total MSA	10,485,164	-482,096	10,003,068

Figure 1. Results by County and Sector.

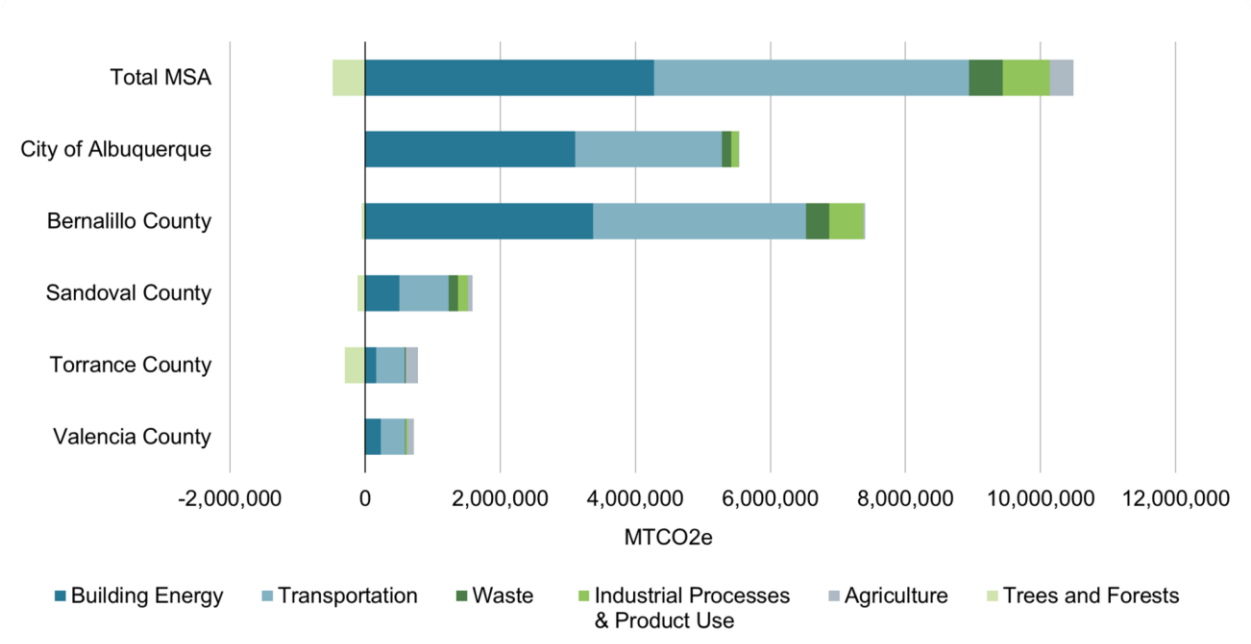
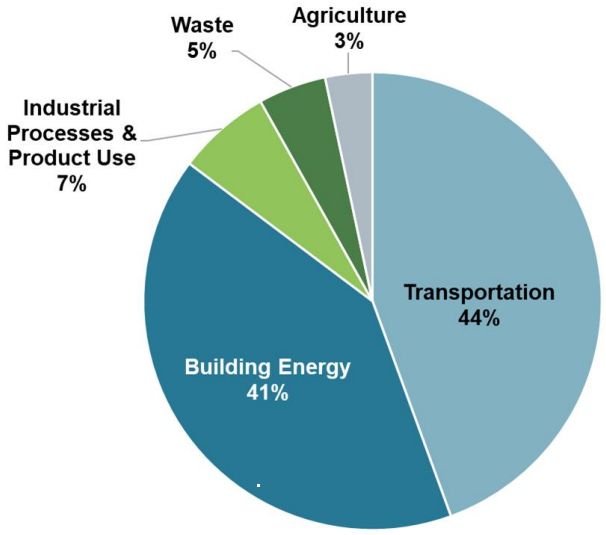


Figure 1 divides emissions by county and sector. Bernalillo County generates the most emissions, taking up almost 75 percent of total MSA emissions. For most counties, the two largest emissions sectors are building energy use and transportation. Bernalillo County and Sandoval County have a larger share of waste and industrial process and product use emissions than other counties. Torrance and Valencia counties have more emissions from agriculture than other counties. Most carbon sequestration from trees and forests comes from Sandoval and Torrance counties.

