Nevada Statewide Greenhouse Gas Emissions Inventory and Projections, 1990-2042

Nevada Division of Environmental Protection
2022 Report

Submitted in accordance with NRS 445B.380

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Disclaimer

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Acronyms and Abbreviations

A4A	Airlines for America
ACC II	Advanced Clean Cars II
AEO	Annual Energy Outlook
AIM	American Innovation and Manufacturing Act
AMPD	Air Markets Program Data
BTS	United States Department of Transportation Bureau of Transportation Statistics
BTU	British Thermal Unit
CAA	Clean Air Act
CARB	California Air Resources Board
CNG	Compressed Natural Gas
CO2e	Carbon dioxide equivalent
DMV	Nevada Department of Motor Vehicles
eGRID	Emission & Generation Resource Integrated Database
EGU	Electric Generating Unit
EIA	United States Energy Information Administration
EO	Executive Order
EPA	United States Environmental Protection Agency
EV	Electric Vehicle
FHWA	Federal Highway Administration
GHG	Greenhouse Gas
GHGRP	Greenhouse Gas Reporting Program
GOE	Nevada Governor's Office of Energy
GWP	Global Warming Potential
IECC	International Energy Conservation Code
IPCC	Intergovernmental Panel on Climate Change
IRP	Integrated Resource Plan
LCFS	Low-Carbon Fuel Standard
LEV	Low Emission Vehicle
LFGTE	Landfill-Gas-to-Energy
LNG	Liquefied Natural Gas
LULUCF	Land Use, Land Use Change, and Forestry
MMTCO2e	Million metric tons of carbon dioxide equivalent
MWh	Megawatt-hour
NCI	Nevada Climate Initiative
NDEP	Nevada Division of Environmental Protection
NDOT	Nevada Department of Transportation
NHTSA	National Highway Traffic Safety Administration
NPC	Nevada Power Company
NRS	Nevada Revised Statutes
NSPS	New Source Performance Standards
ODS	Ozone Depleting Substance
PACE	Property Assessed Clean Energy
PUCN	Public Utilities Commission of Nevada
RPS	Renewable Portfolio Standard
SAFE	Safe and Affordable Fuel-Efficient Vehicles
SB	Senate Bill
SC-GHG	Social Cost of Greenhouse Gases
SEDS	State Energy Data System
SNAP	Significant New Alternatives Policy
SIT	State Inventory Tool
SPPC	Sierra Pacific Power Corporation
TTM	Total Ton-Miles
TWh	Terawatt-hour
VMT	Vehicle Miles Travelled
ZEV	Zero Emission Vehicle

Chemicals and Chemical Compounds

C	Carbon
CaO	Calcium Oxide, or lime
$CaCO_3$	Calcium Carbonate, or limestone
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon dioxide
HFC	Hydrofluorocarbon
NCO	Cyanate
NH	Imidogen
NO	Nitrogen Oxide
NOx	Oxides of Nitrogen
N_2O	Nitrous Oxide
PFC	Perfluorocarbon
SF_6	Sulfur hexafluoride

Executive Summary

Introduction

The Nevada Division of Environmental Protection is pleased to present the 2022 report, *Nevada Statewide Greenhouse Gas Inventory and Projections, 1990 to 2042*. This report has been prepared pursuant to Nevada Revised Statutes (NRS) 445B.380[1], which was approved by the Nevada Legislature during the 2019 Legislative Session and signed by Governor Sisolak on June 3, 2019.

As required by NRS 445B.380, this report contains an updated inventory of greenhouse gas (GHG) emissions in Nevada and a statement of policies to help inform the development of future policy initiatives designed to reduce GHG emissions statewide. The 2022 report includes an updated inventory of actual GHG emissions through 2020 and projection of GHG emissions through 2042 for the largest emitting sectors (transportation and electricity generation) as well as the industry sector, given the potential for rising emissions from Ozone Depleting Substance (ODS) substitutes. It should be noted that 2015 marked the first year that GHG emissions from the transportation sector overtook electricity generation as the largest source of emissions in Nevada.

The report also provides updates to the "statement of policies" included in previous reports. The update includes policies and analyses included in the *2020 State Climate Strategy*[2] and the United States Climate Alliance 2022 Annual Report[3]. Further development and review of policies will be pursued as part of the overall Nevada Climate Initiative[4].

NRS 445B.380 sets emission reduction goals for all GHG emitting sectors of the State's economy. Nevada led the nation as one of the first states to establish a renewable portfolio standard (RPS) in 1997 and later increased the RPS during the 2019 Legislative Session through SB 358 by requiring 50% of electricity sold in Nevada to originate from renewable energy sources by 2030[5]. While the purpose of Nevada's RPS is the expansion of renewable electricity ***use*** statewide in Nevada, the secondary benefit has been a significant reduction in GHG emissions from the electricity generation sector through expanded ***production*** of renewable electricity in Nevada. Note that renewable electricity ***use*** and ***production*** in Nevada are not synonymous.

Building upon the RPS, NRS 445B.380 sets forth economy-wide GHG reduction goals of 28% below 2005 levels by 2025, 45% below 2005 levels by 2030, and zero or near-zero by 2050. These economy-wide GHG emission reduction goals generally correspond to similar reductions required pursuant to

[1] The Department of Conservation and Natural Resources' greenhouse gas emissions inventory responsibility was established by SB 422 of the 2007 Legislative Session.
[2] State of Nevada Climate Initiative: Our Strategy. Nevada Department of Conservation and Natural Resources and Nevada Governor's Office of Energy. [accessed 2022 Nov 18]. https://climateaction.nv.gov/our-strategy/
[3] U.S. Climate Alliance. 2022 Annual Report. [accessed 2022 Nov 17]. http://www.usclimatealliance.org/annual-report
[4] https://climateaction.nv.gov/
[5] Not all the electricity sold in Nevada is produced in Nevada, and not all the electricity produced in Nevada is sold in the state (see Section 4).

Nevada joining the U.S. Climate Alliance in March of 2019.[6] Further, the goals embodied in NRS 445B.380 and via the U.S. Climate Alliance are both reflected as priorities under Executive Order (EO) 2019-22, issued by Governor Sisolak in November 2019. One of the core directives required under EO 2019-22 directs the executive branch to build upon the Statement of Policies included in this report by evaluating, identifying, and analyzing the most effective climate policies and regulatory initiatives for Nevada in a comprehensive State Climate Strategy. The State Climate Strategy serves as a framework for policymakers to evaluate the alignment of various climate policies and programs with timelines and benchmarks to achieve GHG reduction goals.

Assumptions and Key Findings

Under NRS 445B.380 and EO 2019-22, Nevada has set forth benchmarks for reducing GHG emissions and mitigating climate impacts throughout Nevada. Based on the policies considered in this report and best available data, Nevada is anticipated to reduce economy-wide GHG emissions by 21% below 2005 levels in 2025 (7% short of the NRS 445B.380 goal of 28%) and by 23% below 2005 levels in 2030 (22% short of the NRS 445B.380 goal of 45%). Policies considered in this report, and used in developing emission projections, do not always match with the policies in effect at the time of the publication of the report (see Section 2.2 and Table 2-3 of the full report for more information). These projections assume the following:

- The impact of the COVID-19 pandemic is captured by actual emissions for 2020. However, 2021 and later years are projected and therefore the rate at which emissions are recovering is uncertain (see Section 1.3);
- Recently increased RPS requirements are fully met (see Section 4.3 and Appendix A);
- Part Two of the Safer Affordable Fuel-Efficient (SAFE) Vehicle Rule is implemented (see Section 3.3);
- Clean Cars Nevada, which implements the California Advanced Clean Cars I program (ACCI) (see Section 3.3);
- Planned coal-fired electric generating unit retirements (see Section 4.3 and Appendix A);
- Anticipated natural gas-fired electric generating unit retirements (see Section 4.3 and Appendix A);
- Existing emission standards for the oil and natural gas industry, including exploration, production, and delivery, remain in effect (see Section 5.3);
- Changes in emissions from ODS substitutes are affected by large uncertainties as previous federal regulations were vacated, but the U.S. Environmental Protection Agency (EPA) finalized a hydrofluorocarbon (HFC) phasedown rule in October 2021 that, while not considered in this report, is anticipated to result in substantial reductions (see Section 5.3 and Appendix A). An updated projection of national HFC emissions that quantifies the anticipated reductions from the HFC phasedown rule is expected from the EPA and will be incorporated into this report in following years once the data becomes available; and

[6] Nevada Governor Steve Sisolak Joins U.S. Climate Alliance. US Climate Alliance; 2019 Mar 12. [accessed 2022 Nov 18]. https://www.usclimatealliance.org/publications/2019/3/12/nevada-governor-steve-sisolak-joins-us-climate-alliance

- On November 30, 2022, Nevada Power Company and Sierra Pacific Power Company filed a joint application with the Public Utilities Commission of Nevada (PUCN) for approval of the Fourth Amendment to the 2021 Joint Integrated Resource Plan[7]. The Amendment introduces uncertainty into the reported emission projections. The impact of the submitted Amendment on future emissions will be considered after approval by the Public Utilities Commission and likely included in the next year's annual report.

Through 2042, this report projects that emissions from the transportation sector will continue to be the largest emitting sector and that GHG emissions from the industrial sector will be the most rapidly increasing source of emissions under current policies. As such, addressing GHG emissions from these two sectors should be a priority for policymakers in both the near- and long-term. It is also important to note that continued decarbonization of the electricity generation sector is needed to realize greater carbon reduction benefits of transportation sector electrification.

Other key findings from the report include:

- In 2020, Nevada contributed 0.72% of the U.S.'s total gross GHG emissions, despite having 0.94% of the population;
- As of 2015, the transportation sector accounts for the greatest percentage of GHG emissions, with 32% of gross GHG emissions in Nevada in 2020;
- Based on the policies considered in this report and using projected emissions for 2021 and subsequent years, transportation sector emissions are projected to have mostly recovered from the COVID-19 significant decline in 2020, and then follow a very gradual upward trend through 2042, driven by population and economic growth;
- GHG emissions from the electricity generation sector are expected to continue to decrease through 2042, with the conditional retirement of the North Valmy Generating Station in Nevada (currently projected for 2025 based on the 2021 IRP) and the increased RPS established by SB 358 (2019). Additional reductions are expected from the conversion of TS Power (a coal-fired power plant owned and operated by Nevada Gold Mines LLC) from a strictly coal-fired facility to a dual fueled, coal- and natural gas-fired facility;
- Emissions from the residential and commercial sectors are expected to continue to increase, driven by population and economic growth;
- Industrial process sub-sector emissions are also expected to continue to increase, despite U.S. EPA's HFC phasedown rule which was not finalized until October 2021 and therefore is not considered in this report; and
- Upward trends in the transportation, industrial, and residential and commercial sectors offset emissions reduction in the electricity generation sector.

[7] Public Utilities Commission Docket No. 22-11032. [accessed 2022 Dec 06]. https://pucweb1.state.nv.us/puc2/Dktinfo.aspx?Util=Electric

Summary of Changes from 2021 Report

Key changes from the previous 2021 report include:

- Discussion of COVID-19 impacts on GHG emissions, alongside new 2020 reported emissions;
- Updated to 2022 version of EPA State Inventory Tool (SIT); and
- A reformatted Report changed from previous years. Methodology descriptions for each sector have been moved to the Appendix, to provide more focus on the data and trends. However, new or alternative methodologies are introduced and discussed in the main part of the Report.

Conclusions

Going forward, Nevada's pathway to reducing GHG emissions and mitigating the impacts of climate change statewide can be achieved through a variety of budget and policy mechanisms informed by input from this report, the *2020 State Climate Strategy*, and other relevant input from state and local agencies, stakeholder groups, university and scientific experts, and the general public.

Heading into the 2023 Legislative Session, policymakers will need to make important policy and budget decisions necessary for Nevada to meet the NRS 445B.380 GHG reduction goals in 2025 and 2030, and beyond. It should be noted that most policies, such as those for the transportation sector, will require multiple years from policy creation to market/consumer adoption before significant GHG reductions are realized. Continued reductions in the electricity generating sector are also needed to meet GHG reduction benchmarks. Therefore, it is critical that policymakers adopt a strategic near- and long-term approach across all emissions sectors and technologies to effectively meet our 2025 and 2030 goals.

Summary Figures and Tables

A high-level summary of Nevada GHG inventory and projections by sector contained in this report is provided in Figure ES-1, Table ES-1, and Figure ES-2 below.

Figure ES-1 illustrates Nevada's net GHG emissions broken down by each of the seven individual sectors included in the report (transportation, electricity generation, industry, residential and commercial, waste, agriculture, and land use, land use change, and forestry) from 2005 through 2020 and projected emissions from each of these sectors from 2021 through 2030. Note that this report includes updated projections only for the transportation, electricity generation, industry, and residential and commercial sectors[8]. As is standard practice with GHG inventories, net GHG emissions for each year are measured in units of millions of metric tons of carbon dioxide equivalents (abbreviated as "MMTCO2e") on the vertical axis of the graph. Net GHG emissions in 2005 are the benchmark against which Nevada's reduction goals of 28% by 2025 and 45% by 2030 are measured. Reductions in GHG emissions from 2005 through 2020 come primarily from the electricity generation sector. Projections indicate that current policies will

[8] NRS 445B.380 requires updates to the transportation and electricity generation sectors only. While not required by NRS 445B.380, an analysis of the sources and amounts of GHG emissions from industry is included in this report because of the significance of ozone depleting substance (ODS) substitute emissions identified in NDEP's 2019 report. Further, updated emissions for the residential and commercial sector are included because they are estimated with the same tools that NDEP uses for the transportation and electricity generation sectors.

achieve reductions in the electricity generation sector primarily due to the recently increased RPS, but unless more aggressive policies are adopted at the state and federal level, these reductions may be offset by increase in emissions in the other sectors, primarily industry and residential and commercial. Note that projections include the impact on emissions from the COVID-19 pandemic. The pandemic is predicted to mainly impact transportation sector emissions.

Table ES-1 directly compares 2025 and 2030 GHG emissions projections against the NRS 445B.380 reduction goals on both a net GHG and percentage basis and highlights the total amount of additional reductions needed beyond current projections to meet the reduction goals.

Figure ES-2 illustrates the relative contribution of gross GHG emissions from each sector for select years (the 2005 benchmark year, 2020 most recent inventory, 2025, and 2030).

Reported gross and net statewide emissions decreased by nearly 4 MMTCO2e between 2019 and 2020, driven by the impacts of the COVID-19 pandemic and shutdowns. Decreases in emissions are primarily seen in the transportation sector, with secondary decreases seen in the residential and commercial sector.

The transportation sector remains the leading sector of GHG emissions in Nevada starting in 2015, even considering the reported and projected impacts of the COVID-19 pandemic. The electricity generation sector's contribution is predicted to continue to decrease from 31% in 2020, to 27% in 2025, down to 24% by 2030.

