Local Governments for Sustainability USA

Santa Fe County, New Mexico

2023 Community GHG Climate Action Plan

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NBS Workshops: Santa Fe County Public Works Department

NBS Workshops: Santa Fe County Community Services Department

NBS Workshops: Santa Fe County Fire Department

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Abbreviations

CMIP	Coupled Model Intercomparison Project
GHG	Greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
NCCV	National Climate Change Viewer
NCEI	National Centers for Environmental Information
NOAA	National Oceanic and Atmospheric Administration
PSI	Pounds per square inch
RCP	Representative Concentration Pathway
USGS	U.S. Geological Survey
VPD	Vapor pressure deficit

Executive Summary

This plan presents forecasted business as usual community and government operations greenhouse gas (GHG) emissions for Santa Fe County, NM, and presents a plausible, practicable plan to reduce community GHG emissions by 58% between 2019 and 2030. This represents a science-based target that will allow Santa Fe County to do its part in keeping average global temperatures below the critical threshold of 1.5°C (2.7°F) above pre-industrial temperatures.

The plan includes specific annual emissions reduction targets for seven sectors: transportation; residential buildings; commercial buildings; energy production; waste and recycling; water and wastewater management; and nature-based emissions and removals. The plan recommends ways of achieving those targets, specifically taking into account the local priorities of Santa Fe County, including plans to increase tree coverage in the County, increase surface water capture, and improve soil health, as well as a planned effort to increase housing affordability by reducing utility costs to low income residents.

If the County can successfully implement these strategies, prioritized by impact, then the 2030 GHG emissions target is possible, and net zero emissions can be achieved by 2050, as shown in Table 1.

Table 1: Amount of greenhouse gas emissions reduction possible with low, medium, or high effort.

Effort	Low	Medium	High
Percent reduction from 2019 to 2030	**26.7**	**54.0**	**76.9**
Percent reduction from 2019 to 2050	**53.8**	**98.0**	**104.1**

This plan seeks to lay the foundation for future integrated planning efforts that bring together the County's efforts to 1) mitigate GHG emissions and 2) adapt to climate change related hazards. The plan's Climate Conditions Report outlines emerging risks and the projections of future climate and community needs related to rising temperatures, extreme rainfall, flooding, drought, and wildfire.

ICLEI USA developed this plan in partnership with the County. ICLEI is the first and largest global network of local governments devoted to solving the world's most intractable sustainability challenges. Our standards, tools, and programs credibly, transparently, and robustly reduce GHG emissions, improve lives and livelihoods and protect natural resources in the communities we serve.

Climate Change in Santa Fe

Introduction

This section of the plan summarizes Santa Fe County's exposure to climate-related hazards by synthesizing research and data about current hazards, trends, and possible future conditions. Data points from climate projections are included, when available. Further information was drawn from scientific reports and academic articles, which are referenced in the text.

Definitions

The definitions used in this report are reprinted from multiple sources, including the U.S. Climate Resilience Toolkit glossary, Intergovernmental Governmental Panel on Climate Change (IPCC) Annex II 2014 and 2022 glossaries, and other sources as cited. Note that some definitions have been adapted for readability and relevance.

Aridity: The state of a long-term climatic feature characterized by low average precipitation or available water in a region.[1]

Baseline: The baseline, which may also be referred to as a reference period, is the state against which change is measured.[2] In this report, the baseline typically refers to the average across a modeled historical period.

Climate change: A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.[3]

Climate models: Mathematical models that simulate the physical, chemical, and biological processes that influence the climate system.[4]

Climate projections: Simulated responses of the climate system to a scenario of future concentrations of greenhouse gases (GHGs) and aerosols, along with changes in land use, generally derived using climate models. Climate projections vary based on the

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[1] IPCC, "Annex II: Glossary," AR6 (Cambridge, UK and New York, USA, 2022), https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_Annex-II.pdf.
[2] IPCC, "Annex II: Glossary," AR5 (Cambridge, UK and New York, USA, 2014), https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_Annex-II.pdf.
[3] IPCC, "Annex II: Glossary," 2022.
[4] USGCRP, "Glossary," GlobalChange.gov, accessed February 21, 2023, https://www.globalchange.gov/climate-change/glossary.

emission/concentration/radiative forcing scenario used; these scenarios in turn are based on assumptions concerning, for example, future emissions and socioeconomic and technological developments that may or may not be realized.[5]

Drought: An exceptional period of water shortage for existing ecosystems and the human population (due to low rainfall, high temperature and/or wind).[6]

Ensemble modeling: Using a collection of climate model simulations to characterize a climate projection.[7]

Evapotranspiration: The combined processes through which water is transferred to the atmosphere from open water and ice surfaces, bare soil and vegetation that make up the Earth's surface.[8]

Exposure: The presence of people, assets, and ecosystems in places where they could be adversely affected by hazards.[9]

Extreme weather event: An extreme weather event is an event that is rare at a particular place and time of year. By definition, the characteristics of what is considered an extreme weather event vary from place to place.[10]

Greenhouse gas (GHG): Gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of radiation emitted by the Earth's ocean and land surface, by the atmosphere itself and by clouds. This property causes the greenhouse effect. Water vapor, carbon dioxide, nitrous oxide, methane and ozone are the primary GHGs in the Earth's atmosphere.[11]

Hazard: An event or trend that may cause injury, illness, or death to people or damage to community assets. In this report the term "hazard" primarily refers to climate-related physical events or trends.[12]

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[5] IPCC, "Annex II: Glossary," 2022.
[6] IPCC.
[7] IPCC, "Annex II: Glossary," 2014.
[8] IPCC, "Annex II: Glossary," 2022.
[9] U.S. Federal Government, "Glossary," U.S. Climate Resilience Toolkit, accessed February 20, 2023, https://toolkit.climate.gov/content/glossary.
[10] IPCC, "Annex II: Glossary," 2014.
[11] IPCC.
[12] U.S. Federal Government, "Glossary"; IPCC, "Annex II: Glossary," 2014.

Hydrological drought: A period with large runoff and water deficits in rivers, lakes and reservoirs.[13]

Megadrought: A very lengthy and pervasive drought, lasting much longer than normal, usually a decade or more.[14]

Meteorological drought: A period with an abnormal precipitation deficit.[15]

Monsoon: A monsoon is a tropical and subtropical seasonal reversal in both the surface winds and associated precipitation, caused by differential heating between a continental-scale land mass and the adjacent ocean.[16] Monsoons result in a pattern of wet summers and dry winters.[17]

Palmer Drought Severity Index: The Palmer Drought Severity Index attempts to measure the duration and intensity of the long-term drought-inducing circulation patterns.[18]

Radiative forcing: The change in the net, downward minus upward, radiative flux at the tropopause or top of the atmosphere due to a change in an (external) driver of climate change, such as a change in the concentration of carbon dioxide, the concentration of volcanic aerosols or the output of the sun.[19]

Representative Concentration Pathway (RCP): Scenarios that include time series of emissions and concentrations of the full suite of GHGs and aerosols and chemically active gases, as well as land use/land cover. Four RCPs are used in the IPCC Fifth Assessment Report, which span the range from approximately below 2°C warming to high (>4°C) warming best-estimates by the end of the 21st century: RCP2.6, RCP4.5 and RCP6.0, and RCP8.5.[20]

Vapor pressure deficit (VPD): The difference between the amount of moisture in the air and maximum amount of water the air can hold at saturation (which is determined by temperature).[21]

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[13] IPCC, "Annex II: Glossary," 2022.
[14] IPCC.
[15] IPCC.
[16] IPCC, "Annex II: Glossary," 2014.
[17] National Weather Service, "North American Monsoon Highlights," weather.gov, accessed March 18, 2023, https://www.weather.gov/abq/northamericanmonsoon-intro.
[18] NOAA National Centers for Environmental Information (NCEI), "Historical Palmer Drought Indices," Drought.gov, accessed March 18, 2023, https://www.ncei.noaa.gov/access/monitoring/historical-palmers/overview.
[19] IPCC, "Annex II: Glossary," 2022.
[20] IPCC.
[21] Adrian Broz et al., "A Record of Vapour Pressure Deficit Preserved in Wood and Soil across Biomes," *Scientific Reports* 11, no. 1 (January 12, 2021): 662, https://doi.org/10.1038/s41598-020-80006-9.

About Climate Models and Projections

Climate projections are the outputs of climate models, which are built on a series of assumptions about the earth system and future GHG emissions. Climate projections are not predictions for the future, but should instead be considered as an approximation of the range of possible future conditions. This is why it is important to view them in terms of multi-year averages, ranges, and trends. Climate projections are helpful tools that can be used to inform future planning; however, it is not appropriate to use them as the sole foundation for decision-making.[22] In this report, climate projections are compiled from the National Climate Change Viewer (NCCV), Climate Explorer, and Risk Factor platforms.

Most of the projections used in this report are derived from climate models of the Coupled Model Intercomparison Project Phase 5 (CMIP5) developed for the IPCC Fifth Assessment Report. CMIP model output typically has a coarse spatial resolution. To produce finer resolution, locally relevant data, various statistical downscaling techniques are applied. In this report, projections are provided on the county level. For more information about models and downscaling techniques, refer to the data platform technical documentation in the Data Platforms appendix.

Climate data included in this report uses an ensemble modeling approach. In ensemble modeling, a collection of climate model simulations is used to characterize a climate projection, instead of one model or scenario alone.[23] Using an ensemble approach has been shown to increase the reliability and skill of model projections and help to characterize the level of confidence and uncertainty of results.[24]

Except where noted, future projections are compared to the baseline, which is a simulation of historical climate, not historical observations. These historical simulations may also be referred to as modeled history. Most projections are presented as averages over 10- or 25-year periods (e.g. 2025-2049), which is standard for analyzing future climatological values. Graphs display the range of projections (10th and 90th percentiles) in addition to the model median.

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[22] U.S. Federal Government, "Frequently Asked Questions," U.S. Climate Resilience Toolkit Climate Explorer, 2021, https://crt-climate-explorer.nemac.org/faq/.
[23] IPCC, "Annex II: Glossary," 2014.
[24] Claudia Tebaldi and Reto Knutti, "The Use of the Multi-Model Ensemble in Probabilistic Climate Projections," *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* 365, no. 1857 (August 15, 2007): 2053–75, https://doi.org/10.1098/rsta.2007.2076.

Modeling Extreme Events

Modeling risk of extreme events like flooding and wildfire is complex due to the variety of factors at play in these hazards.[25] For flooding, climatic changes in rainfall and snowmelt are key drivers; however, other human and natural factors, including seasonality, urbanization, land use change, dams, and stormwater and agricultural management practices are also highly relevant. Wildfires are also influenced by a myriad of factors, including temperature, soil moisture, humidity, wind, fuel characteristics, land management, and topography.

Risk Factor, a platform that provides community-level data on flood, fire, heat, and wind, uses probabilistic models developed by nonprofit First Street Foundation that take some of these factors into account.[26] For flooding, First Street Foundation models consider topography, hydrology, local climate and terrain characteristics, and future climatic changes to calculate flood risk.[27] For wildfire, First Street Foundation models consider fuels (e.g. trees, vegetation, structures), forest and fuel management, probability of ignition (based on historic fires), and weather patterns that support ignition (e.g. dryness) and help fires spread (e.g. wind), as well as future climate projections.[28]

GHG Scenarios

GHG scenarios consider GHG emission concentration and land use change based on a set of assumptions about future trajectories. Two GHG scenarios are used in this report: RCP4.5 and RCP8.5.

Four RCPs are used in the IPCC Fifth Assessment Report, which span the range from approximately below 2°C warming to high (>4°C) warming best-estimates by the end of the 21st century: RCP2.6, RCP4.5 and RCP6.0, and RCP8.5.[29] Each RCP represents a distinct level of total radiative forcing (or warming effect) on the atmosphere at the end of 2100. Climate projections made using RCP4.5 and RCP8.5 are the most commonly available:

- RCP4.5 (sometimes referred to as the "lower emissions scenario"): a moderate stabilization scenario under which emissions peak around 2040, then decline.
- RCP8.5 (sometimes referred to as the "higher emissions scenario"): a high emissions scenario under which emissions continue rising through 2100.

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[25] USGCRP, "Climate Science Special Report: Fourth National Climate Assessment, Volume I" (Washington, DC, USA: U.S. Global Change Research Program, 2017), https://science2017.globalchange.gov/.
[26] First Street Foundation, "Risk Factor," Risk Factor, accessed March 8, 2023, https://riskfactor.com/about.
[27] First Street Foundation, "First Street Foundation Flood Model: Technical Methodology Document," June 17, 2020, https://assets.firststreet.org/uploads/2020/06/FSF_Flood_Model_Technical_Documentation.pdf.
[28] First Street Foundation, "First Street Foundation Wildfire Model: Technical Methodology," 2022, https://assets.firststreet.org/uploads/2022/05/First_Street_Foundation_Wildfire_Technical_Methodology.pdf.
[29] IPCC, "Annex II: Glossary," 2022.

This report includes projections from both RCP4.5 and RCP8.5, though projections from RCP8.5 are more frequently referenced in the text and included in the appendix. This decision was made because awareness of—and preparedness for—RCP8.5 reflects a more risk-averse approach (i.e. more of a "worst case" scenario). RCP8.5 is associated with over 4°C of warming by 2100. Note that when considering near-term (2050 and earlier) planning and policy, the choice of scenario (RCP4.5 or RCP8.5) is less important, as projections under RCP4.5 and RCP8.5 do not substantially diverge until after 2050.[30]

Navigating Uncertainty

Human-caused climate change is scientific consensus. However, the precise nature of these changes, including their magnitude, timeline, and local impacts, is less certain. Numerous factors contribute to this uncertainty, including the natural variability of Earth's climate (for example, due to semi-cyclical phenomena such as El Niño), climate model uncertainty, evolving knowledge on the Earth system, and uncertainty around future GHG trajectories and land development.[31] The possibility of reaching "tipping points" that trigger major shifts in the Earth's climate system is another contributor. For example, rapid, irreversible loss of the West Antarctic and Greenland ice sheets is a tipping point that could lead to significantly higher sea level rise than currently anticipated.[32]

Climate modeling and uncertainty remain an area of active research. Scientific understanding of the Earth system is constantly improving, as are models used to project future climate. Studying historical trends, evaluating multiple different climate models (ensemble modeling), considering the range of possible outcomes, and adopting flexible, adaptive management techniques can help planners navigate amidst uncertainty.[33]

Local Summary: Climate-Related Hazards in Santa Fe County

Santa Fe County is located in the Arizona/New Mexico Plateau ecoregion, a semi-arid grassland area in the southwestern US.[34] Santa Fe's high elevation and topography contribute to

[30] Cal-Adapt, "Which RCP (Emissions) Scenario Should I Use in My Analysis?," cal-adapt.org, accessed March 1, 2023, https://cal-adapt.org/help/faqs/which-rcp-scenarios-should-i-use-in-my-analysis/.
[31] ClimateData.ca, "Uncertainty in Climate Projections," ClimateData.ca, accessed March 7, 2023, https://climatedata.ca/resource/uncertainty-in-climate-projections/.
[32] IPCC, "Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty" (Cambridge, UK and New York, USA, 2018), https://www.ipcc.ch/sr15/chapter/chapter-3/.
[33] ClimateData.ca, "Uncertainty in Climate Projections."
[34] Jana Ruhlman, Leila Gass, and Barry Middleton, "Arizona/New Mexico Plateau Ecoregion," in *Status and Trends of Land Change in the Western United States—1973 to 2000*, ed. Benjamin M. Sleeter, Tamara S. Wilson, and William Acevedo, 4 vols., U.S. Geological Survey Professional Paper 1794–A, 2012, 263–71, https://pubs.usgs.gov/pp/1794/a/chapters/pp1794a_chapter26.pdf.

significant variations in climate from nearby, lower-elevation areas.[35] Rainfall is variable and limited; the natural environment exhibits a long-term trend towards increasing aridity.[36]

To understand how climate change is impacting Santa Fe County, ICLEI USA reviewed available resources and climate projections to learn more about the climate-related hazards the County is exposed to in the present day, as well as how those hazards could change in a future of higher GHG emissions. Findings and associated climate projections (when available) on these hazards are summarized in the following section.