Totaling county emissions demonstrates that the largest emission sector is transportation at 44 percent of total emissions. Building energy use comes next at 40 percent. Industrial processes and product use emissions come next at seven percent, followed closely by waste and wastewater at six percent. Emissions from agriculture create three percent. This emissions makeup is depicted in Figure 2.

Figure 2. MSA Results by Sector.

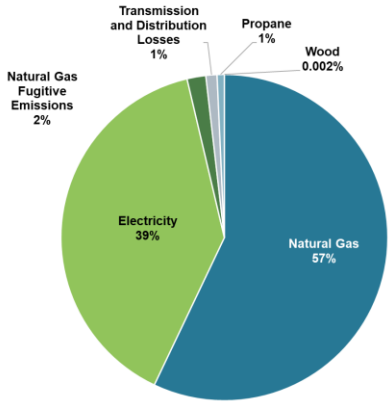


Results by sector

Stationary energy sector

Within the stationary energy sector, natural gas usage accounts for the largest share of emissions at 57 percent. Electricity usage follows at 39 percent. Fugitive emissions from natural gas make up two percent, propane and transmission and distribution losses both make up one percent, and wood makes up less than one percent.

Figure 3. MSA Stationary Energy Emissions by Source.

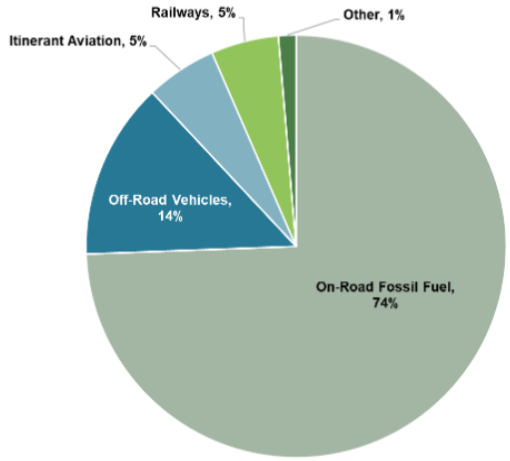


Transportation sector

In the transportation sector, on-road vehicles with internal combustion engines create the most emissions, taking up 74 percent of all transportation emissions. Off-road vehicles and

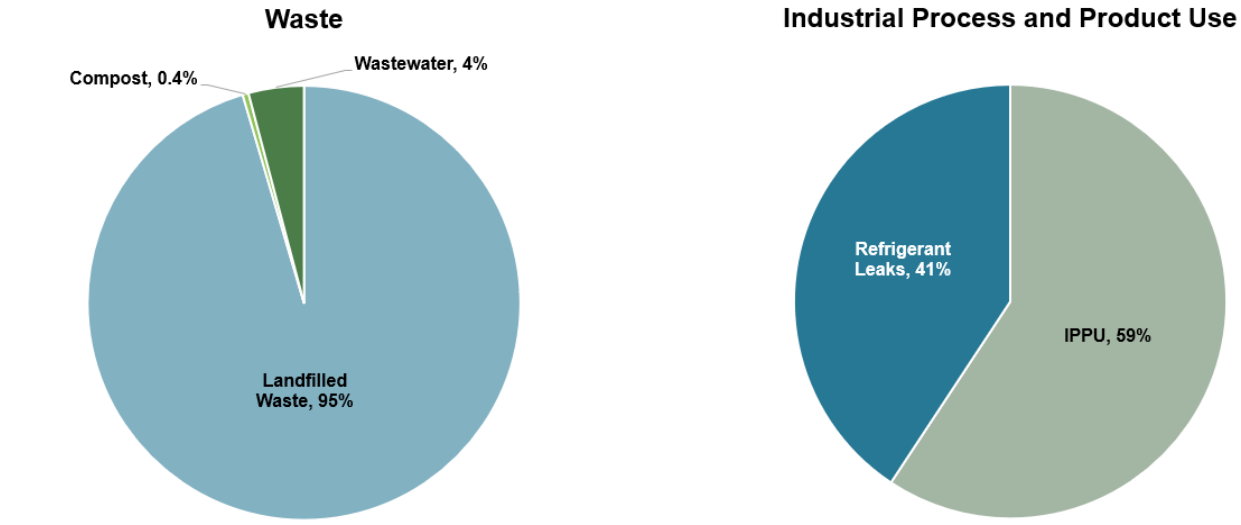
equipment make up 14 percent. International aviation (or flights that go into or out of the Albuquerque International Sunport) makes up six percent, and railway activity makes up five percent. All other sources of transportation-related emissions (electric vehicles and associated transmission and distribution losses, fuel usage and electricity usage from public transit, and fuel use at Double Eagle Airport) make up one percent combined.