Figure ES-1: Nevada Historical and Projected Net GHG Emissions and Sinks by Sector, 2005-2030, with Projections Beginning in 2021 and Comparisons to Nevada's Emission Reduction Goals for 2025 and 2030

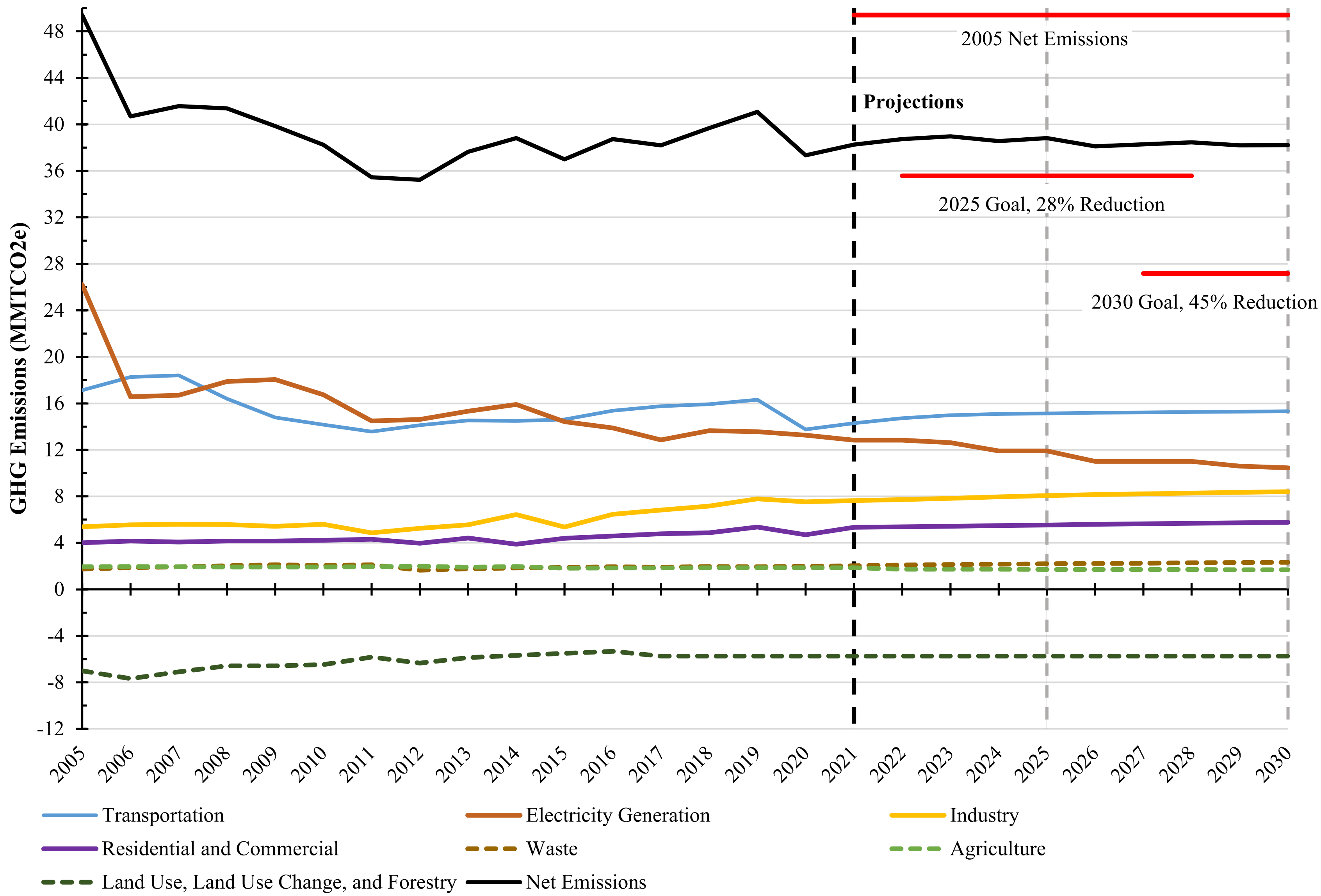
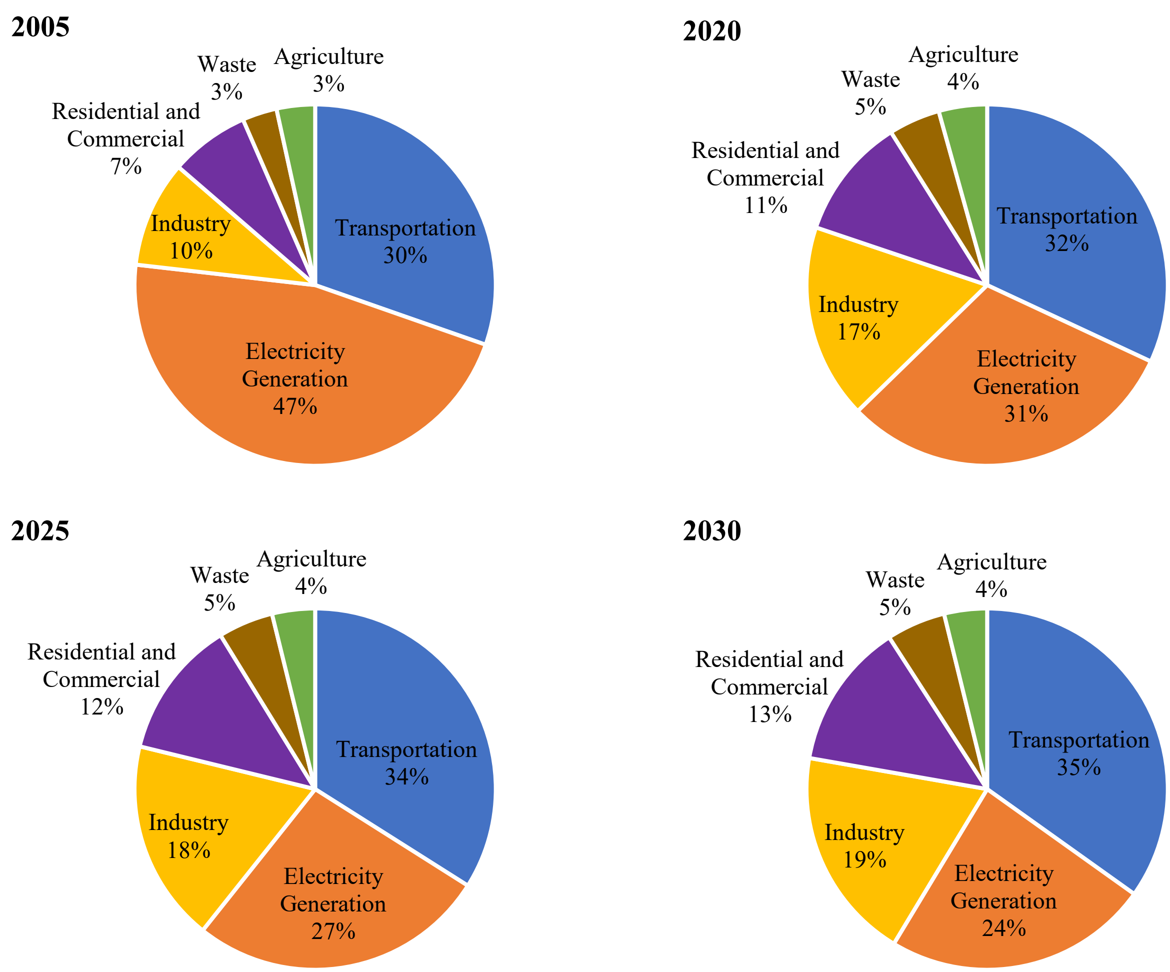


Table ES-1: Nevada Net GHG Emissions Comparison with Nevada's Emission Reduction Goals (MMTCO2e and Percent)

	2005	2025	2030
Net Emissions	49.405	38.808	38.210
Projected Emissions Reduction	-	10.596	11.195
Projected Percent Reduction	**-**	**21.4%**	**22.7%**
Nevada GHG Emissions Goals	-	35.571	27.173
GHG Emissions Reductions	-	13.833	22.232
Percent Reduction	-	28%	45%
Percent Deficit		6.6%	22.3%
Estimated Additional Emissions Reductions Required	-	**3.237**	**11.037**

Figure ES-2: Relative Contributions of Nevada's Gross GHG Emissions by Sector, 2005, 2020, 2025, and 2030



Introduction

1.1 Overview

The *Nevada Greenhouse Gas Emissions Inventory and Projections, 1990-2042* is an inventory of greenhouse gas (GHG) emissions in Nevada starting in 1990 and projected through 2042. In accordance with Nevada Revised Statutes (NRS) 445B.380, this report includes:

- Sources and amounts of GHG emissions in Nevada from transportation (Section 3), electricity generation (Section 4), and industry sectors (Section 5)[9];
- A quantification of GHG emissions reductions required to achieve the 2025 and 2030 reduction goals;
- A statement of policies that could achieve reductions in projected GHG emissions, including:
    - Policies that could achieve reductions in projected GHG emissions to achieve a 28% reduction in GHG emissions by the year 2025 as compared to the 2005 level of GHG emissions in Nevada;
    - Policies that could achieve reductions in projected GHG emissions to achieve a 45% reduction in GHG emissions by the year 2030, as compared to the 2005 level of GHG emissions in Nevada; and
    - A qualitative assessment of whether identified policies support long-term reductions of GHG emissions to zero or near-zero levels by the year 2050.

The GHGs considered by this report are those listed in NRS 445B.137: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), and perfluorinated compounds (PFCs) which includes sulfur hexafluoride (SF_6). Each of these GHGs have a characteristic GWP that contributes to the atmospheric greenhouse effect differently. The GWP is used to derive a common metric, known as the carbon dioxide equivalent (CO2e), which uses the GWP of CO_2 as a reference unit — that is, CO_2 has a GWP of 1. GHG emissions in this report are quantified using units of CO2e and are presented as million metric tons of CO2e, or MMTCO2e. Table 1-1 lists the industrial designations or common names, chemical formulas, and 100 year GWPs of the GHGs considered by this report. Unless the emissions are quantified using apportioned national emissions (which is the case for fluorinated gases), this report uses the GWPs from the Intergovernmental Panel on Climate Change's (IPCC's) Fifth Assessment Report.[10,11,12]

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[9] While the sources and amounts of GHG emissions from industry are not required by NRS 445B.380 for this report, they are included because of the significance of ozone depleting substance (ODS) substitute emissions identified in NDEP's 2019 report.
[10] GHG emissions quantified using this method generally depend on IPCC Fourth Assessment Report GWPs and are noted as such throughout the report.
[11] Previous inventories have utilized GWPs from previous IPCC assessments.
[12] IPCC (2013) *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. [Stocker, T.F., D. Qin, G.-K., Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.

Table 1-1: The GHGs and 100 year GWPs without Climate Carbon Feedbacks[13] for the GHGs Considered in this Report[14]

Greenhouse Gas		100 Year Global Warming Potential
Industrial Designation or Common Name	**Chemical Formula**	
Carbon dioxide	CO_2	1
Methane	CH_4	28
Nitrous oxide	N_2O	265
Hydrofluorocarbons (HFCs)		
HFC-23	CHF_3	12,400
HFC-32	CH_2F_2	677
HFC-125	CHF_2CF_3	3,170
HFC-134a	CH_2FCF_3	1,300
HFC-143a	CH_3CF_3	4,800
HFC-152a	CH_3CHF_2	138
HFC-227ea	CF_3CHFCF_3	3,350
HFC-236fa	$CF_3CH_2CF_3$	8,060
HFC-43-10mee	$CF_3CHFCHFCF_2CF_3$	1,650
Perfluorinated Compounds (PFCs)		
Sulfur hexafluoride	SF_6	23,500
Nitrogen trifluoride	NF_3	16,100
PFC-14	CF_4	6,630
PFC-116	C_2F_6	11,100
PFC-31-10	C_4F_{10}	9,200
PFC-51-14	C_6F_{14}	7,910

This report provides updated emissions from the following sectors[15]:

- Transportation
- Electricity Generation
- Industry

These sectors are detailed in individual sections. Details include descriptions of the sources of emissions within the sector, the methods used to estimate historical and projected GHG emissions, and the updated historical and projected GHG emissions estimates. Sectors also included in this report, but which are not detailed in the same way include:

- Residential and Commercial

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[13] Climate Carbon Feedback refers to the effect that emissions of CO_2 have on climate change, which impacts the carbon cycle, which impacts atmospheric CO_2, which in turn further changes the climate. GWPs calculated without Climate Carbon Feedback utilize metrics that account for such feedback for CO_2, but do not for all the other species of GHGs. While IPCC recognizes this as a limitation, it also acknowledges that more research is required to define GWPs with Climate Carbon Feedback. See for instance Gasser et al. (2017) *Accounting for the climate-carbon feedback in emission metrics. Earth Syst. Dynam., 8, 235-253*

[14] IPCC (2013) Appendix 8

[15] NRS 445B.380 requires updates to the transportation and electricity generation sectors only. While not required by NRS 445B.380, an analysis of the sources and amounts of GHG emissions from industry is included in this report because of the significance of ODS substitute emissions identified in NDEP's 2019 report. Further, updated emissions for the residential and commercial sector are included because they are estimated with the same tools that NDEP uses for the transportation and electricity generation sectors.

- Waste
- Agriculture
- Land Use, Land Use Change, and Forestry (LULUCF)

While historical and projected GHG emissions from these sectors are presented for reference in Sections 2.1 and 2.2 of this report, detailed descriptions of these sectors are not.[16] For all sectors considered in this report, the kinds of activities, processes, or combustion sources found in a particular sector determine the types of GHG emitted by that sector. Table 1-2 summarizes the types of GHGs emitted from each sector.

Table 1-2: GHGs Emitted by the Sectors Considered in this Report

Sector	Greenhouse Gases Emitted
Transportation	CO_2, CH_4, and N_2O
Electricity Generation	CO_2, CH_4, and N_2O
Industry	CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6
Residential and Commercial	CO_2, CH_4, and N_2O
Waste	CO_2, CH_4, and N_2O
Agriculture	CO_2, CH_4, and N_2O
Land Use, Land Use Change, and Forestry (LULUCF)	CO_2, CH_4, and N_2O

1.2 Approach, Datasets, and General Methodology

The principal goal of this report is to provide a general understanding of the sources and quantities of GHGs emitted in Nevada. The inventory and projections of GHG emissions presented in this report were developed using the 2022 release of the United States Energy Information Administration's (EIA's) *State Energy Data System* (SEDS)[17], the 2022 release of the EIA's *Annual Energy Outlook* (AEO)[18], the 2022 release of the United States Environmental Protection Agency's (EPA's) State Inventory Tool (SIT)[19], recommendations developed by the IPCC, and additional federal, state, and local data sources that were used to increase the accuracy of this report. Along with the primary sources of data previously listed, other major sources of information used by NDEP to prepare the emissions inventory and projections are provided in Table 1-3. In the absence of available data, the most technically appropriate statistical methodology was used to either interpolate or extrapolate the missing data. The methods presented in this report are considered by the NDEP to be the most reliable methods available at the time this report was prepared.

Historical and projected GHG emissions in this report are based on data made publicly available in 2022 or earlier. The most recent inventory year available and presented using these datasets is 2020. Therefore, while the changes in emissions due to the COVID-19 pandemic are captured by the 2020 inventory data, the economic recovery in 2021 and later years is only reflected in the near-term emissions projections

[16] NDEP's 2019 report, *Nevada Statewide Greenhouse Gas Emissions Inventory and Projections, 1990-2039* includes detailed descriptions for these four sectors and can be found online at https://ndep.nv.gov/air/air-pollutants/greenhouse-gas-emissions.
[17] State Energy Data System (SEDS): 1960-2020 (complete). US Energy Information Administration. [released 2022 June 24]. https://www.eia.gov/state/seds/seds-data-complete.php?sid=US
[18] Annual Energy Outlook 2022: with projections to 2050. US Energy Information Administration. [released 2022 March 3]. https://www.eia.gov/outlooks/aeo/
[19] State Inventory and Projection Tool. US Environmental Protection Agency; 2022 March 01. [accessed 2022 July 20]. https://www.epa.gov/statelocalenergy/state-inventory-and-projection-tool

herein presented. For this reason, reported emission projections — especially near-term projections — are very uncertain, and should be referenced with caution. More discussion on the potential effects of the COVID-19 pandemic on projected GHG emissions can be found in Section 1.3.

A list of the major sources of information is included in Table 1-3.

Table 1-3: Primary Sources of Data Used in this Report

Sector	Source/Resource	Information Utilized
All Sectors	United States Census Bureau[20]	U.S. population data
	Nevada State Demographer[21]	Nevada population data
Transportation	EIA	Historical fossil fuel consumption data AEO projections
Electricity Generation	EIA[22]	Historical fossil fuel consumption data Electricity Generation data
	EPA Emissions & Generation Resource Integrated Database (eGRID)[23]	Electric generating unit (EGU) data
	EPA Greenhouse Gas Reporting Program (GHGRP)[24]	EGU data
	Public Utilities Commission of Nevada (PUCN)[25]	Utility regulatory filings
Industry	EIA[26]	Historical fossil fuel consumption data AEO projections Oil and natural gas production data
	United States Geological Survey Minerals Yearbook[27]	Annual production and consumption for different minerals
	EPA's 2019 report, Global Non-CO_2 Greenhouse Gas Emission Projections and Mitigation: 2015-2050[28]	U.S. HFC emissions projections
	United Nations Framework Convention on Climate Change GHG Data Interface[29]	U.S. historical fluorinated gas emissions data

[20] 2017 National Population Projections Datasets. US Census Bureau. [updated 2018 Sep 6; accessed 2020 Sep 29]. https://www.census.gov/data/datasets/2017/demo/popproj/2017-popproj.html
[21] Lawton M. Nevada County Population Projections 2021 to 2040. Nevada Department of Taxation, Nevada State Demographer; 2021 Oct 1. https://tax.nv.gov/Publications/Population_Statistics_and_Reports/
[22] U.S. Energy Information Administration Electricity Generation Data. [released 2022 Jun 24; accessed 2022 Sep 30]. https://www.eia.gov/state/seds/
[23] Emissions and Generation Resource Integrated Database. U.S. Environmental Protection Agency; 2022 Jan 1. [accessed 2022 Mar 2]. https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid
[24] Greenhouse Gas Reporting Program. U.S. Environmental Protection Agency [accessed 2022 Mar 2]. https://www.epa.gov/ghgreporting
[25] State of Nevada Public Utilities Commission. [accessed 2021 Nov 1]. http://puc.nv.gov/
[26] U.S. Energy Information Administration State Energy Data System. [accessed 2022 Mar 3]. https://www.eia.gov/state/seds/
[27] National Minerals Information Center. U.S. Geological Survey. [accessed 2020 Oct 1]. https://www.usgs.gov/centers/nmic
[28] U.S. Environmental Protection Agency. Global Non-CO_2 Greenhouse Gas Emission Projections and Mitigation: 2015-2050. U.S. Environmental Protection Agency Office of Atmospheric Programs; released 2019 Oct. Washington D.C. EPA 430-R-19-010. [accessed 2022 Nov 18]. https://www.epa.gov/global-mitigation-non-co2-greenhouse-gases/global-non-co2-greenhouse-gas-emission-projections
[29] GHG Data Interface. United Nations Framework Convention on Climate Change. [accessed 2021 Oct 12]. https://di.unfccc.int/

Sector	Source/Resource	Information Utilized
	U.S. Department of Transportation Pipeline and Hazardous Material Safety Administration[30]	Natural gas transmission and distribution data

1.2.1 EIA's State Energy Data System

The State Energy Data System (SEDS) is an annual report prepared by the EIA that provides estimates of U.S. energy data from 1960 through the most recent year of the report's release. SEDS aggregates estimates of production, consumption, prices, and expenditures by source and sector for the U.S., all 50 states, and many of the U.S. territories. Fuel consumption estimates provided by SEDS are used to estimate the historical fossil fuel emissions from the transportation, electricity generation, industry, and the residential and commercial sectors. The use of the SEDS allows for the reporting of inventory emissions in more recent years. In this 2022 report, actual emissions are reported through 2020.