Rising Temperatures

In the state of New Mexico, historical data shows that, on average, temperatures have increased by over 2°F since 1900 (Figure 1). Statewide temperature projections estimate 5-7°F of warming over the next 50 years.[37]

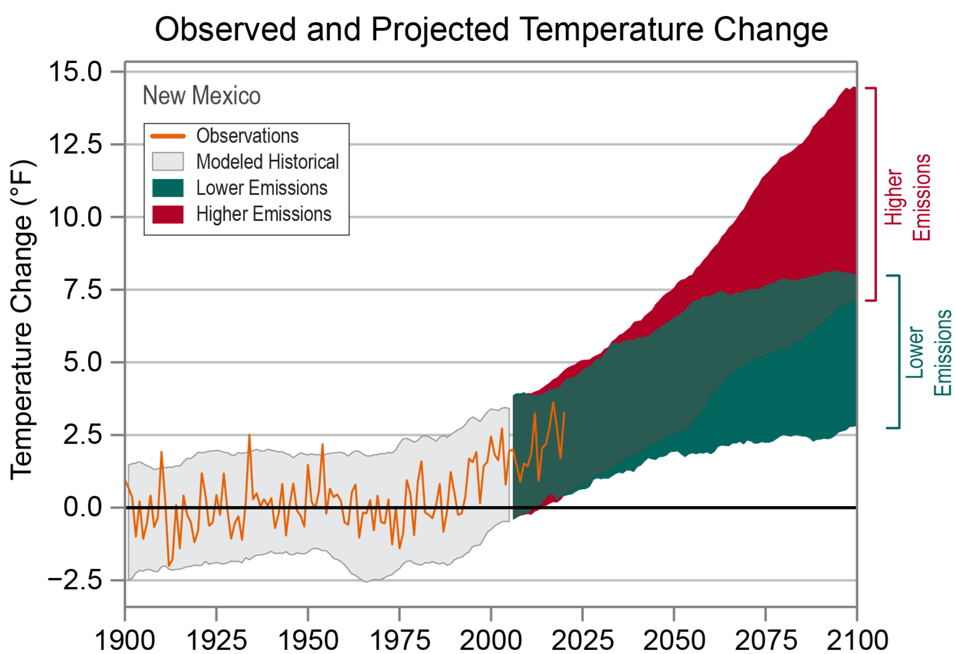

Figure 1. Observed and projected temperature change compared to 1901-1960 historic average for New Mexico.[38] The red shaded area shows the range of possible temperature change under a higher emissions pathway (RCP8.5). The green shaded area shows the range of possible temperature change under a lower emissions pathway (RCP4.5). The gray shaded area shows modeled historical temperatures and the orange line shows observed temperature.

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[35] Nelia W. Dunbar et al., "Climate Change in New Mexico Over the Next 50 Years: Impacts on Water Resources," Bulletin (New Mexico Bureau of Geology and Mineral Resources, December 2022), https://geoinfo.nmt.edu/publications/monographs/bulletins/downloads/164/B-164_FullResolution.pdf.
[36] Jana Ruhlman, Leila Gass, and Barry Middleton, "Arizona/New Mexico Plateau Ecoregion."
[37] Nelia W. Dunbar et al., "Climate Change in New Mexico Over the Next 50 Years: Impacts on Water Resources."
[38] "New Mexico State Climate Summary 2022," NOAA Technical Report NESDIS (Silver Spring, MD: NOAA/NESDIS, 2022), https://statesummaries.ncics.org/chapter/nm/.

In Santa Fe County, annual mean (in other words, the year-round average) temperature projections show a similar warming trajectory to those of the state (Figure 2). Under RCP8.5, annual mean temperatures are projected to increase by 3.3°F in the 2025-2049 period, 6.1°F in the 2050-2074 period, and by 9°F in the 2075-2099 period (Table A1).

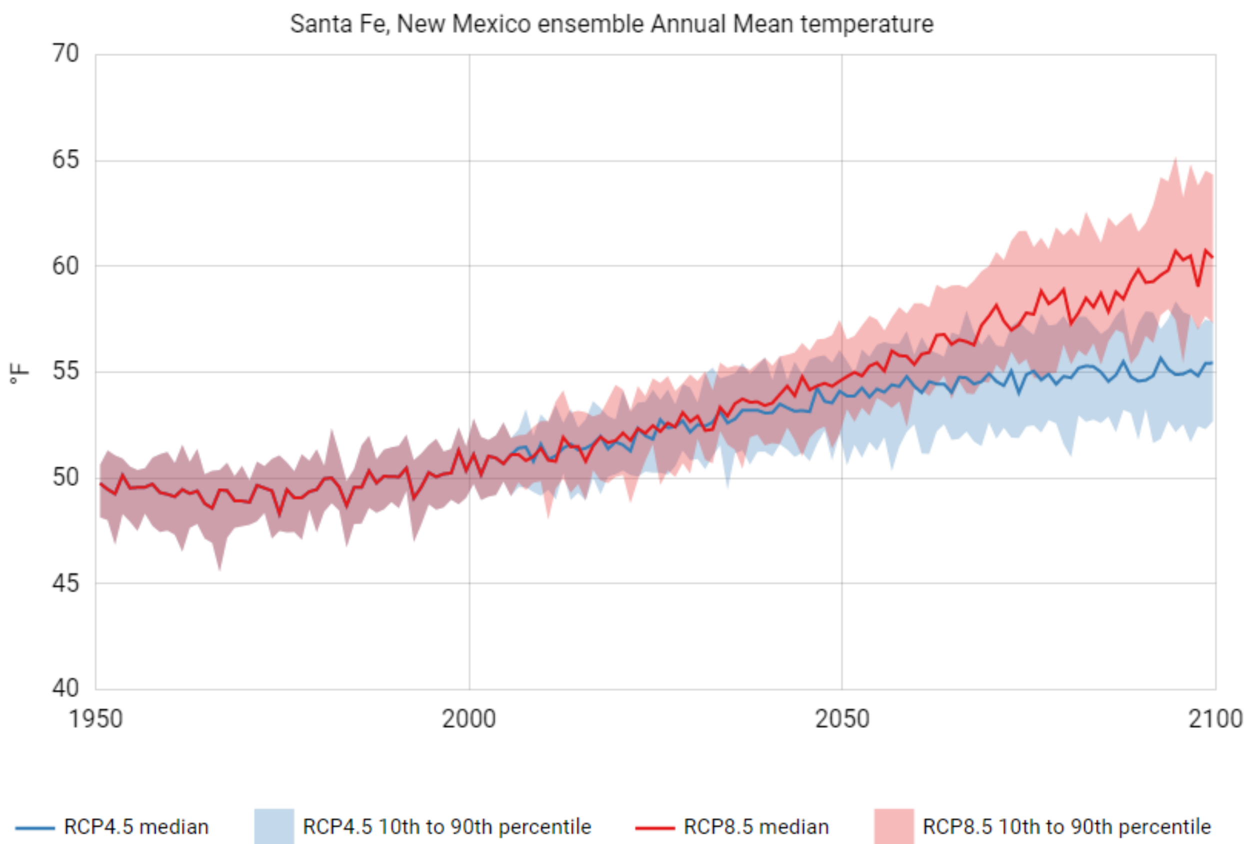

Figure 2. Annual mean temperature (°F) in Santa Fe County projected through 2099 under RCP4.5 (blue) and RCP8.5 (red).[39] The solid lines show the ensemble median. Shaded areas show the 10th to 90th percentile range of projections.

Rising temperatures are evident seasonally (Table A1). In Santa Fe County, the baseline summertime mean temperature is 68.7°F. By the 2075-2099 period, the mean summertime temperature is projected to rise by almost ten degrees (78.3°F). Winter temperatures are also rising. At baseline, winter mean temperature is near freezing, at 32.3°F. As the climate warms, winter mean temperatures rise above freezing: in the 2025-2049 period, winter mean temperature is projected to be around 35.5°F. By the end of the century, winter mean temperatures could exceed 40°F. Models indicate that despite increases, winter minimum

[39] USGS, "National Climate Change Viewer," Data Platform, accessed February 24, 2023, https://apps.usgs.gov/nccv/maca2/maca2_counties.html.

temperatures will likely remain below freezing (Figure A3). View the trends in summer and winter mean temperatures in Figure A1 and Figure A2.

In a future where GHG emissions do not rise as much, temperatures in the County would still increase; however, that increase would be at a more moderate rate. This lower rate of increase is shown by the blue line and shaded area (RCP4.5) in Figure 2.

RCP8.5 Climate Projections Snapshot: Rising Temperatures[40]

Annual Mean Temperature Baseline (1981-2010): 50.3°F 2025-2049: +3.3°F 2050-2074: +6.1°F 2075-2099: +9.0°F	**Summer Mean Temperature** Baseline (1981-2010): 68.7°F 2025-2049: +3.3°F 2050-2074: +6.3°F 2075-2099: +9.6°F
Winter Mean Temperature Baseline (1981-2010): 32.3°F 2025-2049: +3.2°F 2050-2074: +5.8°F 2075-2099: +8.5°F	**Winter Minimum Temperature** Baseline (1981-2010): 19.6°F 2025-2049: +3.1°F 2050-2074: +5.3°F 2075-2099: +7.8°F

Jump to the data on Minimum, Mean, and Maximum Temperature

Hotter Summers and Extreme Heat Events

In New Mexico, dangerously hot conditions, including extremely hot days and warm nights, have risen significantly since 1900.[41] In the future, summer maximum temperatures in Santa Fe County are projected to rise under both RCP4.5 and RCP8.5 (Figure 3), though increases are significantly more pronounced under RCP8.5 in the middle and end of the century. The baseline summer maximum temperature in Santa Fe County is 84.1°F. Under RCP8.5, summer maximum temperature rises to 87.6°F in the 2025-2049 period, 90.6°F in the 2050-2074 period, and 94.1°F in the 2075-2099 period (Table A1).

[40] USGS.
[41] "New Mexico State Climate Summary 2022."

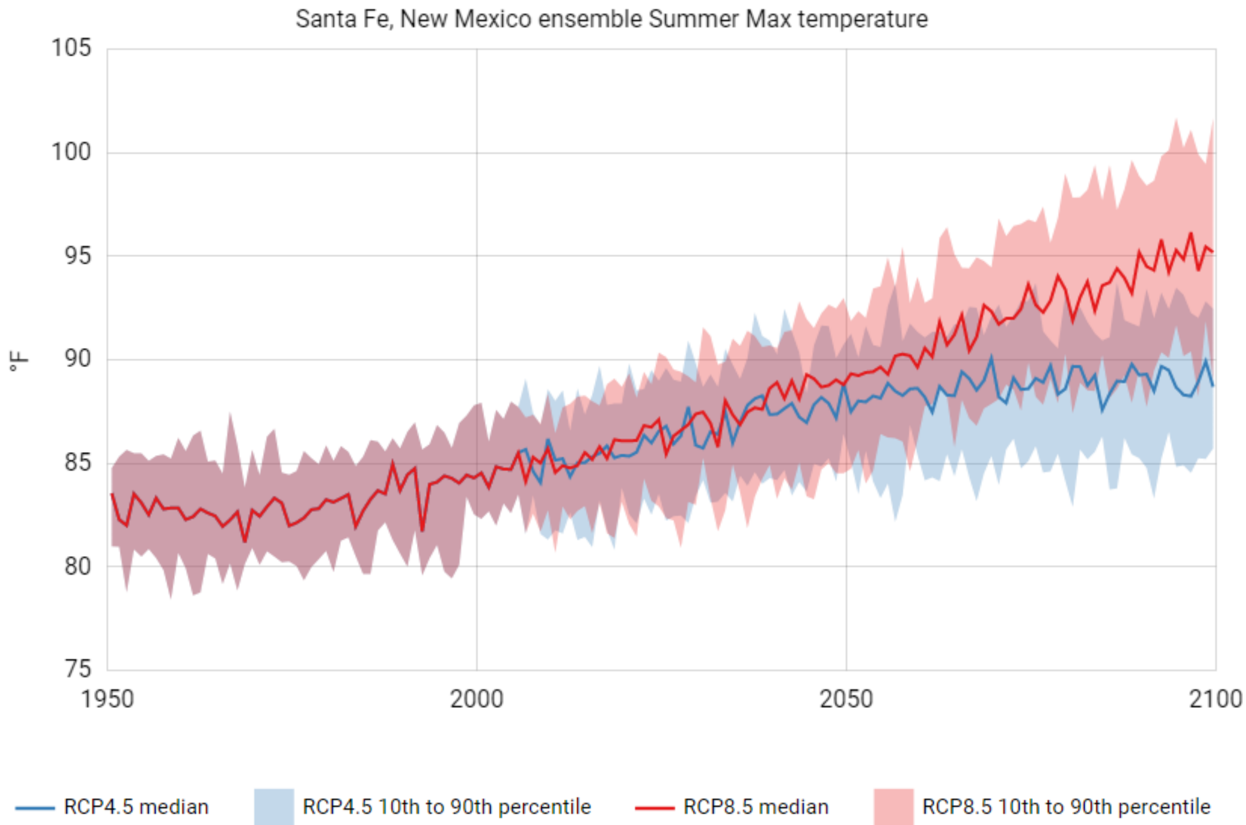

Figure 3. Summer maximum temperature (°F) in Santa Fe County projected through 2099 under RCP4.5 (blue) and RCP8.5 (red).[42] The solid lines show the ensemble median. Shaded areas show the 10th to 90th percentile range of projections.

Extremely hot days, defined as days on which the maximum temperature exceeds 100°F, are rarely documented in historical observations (Figure 4). Projections for the middle and end of the century under the higher emissions scenario show occurrences of these days rising to around 8 days each year (2060s) and around 18 days (2080s). The relatively large shaded area in Figure 4 indicates that there is a wide range in model projections (i.e. some models predict many more extremely hot days than others). Towards the end of the century under RCP8.5, some models predict as many as 50 or more extremely hot days each year.

[42] USGS, "National Climate Change Viewer."

Santa Fe, New Mexico Number of Extremely Hot Days

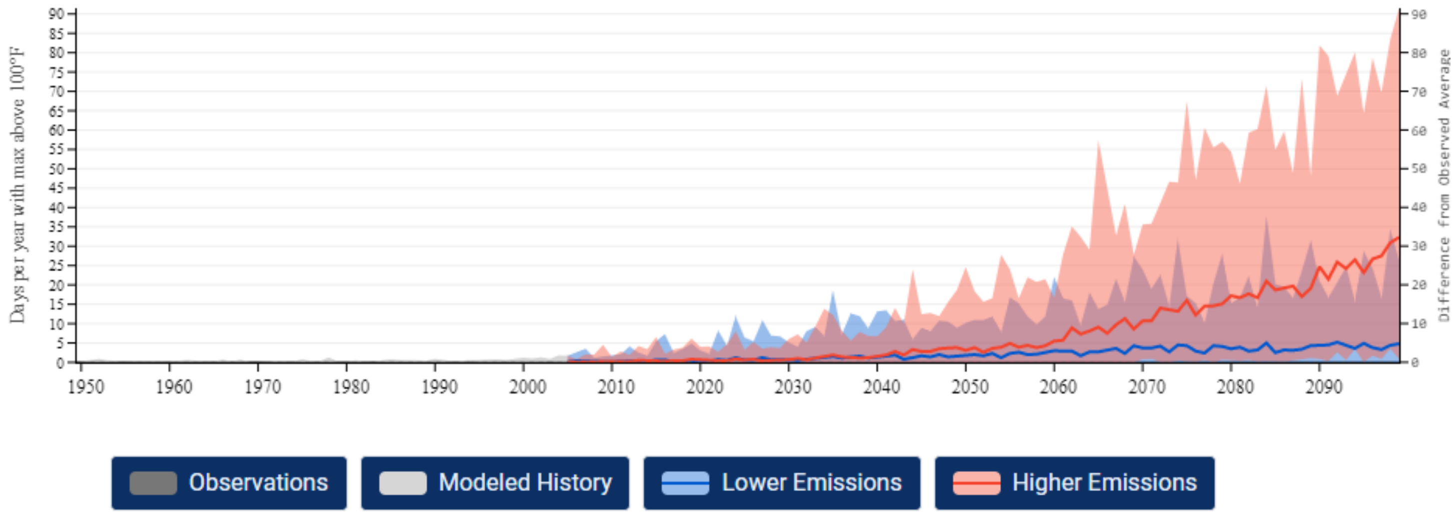

Figure 4. Number of extremely hot days (maximum temperature > 100 °F) per year in Santa Fe County projected through 2099 under RCP4.5 (blue) and RCP8.5 (red).[43] The solid blue and red lines show the ensemble median. Shaded blue and red areas show the range from the highest to the lowest projected value. Dark gray bars show historical observations and light gray areas show modeled history (both are so low on this graph that they are barely visible).

RCP8.5 Climate Projections Snapshot: Hotter Summers and Extreme Heat Events

Summer Maximum Temperature[44]	**Extremely Hot Days**[45]
Baseline (1981-2010): 84.1°F 2025-2049: +3.5°F 2050-2074: +6.7°F 2075-2099: +10.0°F	Observed Average (1960-1991): 0 days 2030s: 1.2 days 2060s: 8.2 days 2080s: 18.3 days

Jump to the data on Summer Maximum Temperature and Extremely Hot Days

[43] U.S. Federal Government, "U.S. Climate Resilience Toolkit Climate Explorer," Data Platform, 2021, https://crt-climate-explorer.nemac.org/.
[44] USGS, "National Climate Change Viewer."
[45] U.S. Federal Government, "U.S. Climate Resilience Toolkit Climate Explorer."

Precipitation Patterns

Broadly, precipitation projections for the state of New Mexico point toward constant precipitation totals that do not differ substantially from natural climatic variation.[46] No clear, significant trend emerges for the state.[47] While historical evidence and the observational record indicate highly variable precipitation is the norm in New Mexico, it is possible that climate change will increase precipitation variability.[48] County projections are also variable (Figure 5).