Figure 4. MSA Transportation Emissions by Source.



Remaining sectors

Figure 5. MSA Waste and Industrial Process and Product Use Emissions by Source.



In the waste and wastewater sector, landfilled waste comprises most of the emissions at 96 percent. Wastewater emissions make up four percent and compost emissions make up less than one percent. The industrial processes and product use sector only contains two sources of emissions. Industrial processes make up 59 percent of this sector and industrial product use (specifically, emissions from refrigerant leakage) makes up 41 percent. The agriculture, forestry and other land uses sector includes emissions from agricultural practices; this sector alone makes up three percent of total MSA emissions. The sector also includes 482,096 $MTCO_2$ sequestered by trees and forests.

INVENTORY TRENDS AND ANALYSIS

In addition to an inventory of the MSA's community-scale greenhouse gas emissions, a business-as-usual (BAU) model was developed to estimate how emissions could change in the future with no additional local climate action work. As no previous inventory has been done for the MSA, the baseline year and the most recent inventory year are the same. Activity and emissions data are projected from 2023 to 2050 by incorporating anticipated changes from known sources such as current population and employment trends, on-the-books policies, and behaviors that can be expected to occur in the future. According to the BAU, **emissions are expected to decrease 14 percent from the 2023 baseline year by 2030 and 35 percent from the baseline by 2050**. In the case that more adoption of electric vehicles occurs, emissions are expected to decrease 15 percent from the baseline by 2030 and 43 percent from the baseline by 2050 when using the low EV adoption scenario. For more information on the high EV adoption scenario, view page 11.

Methodologies

Electric Grid

The BAU accounts for expected changes in the emissions intensity of the electricity grid. The MSA receives electricity from The Public Service Company of New Mexico (PNM) and from a

variety of rural co-ops that procure electricity from Tri-State Generation and Transmission Association (Tri-State). Per PNM's latest Integrated Resource Plan, the utility expects to achieve carbon-free electricity by 2040. Rural co-ops are assumed to achieve carbon-free electricity by 2050 per the Energy Transition Act. These goals are included in the BAU as they reflect on-the-books policies and plans that are likely to occur even in the absence of any action taken through this CCAP.

Building Energy

The BAU building energy emissions projections account for new residential and commercial development, continued application of the 2021 International Energy Conservation Code (IECC) for new construction, and limited adoption of high-efficiency electric equipment (e.g., heat pumps and heat pump water heaters) in the MSA.

New residential and commercial construction forecasts, developed based on expected changes in households and employment in the MSA, were used to estimate growth in energy use from buildings. New construction was assumed to be developed in alignment with the 2021 IECC.

As the market for high-efficiency electric equipment in buildings continues to grow, the BAU assumes that some adoption of these equipment types will occur in the MSA even in the absence of any actions to incentivize their use. A low high-efficiency equipment adoption scenario from the National Renewable Energy Laboratory's Electrification Futures Study was used to estimate the share of new equipment sales each year that would be a heat pump or heat pump water heater. This share is applied to the percentage of buildings each year that are likely to replace their space or water heating equipment (based on average equipment lifespan). Changes in natural gas, propane, and electricity consumption for the stock of buildings replacing equipment are then estimated.

The BAU also accounts for the effects of climate change on heating and cooling energy usage. Projected changes in heating and cooling degree days were obtained from NREL's SLOPE tool for the MSA. These projections reflect Representative Concentration Pathways 4.5 and 8.5. Energy used for space heating and cooling is estimated to change in proportion with the change in heating or cooling degree days.

The inventory reported a small amount of wood used for building energy. Wood consumption is held constant in the BAU, as it is unknown how wood usage will change over time.

Transportation

Forecasted on-road vehicle miles traveled and fuel consumption accounts for expected population growth, fuel efficiency improvements, and some electric vehicle (EV) adoption.