1.2.2 EIA's Annual Energy Outlook

The Annual Energy Outlook (AEO) is an annual report prepared by the EIA that provides modeled projections of U.S. energy usage through 2050. The AEO considers multiple cases, each with multiple assumptions, regarding economic growth, potential future prices of fossil fuels such as oil and gas as well as renewables are considered. For all cases, current laws and regulations as of November 2021 and current views on economic and demographic trends, and technology improvements remain unchanged.[31] The potential impacts of proposed legislation, regulations, and standards are not considered in the AEO. Of the AEO's multiple cases, the Reference case is utilized by NDEP in its energy consumption projections. That is, the AEO and its Reference case assumptions are used in part to project future GHG from the combustion of fossil fuels from the transportation, industry, and the residential and commercial sectors.[32]

1.2.3 EPA's State Inventory Tool

The State Inventory Tool (SIT) is a regularly updated suite of Microsoft Excel-based modules designed to assist states in developing their own GHG emissions inventories and projections from 1990 through 2050 and is developed in part with the data used to prepare the EPA's national GHG emissions inventory.[33] While the SIT's default input data were used as the primary resource for GHG emissions not associated with the combustion of fossil fuels — specifically industrial process emissions for this report — when more accurate data or methods were available, they were utilized.

1.3 GHG Emissions in Nevada and the Effects of COVID-19

Projected GHG emissions in this report are based on data made publicly available in 2022 or earlier. Due to the availability and time required to process historical fuel consumption data, changes in emissions due to the COVID-19 pandemic are reported as actual emissions from 2020 and projections for 2021 and later

[30] Pipeline and Hazardous Materials Safety Administration. U.S. Department of Transportation. [accessed 2021 Oct 7]. https://www.phmsa.dot.gov/

[31] Assumptions to AEO2022. US Energy Information Administration. [released 2022 March 3]. https://www.eia.gov/outlooks/aeo/assumptions/ .

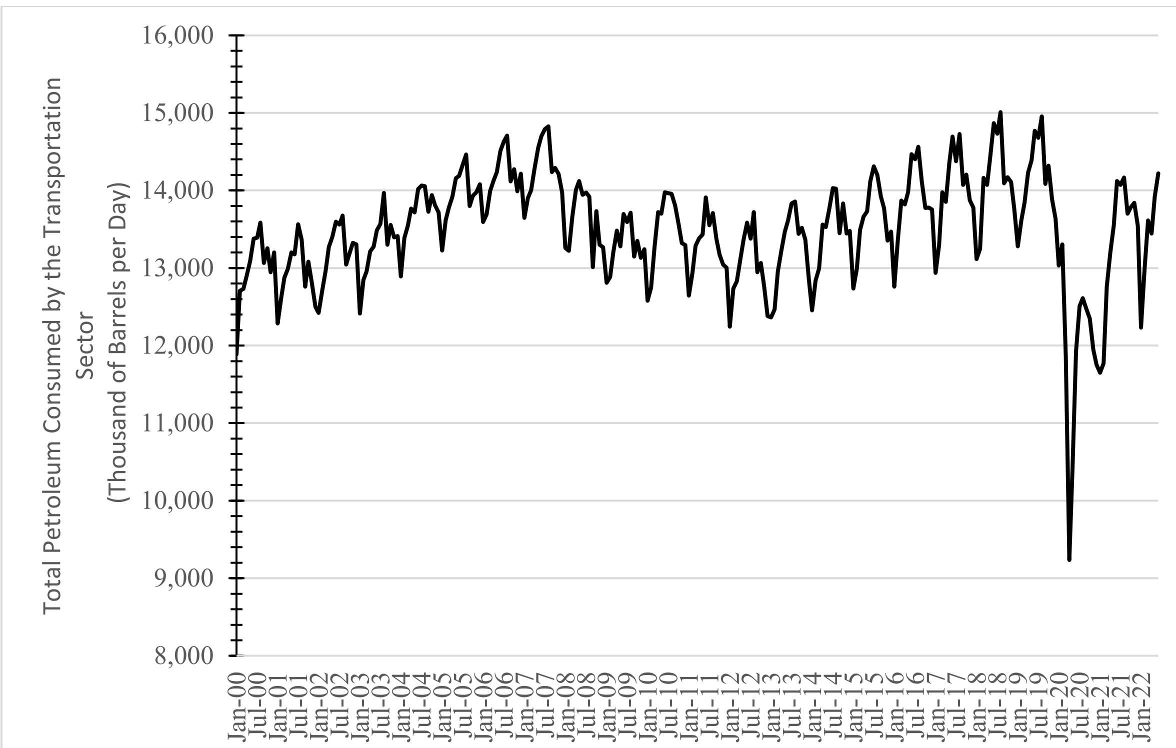
[32] Projections for the electricity generation sector were prepared using Nevada specific information such as the recently updated Renewable Portfolio Standard (RPS) and utility regulatory filings.

[33] The 2022 release of the State Inventory Tool included data to inventory historical emissions from 1990 through 2019 and methods to project emissions from 2020 through 2050.

years — albeit with a high degree of uncertainty. State emissions show a decline of approximately 10% in 2020 from 2019, driven by a decline in the transportation sector emissions of approximately 16% for 2020. In particular, annual consumption of aviation fuel decreased by 44% compared to 2019. Projections indicate a significant recovery starting in 2021 (see Figure 2-1).

In addition, available data for monthly total U.S. consumption of petroleum by the transportation sector may provide a more up-to-date picture of what the recovery in Nevada could look like.[34] Figure 1-1 shows monthly petroleum consumption by the transportation sector in the U.S. from January of 2000 through June of 2022. The sharp decline in January of 2020 (down approximately 70% from January of 2019) is followed by a somewhat rapid W-shaped recovery in 2020, 2021, and 2022; consumption in June of 2022 is only approximately 96% of consumption in June of 2019.

Figure 1-1: Monthly Total U.S. Transportation Sector Petroleum Consumption

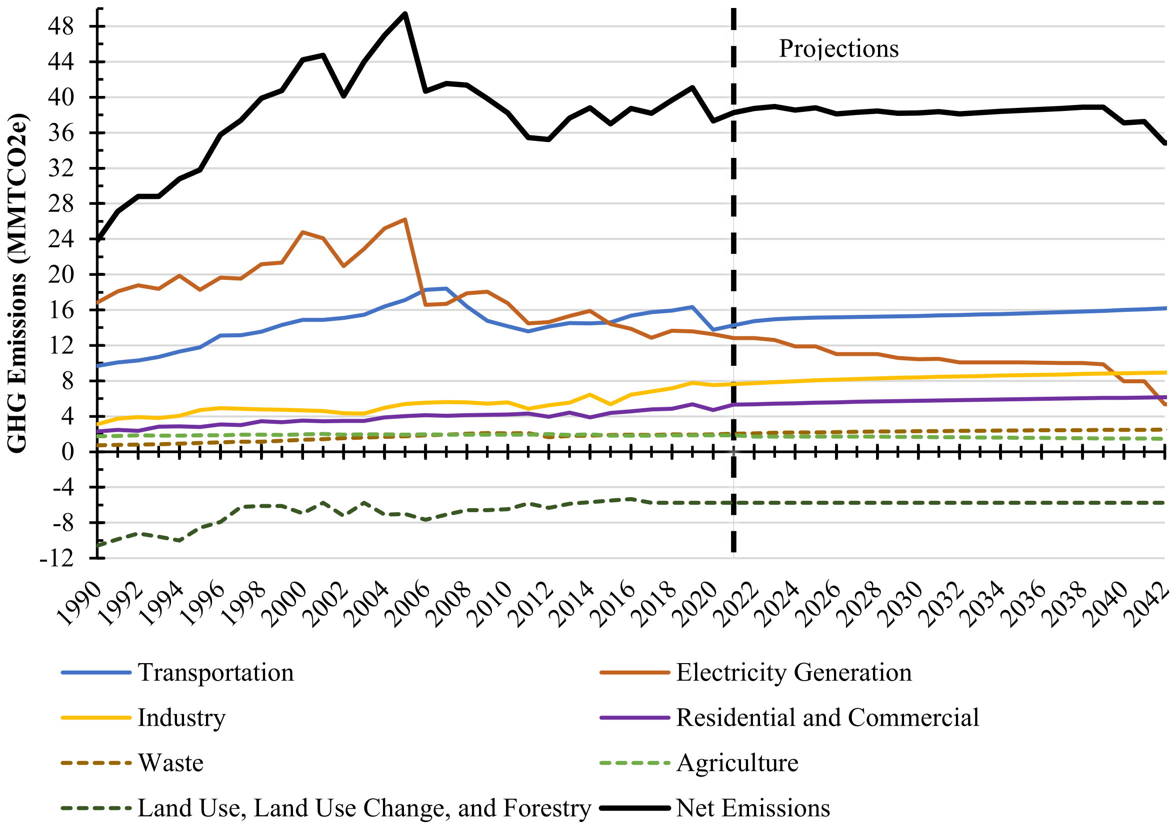


The unprecedented global shutdown driven by the COVID-19 outbreak in early 2020 brought significant declines in many forms of transportation as people were confined to their homes. Nevada's GHG emissions for 2020 show a significant decline relative to 2019, but it is very likely that this decline may be short-lasting and unlikely to affect the ability of the State to meet its GHG reduction goals.

[34] Data from EIA, Total Energy – Monthly Energy Review – Petroleum, Table 3.7c Transportation and electric power sectors. https://www.eia.gov/totalenergy/data/browser/index.php?tbl=T03.07C#/?f=M&start=200001

State of Nevada Greenhouse Gas Emissions

Figure 2-1: Nevada Historical and Projected Total GHG Emissions and Sinks by Sector, 1990-2042, with Updated Projections Beginning in 2021



2.1 GHG Emissions

GHG emissions in Nevada peaked in 2005, when net GHG emissions totaled 49.405 MMTCO2e.[35] Overall, net GHG emissions in 2020 were 24.4% below 2005 levels. Since 2005, significant reductions in Nevada's GHG emissions have occurred due to both the Economic Downturn from 2007 through 2009 (commonly known as the Great Recession) and the permanent shutdown of Nevada's two largest coal-fired power plants — the Mohave and Reid Gardner generating stations. In 2015, transportation exceeded electricity generation and became the State's largest sector of GHGs. This shift was mainly driven by Nevada's increasing reliance on renewable energy and lower-GHG emitting natural gas in the electricity generation sector rather than any significant change in the transportation sector. For 2020, Nevada's net GHG emissions totaled 37.336 MMTCO2e, with transportation accounting for 31.9% of gross emissions.[36]

[35] This report does not include the GHG emissions associated with wildland fires when illustrating statewide emissions.

[36] In this report, gross emissions describe the sum of all sectors acting as sources of GHG emissions while net, or total, emissions are used to describe the sum of all sectors acting as sources of GHG emissions minus all sectors acting as GHG emissions sinks.

For the purposes of this report, only the GHG emissions caused by activities that occurred within the geographical boundaries of the State of Nevada are considered.[37] It is however, important to recognize that GHG emissions are not always spatially associated with their related activities. For instance, the generation (source of emissions) and consumption of electricity (the related activities) can take place in different states. For example, 13.5% of 2020's electricity generation sector GHG emissions (1.764 MMTCO2e) are associated with electricity consumed out-of-state; since that electricity is generated in-state, the related GHG emissions are included in this report.

This distinction of production versus consumption is particularly critical in accounting for the GHG emission reduction impact of some potential mitigation strategies affecting energy demand. For example, reuse, recycling, and source reduction can lead to emissions reductions from lower energy requirements in the material production (such as paper, cardboard, aluminum, etc.) even though the emissions associated with material production may not occur within the State, and as such this reduction in emissions is not reflected in this report.

Table 2-1 lists Nevada's GHG emissions and sinks by sector for select years. Figure 2-2 illustrates updated GHG emissions from the transportation, electricity generation, industry, and residential and commercial sectors from 1990 through 2020 as well as emissions and sinks from the agriculture, waste, and LULUCF sectors from NDEP's 2019 report. Note that because the SEDS energy consumption estimates include the residential and commercial sector (in addition to consumption estimates from the transportation sector, electricity generation sector, and industry stationary combustion sub-sector) they have also been updated in this year's report.

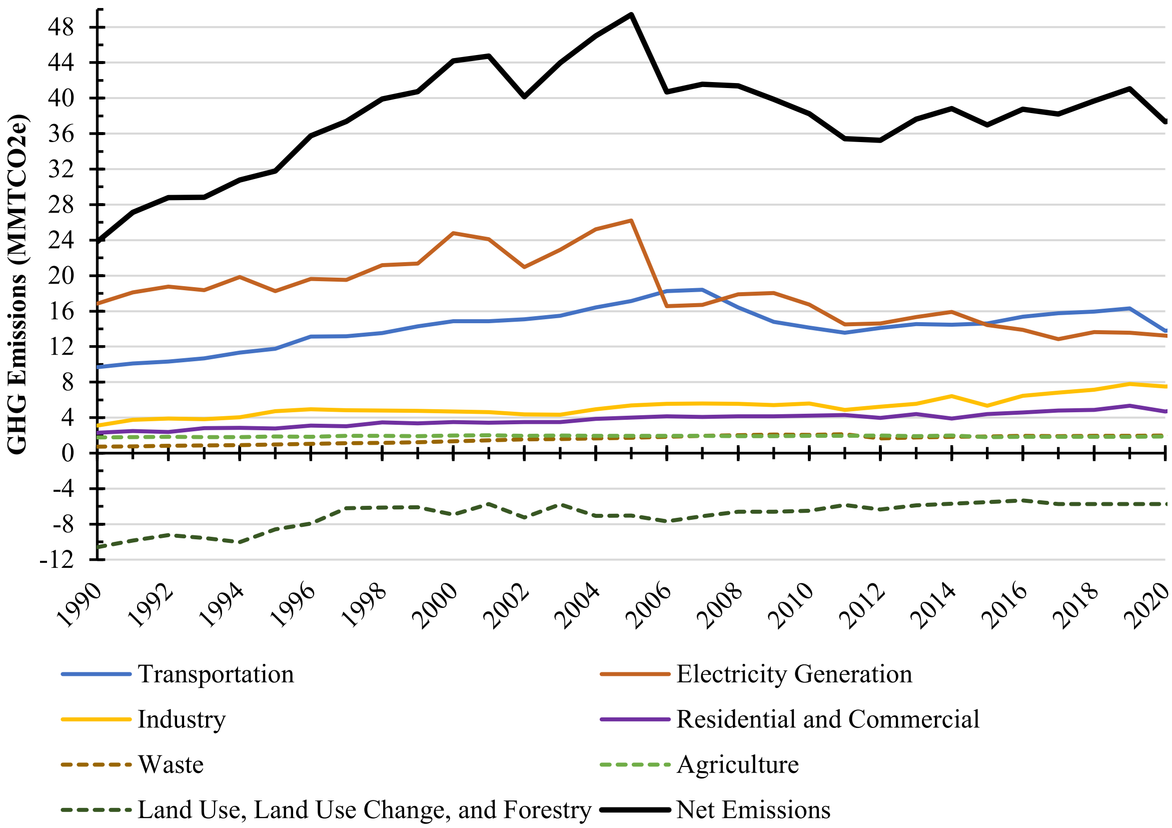
Table 2-1: Nevada GHG Emissions and Sinks by Sector, Select Years (MMTCO2e)

Sector	1990	1995	2000	2005	2010	2015	2018*	2019*	2020*
Transportation	9.685	11.765	14.867	17.127	14.156	14.610	15.934	16.310	13.764
Electricity Generation	16.849	18.263	24.768	26.211	16.746	14.415	13.650	13.571	13.256
Industry	3.105	4.721	4.678	5.378	5.589	5.358	7.160	7.790	7.522
Residential and Commercial	2.295	2.783	3.512	4.015	4.223	4.402	4.864	5.353	4.693
Waste	0.731	0.976	1.340	1.749	2.060	1.890	1.965	1.934	1.986
Agriculture	1.752	1.863	1.980	1.942	1.933	1.822	1.855	1.858	1.863
LULUCF	-10.596	-8.576	-6.933	-7.017	-6.476	-5.509	-5.747	-5.747	-5.747
Gross Emissions	**34.417**	**40.372**	**51.145**	**56.422**	**44.706**	**42.496**	**45.428**	**46.817**	**43.083**
Net Emissions	**23.820**	**31.796**	**44.211**	**49.405**	**38.231**	**36.987**	**39.681**	**41.070**	**37.336**

* Note that 2017-2019 emissions from Waste, Agriculture, and LULUCF are projections originally presented in NDEP's 2019 report.