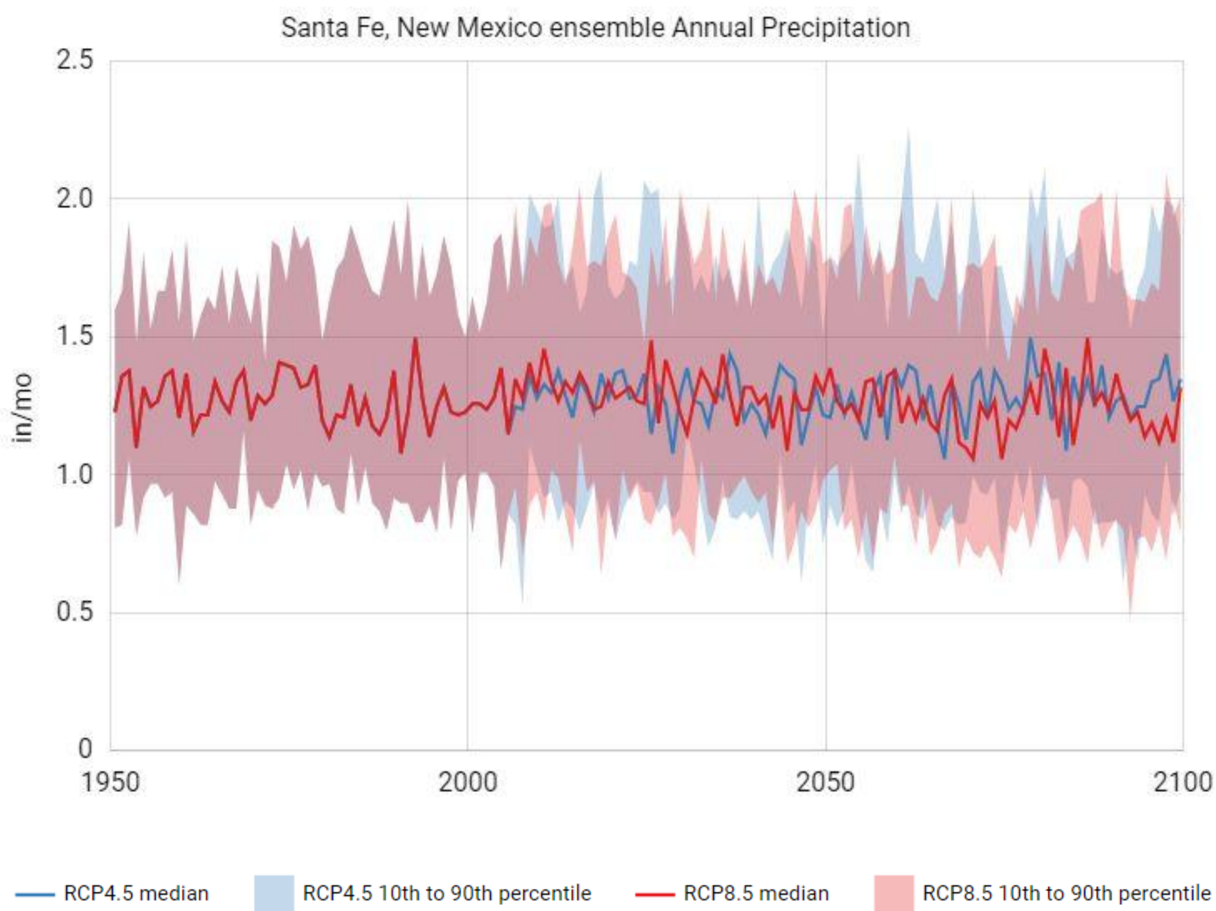

Figure 5. Total annual precipitation (in/mo) in Santa Fe County projected through 2099 under RCP4.5 (blue) and RCP8.5 (red).[49] The solid lines show the ensemble median. Shaded areas show the 10th to 90th percentile range of projections.

Precipitation projections for Santa Fe County show a nearly flat trend (Table A3). However, averages mask significant year-to-year variation (Figure 5). Precipitation projections show a

[46] USGCRP, "Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II" (Washington, DC, USA: U.S. Global Change Research Program, 2018), https://nca2018.globalchange.gov/.
[47] Nelia W. Dunbar et al., "Climate Change in New Mexico Over the Next 50 Years: Impacts on Water Resources."
[48] Nelia W. Dunbar et al.
[49] USGS, "National Climate Change Viewer."

large range of variation across models, with some models projecting increased precipitation, and others projecting decreases (Figure A4). This means that the directionality of expected precipitation changes is uncertain and confidence in these projections is low. Some statewide research indicates declines in spring precipitation and slight increases in winter precipitation in northern mountain areas.[50] Local projections for Santa Fe County do show a slight downward trend in spring precipitation (Figure A5).

The North American Monsoon system, which provides needed summer rainfall, is already highly variable from year to year.[51] It is uncertain how climate change will impact monsoonal precipitation in New Mexico.[52]

While extreme precipitation events have increased in much of the continental US, this trend is not evident in recorded data from New Mexico. Historically, extreme precipitation days vary and fluctuate without an observable trend, similar to total annual precipitation.[53] Projections for Santa Fe show roughly constant model medians of an average of 0.5 extreme precipitation events each year (Figure 6). Extreme precipitation events occur on days in which more than one inch of precipitation is received in a single day/ There is significant variation across models, however, with some models predicting as many as three to four 1-inch precipitation days in some years, which exceeds the range of historic observations. This indicates the potential for more frequent occurrence of high intensity rainstorms in Santa Fe.

RCP8.5 Climate Projections Snapshot: Precipitation Patterns

Annual Precipitation[54]	**Extreme Precipitation Events**[55]
Baseline (1981-2010): 1.3 in/mo 2025-2049: 1.3 in/mo 2050-2074: 1.3 in/mo 2075-2099: 1.3 in/mo	Observed Average (1960-1991): 0.5 days 2030s: 0.5 days 2060s: 0.5 days 2080s: 0.6 days

Jump to the data on Annual Precipitation and Extreme Precipitation Events

[50] "New Mexico State Climate Summary 2022."
[51] "New Mexico State Climate Summary 2022."
[52] Nelia W. Dunbar et al., "Climate Change in New Mexico Over the Next 50 Years: Impacts on Water Resources."
[53] "New Mexico State Climate Summary 2022."
[54] USGS, "National Climate Change Viewer."
[55] U.S. Federal Government, "U.S. Climate Resilience Toolkit Climate Explorer."

Santa Fe, New Mexico Number of Extreme Precipitation Events

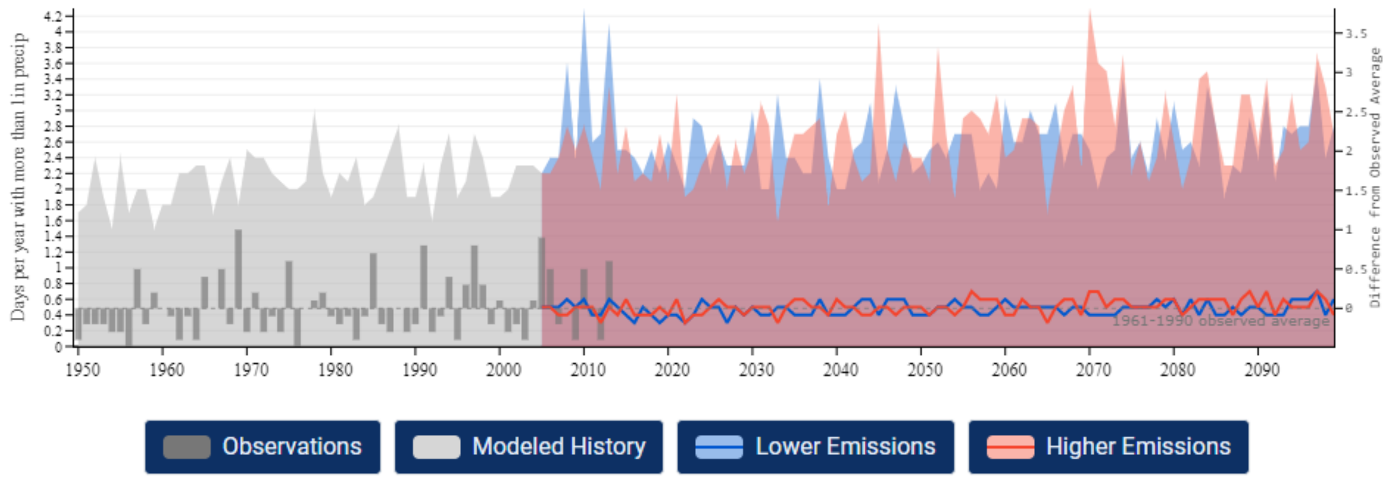

Figure 6. Number of extreme precipitation events (days with > 1 inch precipitation) per year in Santa Fe County projected through 2099 under RCP4.5 (blue) and RCP8.5 (red).[56] The solid blue and red lines show the ensemble median. Shaded blue and red areas show the range from the highest to the lowest projected value. The dashed gray line shows the 1961-1990 observed average. Dark gray bars show historical observations. Bars that are above the dashed line are higher than the historical average; bars that are below the dashed line are lower than the historical average. The light gray shaded area shows modeled history.

Flooding

Flooding is a complex phenomenon linked to multiple causal factors, including heavy precipitation, stream dynamics, topography, storms, land cover, and development patterns. In New Mexico, localized high-intensity storms (usually monsoonal) are a main driver of flood risk.[57] This type of storm is challenging to simulate with climate models. Studies suggest these storms may occur more often in the future; storm severity is not projected to increase.[58] The higher end of the range of model variation (the red shaded area in Figure 6) in days with more than 1 inch of precipitation in Santa Fe County may point toward this trend.

The results of probabilistic flood modeling for Santa Fe County on the Risk Factor platform indicate that there are around 4,188 properties (7% of the total) with more than a 26% chance of being affected by flooding between 2021 and 2051.[59] The platform reports that 429 of these properties were protected by 6 "known adaptation measures" (e.g. gray infrastructure) as of

[56] U.S. Federal Government.
[57] Nelia W. Dunbar et al., "Climate Change in New Mexico Over the Next 50 Years: Impacts on Water Resources."
[58] Nelia W. Dunbar et al.
[59] First Street Foundation, "Santa Fe County, New Mexico Flood Factor," Risk Factor, accessed March 17, 2023, https://riskfactor.com/county/santa-fe-county-nm/35049_fsid/flood.

March 17, 2023, though the precise nature and location of these measures is not disclosed. Flood risk may be increasing, somewhat: if a 100-year flood event were to occur in 2051, Risk Factor estimates an 51 additional properties would be affected compared to 2021 numbers.

Based on severity of impact, roads and commercial properties are the main drivers of flood risk in Santa Fe, though those two categories of assets are by no means alone in facing risk (Table 2).

Table 2. Property and facility overall flood risk level (by property/facility type) and estimated number of assets at risk in 2021.[60] Risk level reflects the level of risk to properties/facilities based on flood likelihood and depth, not the proportion of properties/facilities that are at risk.[61]

Asset Type	Level of Risk	Number of Assets at Risk
Residential	Minor	3,732 out of 58,293 properties
Roads	Moderate	1,145 out of 5,123 miles of roads
Commercial	Moderate	543 out of 4,771 properties
Critical Infrastructure	Minor	3 out of 68 facilities
Social Facilities	Minor	77 out of 467 facilities

Note that there are multiple variables that could increase the County's exposure beyond what is reflected in Table 2. Risk Factor models are based on RCP4.5 (lower emissions scenario); were GHG concentrations to continue increasing significantly in line with RCP8.5, it is possible that more properties would be exposed. Furthermore, Risk Factor models do not consider future development. If construction occurs in at-risk areas that are more prone to flooding, that would increase the County's exposure.

Drought and Water Availability

Droughts in the greater Southwest region are expected to worsen under climate change. Severe drought, aridification, and groundwater depletion combined with land use change and population growth are expected to worsen existing water shortages in New Mexico.[62] Review of the evidence on historical climate in New Mexico shows a pattern of frequent wet and dry periods, as well as droughts more severe than any documented in historical records (Figure 7).[63]

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[60] First Street Foundation.
[61] First Street Foundation, "Community Methodology - Is Your Community at Risk of Flooding?," Risk Factor, March 17, 2023, https://help.riskfactor.com/hc/en-us/articles/4408457052055-Community-methodology-Is-your-community-at-risk-of-flooding-.
[62] USGCRP, "Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II."
[63] "New Mexico State Climate Summary 2022."

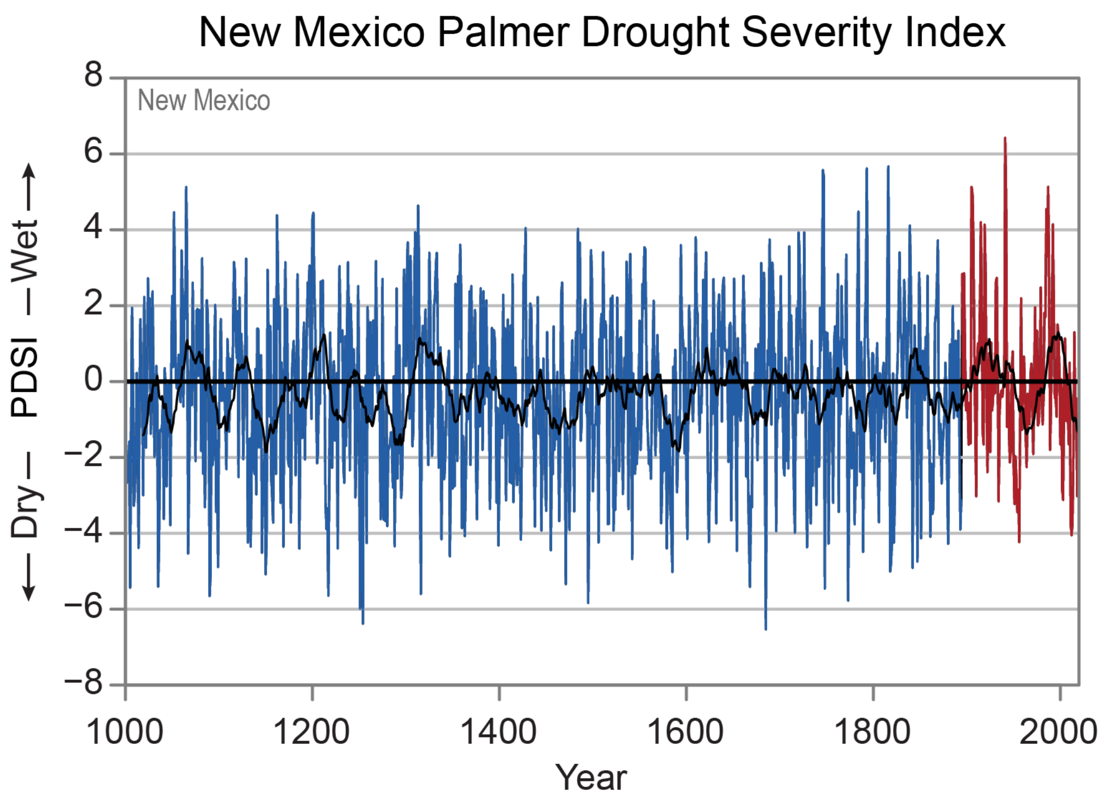

Figure 7. New Mexico Palmer Drought Severity Index, 1000-2020. Red lines indicate values based on precipitation and temperature measurements. Blue lines (period prior to 1895) indicate values estimated from indirect sources (e.g. tree rings). The fluctuating black line is the 20-year period average.[64]

Regional projections indicate that droughts in New Mexico may become more frequent, severe, and long-lasting in the future. Rising temperatures coupled with flat precipitation trends signal increasingly arid conditions. In hotter weather, evapotranspiration (water transfer to the atmosphere from land and vegetation) increases, making it more difficult for precipitation to replenish water bodies and soil moisture. This will result in reduced streamflow and drier soil, increasing drought intensity.[65] Furthermore, models indicate that hotter temperatures in the Southwest significantly increase the probability of multi-decadal megadroughts.[66]

In the spring, snowmelt flows into major rivers, including the Rio Grande, which are important surface water sources for New Mexico communities. Hotter temperatures and earlier spring heat are linked to reductions in snowpack in the region. These conditions (heat and decreased snowpack) were shown to have amplified recent hydrological drought and severe water

[64] "New Mexico State Climate Summary 2022."
[65] "New Mexico State Climate Summary 2022."
[66] USGCRP, "Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II."

shortages in the Rio Grande and Colorado River Basins.[67] Under RCP8.5, hydrologic models project significant declines in the Rio Grande Basin.[68]

Local projections for Santa Fe County point to worsening drought. While there is no single indicator used to project drought, there are related indicators that signify drought conditions. Evaporative deficit, a measure of aridity, increases substantially by the end of the century (Figure 8). Soil storage (water stored in the soil) in Santa Fe County is projected to decline by almost 50% by the 2075-2099 period (Table A6 and Figure A6). Runoff shows declines, though on a smaller scale (Table A7 and Figure A7).