Due to the uncertainty of federal EV tax credits and their impacts on EV adoption over time, two EV adoption scenarios were modeled to provide upper and lower bounds for the BAU:

- Low:
    1. This scenario was developed from NREL's Electrification Futures Study (EFS) using stock vehicle information for New Mexico under the reference electrification scenario.

2. This scenario models a small growth in EV adoption over time of up to 8% of passenger vehicles, 4% of light trucks, and 0% of transit buses, medium trucks, heavy trucks, and motorcycles by 2050.

- High:

1. The high electrification scenario was developed from Rocky Mountain Institute's Energy Policy Simulator (EPS) for New Mexico in their modeled BAU scenario. The EPS's BAU scenario includes on-the-books policies in New Mexico or expected to be on the books by the end of 2023 to assess the impact of New Mexico's climate policy portfolio. These policies include federal EV tax credits from the IRA, Advanced Clean Trucks and Low NOx rules for medium and heavy-duty vehicles, and Advanced Clean Cars I & II. The data pulled from EPS has been saved on file.
2. This scenario models a high growth in EV adoption over time of up to 80% EV adoption of cars and buses, ~58% of light and medium freight trucks, 41% of heavy freight trucks, and 31% of motorbikes by 2050.

CAFE standards, which account for expected improvements to vehicle efficiency, are also taken into account for transportation. Projected light-duty internal combustion engine fuel efficiencies were obtained from the EIA's Annual Energy Outlook for 2023. Medium- and heavy-duty and transit vehicle internal combustion engine projected fuel economy data is obtained from NREL's Annual Transportation Baseline (ATB) data (spreadsheet on file). It is assumed that medium-duty and bus fuel economies will improve at the same rate as class 6 vehicles and heavy-duty vehicles will improve at the same rate as class 8 vehicles in NREL's ATB data. The mid-case scenario with EPA65 test cycles was used for forecasting fuel efficiencies.

Other non-road transportation activities are forecasted as follows:

- Aviation activity and emissions are expected to change at the same rate as the population.
- Emissions from off-road fuel usage and railway activity are held constant.

Waste and Wastewater

Emissions from residential and commercial solid waste are expected to follow population growth in the MSA. Construction and demolition waste is projected to change at the same rate as new construction square footage. The share of waste diverted to recycling or composting streams is held constant in the BAU. Wastewater emissions are also expected to increase at the same rate as Albuquerque MSA’s population. No changes to wastewater treatment methods or technology are included in the BAU.

Industrial Processes and Product Use

Refrigerant usage is projected to grow at the same rate as residential household growth and commercial and industrial square footage. Refrigerant emissions are expected to decrease over time following restrictions on the usage of HFC refrigerants from the American Innovation and Manufacturing (AIM) Act. Industrial process emissions are held constant. Note that some growth in industrial process emissions is expected due to the addition of data centers to the MSA. At

the time of development of this BAU, inadequate information was available about these projects to include.

Agriculture, Forestry, and Other Land Use

Projected emissions from livestock, land, and forest carbon sequestration are held constant.