[37] The only exception to this being the accounting of certain industrial process emissions. Refer to Section 5.2.2, for more details.

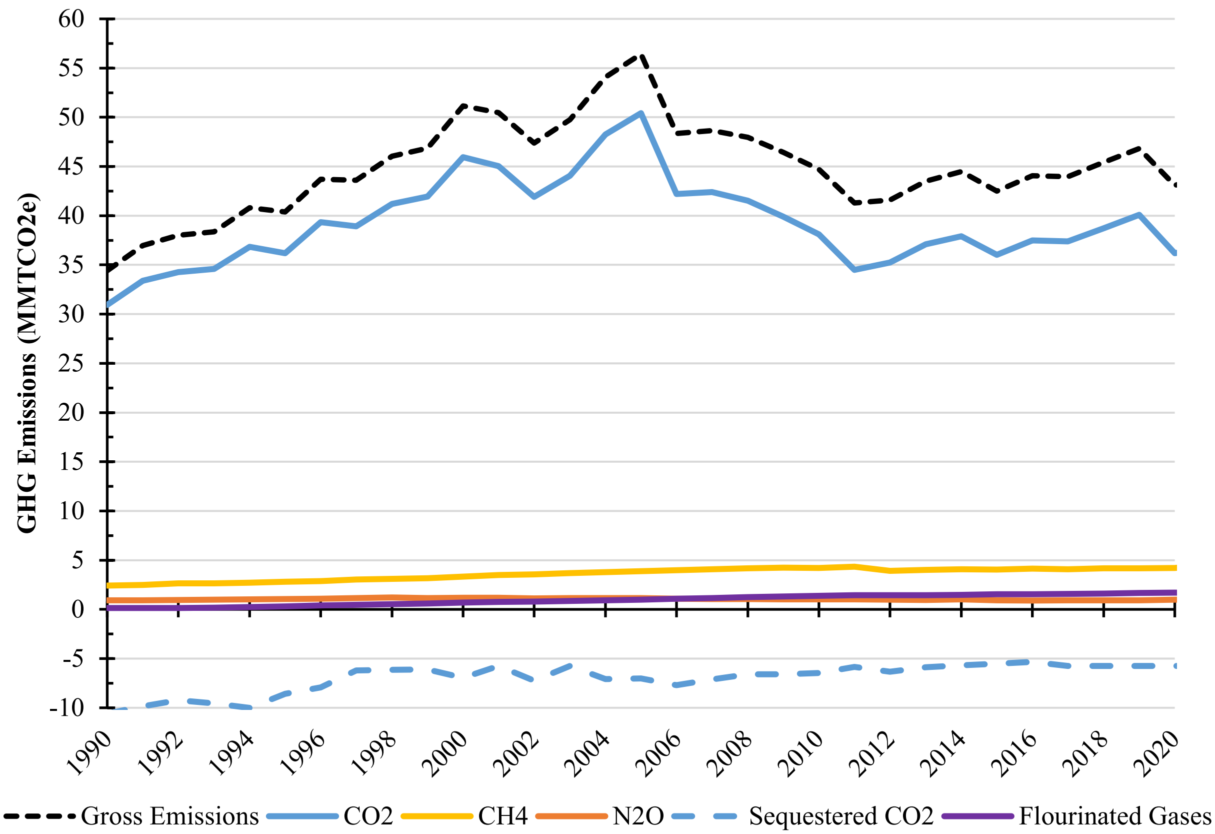
Figure 2-2: Nevada Total GHG Emissions and Emissions from Individual Sectors, 1990-2020



The primary GHG in Nevada is CO_2, which accounted for 84% of gross GHG emissions in 2020. Figure 2-3 illustrates Nevada's total GHG emissions and GHG emissions by individual GHGs for 1990 through 2020. Apart from some industrial processes and the application of minerals to agricultural soils as fertilizers, CO_2 emissions are the result of fossil fuel combustion.[38] CH_4 emissions are the result of the decay of organic matter, the production, transmission, and distribution of natural gas and oil, and fossil fuel combustion byproducts. N_2O emissions are the result of agricultural activities relating to livestock and fertilizers and fossil fuel combustion byproducts. Emissions of HFC, PFC, and SF_6 in Nevada are the result of ozone depleting substance (ODS) substitute usage (which are used in air conditioners, aerosols, foams, fire extinguishers, refrigerators, and solvents) (HFC), semiconductor manufacturing (PFC), and electric power transmission and distribution (SF_6).

[38] The land use, land use change, and forestry (LULUCF) sector sequesters CO_2 emissions.

Figure 2-3: Nevada Gross GHG Emissions and GHG Emissions by Individual GHG, 1990-2020



GHG emissions in Nevada are generally tied to the State's population and economy. As the population increases, activities such as the need to travel, for electricity, for heating and cooling homes and businesses, and the total amount of waste generated all increase. Economic expansion/contraction can also lead to changes in GHG emissions. Table 2-2 lists the annual changes in GHG emissions in Nevada by sector for 2015 through 2020.

Table 2-2: Annual Changes in Nevada GHG Emissions by Sector, 2015-2020 (MMTCO2e and Percent)

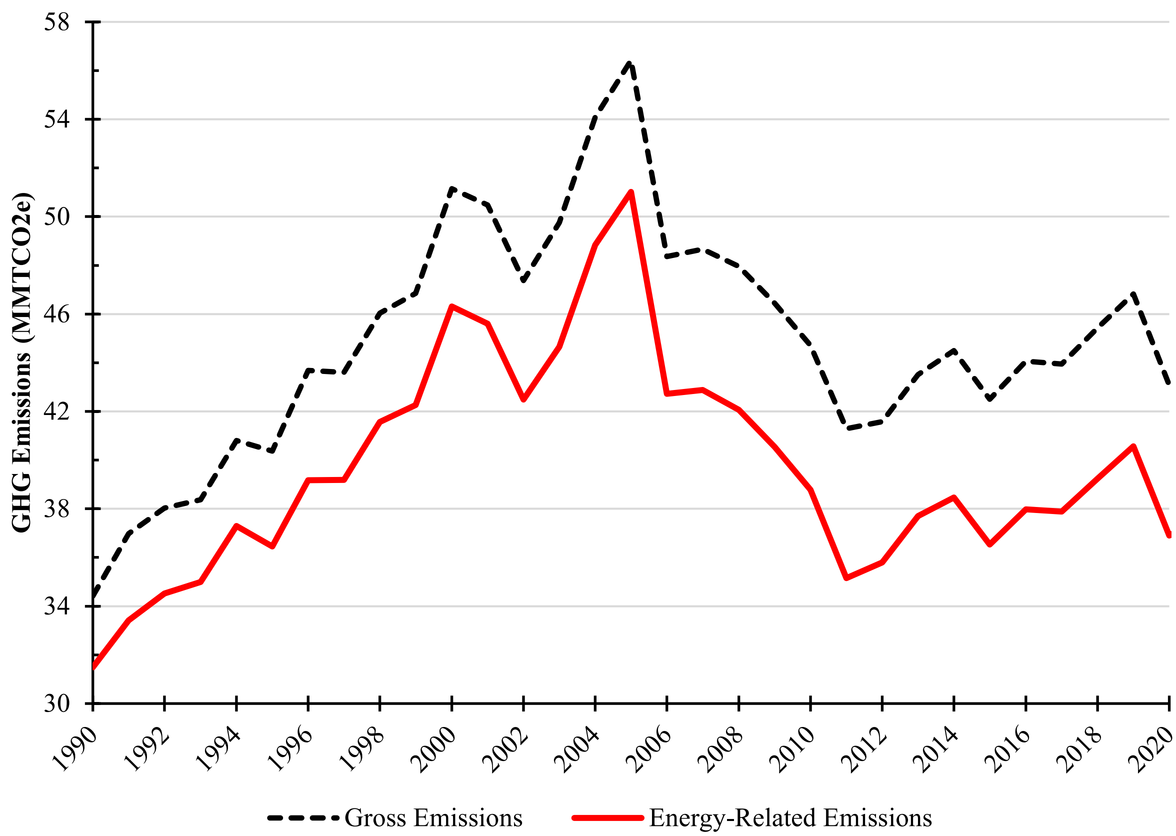
Sector	2015-2016		2016-2017*		2017-2018*		2018-2019*		2019-2020*	
Transportation	0.758	5.19%	0.381	2.48%	0.185	1.18%	0.376	2.36%	-2.546	-15.61%
Electricity Generation	-0.528	-3.67%	-1.028	-7.40%	0.791	6.15%	-0.079	-0.58%	-0.315	-2.32%
Industry	1.086	20.27%	0.375	5.83%	0.341	5.01%	0.630	8.80%	-0.269	-3.45%
Residential and Commercial	0.182	4.13%	0.200	4.37%	0.080	1.68%	0.489	10.06%	-0.661	-12.34%
Waste	0.060	3.17%	-0.053	-2.69%	0.068	3.57%	-0.031	-1.57%	0.052	2.68%
Agriculture	0.013	0.69%	0.005	0.25%	0.015	0.82%	0.004	0.20%	0.005	0.26%
LULUCF	0.178	-3.22%	-0.416	7.80%	0.000	0.00%	0.000	0.00%	0.000	0.00%
Gross Emissions	**1.569**	**3.69%**	**-0.119**	**-0.27%**	**1.481**	**3.37%**	**1.389**	**3.06%**	**-3.734**	**-7.98%**
Net Emissions	**1.747**	**4.72%**	**-0.534**	**-1.38%**	**1.481**	**3.88%**	**1.389**	**3.50%**	**-3.734**	**-9.09%**

* Note that 2017-2020 emissions from Waste, Agriculture, and LULUCF are projections originally presented in NDEP's 2019 report.

2.1.1 Fossil Fuel Combustion and Carbon Dioxide Emissions

This report presents historical and projected GHG emissions in Nevada by economic sector. While Nevada's GHG emissions are overwhelmingly associated with the combustion of fossil fuels, the interrelatedness of these sectors and their shared dependence on fossil fuels is not always clear. The transportation, energy generation, stationary combustion and natural gas and oil industry sub-sectors, and the residential and commercial sectors are all sources of energy-related GHG emissions. Combined, these sectors accounted for 51.017 MMTCO2e emissions in 2005 and 36.903 MMTCO2e emissions in 2020, or, 90.4% and 85.7% of Nevada's gross GHG emissions, respectively. Figure 2-4 illustrates both Nevada's gross GHG emissions and energy-related emissions from 1990 through 2020. The decline in energy-related emissions as a percentage of gross GHG emissions is due to Nevada's less carbon intense electricity generation sector (that is, less coal and more natural gas and renewables) and an increase of non-energy related emissions from industrial processes and emissions from the waste sector.

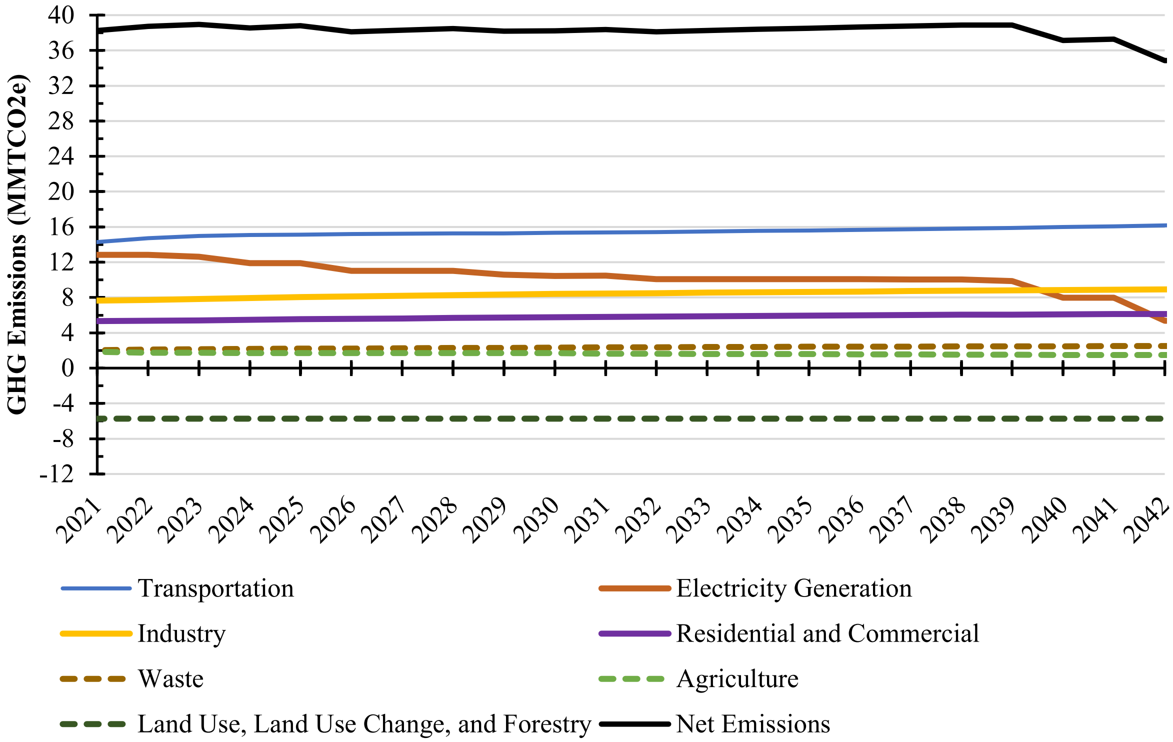
Figure 2-4: Nevada Gross GHG Emissions and Energy-Related Emissions, 1990-2020



2.2 Emissions Projections

Projected GHG emissions in this report are based on data made publicly available in 2022 or earlier. Due to the time required to process historical fuel consumption data, 2021 emissions are not reported in the inventory, but are projected. Changes in emissions due to the COVID-19 pandemic are considered in these projections starting with 2021— albeit with a high degree of uncertainty associated with near-term projections. Under the policies considered in this report, GHG emissions in Nevada are projected to remain relatively unchanged through 2038, followed by decreases in total emissions in 2039 and again in 2041 that are driven by the depreciation-based retirement dates of facilities within the electricity generation sector (Section 4.3). Net GHG emissions in 2025 are projected to be 38.808 MMTCO2e, 21.4% below 2005 levels, net GHG emissions in 2030 are projected to be 38.210 MMTCO2e, 22.7% below 2005 levels, and net GHG emissions in 2042 are projected to be 34.836 MMTCO2e, or 29.5% below 2005 levels. The sectors whose emissions are projected to increase through 2042 are transportation (additional 2.403 MMTCO2e), industry (additional 1.407 MMTCO2e), residential and commercial (additional 1.447 MMTCO2e), and waste (additional 0.543 MMTCO2e). While transportation sector emissions were reduced by 2.546 MMTCO2 between 2019 and 2020, this was due to the COVID-19 pandemic and emissions are expected to bounce back in 2021 and — without any changes in existing policy — will continue to increase through 2042. Figure 2-5 illustrates Nevada's projected total GHG emissions and the emissions from individual sectors from 2021 through 2042.[39]

Figure 2-5: Projected Nevada Net GHG Emissions and Emissions from Individual Sectors, 2021-2042



Some of the state- and federal-level policies affecting Nevada's GHG emissions that were considered in developing the projections in this report are listed in Table 2-3. Table 2-3 is not a comprehensive list; generally, both the SIT and the AEO depend on the federal regulations that were in place when they were prepared. The federal regulations that have changed since the release of the SIT and the completion of this report have been noted as such in Table 2-3.

[39] Note that emissions projections for 2040 through 2042 from the waste, agriculture, and land use, land use change, and forestry sectors are the result of the same methods that were applied in NDEP's 2019 report being applied through the year 2042 rather than 2039.