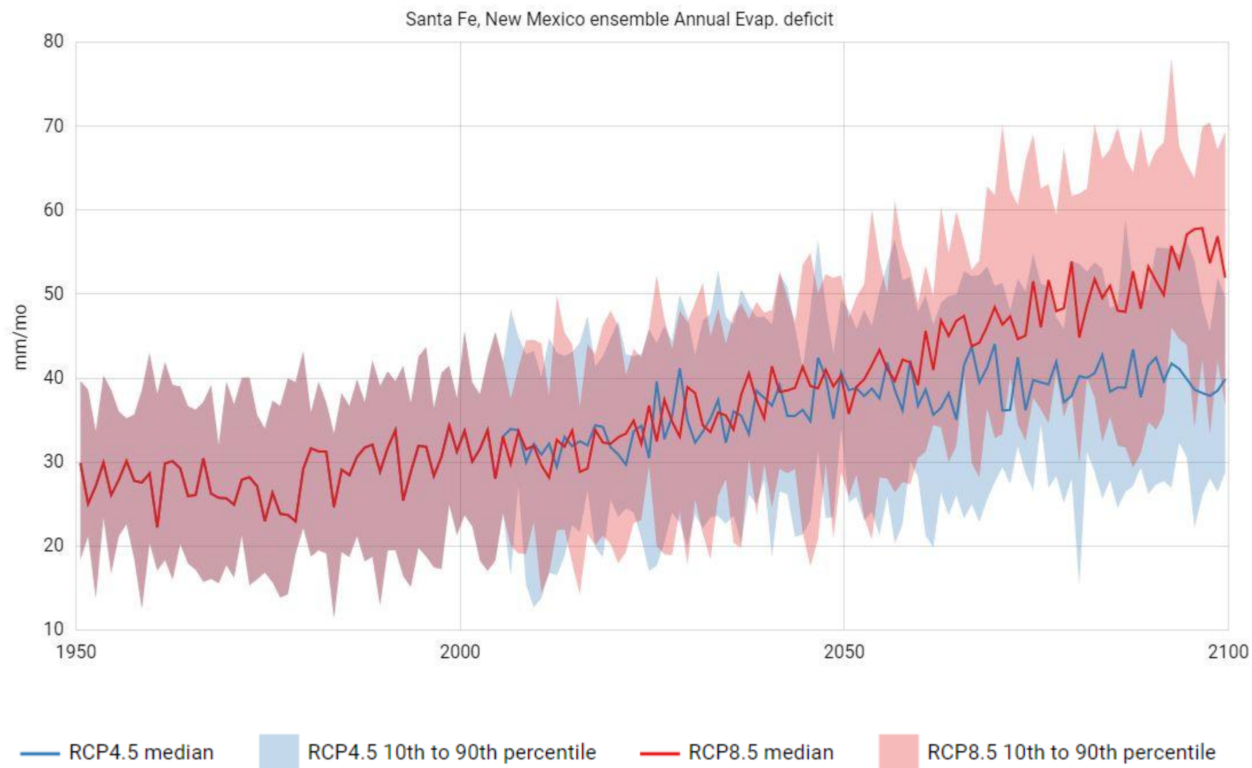

Figure 8. Average annual evaporative deficit (mm/month) in Santa Fe County projected through 2099 under RCP4.5 (blue) and RCP8.5 (red).[69] The solid lines show the ensemble median. Shaded areas show the 10th to 90th percentile range of projections.

[67] USGCRP.
[68] USGCRP.
[69] USGS, "National Climate Change Viewer."

RCP8.5 Climate Projections Snapshot: Water Availability and Drought[70]

Annual Average Evaporative Deficit	**Annual Soil Storage**
Baseline (1981-2010): 30.07 mm/mo 2025-2049: 36.81 mm/mo 2050-2074: 44.12 mm/mo 2075-2099: 51.33 mm/mo	Baseline (1981-2010): 1.23 in/mo 2025-2049: 1.06 in/mo 2050-2074: 0.82 in/mo 2075-2099: 0.63 in/mo
Annual Runoff Baseline (1981-2010): 0.15 in/mo 2025-2049: 0.15 in/mo 2050-2074: 0.13 in/mo 2075-2099: 0.12 in/mo	

Jump to the data on Evaporative Deficit, Soil Storage, and Runoff

Wildfire

Wildfire in the Southwest has been on the rise in recent decades, due in part to climate change (Figure 9).[71] As temperatures rise, climate models project that increased drought and aridity in New Mexico will contribute to more frequent and intense wildfires.[72]

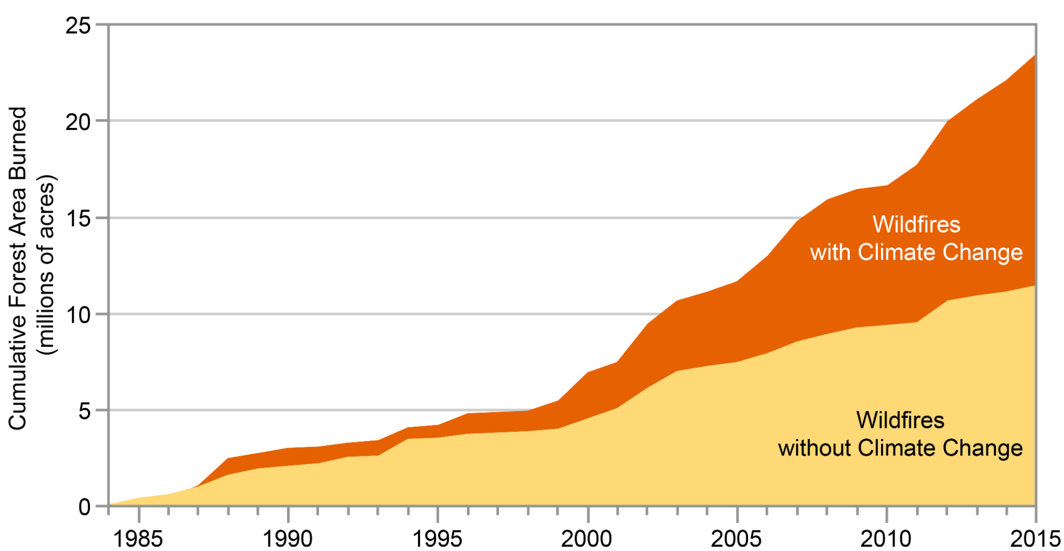

Figure 9. Cumulative forest area burned over the 1984-2015 period, estimated with and without influence of climate change.[73]

[70] USGS.
[71] USGCRP, "Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II."
[72] "New Mexico State Climate Summary 2022."
[73] USGCRP, "Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II."

Recent increases in vapor pressure deficit (i.e. how "thirsty" the atmosphere is) have contributed to increased incidence of wildfire in the Southwest.[74] A recent study showed that observed increases in vapor pressure deficit are strongly linked to climate change.[75] Under RCP8.5, annual average and summertime vapor pressure deficit increase significantly in Santa Fe County. Compared to the baseline, annual and summer average vapor pressure deficits increase by around 25% by the 2025-2049 period, and by almost 50% by the 2075-2099 period (Table A8). The rising trend is visible in Figure 10.

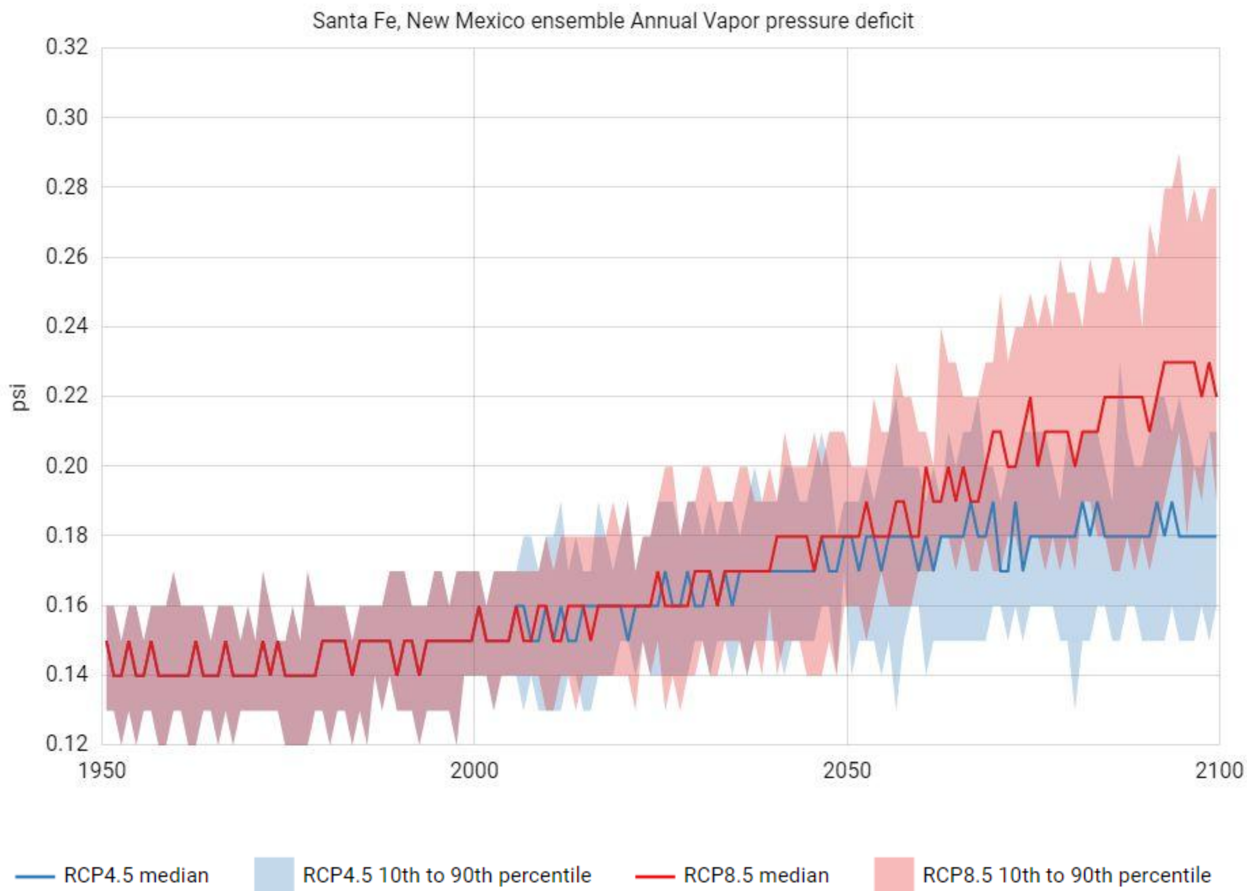

Figure 10. Average annual vapor pressure deficit (psi) in Santa Fe County projected through 2099 under RCP4.5 (blue) and RCP8.5 (red).[76] The solid lines show the ensemble median. Shaded areas show the 10th to 90th percentile range of projections.

[74] Rong Fu, "Study Shows That Climate Change Is the Main Driver of Increasing Fire Weather in the Western U.S.," Drought.gov, November 9, 2021, https://www.drought.gov/news/study-shows-climate-change-main-driver-increasing-fire-weather-western-us.
[75] Yizhou Zhuang et al., "Quantifying Contributions of Natural Variability and Anthropogenic Forcings on Increased Fire Weather Risk over the Western United States," *Proceedings of the National Academy of Sciences* 118, no. 45 (November 9, 2021): e2111875118, https://doi.org/10.1073/pnas.2111875118.
[76] USGS, "National Climate Change Viewer."

The results of probabilistic fire modeling for Santa Fe on the Risk Factor platform indicate that essentially all Santa Fe properties (77,058 in total, or 99%) have at least some risk of being impacted by wildfire between 2022 and 2052.[77] Fire models indicate major risk across all property and infrastructure types (Table 3). Figures 11 and 12 provide a visual of Santa Fe's increasing fire risk. By the 2041-2050 period, properties in a greater proportion of the county's area have 1 or 2% annual risk of being affected by wildfire.

Table 3. Property and facility overall wildfire risk level (by property/facility type) and estimated number of assets at risk in 2022.[78] Risk level reflects the level of risk to properties/facilities based on average probability of being in a wildfire and/or exposed to embers, not the proportion of properties/facilities that are at risk.[79]

Asset Type	Level of Risk	Assets at Risk
Residential	Major	58,295 out of 58,304 properties
Commercial	Major	4,756 out of 4,771 properties
Critical Infrastructure	Major	290 out of 290 facilities
Social Facilities	Major	467 out of 467 facilities

Similar to flood risk, there are multiple variables that could increase the County's wildfire exposure beyond what is reflected in Table 3. A higher emissions scenario (RCP8.5 as opposed to RCP4.5, which is used in Risk Factor models) could increase exposure, as could development in at-risk areas (e.g. WUI zones).

Wildfires are associated with a number of secondary impacts on people and the environment. Areas that have been burned are vulnerable to erosion and landslides; heavy precipitation events can compound that risk and cause dangerous debris flows.[80] Loosened ash sediment that flows into rivers and waterbodies reduces water quality and reservoir storage[81] and has been linked to reduced native aquatic species abundance in New Mexico.[82] Smoke inhalation is a public health risk.

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[77] First Street Foundation, "Santa Fe County, New Mexico Fire Factor," Risk Factor, accessed March 17, 2023, https://riskfactor.com/county/santa-fe-county/35049_fsid/fire.

[78] First Street Foundation.

[79] First Street Foundation, "Community Wildfire Risk FAQ," Risk Factor, accessed March 18, 2023, https://help.riskfactor.com/hc/en-us/articles/5720773111063?_gl=1*kpdv54*_ga*MTk2MDQzNzE2Ni4xNjY4NjMzMTUw*_ga_74PQ3C54LC*MTY3OTE3MDkzMi44LjEuMTY3OTE3MDk0My40OS4wLjA.

[80] USGCRP, "Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II."

[81] USGS, "Increases in Wildfire-Caused Erosion Could Impact Water in the West," 2017, https://www.usgs.gov/news/national-news-release/increases-wildfire-caused-erosion-could-impact-water-supply-and-2.

[82] USGCRP, "Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II."

Risk Factor Fire Model - Santa Fe County 2011-2021 Baseline

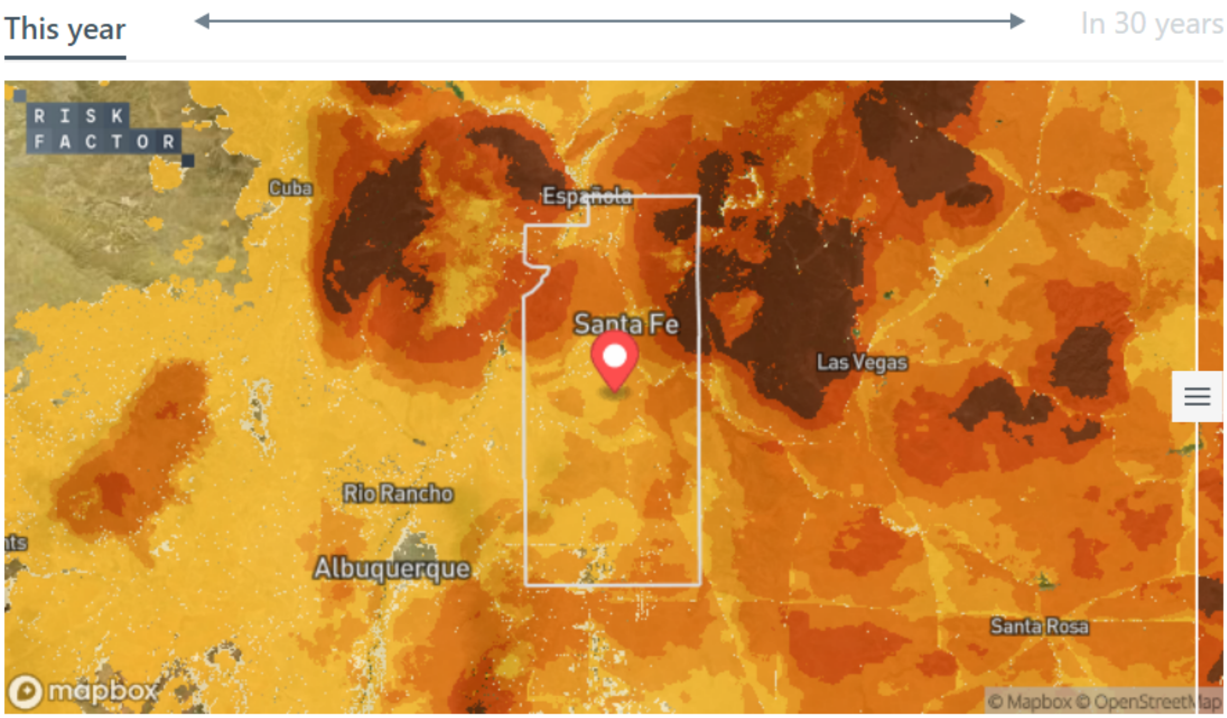

Figure 11. Baseline (2011-2021) wildfire exposure in Santa Fe under RCP4.5.[83] Shaded areas have some risk of wildfire occurring in that area in the given year. The darker the shading, the higher the annual likelihood that an area will be impacted by wildfire.

[83] First Street Foundation, "Santa Fe County, New Mexico Fire Factor."