Business-As-Usual Projections Results

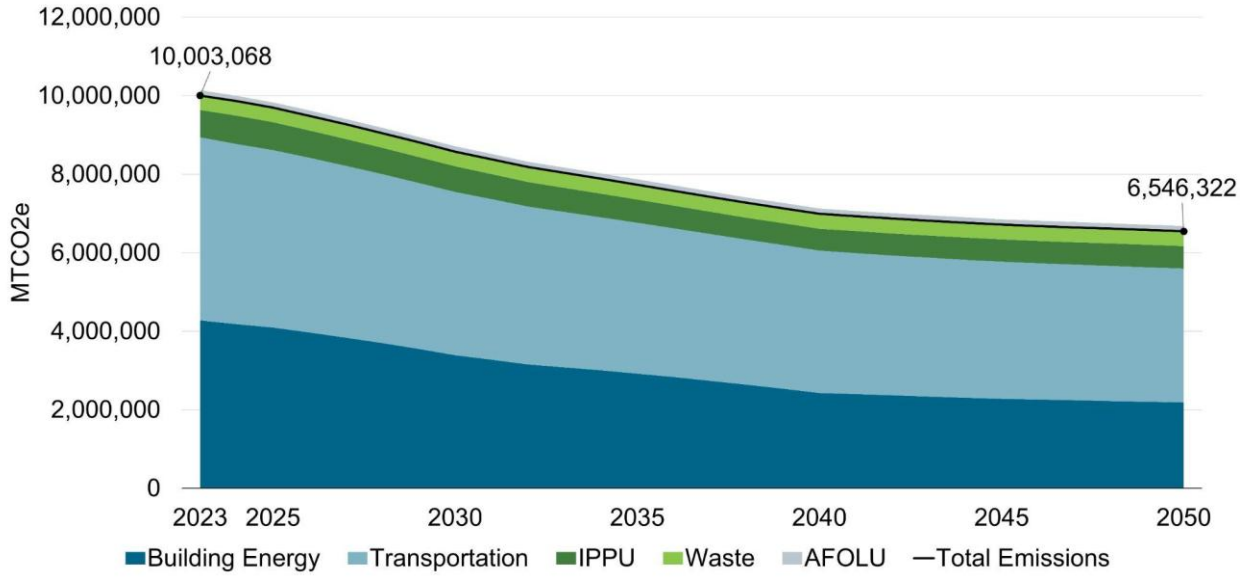
According to the BAU, emissions are projected to decrease from 10,003,068 $MTCO_2e$ to 8,576,260 $MTCO_2e$ between 2023 and 2030 in a low EV adoption scenario. Emissions are projected to decrease to 6,546,322 $MTCO_2e$ by 2050 in this scenario. This is a 14 percent decrease by 2030 and a 35 percent decrease by 2050. In a high EV adoption scenario, emissions are expected to decrease to 8,486,023 $MTCO_2e$ by 2030 and 5,715,117 $MTCO_2e$ by 2050. This amounts to a decrease of 15 percent by 2030 and a decrease of 43 percent by 2050.

Table D5. Business-As-Usual Emissions by Sector in the Albuquerque MSA from 2023-2050.

Sector	Base Year Emissions (2023) ($MTCO_2e$)	Most Recent Inventory Year Emissions (2023) ($MTCO_2e$)	Short-Term BAU Projection Year (2030) ($MTCO_2e$)	Long-Term BAU Projection Year (2050) ($MTCO_2e$)
Building Energy	4,280,832	4,280,832	3,392,160	2,187,241
Transportation (Low EV Scenario)	4,659,838	4,659,838	4,157,861	3,406,699
Transportation (High EV Scenario)	4,659,838	4,659,838	4,067,624	2,575,494
Waste and Wastewater	502,992	502,992	511,049	509,477
Industrial Processes and Product Use	692,698	692,698	648,483	576,198
Agriculture, Forestry, and Other Land Use	-133,293	-133,293	-133,293	-133,293
Total Emissions (low EV adoption scenario)	10,003,068	10,003,068	8,576,260	6,546,322
Total Emissions (high EV adoption scenario)	10,003,068	10,003,068	8,486,023	5,715,117

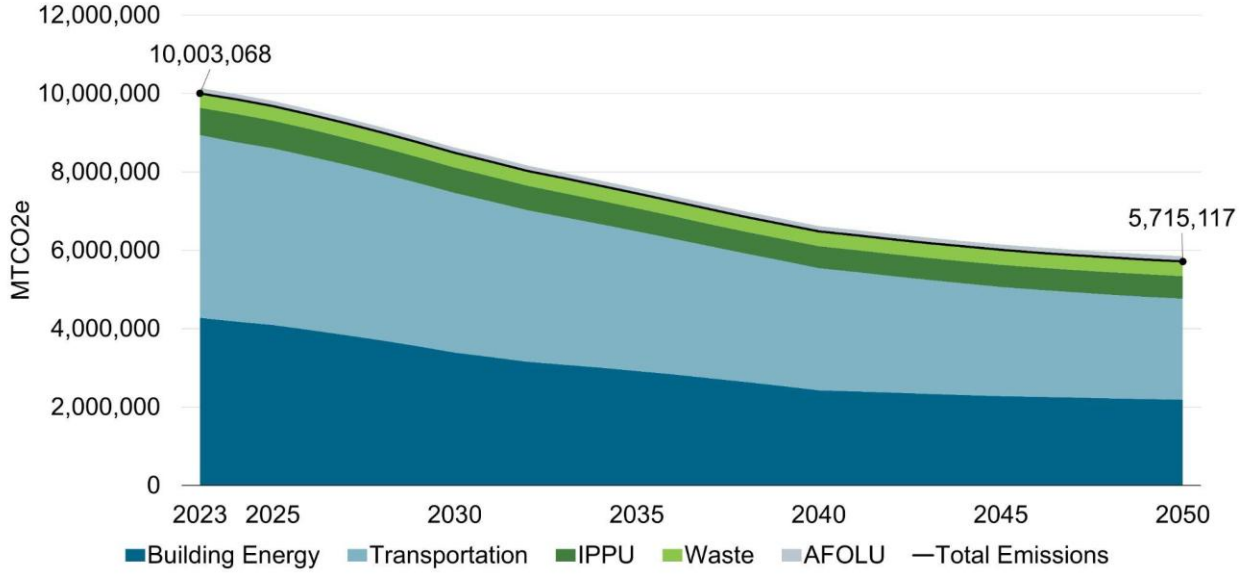
The building energy sector is projected to see a 49 percent decrease in emissions by 2050, the transportation sector is projected to decrease 27 percent in a low EV adoption scenario, the waste and wastewater sector is projected to increase one percent, the industrial processes and product use sector is projected to decrease 17 percent, and no change is expected in the agriculture, forestry, and other land use sector. Figure 6 shows BAU results in the low EV adoption scenario, and Figure 7 shows BAU results in the high EV adoption scenario.