Table 2-3: State- and Federal-Level Policies Considered in Projections

Sector	Policy	Current Status
Transportation	Part Two of the Safer Affordable Fuel-Efficient (SAFE) Vehicle Rule	In April 2021, EPA and NHTSA formally announced that they are reconsidering this action and soliciting public comments on a more stringent path forward. A new rule was finalized in late December 2021, but it is not considered in this report.
	Clean Cars Nevada	Clean Cars Nevada is effective starting January 1, 2022 and applies to all new model year 2025 and later light-duty vehicles. The California Air resources Board has approved new regulations for light-duty vehicles (collectively, Advanced Clean Cars II) starting with model year 2026 light-duty vehicles. Emissions projections presented in this report do not take in consideration the adoption of the new standards.
	Phase 2 greenhouse gas emissions standards for medium- and heavy-duty vehicles	As they apply to truck trailers, the phase 2 fuel economy standards in this rule were vacated by the United States Court of Appeals for the D.C. Circuit on November 12, 2021.
Electricity Generation	The updated Renewable Portfolio Standard (RPS) in NRS 704.7821	No changes to the RPS are currently expected.
	The voluntary retirement of the North Valmy Generating Station, with Unit 1 shutting down in 2025 and Unit 2 shutting down in 2025	Because the retirements are still voluntary, it is unknown whether or not these retirements will happen according to this timeline. However, the recent submission of the Regional Haze State Implementation Plan by Nevada, has a mandatory closure date for both units of December 2028. If the Plan is approved by EPA, the closure will become federally enforceable.
	The 2021 Integrated Resource Plan (IRP) approved retirement dates and depreciation-based retirement dates of NV Energy's natural gas-fired electricity generating resources	On November 30, 2022, NV Energy submitted a fourth amendment to the 2021 IRP. The proposed changes must be approved by the Public Utilities Commission of Nevada and are not included in this year's report.
Industry	The EPA's finalized rollback of the 2012 and 2016 new source performance standards (NSPSs) for the oil and natural gas industry on August 13, 2020.	EPA proposed Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Source for the oil and natural gas industry on November 15, 2021.
	Significant New Alternatives Policy (SNAP) Program regulating ODS substitutes	SNAP Rule 20 was vacated by the D.C. Circuit Court on August 8, 2017.
		SNAP Rule 21 was vacated by the D.C. Circuit Court on April 5, 2019.
	Phasedown of Hydrofluorocarbons: Establishing the Allowance Allocation and Trading Program under the AIM Act	NDEP was not able to assess the specific effects of this rulemaking on anticipated fluorinated gas use projections in Nevada. However, EPA announced the rule would phase down the production and consumption of HFCs in the United States by 85% over the next 15 years.[40]

[40] Final Rule - Phasedown of Hydrofluorocarbons: Establishing the Allowance Allocation and Trading Program under the AIM Act. U.S. Environmental Protection Agency. [accessed 2022 Nov 18]. https://www.epa.gov/climate-hfcs-reduction/final-rule-phasedown-hydrofluorocarbons-establishing-allowance-allocation

2.3 Nevada's Emission Reduction Goals, the State of Nevada Climate Initiative and 2020 Climate Strategy

On March 12, 2019, Governor Steve Sisolak announced that Nevada would join the U.S. Climate Alliance, a bipartisan coalition of 25 state governors committed to realizing the goals of the Paris Agreement, including reducing GHG emissions to keep global temperature rise well below 2ºC (3.6ºF). In 2019, the Nevada Legislature passed multiple climate-forward bills including SB 358 to increase the statewide RPS to 50% by 2030. The adoption of SB 254 followed, requiring NDEP to develop an annual, rather than quadrennial, GHG emissions inventory for all major sectors of Nevada's economy, including electricity generation, transportation, and other key sectors. SB 254 also set economy-wide GHG emissions-reduction targets for the State: 28% by 2025, 45% by 2030, and net-zero by 2050 (compared to a 2005 GHG emissions baseline). NDEP's 2021 GHG emissions inventory shows that under the policies considered in this report, Nevada will fall 7% short of the 2025 goal and 22% short of the 2030 goal if no additional policies or actions are implemented by state and local governments.

In November 2019, Governor Sisolak issued an executive order on climate change (EO 2019-22) directing State of Nevada agencies to identify and evaluate policies and regulatory strategies to achieve economy-wide GHG emissions-reduction targets established by NRS 445B.380. The Department of Conservation and Natural Resources and the Governor's Office of Energy were tasked with coordination and implementation of the EO, including development of Nevada's first comprehensive *State Climate Strategy*.

Consistent with the goals of the EO to ensure a vibrant, climate-resilient future for Nevada, Governor Sisolak launched the Nevada Climate Initiative (NCI) in the summer of 2020.[41] The NCI is focused on helping inform and coordinate the new policies necessary to reduce Nevada's economy-wide GHG emissions and help establish more resilient communities that are prepared to successfully adapt to changing environmental and climatic conditions. The *2020 State Climate Strategy*[42] builds a foundation for future climate action under the NCI in anticipation of the need to take climate action on multiple fronts and serves as a roadmap for policymakers at all levels of government in Nevada for achieving the State's collective climate goals.

Reported total emissions decreased by 3.7 MMTCO2e between 2019 and 2020, driven by the COVID-19 pandemic. Since 2006, the average annual change in total reported emissions is close to zero, and so is the average annual change projected through 2042. In general, the emission reduction trend observed and projected for the electricity generation sector is offset by the upward trends in the industrial, residential and commercial, and transportation sectors which are all mainly driven by increase in population.

Table 2-4 lists Nevada's net GHG emissions by sector for 2005, 2020, 2025, and 2030 and Figure 2-6 illustrates relative contributions of GHG emissions from the various sectors for 2005, 2020, 2025, and 2030. Figure 2-7 illustrates Nevada's net GHG emissions by sector from 2005 through 2030 with

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[41] State of Nevada Climate Initiative. Nevada Department of Conservation and Natural Resources. [accessed 2020 Dec 23]. http://climateaction.nv.gov/

[42] State of Nevada Climate Initiative: Our Strategy. Nevada Department of Conservation and Natural Resources and Nevada Governor's Office of Energy. [accessed 2020 Dec 23]. https://climateaction.nv.gov/our-strategy/

statutory (NRS 445B.380) 2025 and 2030 emission reduction goals included for comparison. Finally, Table 2-5 compares 2005 net GHG emissions against 2025, 2030, and statutory (NRS 445B.380) emission reduction goals for 2025 and 2030.

Table 2-5 provides a quantification of reductions in GHG emissions necessary to achieve the GHG emissions reductions goals for 2025 and 2030. Based on current projections, and without considering the impact of the COVID-19 pandemic, Nevada is short 1.9 MMTCO2e (or 5%) of the 2025 goal. Nevada may still be able to meet the 2025 goal if strategic, near-term investments and policies are adopted. But Nevada is currently projected to fall well short of its 2030 goal for GHG emission reductions unless more aggressive investment and policies are adopted in both the near and medium term. Based on Nevada policies considered in this report, it is estimated that Nevada will fall 24% short of achieving the 2030 goal of a net GHG emissions reduction of 45% (22.184 MMTCO2e) below 2005 levels.

The overarching goals of the *2020 State Climate Strategy* are to: (1) provide a framework for reducing Nevada's GHG emissions across all economic sectors; (2) lay the groundwork for climate adaptation and resilience; and (3) establish a structure for continued, ongoing climate action across the State.

The *2020 State Climate Strategy* informs policymaking on how Nevada will achieve the targets established by NRS 445B.380 and provides an integrated framework for evaluating climate policies that make sense for Nevada. Given the complexities of climate change, it is imperative that policies to reduce GHG emissions be approached systematically so there is a clear understanding of the benefits and tradeoffs. This will optimize effectiveness of each given policy and therefore maximize the benefits for all Nevadans. By taking a well-informed, strategic approach to addressing climate change in Nevada, the State can fully capture the economic benefits of clean technologies.

Table 2-4: Nevada Net GHG Emissions by Sector, Select Years (MMTCO2e)

Sector	2005	2020*	2025	2030
Transportation	17.127	13.764	15.138	15.325
Electricity Generation	26.211	13.256	11.907	10.452
Industry	5.378	7.522	8.068	8.402
Residential and Commercial	4.015	4.693	5.532	5.768
Waste	1.749	1.986	2.198	2.323
Agriculture	1.942	1.863	1.713	1.688
LULUCF	-7.017	-5.747	-5.747	-5.747
Net Emissions	**49.405**	**37.336**	**38.808**	**38.210**

* Note that 2020 emissions from Waste, Agriculture, and LULUCF are projections first presented in NDEP's 2019 report.

Table 2-5: Nevada Net GHG Emissions Comparison with NRS 445B.380 Goals (MMTCO2e and Percent)

	2005	2025	2030
Net Emissions	49.405	38.808	38.210
Projected Emissions Reduction	-	10.596	11.195
Projected Percent Reduction	**-**	**21.4%**	**22.7%**
Nevada GHG Emissions Goals	-	35.571	27.173
GHG Emissions Reductions	-	13.833	22.232
Percent Reduction	-	28%	45%
Percent Deficit		6.6%	22.3%
Estimated Additional Emissions Reductions Required	-	**3.237**	**11.037**

Figure 2-6: Relative Contributions of Nevada's Gross GHG Emissions by Sector, 2005, 2020, 2025, and 2030

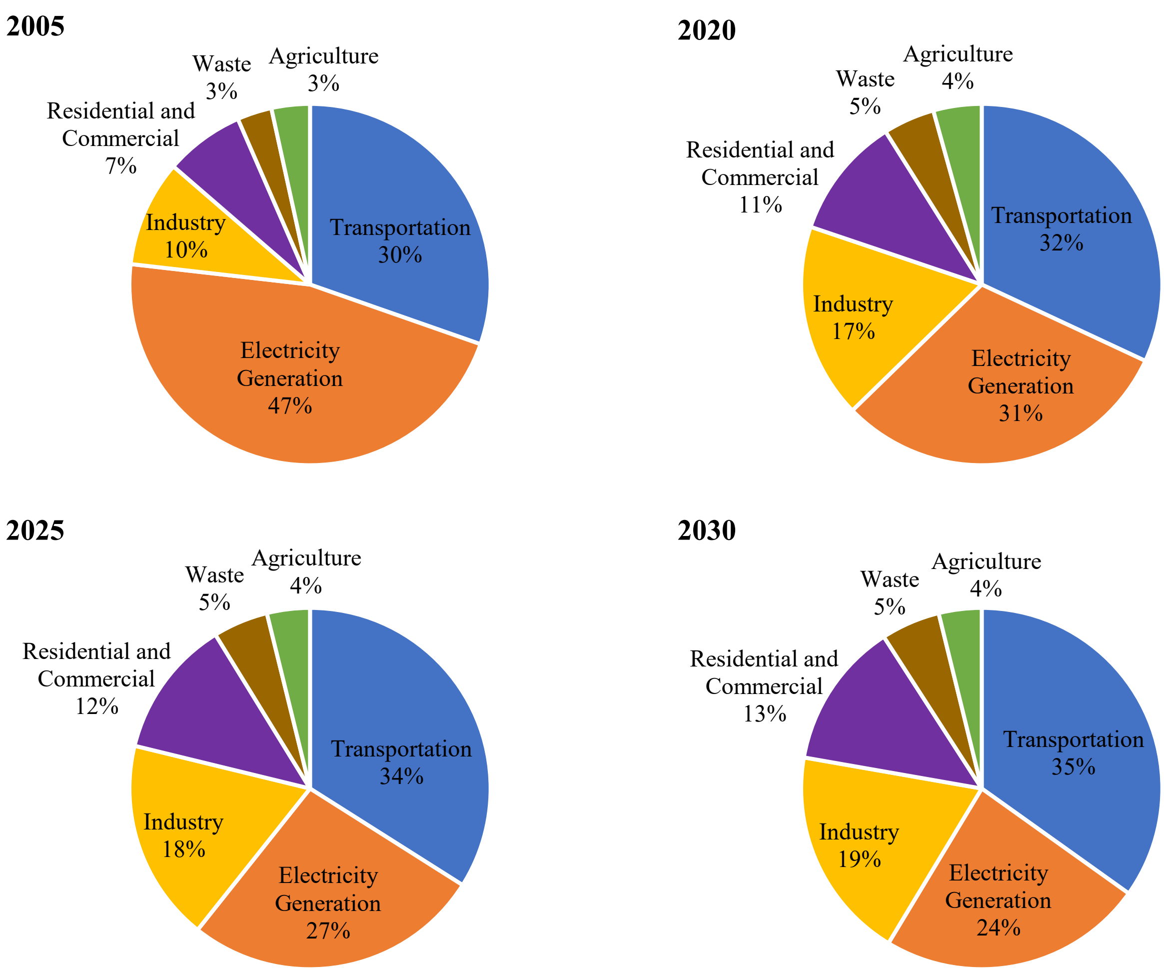
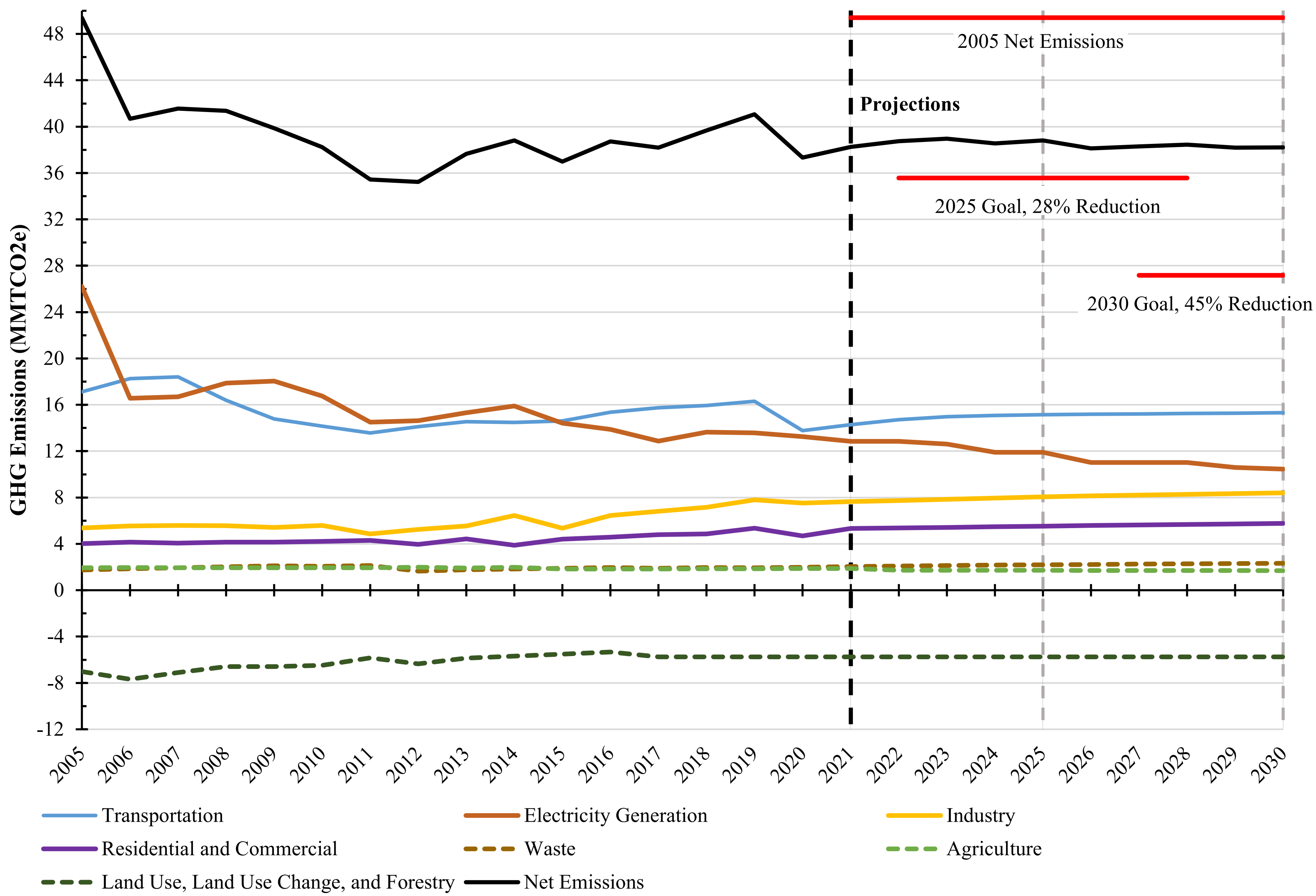


Figure 2-7: Nevada Historical and Projected Net GHG Emissions and Emissions by Sector, 2005-2030, with Updated Projections Beginning in 2021 and Comparison to NRS 445B.380's 2025 and 2030 Goals



Transportation

Figure 3-1: Nevada Net GHG Emissions with Transportation Sector Emissions Emphasized and Updated Projections Beginning in 2021, 1990–2042