Risk Factor Fire Model - Santa Fe County 2041-2050 Projections

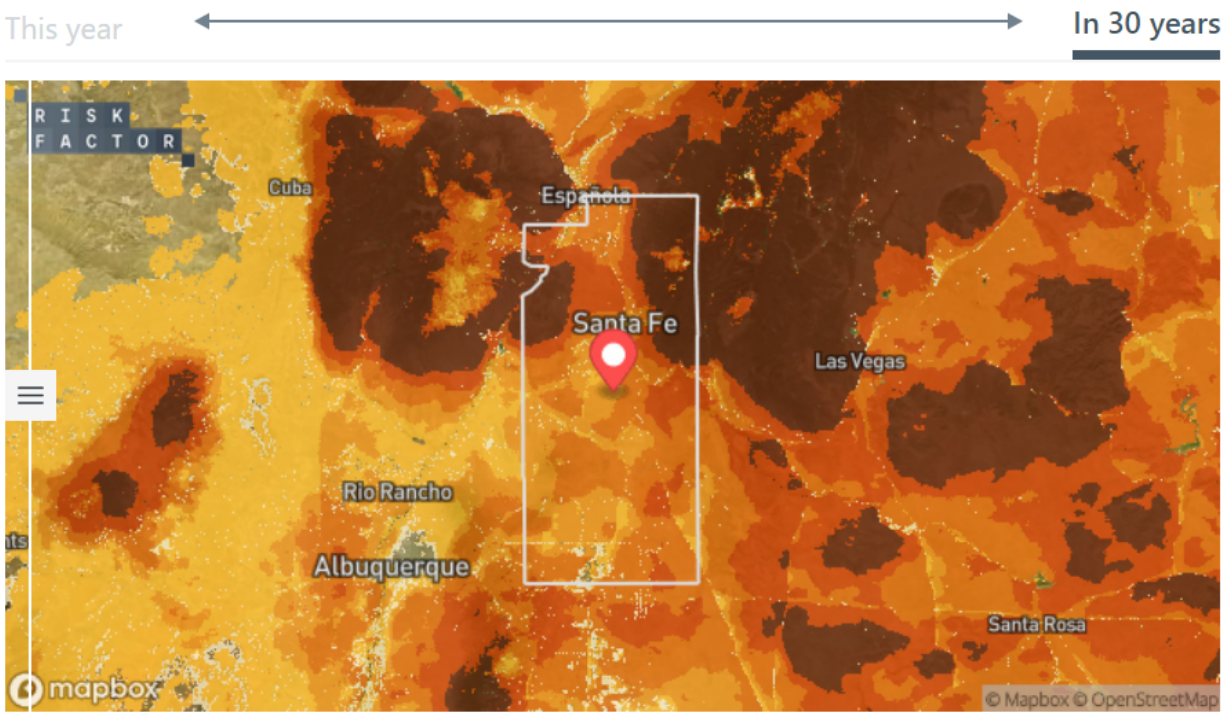

Figure 12. Projected (2041-2050) wildfire exposure in Santa Fe under RCP4.5.[84] Shaded areas have some risk of wildfire occurring in that area in the given year. The darker the shading, the higher the annual likelihood that an area will be impacted by wildfire.

RCP8.5 Climate Projections Snapshot: Wildfire[85]

Annual Average Vapor Pressure Deficit	**Summer Vapor Pressure Deficit**
Baseline (1981-2010): 0.15 psi 2025-2049: 0.17 psi 2050-2074: 0.19 psi 2075-2099: 0.22 psi	Baseline (1981-2010): 0.26 psi 2025-2049: 0.29 psi 2050-2074: 0.33 psi 2075-2099: 0.38 psi

Jump to the data on [Vapor Pressure Deficit]

[84] First Street Foundation.
[85] USGS, "National Climate Change Viewer."

Conclusion

Review of climate projections for Santa Fe makes it clear that the County will be more exposed to climate-related hazards in a future of continued GHG emissions. The research and climate projections reviewed for this report indicate that warming trends in Santa Fe will continue, leading to hotter summers, warmer winters, and extreme heat events. Drought will pose increasing challenges for water management. As the climate becomes drier, the County will be at greater risk from wildfire impacts. Changing rainfall patterns could worsen extreme events, making flooding more likely.

It is imperative that the County consider its shifting hazard landscape in future planning efforts. In order to build resilience, the County will need to work with a strong, inclusive coalition of partners. The County's Climate Action Plan introduces several strategies for building resilience, including conventional "gray" infrastructure approaches and nature-based solutions (e.g. green stormwater infrastructure). These and other strategies can serve as an entrypoint for the County's efforts to adapt to the changing climate.

Climate Action Plan Introduction

In 2017, Santa Fe County approved Resolution #2017-68, aligning the County with the 2015 Paris Agreement goals of reducing GHG emissions to net zero by 2050. In 2020 the County passed Resolution #2020-93, in support of the 30x30 global initiative to protect 30% of all County lands and water by 2030. More recently, Santa Fe County joined the Race to Zero, pledging to focus on high impact actions to reduce GHG emissions from built environments in the County by 60% Countywide by 2030 as a quick track to achieve the overarching net zero emissions goal. Net zero refers to reducing greenhouse gas emissions where practicable, and offsetting remaining emissions with greenhouse gas removals or other offsets. As an interim goal, the County has a science-based target (SBT) for emissions reductions by 2030, which encompasses the Race to Zero and nature based solution action steps. SBTs are climate goals in line with the latest climate science. They represent a community's fair share of the ambition necessary to meet the Paris Agreement commitment to keep warming below 1.5°C (2.7°F). To achieve this goal, the Intergovernmental Panel on Climate Change (IPCC) states that we must reduce global emissions by 50% by 2030 and achieve climate neutrality by 2050. Equitably reducing global emissions by 50% requires that high-emitting, wealthy nations reduce their emissions by more than 50%. To this end, the County is working on a two-track approach: reduction of greenhouse gas emissions that occur specifically as a result of County government operations; and reducing the emissions of the County's community as a whole, while increasing energy efficiency and PV funding access to LMI households.

County staff have completed GHG inventories—an accounting of all GHG sources, types, and amounts–for both of these tracks. These inventories, which cover the 2019 calendar year, help identify sectors where emissions reductions will be most effective, as well as providing a baseline against which to provide a quantitative account of successes in subsequent years. In 2022, the County adopted a plan to reduce emissions associated with County government operations. This Climate Action Plan will provide a high-level roadmap and strategies for reducing the County's community-wide emissions.
San
The Plan uses the 2019 GHG inventory, as well as projected population growth for the County and a reasonable estimate of reductions in power plant emissions to create a business-as-usual projection of emissions from 2019 to 2050. The Plan provides a matrix of common-sense high-impact actions and specific strategies to reduce greenhouse gas emissions. The Plan also takes into account the local priorities of Santa Fe County, including plans to increase tree coverage in the County, increase surface water capture, soil health, and a planned effort to increase housing affordability by reducing utility costs to low income residents.

Purpose

The global scientific community has determined that increasing global average temperature beyond 1.5°C (2.7°F) above pre-industrial levels will greatly increase the negative consequences of global climate change. In order to prevent temperatures from rising, global net emissions of greenhouse gases must reach zero by 2050. Scientists also recommend a global interim emissions reduction goal for 2030, based on 2018 emissions. For a given community, the SBT takes into account the human development index of the community to assign a per-capita reduction target, and the projected growth of the community to assign an absolute reductions target.

The purpose of this Plan is to calculate the SBT for the Santa Fe County community, and then develop a high-level roadmap to achieving that emission reduction goal. The Plan provides reasonable per-year reduction targets in several sectors, as well as general recommendations on how to meet those targets. These targets are tailored to the Santa Fe County community by taking into account existing County goals and policies, as well as meeting with County staff to discuss the County's policy priorities. Lastly, the Plan provides suggested sources of federal funding for implementing the plan.

Scope and Process

ICLEI used the County's 2019 community-wide GHG inventory, which was completed using ICLEI's ClearPath Climate Planner, to estimate baseline emissions for the County. This inventory included only sources of emissions in the land use sector, such as removal of trees. However, carbon dioxide uptake by existing trees, as well as additional trees in the County actually make this sector a net sink of GHGs. Additionally, the County's 2022 Nature Based Solutions report was used to prioritize strategies to develop a Climate Action Plan that will allow the County to reach its 2030 SBT emissions goal. The Plan specifically recommends action in the following areas in order of impact:

- Transportation
- Commercial buildings
- Residential buildings
- Energy production
- Waste and recycling
- Water and wastewater management

- Nature-based emissions and removals

Community-wide emissions were projected using the following variables:

1. *Santa Fe Projected Population Growth*

As a community's population grows, per-capita emission reductions can be offset. Santa Fe staff suggested that ICLEI base projected growth on an increase of 9.8% in population between 2019 and 2030. ICLEI assumed that this growth rate would continue past 2030 until 2050.

2. *Preliminary Energy Mix Roadmap*

A major source of emissions for any community is the use of fossil fuels to produce electricity. However, across the country, emissions associated with electricity use are dropping as cheap renewable energy offsets fossil fuel power generation. ICLEI assumed a standard 80% reduction in emissions associated with grid electricity between 2019 and 2030, as well as a total 99% reduction in grid emissions between 2019 and 2050.

3. *On-Road Transportation Fuel Efficiency Standards[86] (CAFE Standards)*

Fuel efficiency standards are used to project the reduction of emissions intensity for each mile driven by gasoline on-road vehicles. Fuel efficiency standards decrease emissions due to federally mandated improvements in vehicle fuel economy. ICLEI developed variables from fuel efficiency projections provided by the Center for Climate and Energy Solutions (C2ES)[87].

ICLEI used these three items in its ClearPath Climate Planner to create a business-as-usual projection of community-wide emissions if no other climate mitigation measures were adopted. We then modeled the effect of various emissions reduction strategies, such as building more efficient buildings, promoting electric vehicles, and reducing landfill waste, to find a way for Santa Fe County to meet its 2030 emissions target. Finally, we reviewed County policies and met with County staff to determine the County's priorities for these strategies, to allow the County to meet its targets while also meeting the needs of its own unique community.

[86] ICLEI USA, "ClearPath Reference Sheet – Default Carbon Intensity Factors," accessed May 11, 2023, https://docs.google.com/document/d/1WwVVIpNBxY8vkbN1zVqv5J2JOtYld4CV/edit.
[87] C2ES, "Federal Vehicle Standards," accessed May 11, 2023, https://www.c2es.org/content/regulating-transportation-sector-carbon-emissions/.

Results and Recommended Actions

Baseline, Business-as-Usual, and Target Emissions

Santa Fe County's 2019 emissions were reported as 1,864,100 metric tons carbon dioxide equivalent (MTCO_2e).[88] However, the 2019 inventory only included processes that emit GHGs, and did not include processes, such as tree growth, that remove GHGs. ICLEI's analysis of total emissions associated with land use in the County suggests that, rather than being a source of GHG in 2019, existing and new tree growth in the County *removed* a net total of 192,183 MTCO2e from the atmosphere that year. As a result, total baseline emissions for 2019 were 1,671,917 MTCO2e for 2019.

Based on the changes in population, emissions associated with grid electricity, and improving fuel efficiency of on-read vehicles discussed above, as well as the assumption that vegetation in the County would continue to absorb the same amount of GHG each year, ICLEI calculated emissions for 2030 and 2050 under a business-as-usual scenario (BAU; where no other changes occur to raise or reduce emissions). Those results can be seen in Table 4.

Table 4: Baseline and projected emissions in a business-as-usual scenario (MTCO2e)

Year	Total GHG Emissions (MTCO2e)
2019	1,671,917
2030	1,414,858
2050	1,187,353

The BAU scenario, due to decreased emission associated with electricity and vehicle fuel use, does show a reduction in emissions of 15% between 2019 and 2030. However, ICLEI calculated that based on the community's Human Development Index, the per-capita SBT for emissions reduction is 63% per-capita reduction of 2019 emissions by 2030. This translates into a 59% total reduction of 2019 emissions when adjusted for population growth. Therefore, emissions reduction strategies must be implemented by the community to achieve the SBT.

[88] Carbon dioxide equivalent is a standard method of reporting GHG emissions that compares the warming potential of other GHGs to carbon dioxide. For example, methane has an effect on climate that is 28 times greater than carbon dioxide, so one ton of methane equals 28 MTCO2e.

Recommended Actions

For most communities, large-scale emissions reductions can be achieved through three general strategies: reducing overall energy consumption; accelerating the adoption of renewable and non-emitting electricity production for the grid; and replacing fuel-based building systems and transportation with electric-based systems (to take advantage of generally better efficiencies and decreasing electricity-based emissions). These general strategies can be applied to the major emission sectors: the residential, commercial, and industrial built environment; transportation; solid waste; and water and wastewater. Additionally, changes to land use, such as the increase and improvement of natural areas described in Santa Fe's 30 X 30 plan, can offset emissions by removing carbon from the atmosphere. To explore possible reductions in emissions, three scenarios were modeled, representing low, medium, and high effort, with corresponding low, medium, and high emissions reductions. The recommended strategies are described here, and the amount of implementation of each is shown in Table 5.

Transportation

- Promote electric vehicles (EVs). The main perceived barriers to EV ownership are up-front cost and "range anxiety", the fear of being stranded unable to find charging equipment when the vehicle's battery is low. Installation of public EV charging equipment at County facilities and amending zoning ordinances to remove barriers to EV charging equipment at developments, such as landscaping or setback restrictions, can facilitate installation of EV charging equipment. Electrifying County vehicles to provide an example to the community can also promote EV adoption, especially if the County focuses on high-use vehicles. Recently proposed EPA rules on tailpipe emissions may force more carmakers to produce EVs, lowering the cost of these vehicles and increasing availability in vehicle types which have not been widely available in electric form, such as pick-up trucks.
- Reduce per-capita vehicle miles traveled. Improving availability and safety of bicycle lanes and pedestrian sidewalks, as well as increasing development density and mixed use development to reduce travel distances can reduce the amount that residents need to drive, reducing emissions, but also saving residents money that would be spent on fuel and vehicle maintenance, as well as reducing time spent in traffic.

Residential, commercial, and industrial built environments

- Increase residential, commercial, and industrial building efficiency. Improving building efficiency not only reduces GHG emissions, but can also reduce the overall cost of homeownership, making living in the County more affordable. Educating residents on programs which can fund efficiency improvements, such as the Weatherization

Assistance Program, can allow them to lower their cost of living while reducing the up-front costs of energy efficiency.

- Educate residents on household energy savings. Partnering with local electrical utilities to provide Home Energy Reports to residents allows residents to compare their energy use to their peers, and can often prompt significant reductions in usage. Combined with County-supplied information on simple ways to save household energy, as well as information on the long-term cost savings that result from using less energy, can help residents implement real improvements in their homes.
    - If any part of the County is within the Xcel Energy service area, this utility distributes free, annual Community Energy Reports that give information, including greenhouse gas emission estimates, at the city or county level. This can assist the County tracking emissions in order to gauge the success of programs. More information, including an application link here: Community Energy Reports | Xcel Energy.
- Increasing building electrification. Replacing oil and natural gas heating systems at end of life in homes and businesses with heat pumps minimizes the up-front cost associated with electrical heating systems. The high efficiency of electric heat pumps reduces long term costs, and also shields residents and businesses from fuel-price shocks.
- Install residential solar. Installing on-site solar panels, especially with battery storage can reduce emissions, lower residents' power bills, and provide back-up power in case of a grid outage. Additionally, the high amount of solar irradiance in New Mexico makes Santa Fe County an ideal location for solar power.[89] However, the up-front cost of on-site solar can be daunting. These costs can be reduced by participating in New Mexico's community solar program, which allows residents to offset their emissions, buy purchasing shares in, or leasing a portion of, a commercial solar array. This program will open up solar power to residents who have shaded roofs, or who rent.[90] 30% of all projects will be dedicated to serving low income households. Additionally, Santa Fe County can partner with organizations such as Solar United Neighbors, a non-profit that specializes in helping form County-level purchasing cooperatives to reduce the up-front cost of solar panels.

Solid Waste

- Promoting and educating on recycling and reusing materials can help reduce landfilled waste, which produces greenhouse gases as it decomposes. By reducing the amount of material that goes into the landfill, residents can save money. Remember, everything

[89] NREL, "Solar Resource Maps and Data," accessed May 11, 2023, https://www.nrel.gov/gis/solar-resource-maps.html.
[90] New Mexico Public Regulations Commission, "Community Solar," accessed May 11, 2023, https://www.nm-prc.org/utilities/community-solar/.

that goes into the garbage has been paid for in some way by the person throwing it away. Additionally, reducing the amount of material going into the landfill can extend the lifetime of the landfill.

Water and wastewater energy use

- As with other efficiency measures, reducing water use can reduce costs to the County community. Santa Fe County's high altitude, semiarid steppe, grass, shrub and woodland, coniferous national forested landscapes make water a precious resource for the community.

Expand Forest and Non-Forest Tree Coverage

- Increasing the quality and amount of natural area in Santa Fe in line with the County's 30x30 and Nature Based Solution Plans, can significantly offset community greenhouse gas emissions and are essential to the County meeting its SBT emissions goals.

Table 5: Baseline and projected emissions in a business-as-usual scenario (MTCO2e)

Strategy	Low Effort	Medium Effort	High Effort	Unit
Replace gasoline vehicles with electric vehicles	1	6	10	% vehicles each year
Reduce resident driving mileage	5	10	20	% reduction per capita miles by 2050
Increase residential building efficiency	1	5	10	% efficiency increase per year
Educate residents on household energy savings	3,000	4,500	6,000	Number of households educated
Install residential solar	1	2	3	% of households per year
Convert residential buildings to electric	1	5	10	% of buildings each year
Increase commercial building efficiency	1	2	3	% efficiency increase per year
Convert commercial buildings to electric	1	5	10	% of buildings each year
Perform commercial building benchmarking	1	2	3	% of buildings each year
Reduce industrial building energy usage	1	2	3	% efficiency increase per year
Reduce landfilled municipal solid waste	1	5	10	% reduction each year
Reduce water usage	1	2	3	% reduction each year
Increase carbon sequestration through land use	15	30	30	% increased sequestration by 2050

Results

Figures 13 to 14 show the results of these strategies, and Tables 6 and 7 quantify the emissions for 2030 and 2050.