Figure 6. Business-As-Usual Emissions from 2023 to 2050 in a Low EV Adoption Scenario.



In a high EV adoption scenario, the building energy sector is projected to see a 49 percent decrease in emissions by 2050, the transportation sector is projected to decrease 45 percent, the waste and wastewater sector is projected to increase one percent, the industrial processes and product use sector is projected to decrease 17 percent, and no change is expected in the agriculture, forestry, and other land use sector. See Figure 7 below.

Figure 7. Business-As-Usual Emissions from 2023 to 2050 in a High EV Adoption Scenario.



The largest emissions sectors remaining in 2050 are building energy and transportation — even in the high EV adoption scenario. Focusing strategies on reducing fossil fuel use in these

sectors will be the most effective approach for achieving emissions reductions in the ABQ MSA. Waste emissions are projected to increase slightly over that time, highlighting the importance of waste reduction and diversion initiatives. Lastly, while carbon sequestration is not projected to change over time, protecting trees and forests is vital to retain their benefits.

SCIENCE-BASED TARGETS

Methodologies

The One Planet City Challenge (OPCC) approach is based on the latest data from IPCC's Special Report on Global Warming of 1.5℃. It includes considerations of fair emissions budget allocations compatible with 1.5℃. It is compliant with the Global Covenant of Mayors and CDP reporting requirements.

Data Requirements

- Community-wide Human Development Score Index (HDSI) - **use USA HDSI of 0.921**[1]
- Community-wide emissions baseline close to 2018 (typically 2016 - 2019 is acceptable)
- If the above is not available, apply backcasting of emissions where the existing inventory total emissions in Scope 1 & 2 are divided by the same year's population. Apply that per capita value to the population of the community in 2018.

Results

Using the data described above, the Albuquerque MSA's science-based emissions target is 62% reduction in scope 1 and 2 emissions from 2023 emissions by 2030. This equates to a total emissions value of 3,697,465 $MTCO_2e$ in scope 1 and 2 emissions in 2030.

CONCLUSION & NEXT STEPS

The 2023 Central New Mexico Community-Scale Greenhouse Gas Inventory estimates that the region produced 10,485,164 $MTCO_2e$. Combined with the Business-as-Usual and Science-based Target calculations, the inventory makes clear that without bold additional action, emissions will remain much higher than what climate science—and community well-being—requires. To close that gap, the next phase of work includes developing a strategy model and a Comprehensive Climate Action Plan that shows how specific actions across transportation, buildings, land use, waste, and energy can meaningfully cut emissions. The City of Albuquerque will also commission a 2025 Community-Scale GHG Inventory, creating a regular rhythm for tracking progress, adjusting course, and holding institutions accountable over time.

Additional information on the inventories can be found at https://www.resilientfuturesnm.org/ or https://www.cabq.gov/sustainability/regional-planning-efforts.

[1] USA HDSI was 0.921 at the time of the initial SBT movement. The Global Average was 0.721. Both have risen in the latest HDSI report, March 2024, to 0.927 and 0.739, respectively.