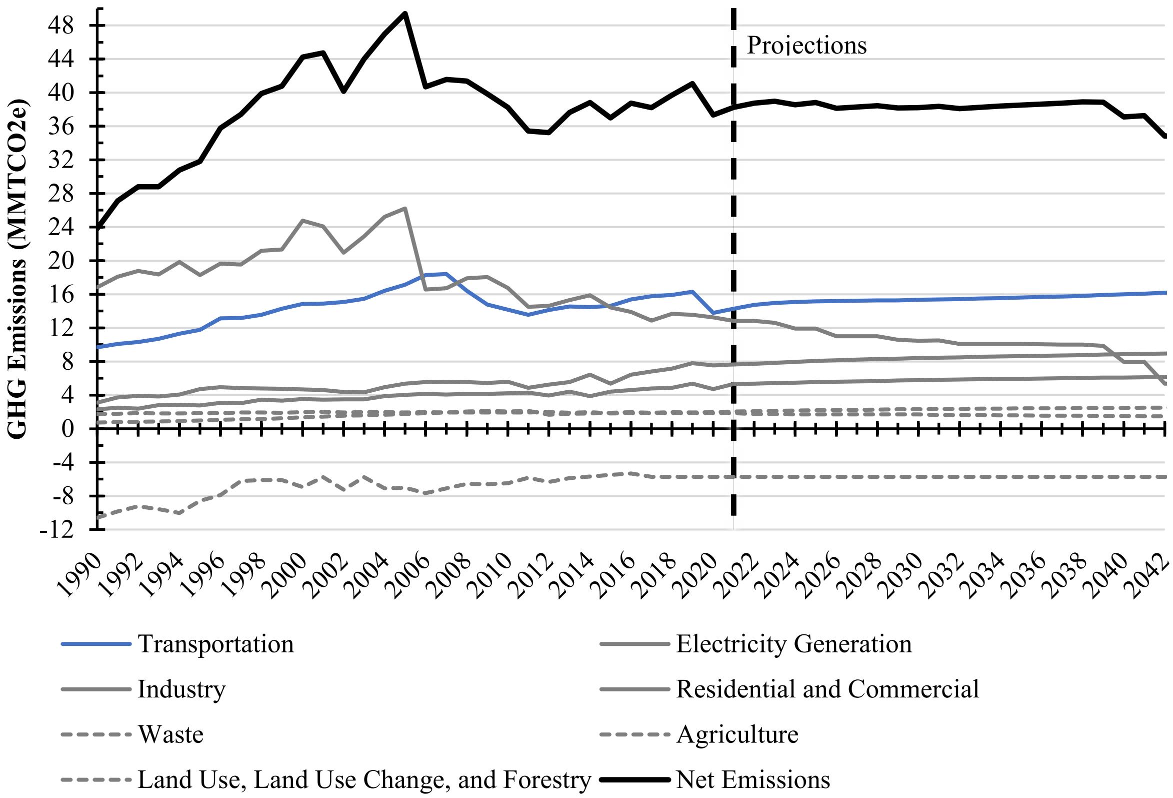
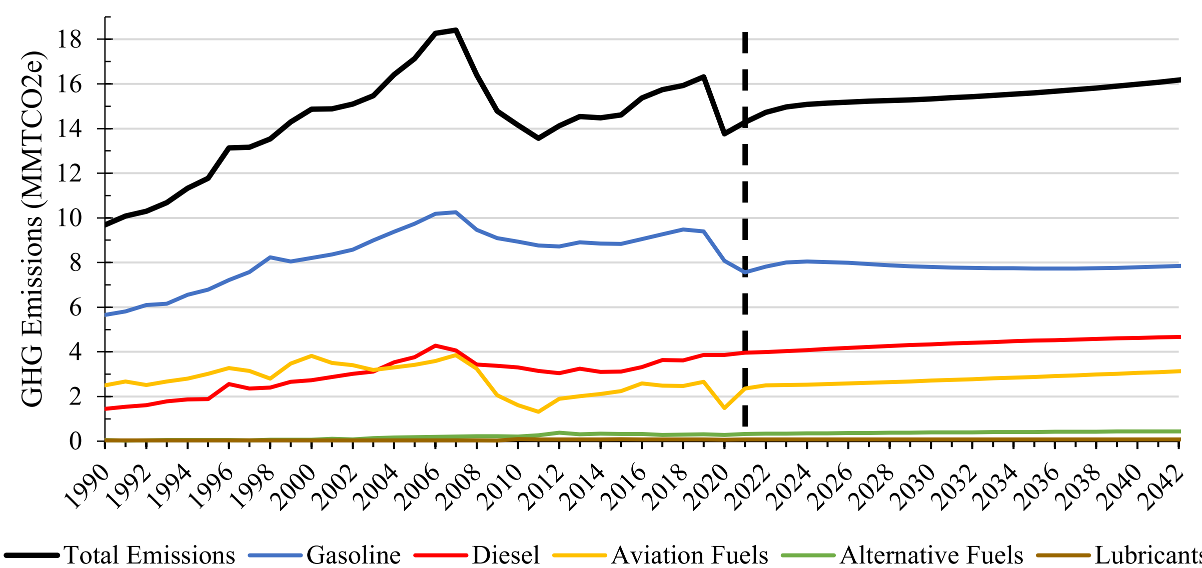


Figure 3-2: Transportation Sector GHG Emissions and Emissions by Fuel Type with Projections Beginning in 2021, 1990–2042



3.1 Overview

The transportation sector includes all mobile sources of emissions. That is, highway vehicles, aircraft, locomotives, marine vessels, and all manner of motorized non-road equipment and vehicles such as construction equipment, farm equipment, airport ground support equipment, and recreational vehicles. Federal regulations controlling emissions from mobile sources varies widely depending on their use and when regulations for a specific vehicle/equipment type were first adopted. Of all the mobile sources, highway vehicles are both the most tightly regulated and the largest contributor of GHG emissions.

Transportation sector emissions peaked in 2007 and exceeded the electricity generation sector in 2015 becoming the largest sector of GHG emissions in Nevada. The transportation sector is projected to remain the largest sector of GHG emissions, displaying a continuous upward trend in Nevada through 2042. The types of GHG's emitted from this sector are CO_2, CH_4, and N_2O, although the overwhelming majority is attributed by CO_2 emissions. Total transportation sector emissions and emissions for individual fuel types for 1990 through 2042 are illustrated in Figure 3-2.

3.2 GHG Emissions, 1990-2020

The transportation sector exceeded electricity generation in 2015 becoming the largest sector of GHG emissions in Nevada. In 2020, there were 13.764 MMTCO2e emissions attributed to transportation in Nevada, nearly 32% of the State's total GHG emissions. The types of GHGs emitted from this sector are CO_2, CH_4, and N_2O. CH_4 and N_2O account 1.1% of transportation's 2020's GHG emissions. Total transportation sector emissions and emissions for individual fuel types for 1990 through 2042 are illustrated in Figure 3-2.

Transportation sector emissions peaked in 2007 at 18.408 MMTCO2e. The reduced emissions in the years following the 2007 peak were likely due to the Great Recession which caused a reduction in transportation activity across the country. Another sharp reduction is observed in 2020, as the result of the COVID-19 global shutdown. Sector emissions are estimated to be 17.127 MMTCO2e for 2005 and 13.764 MMTCO2e for 2020, representing nearly 32% of the State's total GHG emissions for that year. Figure 3-3 illustrates transportation sector GHG emissions in Nevada from 1990 through 2020 by fuel type and Table 3-1 lists transportation sector GHG emissions in Nevada for select years. In both Figure 3-3 and Table 3-1, aviation fuels include kerosene, naphtha, and aviation gasoline and alternative fuels include the combined emissions from the use of compressed natural gas (CNG), liquefied natural gas (LNG), and other hydrocarbon gas liquids (such as liquefied petroleum gas).

Figure 3-3: Transportation Sector GHG Emissions and Emissions by Fuel Type, 1990–2020

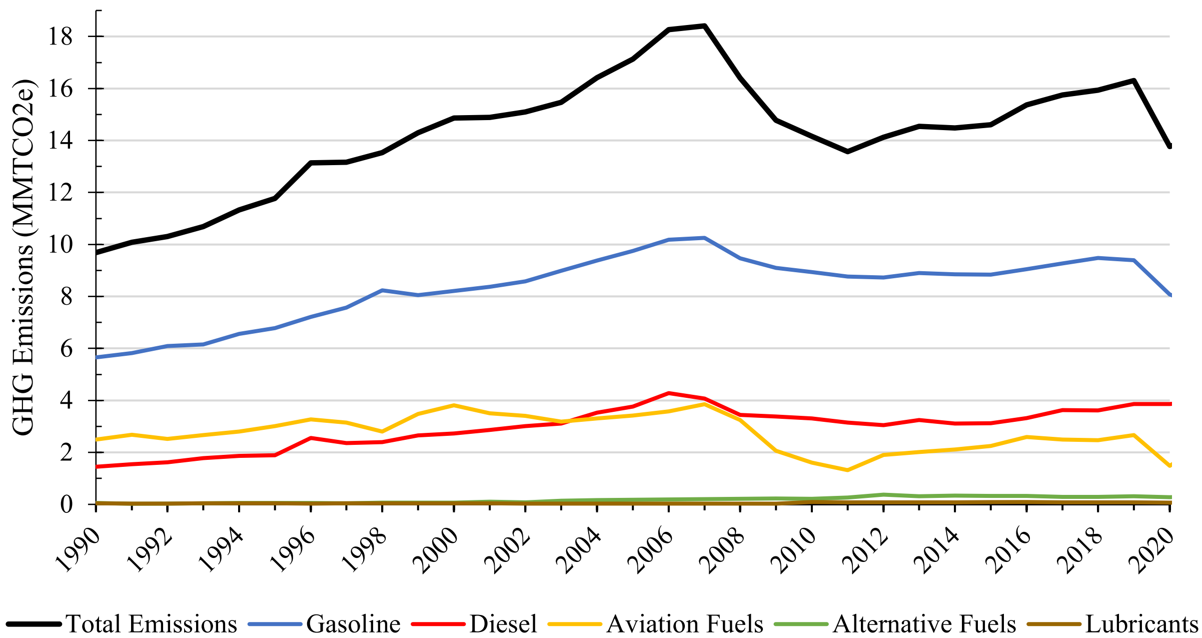


Table 3-1: Transportation Sector GHG Emissions in Nevada by Fuel Type, Select Years (MMTCO2e)

Fuel Type	1990	1995	2000	2005	2010	2015	2018	2019	2020
Gasoline	5.654	6.780	8.211	9.744	8.938	8.832	9.473	9.390	8.076
Diesel	1.448	1.884	2.730	3.757	3.308	3.120	3.619	3.867	3.856
Aviation Fuels	2.496	3.014	3.815	3.420	1.609	2.249	2.471	2.665	1.483
Alternative Fuels	0.049	0.051	0.071	0.173	0.215	0.321	0.293	0.312	0.281
Lubricants	0.038	0.037	0.039	0.033	0.087	0.087	0.079	0.077	0.069
Total Emissions	**9.685**	**11.765**	**14.867**	**17.127**	**14.156**	**14.610**	**15.934**	**16.310**	**13.764**

The Transportation sector GHG emissions show an overall positive trend from 1990 to 2020, with sharp declines occurring only during the Great Recession and the COVID-19 shutdown. This increase has been driven largely by aircraft (that is, aviation fuels) and highway vehicles[43]. Without the increasingly stringent federal highway vehicle fuel economy standards of the 2010's, it is likely that current transportation sector emissions would be much higher. Annual changes in transportation sector GHG emissions by fuel from 2015 through 2020 are listed in Table 3-2.

[43] While SEDS does not report fossil fuel consumption specifically from highway vehicles — emissions are listed by fuel type, not vehicle type — the SIT's *CH_4 and N_2O Emissions from Mobile Combustion* module also estimates CO_2 emissions, and that module does list highway vehicle emissions. And while IPCC guidelines do not advise using VMT to estimate CO_2 emissions for the purposes of creating an inventory, the emissions associated with the vehicle/equipment types considered by the *CH_4 and N_2O Emissions from Mobile Combustion* module were used to prorate CO_2 emissions to estimate highway vehicle GHG emissions for discussion purposes only.

Table 3-2: Annual Change in Transportation Sector GHG Emissions in Nevada by Fuel Type, 2015-2020 (MMTCO2e and Percent)

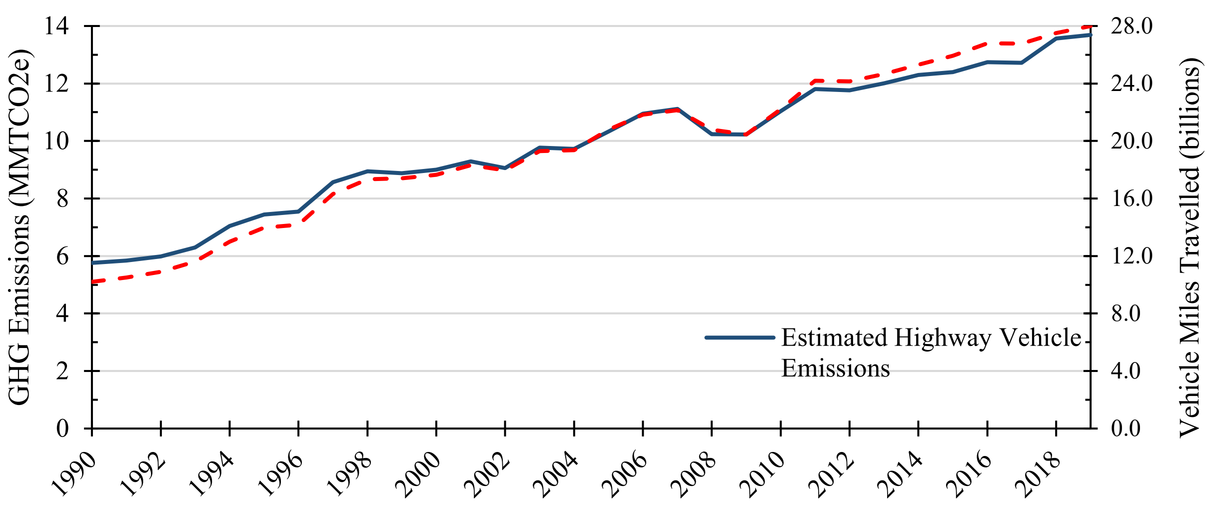
Fuel Type	2015-2016		2016-2017		2017-2018		2018-2019		2019-2020	
Gasoline	0.216	2.45%	0.215	2.38%	0.210	2.27%	-0.083	-0.88%	-1.314	-13.99%
Diesel	0.195	6.25%	0.312	9.42%	-0.008	-0.22%	0.247	6.83%	-0.011	-0.28%
Aviation Fuels	0.341	15.18%	-0.098	-3.80%	-0.022	-0.88%	0.194	7.86%	-1.182	-44.35%
Alternative Fuels	0.007	2.21%	-0.045	-13.70%	0.009	3.20%	0.019	6.62%	-0.031	-9.94%
Lubricants	-0.002	-2.38%	-0.003	-3.22%	-0.004	-4.49%	-0.002	-1.98%	-0.009	-11.23%
All Fuel Types	**0.758**	**5.19%**	**0.381**	**2.48%**	**0.185**	**1.18%**	**0.376**	**2.36%**	**-2.546**	**-15.61%**

3.2.1 Highway Vehicle Emissions

Highway vehicle GHG emissions are the result of passenger cars, light-duty trucks, and medium- and heavy-duty vehicles operating on Nevada's roads and highways. These vehicles are registered by the Nevada Department of Motor Vehicles to operate on Nevada's highways. Highway vehicle standards are regulated at the federal level by the National Highway Traffic Safety Administration (NHTSA) and EPA, where NHTSA has the authority to set safety and fuel economy standards and EPA has the authority to regulate vehicle emissions (including GHGs). Federal regulations for highway vehicles are generally created for two groups, (1) passenger cars and light-duty trucks and (2) medium- and heavy-duty vehicles. California is the only state in the nation with the authority to set their own, more stringent, vehicle emission standards. In order to do so, they must first seek and receive a waiver from the EPA.

NHTSA and EPA coordinate their efforts to set standards for highway vehicles that ensure vehicle/passenger safety while improving fuel economy and reducing vehicle emissions (especially smog-forming pollutants like particulate matter, or PM, and oxides of nitrogen, or NOx, which are both criteria pollutants). These efforts have been generally successful at reducing criteria pollutant emissions from vehicles, but GHG emissions have not been as successfully managed. Since 2009 (both the recent low for highway vehicle GHG emissions and the end of the Great Recession), it is estimated that total VMT in Nevada has increased by 36.9% (that's more than 7.5 billion additional miles travelled annually compared to 2009) while emissions have increased by 33.9%. Figure 3-4 illustrates the relationship between estimated highway vehicle GHG emissions and total VMT from 1990 through 2019 in Nevada.