Figure 13: Results of low-effort implementation of strategies

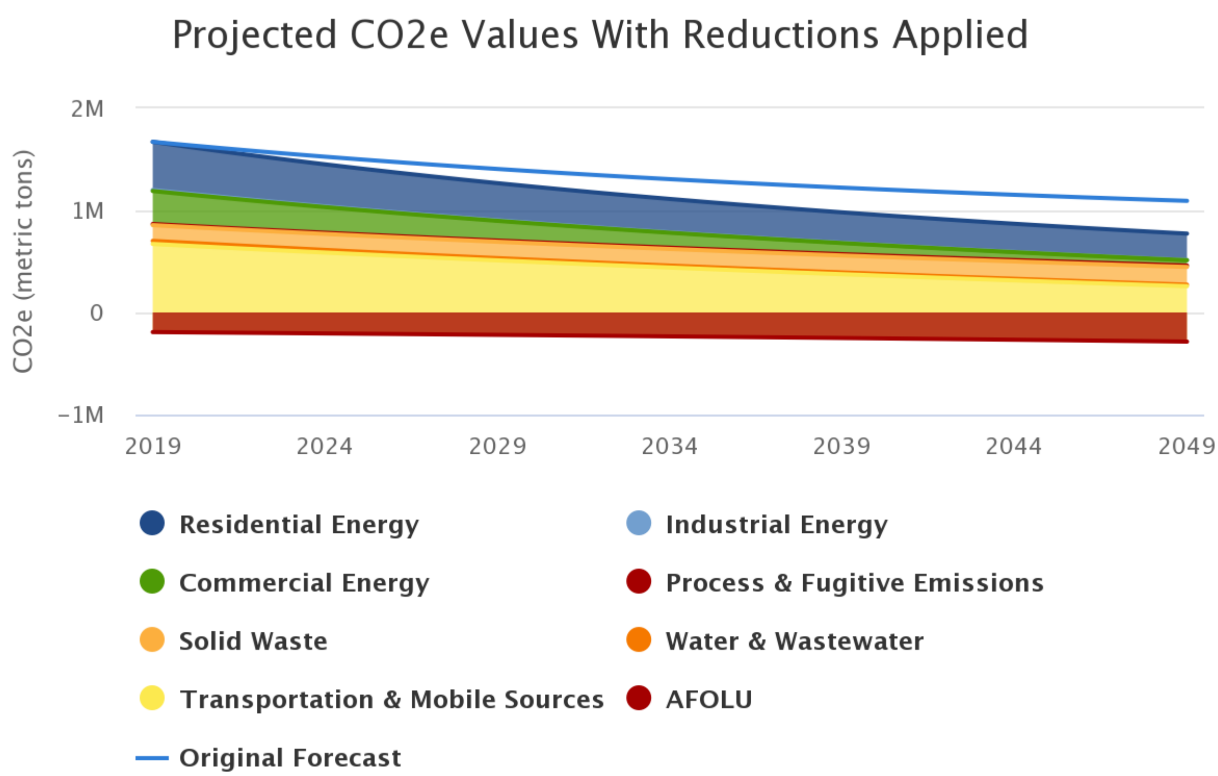

Figure 14: Results of medium-effort implementation of strategies

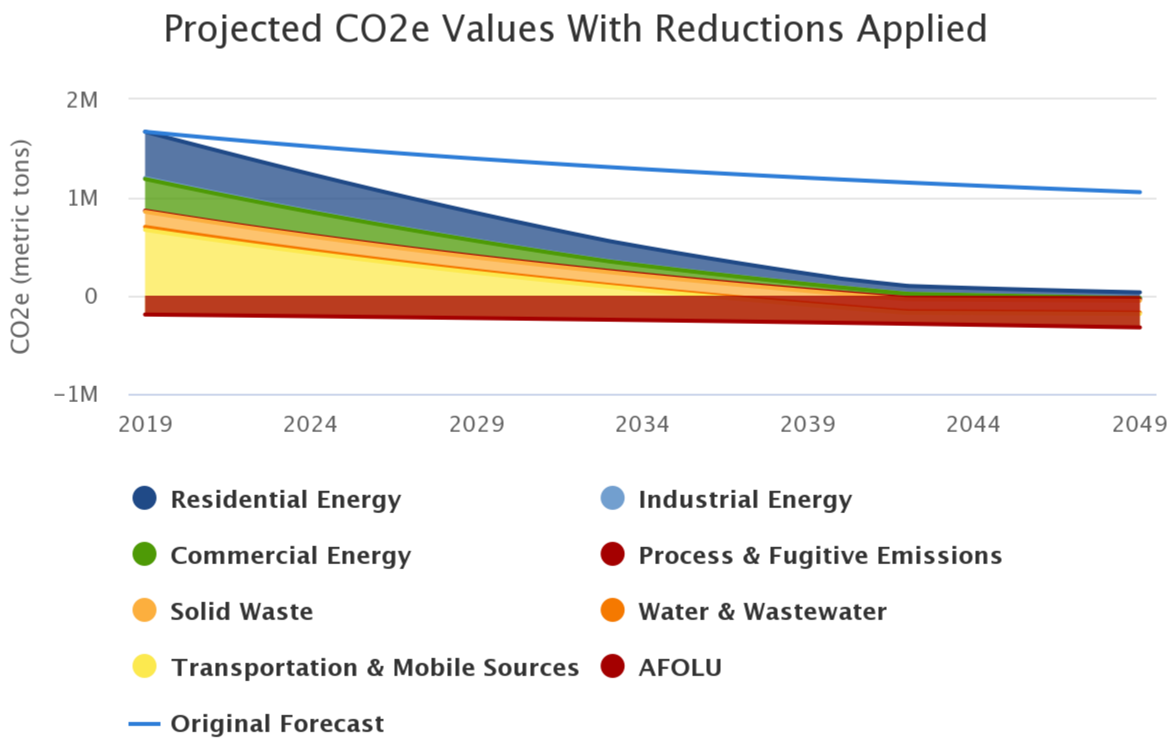

Figure 15: Results of high-effort implementation of strategies

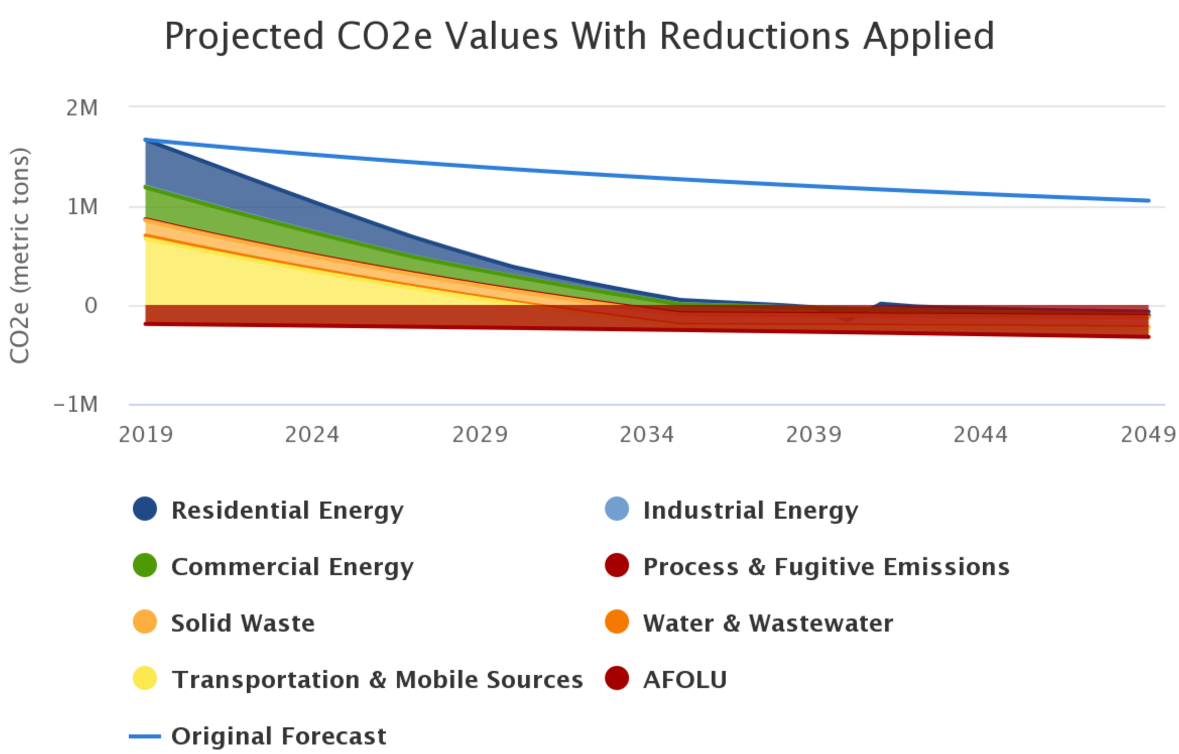

Table 6: Projected 2030 emissions reductions due to low, medium, and high-effort implementation of strategies (MTCO2e)

Sector	Low	Medium	High
Transportation	718,530	429,329	245,753
Residential Energy	355,085	259,806	90,742
Commercial Energy	183,471	141,946	134,634
Industrial Energy	5,642	5,046	4,508
Solid Waste	160,874	133,281	111,735
Water and Wastewater	21,214	20,124	19,149
Land Use	-222,253	-232,669	-232,669
Process and Fugitive	11,656	11,656	11,656
Total	**1,234,209**	**768,429**	**385,508**
Percent reduction from 2019	**26.2**	**54.0**	**76.9**

Table 7: Projected 2050 emissions reductions due to low, medium, and high-effort implementation of strategies (MTCO2e)

Sector	Low	Medium	High
Transportation	543,616	137,677	82,042
Residential Energy	258,580	56,026	31,876
Commercial Energy	52,293	13,609	9,653
Industrial Energy	2,043	1,507	1,108
Solid Waste	173,611	121,468	104,362
Water and Wastewater	14,799	13,808	13,058
Land Use	-285,654	-323,570	-323,570
Process and Fugitive	13,699	13,699	13,699
Total	**777,978**	**34,224**	**-67,736**
Percent reduction from 2019	**53.8**	**98.0**	**104.1**

Under the medium scenario, the total emissions of 644,591 MTCO2e in 2030 represents a 54% reduction from total 2019 emissions, close to the SBT, and almost completely reduces emissions in 2050. Very little additional action would be required to reach the SBT by 2030 and net zero emissions by 2050.

Additional Recommendations

As well as implementing plans to reduce community emissions, Santa Fe County can reduce emissions in its own local government operations. This will allow the County to act as a model and inspiration for community members, as well as reaping the long-term cost savings associated with emissions reductions. We recommend:

- Establishing an Energy Manager position to analyze County utility usage, and plan and implement efficiency strategies in County operations. By tracking utility usage in County operations in specific energy tracking software such as EnergyCAP, an Energy Manager can find and address inefficiencies in County buildings and infrastructure, and reduce the County's operational costs. Establishing an Energy Manager position can often pay for itself. Additionally, by tracking the cost savings that are associated with implementing specific efficiency measures, the Energy Manager can quantify those savings, and potentially divert some of the cost savings back into additional energy efficiency actions. Use of programs such as the Green Revolving Investment Tracking System (GRITS) to do this can also pay for itself. An Energy Manager can also provide analytics for GHG emissions reduction policy recommendations throughout the County
- Creating an infrastructure-focused cross departmental team (CDT) can offer many benefits, as long as there is buy-in from elected officials and high-level staff. A regularly meeting, high-level CDT composed of staff responsible for County facilities, as well as public infrastructure, can provide a single channel for implementing and streamlining energy efficiency strategies. For example, an infrastructure CDT can simplify data collection for greenhouse gas inventorying by bringing all of the County's energy users to one forum. A CDT can have additional benefits. For example, in Palm Beach County, FL, the infrastructure CDT worked to align water utility and engineering strategic plans so that the two departments could combine pipe installations with road resurfacing. This saved the County money and reduced inconvenience for residents.
- Partnership with other local governments. For example, the City of Santa Fe also conducts greenhouse gas inventories and is implementing a climate action plan. By working together with the City where these inventories and plans overlap, the County can reduce redundancy.

Recommendations to Increase Resiliency in Response to Climate Change

As outlined in the Climate Conditions Report, climate change is increasing Santa Fe's environmental hazard risk. Research and data on future climate indicate that climate change is likely to lead to warmer year-round temperatures and hotter summers. Water scarcity, drought, and aridity–already part of life in the Southwest–are likely to be worsened by climate change, as are extreme events, including heavy rainfall, flooding, and of significant concern, wildfire.

To achieve meaningful reductions in climate-related hazard risk, the County will need to work in partnership with local residents and businesses. There are multiple avenues through which the

County can act to build resilience, including deployment of conventional or "gray" infrastructure (e.g. constructed fire breaks) and nature-based solutions (e.g. urban tree canopy). The nature-based concept describes the potential for intact, functioning natural systems and assets to enhance our own ability to mitigate GHG emissions and adapt to the impacts of climate change (for more on nature-based solutions, see County Nature Based Solutions EMPSi Report).

Conventional/Built Infrastructure:

- **Resilience hubs:** Resilience hubs are typically pre-existing community facilities (e.g. houses of worship, schools, community centers) that are augmented to support residents in the event of a natural disaster. Resilience hubs can serve as a community home base from which resources, communications, and services are coordinated. Ideally, resilience hubs advance multiple goals, including those related to social equity, community self-determination and empowerment, climate resilience, and GHG mitigation.
- **Shade structures and pop-up cooling stations:** Shade structures and mobile, pop-up cooling stations are flexible ways to provide residents relief from the heat.
- **Energy resilience:** Support energy resilience with strategic installation of microgrids and dispatchable batteries.

Nature-based Solutions:

- **Urban forestry and green streets program:** Intact tree canopy can mitigate extreme heat, provide wildlife habitat, and reduce stormwater runoff, in addition to many other co-benefits.
- **Climate-smart landscaping practices:** Climate-smart landscaping practices can include interventions like replacing lawns with native plants, reducing/eliminating pesticide application, and creating rain gardens. These practices have benefits for ecosystems and can support a more resilient landscape by increasing infiltration of stormwater for building healthier soils, increasing biodiversity, and improving soil moisture.
- **Require green infrastructure:** Green infrastructure, which includes features like wetlands and bioswales, can help naturally manage stormwater and reduce flooding while creating co-benefits (e.g. wildlife habitat, community greening). The County could encourage adoption of green infrastructure by, for example, mandating its adoption on County property or passing ordinance for green infrastructure, mandating its use throughout County for larger structures and in key identified, high impact areas.

Other Recommendations:

- **Incorporate climate resilience into comprehensive plans:** Comprehensive planning, through a Cross Departmental Team (CDT), previously mentioned, are critical interdisciplinary partnering strategies for identifying and planning for effectively and efficiently addressing a regional government's critical priorities across multiple thematic areas, including land use, governance, natural resource management, transportation planning, public works, infrastructure, and community development. Incorporating climate resilience into comprehensive plans with such a group helps to decrease silos and local governments to move the needle on climate action planning toward implementation more cooperatively and cohesively.
- **Climate-smart codes and zoning:** Codes and zoning regulations can significantly reduce wildfire risks to life and property. For example, Wildland Urban Interface (WUI) codes create minimum requirements for building and development. WUI codes, which combine relevant rules in one place, make it easier for developers and residents to understand their risk and comply with regulations. In general, climate-smart zoning can be used to shift development away from high-risk areas.
- **Youth outreach:** Other municipalities have successfully broadened their reach and advanced partnerships with underserved communities through youth outreach, such as by supporting a Climate Ambassadors program.

Potential Funding Opportunities

The main upcoming sources of federal funding for climate mitigation initiatives are the Inflation Reduction Act of 2022, the Infrastructure Investment and Jobs Act, the Environmental Protection Agency's Climate Pollution Reduction Grant (CPRG) program, and the Department of Energy's Energy Efficiency and Conservation Block Grants (EECBG).