Figure 3-4: Estimated Highway Vehicle GHG Emissions in Nevada and Total VMT, 1990-2019



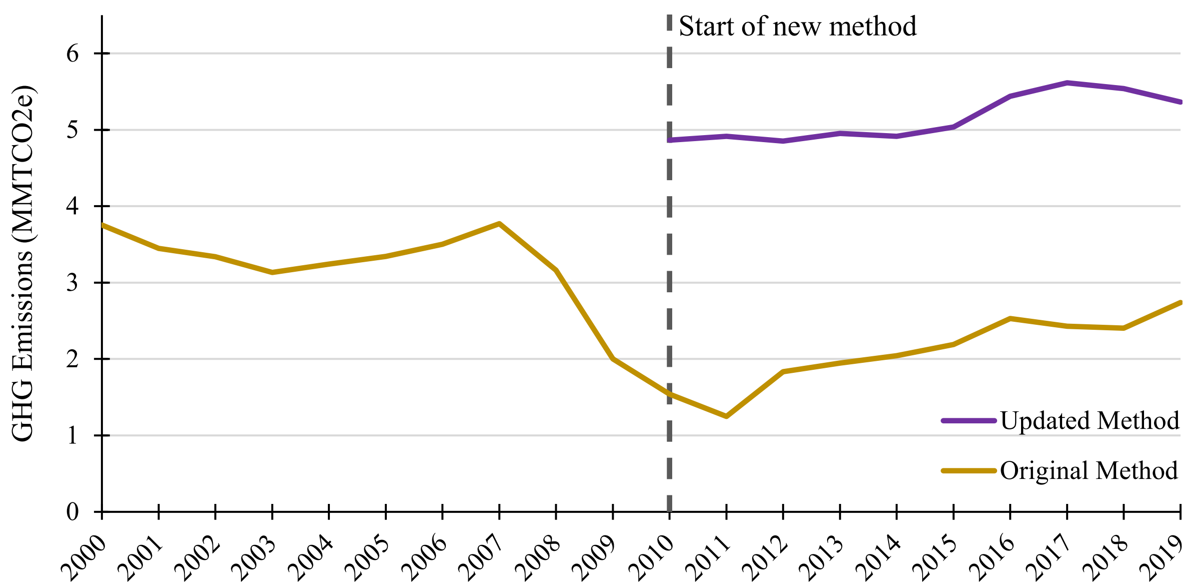
3.2.2 Jet Fuel Emissions

The 2021 release of SEDS includes a new method for allocating commercial aviation jet fuel consumption to states for 2010-2019. Previously, and what's presented throughout this report, jet fuel consumption was associated with the state where the jet fuel was purchased (as reported in the EIA publication *Petroleum Supply Annual*). However, not all commercial aircraft refuel between landing at one airport and departing to another, so the jet fuel sold at an airport in one state to refuel an aircraft might be used for the next several flights of that aircraft. The new method of allocating consumption is based on total ton-miles traveled. From page 56 of the 2021 SEDS technical notes:[44]

> For commercial aviation, SEDS takes annual jet fuel volume data for about 75 to 92 U.S. airports collected by A4A [Airlines4America, the North American airline industry trade group]. Using BTS's [U.S. Department of Transportation Bureau of Transportation Statistics] "Air Carrier Statistics (Form 41 Traffic)—All Carriers" database, "T-100 Segment (All Carriers)" table, SEDS calculates the "total ton-miles" (equal to the product of the estimated total weight of the aircraft, passengers, and cargo multiplied by flight distances) for each origin airport. SEDS first uses the total ton-miles (TTM) data to fill in earlier missing A4A data assuming the growth rates of the airport-level jet fuel volume and TTM are the same. Then, for each year, SEDS calculates a simple ratio of jet fuel volume and TTM for the airports covered in the A4A dataset and applies it to the TTM of all the other U.S. airports to estimate their jet fuel use for commercial aviation. SEDS aggregates the estimates at the airport level to the state level.

The effect of the new method is a different allocation of jet fuel consumption and related GHG emissions across states. For Nevada, jet fuel emissions almost double using the new method. Figure 3-5 illustrates estimated jet fuel emissions in Nevada using both methods.

Figure 3-5: Estimated Jet Fuel Emissions in Nevada Using Two EIA Methods of Attribution, 2000-2019



[44] State Energy Consumption Estimates, 1960 Through 2019. U.S. Department of Energy, Energy Information Administration. [accessed 2021 Oct 18] [Technical Notes p56]. https://www.eia.gov/state/seds/archive/seds2019.pdf

Using the new method, jet fuel emissions are annually an average of 3 MMTCO2e emissions higher in Nevada for the period 2010-2019. Because of the significant difference in approach between the two methods and the fact the SEDS does not provide estimates for the 2005 baseline (making any emissions reduction analysis impossible), NDEP is continuing to use the previous SEDS jet fuel allocation method until it has been determined how best to incorporate the updated method into Nevada's pre-2010 jet fuel consumption data with a focus on the 2005 baseline year Nevada has set for our GHG reduction goals.

3.3 Emissions Projections, 2021-2042

There is a high degree of uncertainty with projected transportation sector emissions. In the near-term, this is due in large part to the effect of the COVID-19 pandemic on emissions in 2021 and later years (see Section 1.3) and the changes the pandemic has had on the rise of teleworking and hybrid work schedules for many Nevadans. If made permanent, these changes to how some people work will result in a permanent reduction in VMT and therefore transportation sector emissions. In the long-term, there have been several transportation sector regulations that have been announced or finalized and others still that have been vacated by the courts since the assumptions in the 2022 release of the AEO were finalized.

The 2022 AEO Reference case used to prepare these projections assumes current laws and regulations as of November 2021 remain unchanged. This includes regulations such as the Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule Part Two, which rolls back the Tier 3 passenger car and light-duty truck fuel economy standards for vehicle model years 2021 through 2026;[45] as well as the Phase 2 GHG standards for medium- and heavy-duty vehicles, requiring more fuel efficient vehicles through model year 2027 for medium- and heavy-duty vehicles.

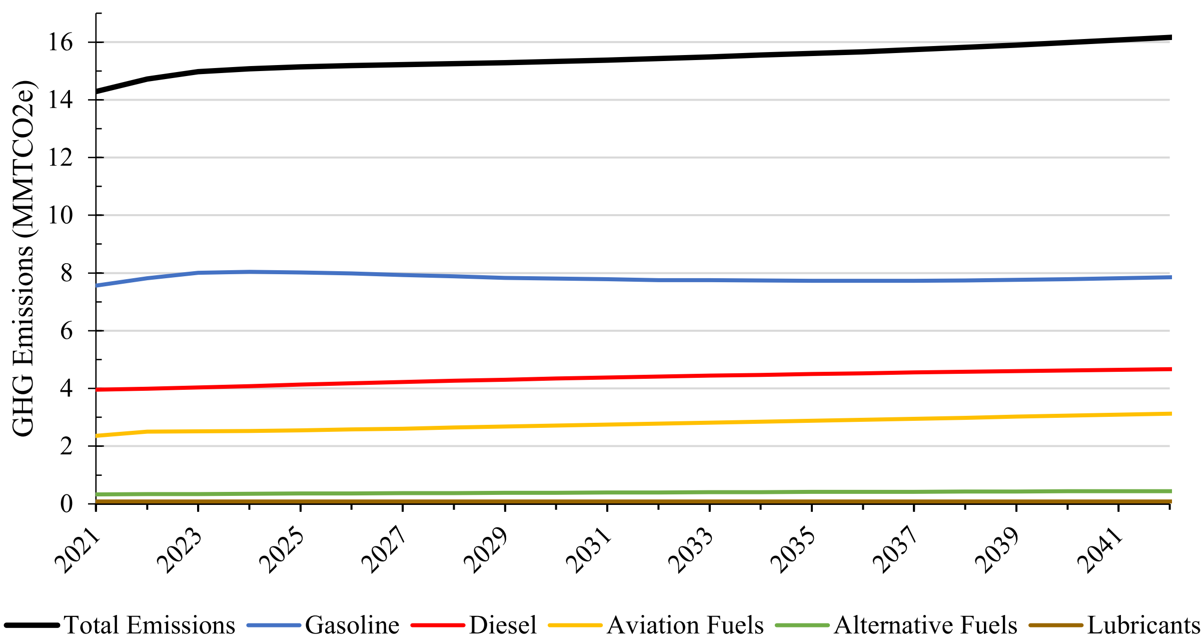
Since September 2020, Nevada adopted regulations collectively referred to as Clean Cars Nevada, becoming the sixteenth state to adopt California's Low and Zero Emission Vehicle (LEV and ZEV, respectively) programs which will require light-duty vehicle manufacturers to meet more stringent fleetwide GHG emission standards beginning with model year 2025 vehicles and make more zero emission vehicles available for sale in the State. The adoption of Clean Cars Nevada is considered in these projections and are discussed in greater detail in Section 3.3.1. However, emission reductions due to the adoption of Clean Cars Nevada are affected by large uncertainty. As CARB has adopted California's new LDV standards for model year 2026 and later, whether Nevada will follow by adopting such new standards or not will impact future emissions in the Transportation Sector. This report reflects Clean Cars Nevada because this is the regulation currently in place. But this assumption is already outdated, as Nevada will either adopt the new CARB standards or fall back to the federal standards. In either case, projected emissions will be different. Also, not considered in this report is the November 12, 2021, decision by the U.S. Court of Appeals for the District of Columbia vacating all parts of the Phase 2 GHG standards as they relate to trailers and the resulting increase in emissions that will occur because of this action.

Based on the assumptions considered by the AEO, which include the impact of COVID-19, and with the projected avoided emissions associated with Clean Cars Nevada, transportation sector GHG emissions are

[45] U.S. Environmental Protection Agency. Control of Air Pollution From Motor Vehicles: Tier 3 Motor Vehicle Emission and Fuel Standards. Federal Register. 2014 Apr 28; Vol 79, No. 81, 23414. https://www.govinfo.gov/content/pkg/FR-2014-04-28/pdf/2014-06954.pdf

estimated to jump up to 14.286 MMTCO2e and will slowly increase through 2042, reaching an estimated 15.138 MMTCO2e in 2025, 15.325 MMTCO2e in 2030, and 16.167 MMTCO2e emissions in 2042. Figure 3-6 illustrates transportation sector GHG emissions projections in Nevada by fuel type for 2021 through 2042. It is estimated that gains in emission reductions due to new federal and State regulations will be offset by population and economic growth.

Figure 3-6: Transportation Sector Projected GHG Emissions and Emissions by Fuel Type, 2021–2042



3.3.1 Clean Cars Nevada

California Air Resources Board approved the Advance Clean Cars II Program (ACCII) in 2022. ACCII replaces the LEV and ZEV standards in ACCI (adopted by refence by Clean Cars Nevada in 2021) for model year 2026 and later. The emission reduction analysis reported here is based on ACCI and therefore outdated. Nevada will either adopt ACCII or revert to federal standards, and this will impact the future emissions in the Transportation Sector. This section is presented here because the emissions projections included in this Report still reflect Clean Cars Nevada's standards for model year 2025 and later.

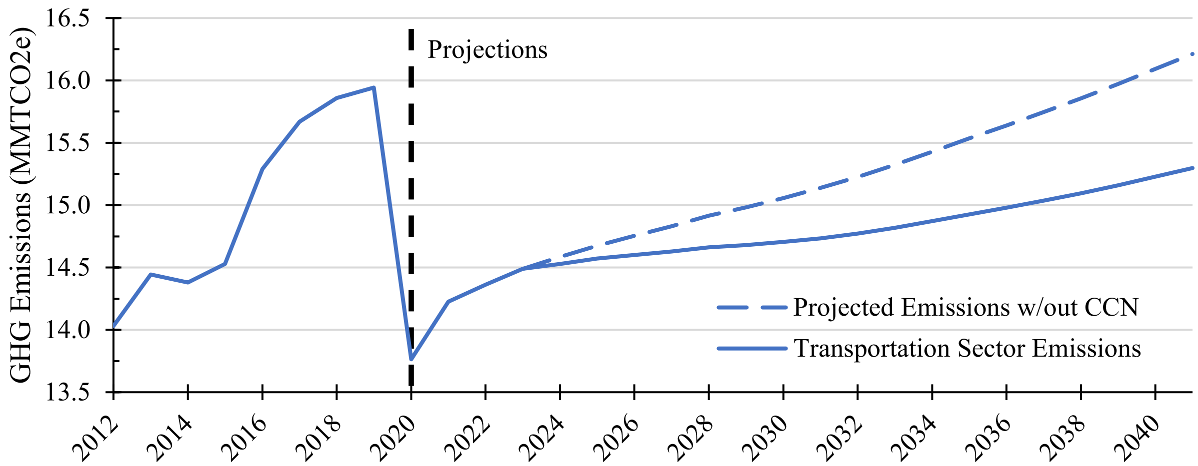
On October 25, 2021, Nevada became the sixteenth state to adopt California's LEV and ZEV programs.[46,47] Beginning with new model year 2025 vehicles, these programs will require light-duty vehicle manufacturers to meet more stringent fleetwide GHG emission standards and to make zero emission vehicles available for sale in Nevada. The impact of the Clean Cars Nevada regulation on transportation emissions is relatively small and only becomes significant after the standards affect several years of new model year light-duty vehicles. By 2030, estimated reduced emissions will be 2.4% of the

[46] A comprehensive list of states that have adopted California's LEV and ZEV programs is available at: https://ww2.arb.ca.gov/resources/documents/states-have-adopted-californias-vehicle-standards-under-section-177-federal

[47] More information about Clean Cars Nevada can be found online at: http://ndep.nv.gov/air/clean-cars-nevada

total annual emissions from the transportation sector, and less than 1% of the total statewide net emissions. By 2041, these programs will provide an annual benefit of avoiding 0.915 MMTCO2e GHG emissions from highway vehicles in Nevada, 6% and 2.5% of the emissions from the transportation sector and total statewide net emissions, respectively. Figure 3-7 illustrates the estimated, avoided emissions associated with Clean Cars Nevada. The estimate takes into account avoided tailpipe emissions from minimum compliance with the standards only as increased emissions from the generation of electricity to charge the increasing number of zero emission vehicles is already considered by NV Energy in their recent IRP.

Figure 3-7: Transportation Sector GHG Emissions, 2012-2041, with and without the Avoided Emissions Associated with Clean Cars Nevada



Electricity Generation

Figure 4-1: Nevada Net GHG Emissions with Electricity Generation Sector Emissions Emphasized and Updated Projections Beginning in 2021, 1990–2042

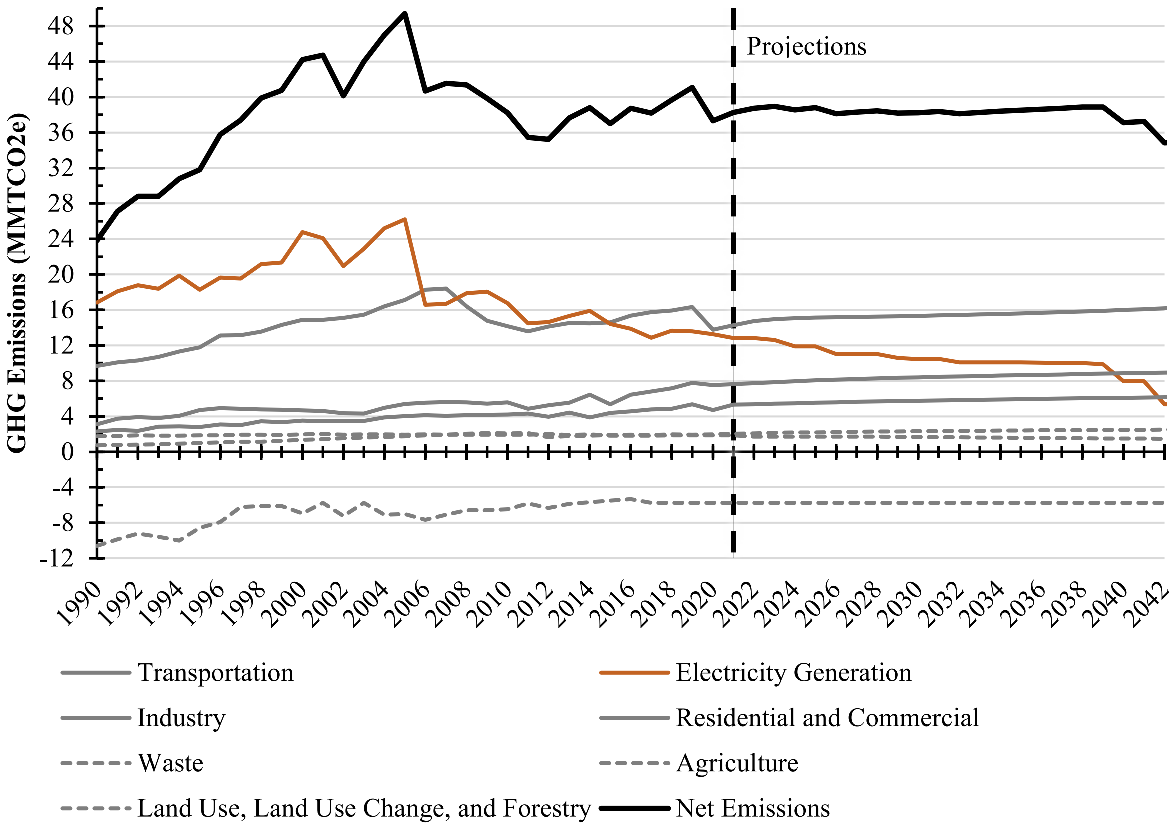
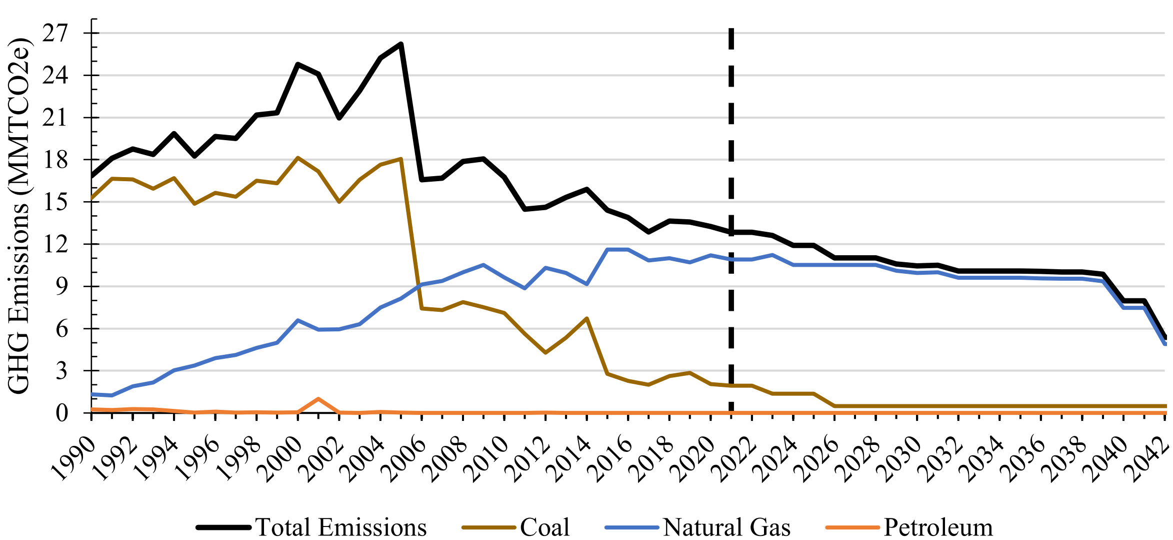


Figure 4-2: Electricity Generation Sector GHG Emissions and Emissions by Fuel Type with Projections Beginning in 2021, 1990–2042



4.1 Overview

This report estimates emissions for all fossil fuel-fired electricity generated in Nevada. Not all electricity that is generated in Nevada is consumed in Nevada and not all electricity that is consumed in Nevada is generated in Nevada. A generation-based accounting of emissions is considered to be more accurate of the actual GHG emissions for the State, as emissions are estimated through reported fuel usage at the generating unit level. In 2020, there were an estimated 1.764 MMTCO2e emissions associated with electricity transmitted out-of-state.