Funding sources in those acts relevant to this plan include:

Inflation Reduction Act of 2022

- Ability for tax-exempt entities such as the County to monetize tax incentives in certain programs, such as the Alternative Fuel Vehicle Refueling Property Tax Credit and Energy-Efficient Commercial Buildings Tax Deduction https://www.epa.gov/green-power-markets/inflation-reduction-act
- The Investment Tax Credit will provide a 30% tax credit for investments in clean energy, as well as an extra 20% tax credit for investments in low income communities.

https://home.treasury.gov/system/files/136/Fact-Sheet-IRA-Equitable-Clean-Energy-Economy.pdf

- $1.9 billion specifically to improve neighborhood walkability through the Neighborhood Access and Equity Grant Program. This funding has an 80% federal share, or a 100% federal share for underserved communities. Deadlines and application information have not yet been released. https://fundingnaturebasedsolutions.nwf.org/programs/neighborhood-access-and-equity-grant-program/

Infrastructure Investment and Jobs Act

- The National Electric Vehicle Incentive (NEVI) program, which will provide $5 billion nationally to fund electric vehicle charging equipment. It is expected that $38 million will be allocated to New Mexico. Deadlines and funding amounts have not yet been announced. https://www.dot.nm.gov/nevi/
- New competitive grant programs for charging and fueling infrastructure, which will provide 2.5 billion nationally for public electric vehicle charging and alternate fuels along pre-designated Alternative Fuel Highways, including Interstate I-25 in Santa Fe County. https://www.transportation.gov/rural/ev/toolkit/ev-infrastructure-funding-and-financing/federal-funding-programs
- $193 million between 2022 and 2026 for public transit investments. https://www.transit.dot.gov/funding/grants/fta-program-fact-sheets-under-bipartisan-infrastructure-law

Additional funding

- The U.S. Department of Agriculture Forest Service has received $1.5 billion to support urban tree-planting, urban forest planning and management, and related activities, particularly in disadvantaged communities, including $1.9 million for New Mexico. https://www.fs.usda.gov/managing-land/urban-forests/ucf
- The U.S. Department of Energy is offering grants up to $400,000 for energy and efficiency upgrades in disadvantaged communities through their Building Upgrade Program. Up to $5,000 is available for assistance with applications, and applications are open now on a rolling basis. https://www.energy.gov/eere/articles/us-department-energy-announces-buildings-upgrade-prize

Appendix A: Climate Data

Data Platforms

Platform	Description
National Climate Change Viewer (NCCV)	The NCCV, created by the US Geological Survey (USGS) allows users to visualize and download data on projected climatic changes across climate indicators (temperature and precipitation) as well as simulated water balance indicators (snow water equivalent, runoff, soil water storage, and evaporative deficit) for states and counties in the US. See technical documentation for more information.
Climate Resilience Toolkit Climate Explorer	The Climate Explorer, created by several federal government science agencies, allows users to view and download graphs and maps showing past observations and projected climate conditions for counties in the US. Projections are provided for temperature, precipitation, and indicators relating to heating/cooling and agriculture. See About page for more information.
Risk Factor	Risk Factor is an online platform created by the nonprofit First Street Foundation that provides data on climate hazards and exposure. As of April 2023, Risk Factor provides free access to high-level information and data on exposure to flooding, wildfires, extreme heat, and severe wind at the city, county, zip code and address level. Detailed property-level information is available for purchase. See Risk Factor's About page for more information.

Seasons

Season	Months
Winter	December, January, February
Spring	March, April, May
Summer	June, July, August
Fall	September, October, November

Indicators

Indicator (Unit)	Description	Source
Temperature		
Mean Temperature (°F)	The average of minimum and maximum annual or seasonal air temperature	NCCV
Maximum Temperature (°F)	The maximum annual or seasonal air temperature	NCCV
Minimum Temperature (°F)	The minimum annual or seasonal air temperature	NCCV
Extremely Hot Days (days)	Number of days with maximum temperature > 100°F	Climate Explorer
Precipitation		
Average Precipitation (in/month)	The average annual or seasonal accumulated monthly precipitation (inches per month)	NCCV
Extreme Precipitation Events (days)	Number of extreme precipitation events (days with > 1 inch precipitation)	Climate Explorer
Hydrological		
Evaporative Deficit (mm/month)	The average annual or seasonal difference between potential evapotranspiration and actual evapotranspiration	NCCV
Soil Storage (in/month)	The average annual or seasonal amount of water stored in the soil column	NCCV
Runoff (in/month)	The average annual or seasonal amount of runoff (sum of direct runoff) that occurs from precipitation and snowmelt and surplus runoff which occurs when soil moisture is at 100% capacity	NCCV
Other		
Annual Vapor Pressure Deficit (psi)	The difference between the amount of moisture in the air and maximum amount of water the air can hold at saturation	NCCV

Climate Data and Projections Detailed View

Temperature

Minimum, Mean, and Maximum Temperature

Table A1. Minimum, mean, and maximum temperatures (°F) annually and by season averaged across three 25-year climatology periods for Santa Fe County under RCP8.5.[91] All values are the ensemble median. 1981-2010 baseline provided for comparison.

RCP 8.5												
	Baseline (1981-2010)			2025-2049			2050-2074			2075-2099		
Season	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Annual	35.88	50.28	64.69	38.88	53.53	68.18	41.43	56.37	71.31	44.21	59.32	74.43
Winter	19.63	32.28	44.93	22.7	35.46	48.23	24.97	38.05	51.13	27.41	40.78	54.15
Spring	34.14	49.33	64.52	36.76	52.39	68.03	39.06	55.21	71.36	41.53	57.9	74.27
Summer	53.39	68.74	84.1	56.51	72.06	87.6	59.35	75.06	90.78	62.55	78.3	94.05
Fall	36.36	50.78	65.19	39.52	54.18	68.84	42.31	57.12	71.94	45.31	60.25	75.2

[91] USGS, "National Climate Change Viewer."

Summer Mean Temperature

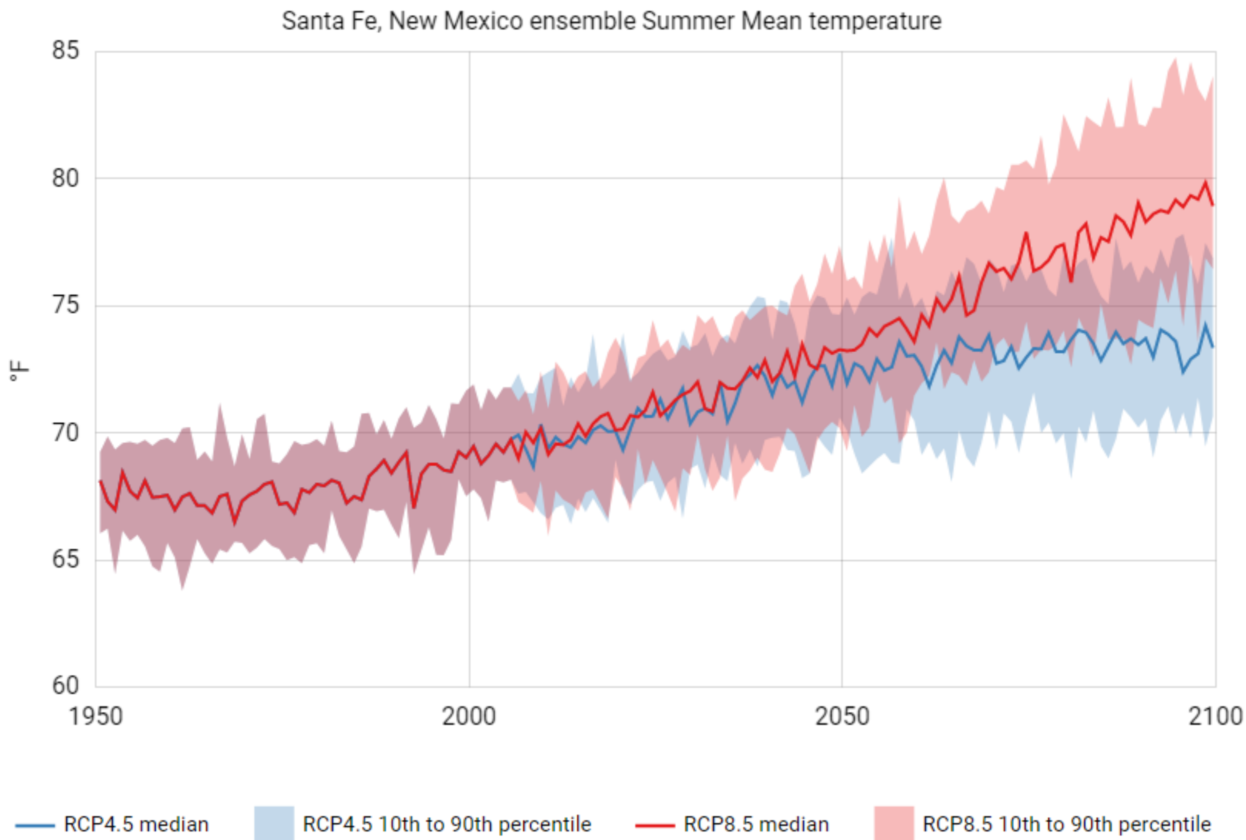

Figure A1. Summer mean temperature (°F) in Santa Fe County projected through 2099 under RCP4.5 (blue) and RCP8.5 (red).[92] The solid lines show the ensemble median. Shaded areas show the 10th to 90th percentile range of projections.

[92] USGS.

Winter Mean Temperature

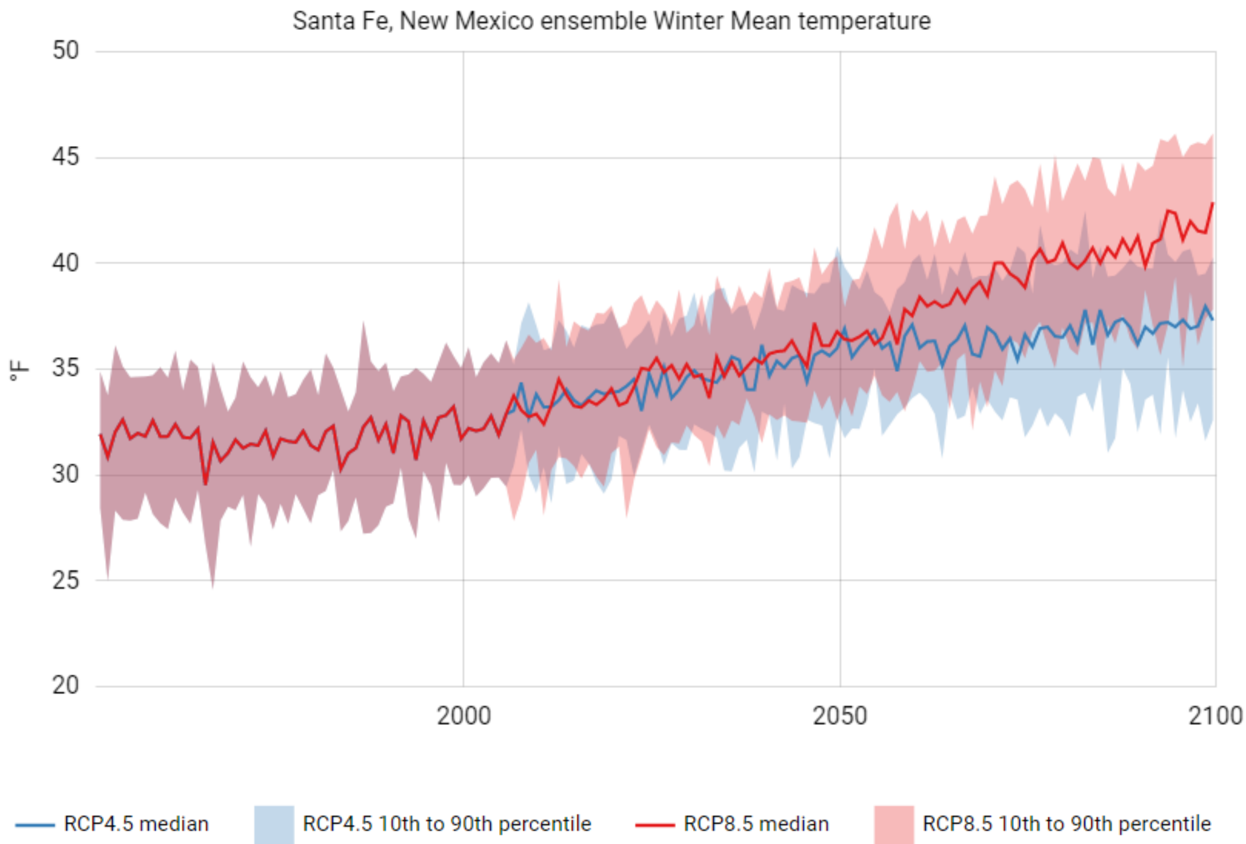

Figure A2. Winter mean temperature (°F) in Santa Fe County projected through 2099 under RCP4.5 (blue) and RCP8.5 (red).[93] The solid lines show the ensemble median. Shaded areas show the 10th to 90th percentile range of projections.

[93] USGS.

Winter Minimum Temperature

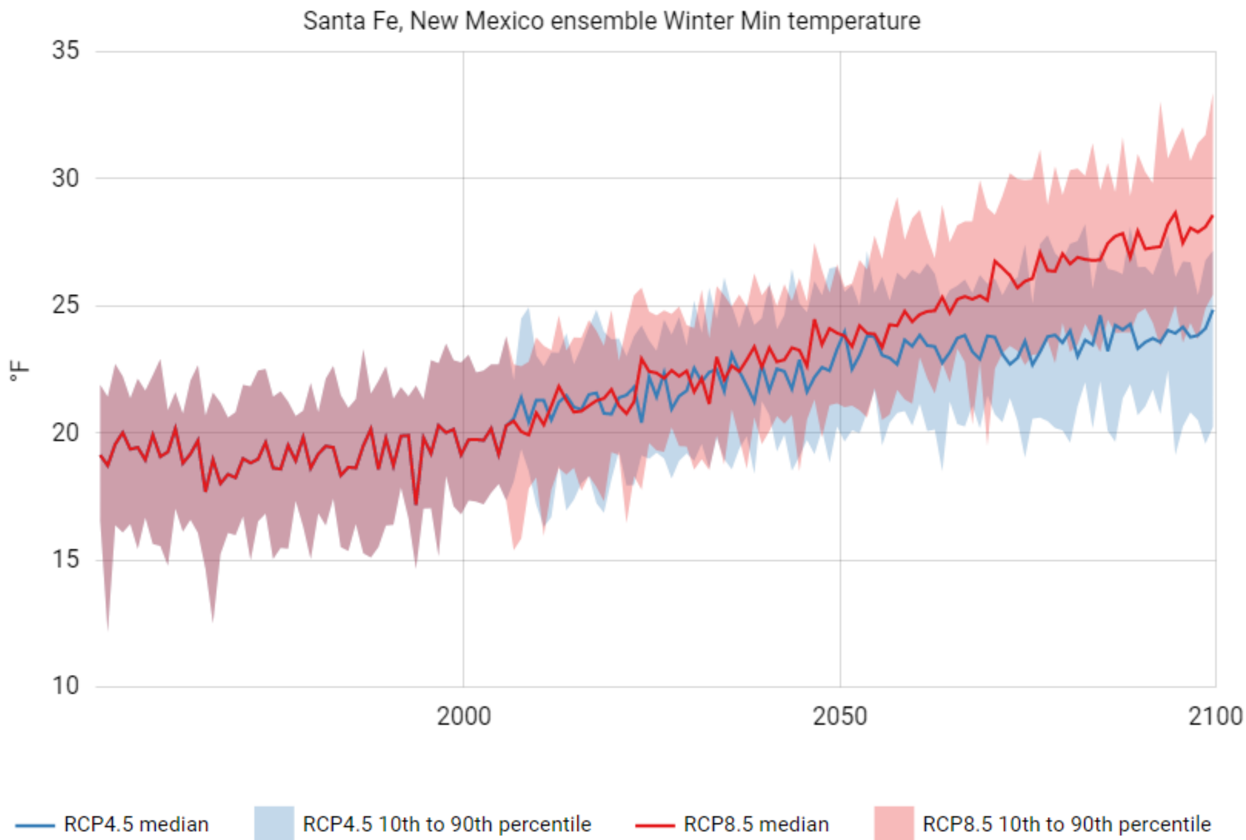

Figure A3. Winter minimum temperature (°F) in Santa Fe County projected through 2099 under RCP4.5 (blue) and RCP8.5 (red).[94] The solid lines show the ensemble median. Shaded areas show the 10th to 90th percentile range of projections.

[94] USGS.

Extremely Hot Days

Table A2. Number of extremely hot days (maximum temperature > 100 °F) per year in Santa Fe County projected under RCP8.5 averaged by decade.[95] All values are the ensemble median. Historical observations (not modeled history) are provided for comparison.

RCP 8.5	
Time Period	**Decadal Average**
Historical Observations (1960-1991)	*0*
2010s	0.4
2020s	0.6
2030s	1.2
2040s	2.8
2050s	3.8
2060s	8.2
2070s	13.5
2080s	18.3
2090s	26.3

[95] U.S. Federal Government, "U.S. Climate Resilience Toolkit Climate Explorer."

Precipitation

Annual and Seasonal Average Precipitation

Table A3. Annual and seasonal precipitation (inches/month) averaged across three 25-year climatology periods for Santa Fe County under RCP8.5.[96] All values are the ensemble median. 1981-2010 baseline provided for comparison.

RCP 8.5				
Season	**Baseline (1981-2010)**	**2025-2049**	**2050-2074**	**2075-2099**
Annual	1.3	1.31	1.27	1.26
Winter	0.83	0.86	0.85	0.83
Spring	1	0.97	0.9	0.89
Summer	2.05	2.04	1.98	1.98
Fall	1.3	1.37	1.34	1.34

[96] USGS, “National Climate Change Viewer.”

Change in Annual Average Precipitation

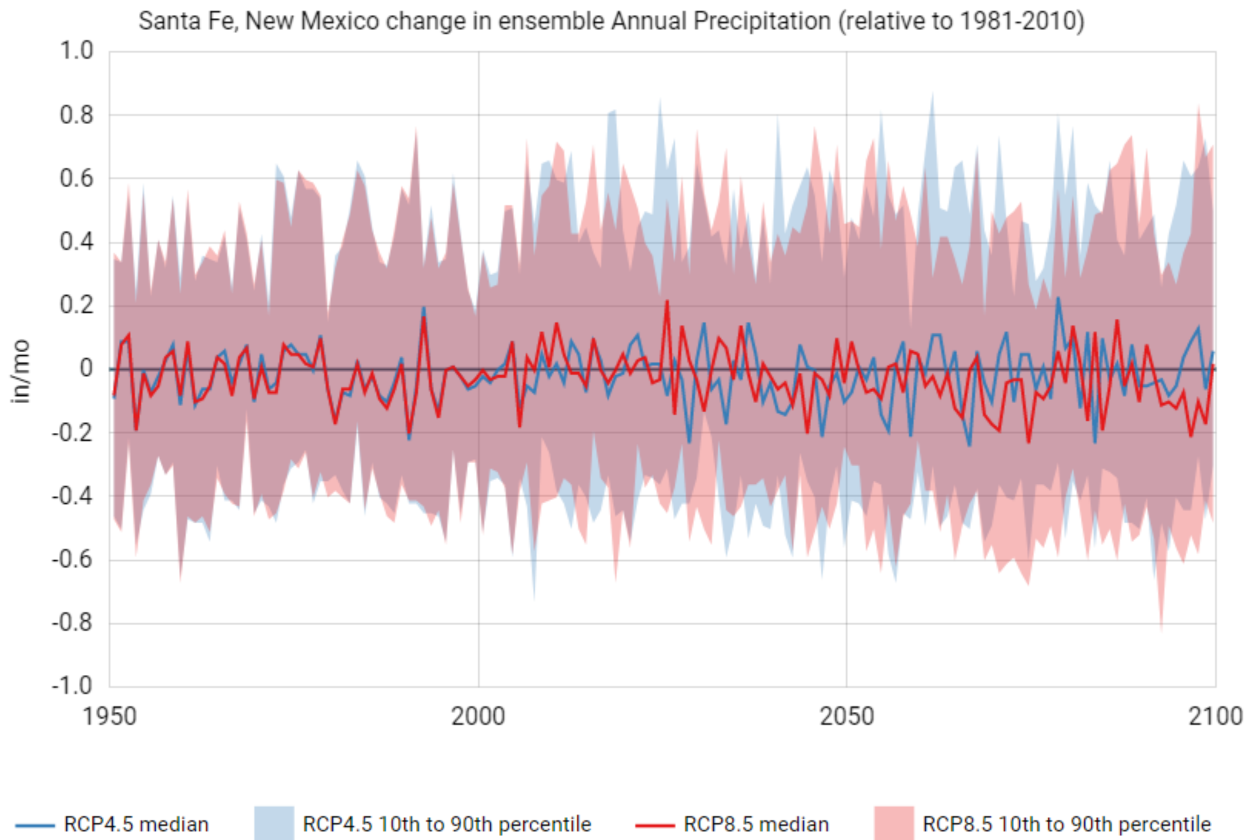

Figure A4. Change in annual average precipitation (in/mo) in Santa Fe County projected through 2099 under RCP4.5 (blue) and RCP8.5 (red).[97] The solid lines show the ensemble median. Shaded areas show the 10th to 90th percentile range of projections.

[97] USGS.

Spring Average Precipitation

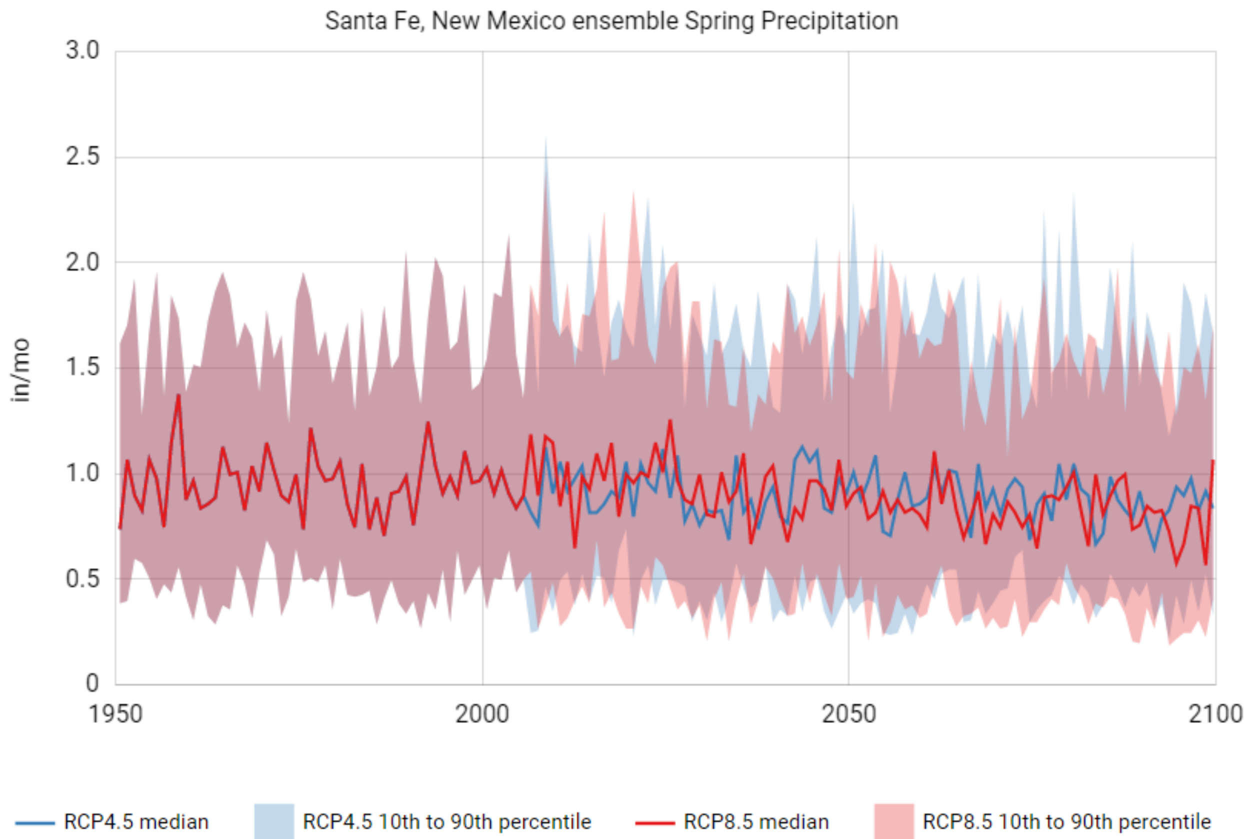

Figure A5. Spring precipitation (in/mo) in Santa Fe County projected through 2099 under RCP4.5 (blue) and RCP8.5 (red).[98] The solid lines show the ensemble median. Shaded areas show the 10th to 90th percentile range of projections.

[98] USGS.

Extreme Precipitation Events

Table A4. Number of extreme precipitation events (days per year with > 1 inch of precipitation) in Santa Fe County projected under RCP8.5 averaged by decade.[99] All values are the ensemble median. Historical observations (not modeled history) are provided for comparison.

RCP 8.5	
Time Period	**Decadal Average**
Historical Observations (1960-1991)	*0.5*
2010s	0.4
2020s	0.5
2030s	0.5
2040s	0.5
2050s	0.5
2060s	0.5
2070s	0.6
2080s	0.6
2090s	0.5

[99] U.S. Federal Government, "U.S. Climate Resilience Toolkit Climate Explorer."

Drought

Evaporative Deficit

Table A5. Annual and seasonal average evaporative deficit (mm/month) averaged across three 25-year climatology periods for Santa Fe County under RCP8.5.[100] 1981-2010 baseline provided for comparison.

RCP 8.5				
Season	**Baseline (1981-2010)**	**2025-2049**	**2050-2074**	**2075-2099**
Annual	30.07	36.81	44.12	51.33
Winter	0.22	1.17	3.26	6.6
Spring	24.43	33.96	44.9	55.06
Summer	71.87	83.43	94.69	105.04
Fall	23.77	28.7	33.58	38.55

[100] USGS, "National Climate Change Viewer."

Soil Storage

Table A6. Annual and seasonal average soil storage (in) averaged across three 25-year climatology periods for Santa Fe County under RCP8.5.[101] 1981-2010 baseline provided for comparison.

RCP 8.5				
Season	**Baseline (1981-2010)**	**2025-2049**	**2050-2074**	**2075-2099**
Annual	1.23	1.06	0.82	0.63
Winter	2.04	2.02	1.73	1.38
Spring	1.92	1.48	1.05	0.74
Summer	0.34	0.21	0.13	0.09
Fall	0.63	0.52	0.37	0.3

[101] USGS.

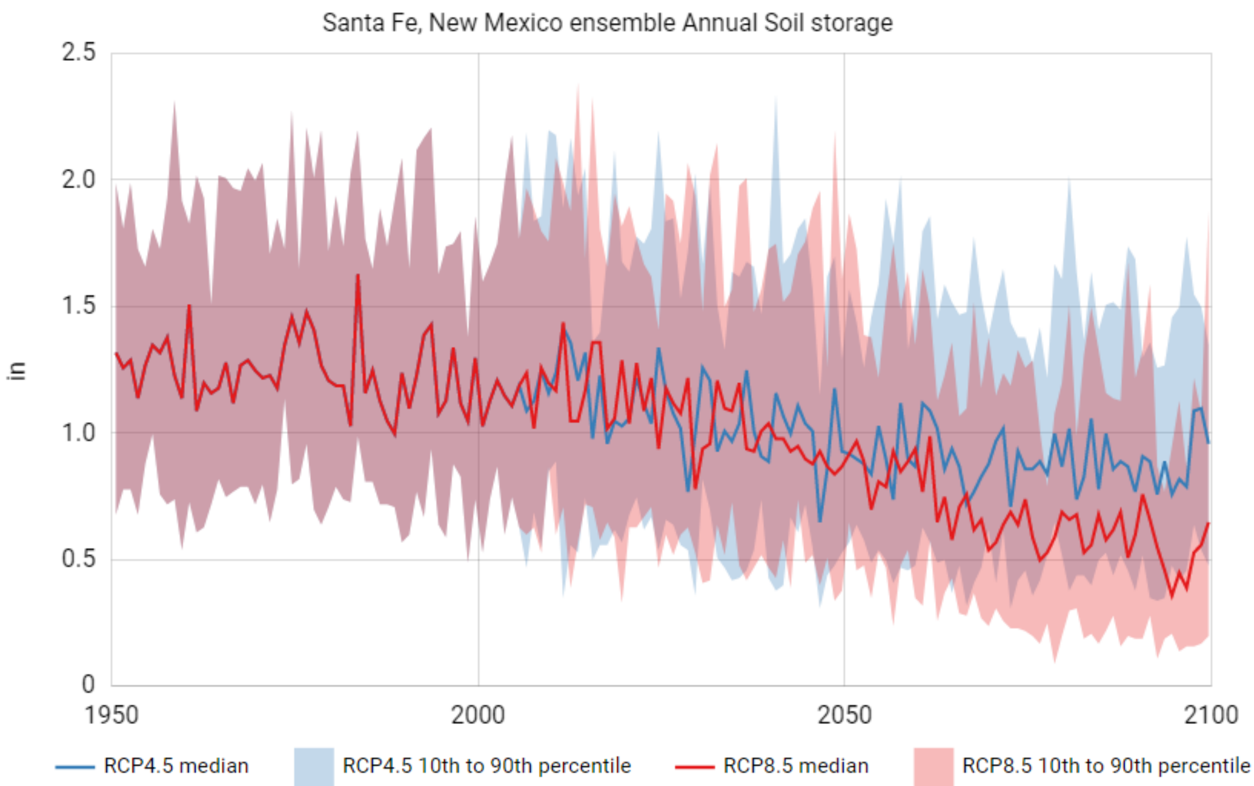

Figure A6. Annual soil storage (in/month) in Santa Fe County projected through 2099 under RCP4.5 (blue) and RCP8.5 (red).[102] The solid lines show the ensemble median. Shaded areas show the 10th to 90th percentile range of projections.

[102] USGS.

Runoff

Table A7. Annual and seasonal average runoff (in/mo) averaged across three 25-year climatology periods for Santa Fe County under RCP8.5.[103] 1981-2010 baseline provided for comparison.

RCP 8.5				
Season	**Baseline (1981-2010)**	**2025-2049**	**2050-2074**	**2075-2099**
Annual	0.15	0.15	0.13	0.12
Winter	0.04	0.07	0.08	0.09
Spring	0.23	0.22	0.18	0.15
Summer	0.24	0.19	0.15	0.13
Fall	0.11	0.11	0.09	0.09

[103] USGS.

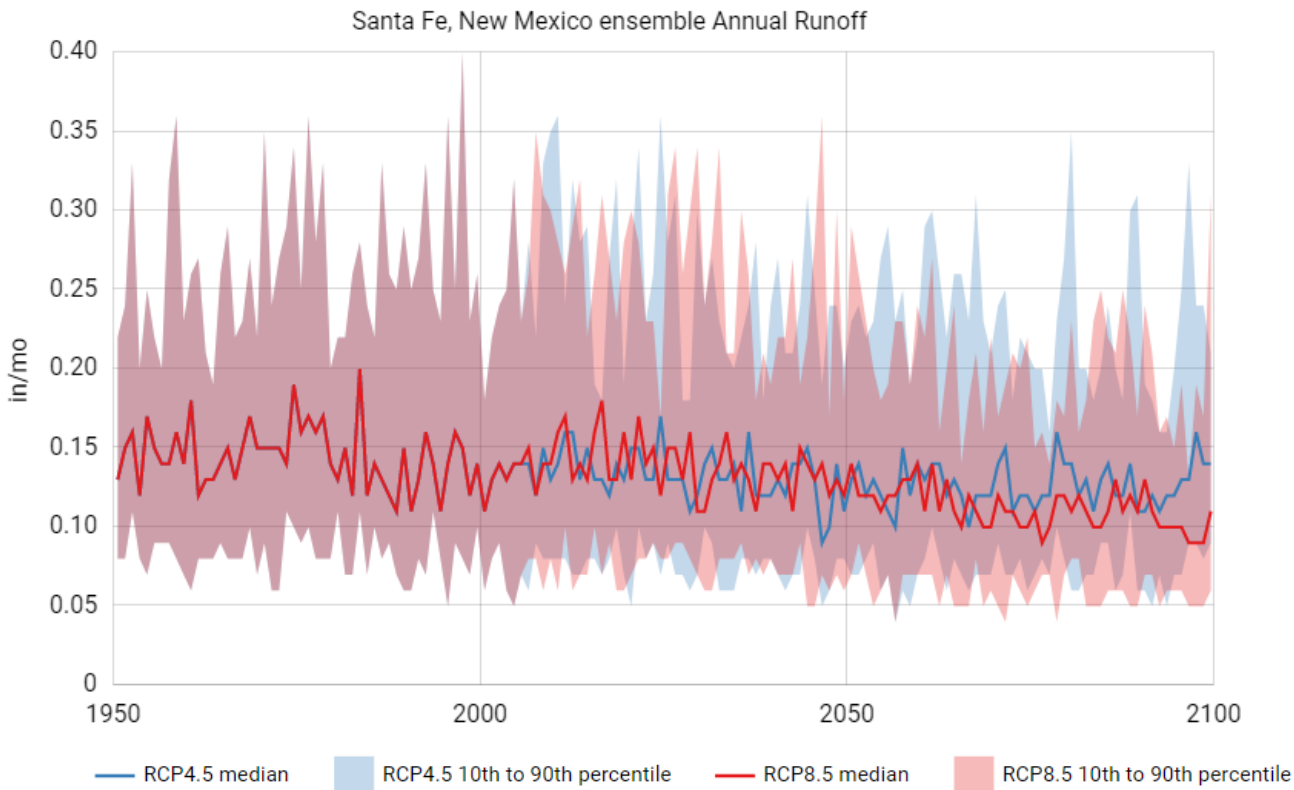

Figure A7. Runoff (in/month) in Santa Fe County projected through 2099 under RCP4.5 (blue) and RCP8.5 (red).[104] The solid lines show the ensemble median. Shaded areas show the 10th to 90th percentile range of projections.

[104] USGS.

Wildfire

Vapor Pressure Deficit

Table A8. Annual and seasonal vapor pressure deficit (psi) averaged across three 25-year climatology periods for Santa Fe County under RCP8.5.[105] 1981-2010 baseline provided for comparison.

RCP 8.5				
Season	**Baseline (1981-2010)**	**2025-2049**	**2050-2074**	**2075-2099**
Annual	0.15	0.17	0.19	0.22
Winter	0.06	0.07	0.07	0.08
Spring	0.15	0.17	0.2	0.22
Summer	0.26	0.29	0.33	0.38
Fall	0.14	0.16	0.18	0.2

[105] USGS.