Electricity generation has historically been Nevada's largest sector of GHG emissions, but the retirements of two coal-fired power plants (Mohave Generating Station in 2005 and Reid Gardner Generating Station's last unit in 2017) and their partial replacement with natural gas-fired power plants and the adoption of renewable energy have led to significant emissions reductions. This change in fuel type results in a less carbon intense emissions profile for the electricity generated in Nevada.

It is projected that by 2042, emissions from electricity generation will be 5.377 MMTCO2e emissions, or 13% of the State's gross GHG emissions. Reductions in emissions and the electricity generation sector's continued decline through the projection period are largely associated with the assumed retirement of the North Valmy Generating Station (one of Nevada's two remaining coal-fired power plants) and the announced plan to convert TS Power (Nevada's other remaining coal-fired power plant) to a dual fuel facility that can operate on both coal and natural gas. Total electricity generation sector emissions by fuel type for 1990 through 2042 are illustrated in Figure 4-2. Electricity generation sector emissions were 26.211 MMTCO2e in 2005 and are projected to be 11.907 MMTCO2e and 10.452 MMTCO2e in 2025 and 2030, respectively.

On November 30, 2022, Nevada Power Company and Sierra Pacific Power filed a joint application with the Public Utilities Commission of Nevada (PUCN) for approval of the Fourth Amendment to the 2021 Joint Integrated Resource Plan[48]. The Amendment introduces uncertainty into the reported emission projections. The impact of the submitted Amendment on future emissions will be considered after approval by the Public Utilities Commission and likely included in the next year's annual report.

4.2 GHG Emissions, 1990-2020

Electricity generation sector emissions peaked in 2005 at an estimated 26.211 MMTCO2e emissions. Significant emissions reductions following 2005 are the result of coal-fired EGU shutdowns, their partial replacement with natural gas-fired EGUs (natural gas accounted for 84.5% of 2020 emissions, 11.205 MMTCO2e), and an ever-increasing reliance on renewable electricity (that is, hydroelectric, solar thermal and photovoltaic, wind, and geothermal resources). In 2020, it is estimated that 13.256 MMTCO2e emissions attributed to electricity generation were emitted in Nevada, that's nearly 31% of the State's gross GHG emissions.

[48] Public Utilities Commission Docket No. 22-11032. [accessed 2022 Dec 06]. https://pucweb1.state.nv.us/puc2/Dktinfo.aspx?Util=Electric

Figure 4-3 shows electricity generation sector GHG emissions in Nevada from 1990 through 2020 by fuel type and Table 4-1 lists electricity generation sector GHG emissions in Nevada for select years.

Figure 4-3: Electricity Generation Sector GHG Emissions by Fuel Type, 1990–2020

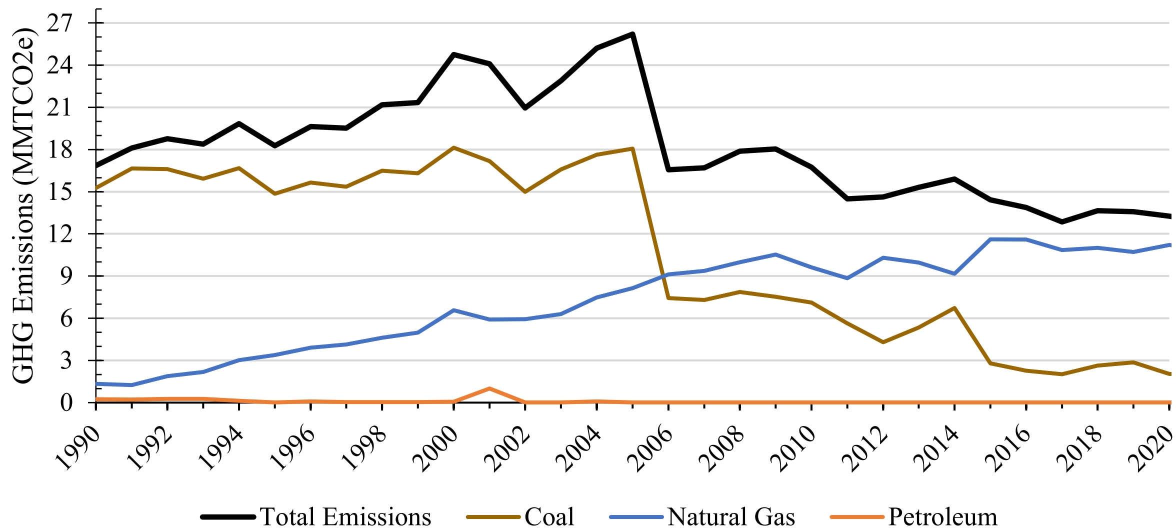


Table 4-1: Electricity Generation Sector GHG Emissions in Nevada by Fuel Type, Select Years (MMTCO2e)

Fuel Type	1990	1995	2000	2005	2010	2015	2018	2019	2020
Natural Gas	1.333	3.380	6.581	8.133	9.627	11.614	11.009	10.710	11.205
Coal	15.266	14.858	18.132	18.059	7.108	2.787	2.631	2.851	2.045
Petroleum	0.250	0.024	0.055	0.019	0.011	0.013	0.009	0.011	0.006
Total Emissions	**16.849**	**18.263**	**24.768**	**26.211**	**16.746**	**14.415**	**13.650**	**13.571**	**13.256**

Large changes to the State's GHG emissions are often driven by the opening or closing of EGUs (for example, emissions in 2005 versus 2006 clearly show the impact of the Mohave Generating Station shutting down). Smaller inter-annual variability is likely associated with factors such as weather variability and the economy. An especially hot summer could mean higher demand for air conditioning, which would not be otherwise utilized in cooler conditions, resulting in an increase in emissions. Annual changes in electricity generation sector GHG emissions by fuel from 2015 through 2020 are listed in Table 4-2.

Table 4-2: Annual Change in Electricity Generation Sector GHG Emissions in Nevada by Fuel Type, 2015-2020 (MMTCO2e and Percent)

Fuel Type	2015 to 2016		2016 to 2017		2017 to 2018		2018 to 2019		2019 to 2020	
Natural Gas	-0.010	-0.09%	-0.763	-6.57%	0.168	1.55%	-0.300	-2.72%	0.495	4.63%
Coal	-0.514	-18.43%	-0.264	-11.62%	0.622	30.96%	0.220	8.34%	-0.806	-28.26%
Petroleum	-0.004	-30.73%	-0.001	-12.90%	0.001	13.89%	0.001	15.45%	-0.005	-47.18%
All Fuel Types	**-0.528**	**-3.67%**	**-1.028**	**-7.40%**	**0.791**	**6.15%**	**-0.079**	**-0.58%**	**-0.315**	**-2.32%**

Using EIA data, Figure 4-4 shows, in terawatt-hours (TWh)[49], the amount of electricity generated in Nevada from 1990 through 2020 by source.[50] Table 4-3 shows the amount of electricity generated in Nevada for select years by source, in TWh. While emissions from the electricity generation sector have reduced by nearly half, the amount of electricity generated has remained largely unchanged. A benefit of viewing the sector in this way is that all sources of electricity are considered, not just the ones that emit GHGs. It also shows that renewable energy has long been a part of Nevada's diverse generation mixture. The generation of electricity via hydroelectric dams and geothermal deposits was present before 1990 and the relatively recent introduction of solar and wind demonstrates that renewable energy has become a relied upon portion of the state's generation mix. Renewable energy accounted for 26% of the electricity generated in Nevada in 2018; that percent is expected to rise as the RPS increases and new renewable energy projects are constructed.

Figure 4-4: Amount of Electricity Generated in Nevada by Source, 1990-2020, TWh

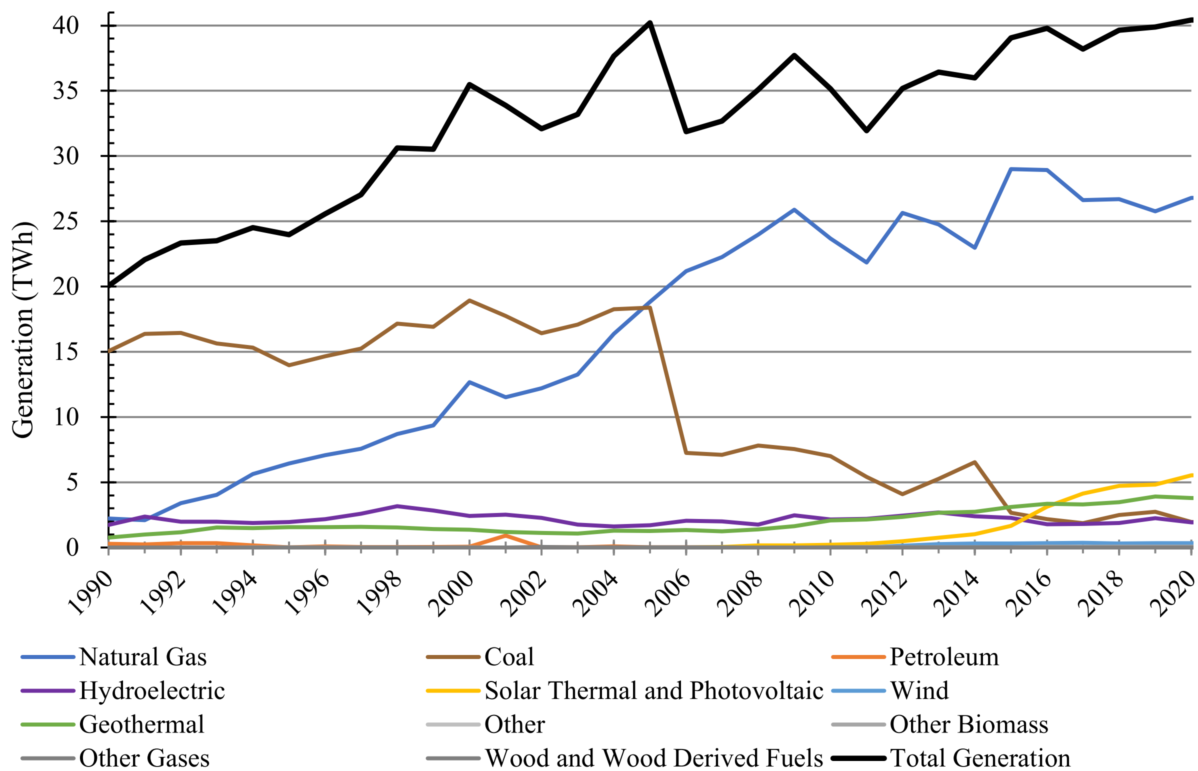


Table 4-3: Electricity Generated in Nevada by Source, Select Years (TWh)

Source	2005	2010	2015	2016	2017	2018	2019	2020
Natural Gas	18.836	23.688	29.000	28.922	26.626	26.689	25.775	26.801
Coal	18.384	6.997	2.657	2.167	1.866	2.485	2.735	1.953
Petroleum	0.021	0.011	0.016	0.011	0.009	0.010	0.012	0.006
Hydroelectric	1.702	2.157	2.264	1.789	1.813	1.881	2.242	1.923
Solar Thermal and Photovoltaic	0.000	0.217	1.657	3.124	4.146	4.719	4.811	5.535

[49] For reference, 1 TWh is the same as 1,000,000 megawatts-hours (MWh).
[50] U.S. Energy Information Administration Electricity Generation Data. [released 2022 Jun 24; accessed 2022 Mar 3]. https://www.eia.gov/state/seds/

Source	2005	2010	2015	2016	2017	2018	2019	2020
Wind	0.000	0.000	0.310	0.344	0.361	0.312	0.329	0.325
Geothermal	1.263	2.070	3.111	3.353	3.292	3.462	3.909	3.801
Other	0.000	0.000	0.001	0.021	0.032	0.029	0.022	0.026
Other Biomass	0.000	0.000	0.026	0.055	0.058	0.053	0.054	0.054
Other Gases	0.008	0.006	0.006	0.001	0.000	0.000	0.000	0.000
Wood and Wood Derived Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Generation	**40.214**	**35.146**	**39.047**	**39.787**	**38.201**	**39.640**	**39.890**	**40.425**

4.3 Projected Emissions, 2021-2042

In 2021, there were 19 fossil fuel-fired power plants — 17 natural gas-fired and two coal-fired — operating in Nevada. Of these 19, three are transmitting some or all of their electricity out-of-state. Table 4-4 provides some information for these power plants. These power plants, in addition to the natural gas generator that intermittently operates at Nevada Solar One (a concentrating solar thermal power plant in Clark County) were considered in the projections.

Table 4-4: Information for Power Plants Operating in Nevada in 2021

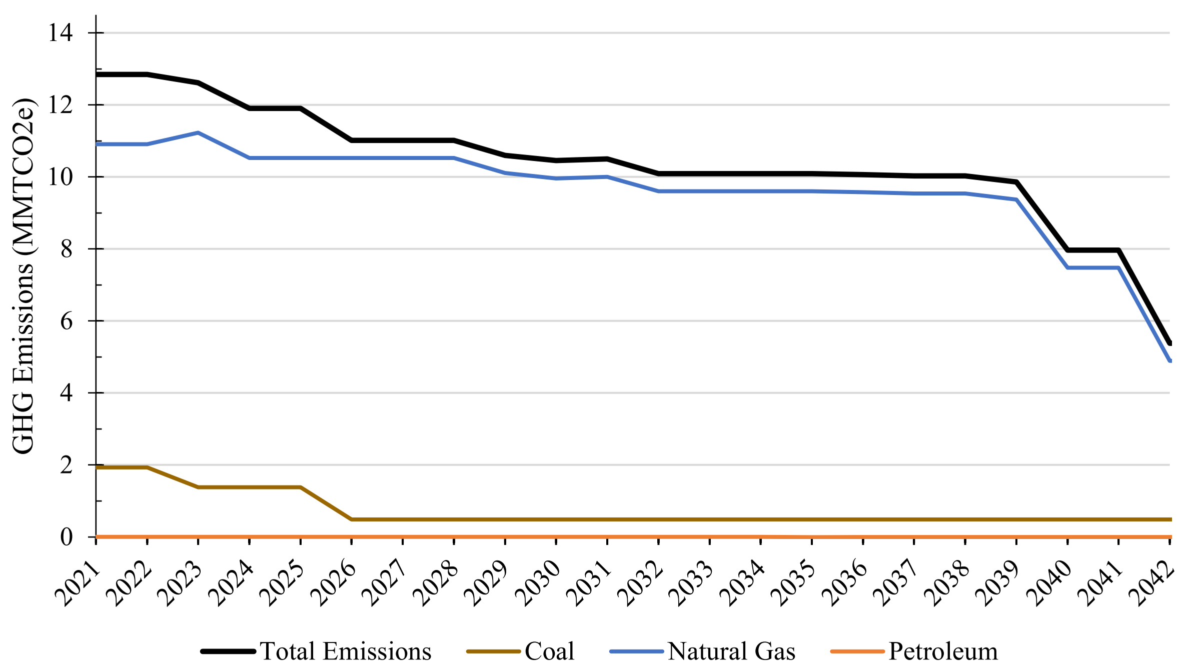
Power Plant Name	County Located	Destination for Electricity	Combined Facility Nameplate Capacity (MW)	Projected Closure
Coal-Fired Power Plants				
North Valmy Generating Station	Humboldt	Nevada and Idaho	567	2025
TS Power	Eureka	Nevada	242	2048
Natural Gas-Fired Power Plants				
Apex Generating Station	Clark	California	600	2043
Chuck Lenzie Generating Station	Clark	Nevada	1,465	2041
CityCenter Central Plant Cogen Units	Clark	Nevada	8.6	
Clark Mountain Combustion Turbines	Storey	Nevada	170	2034
Desert Star Energy Center	Clark	California	536	2040
Edward W. Clark Generating Station	Clark	Nevada	1,375	2030-2034
Fort Churchill Generating Station	Lyon	Nevada	230	2028
Frank A. Tracy Generating Station	Storey	Nevada	863	2028-2043
Harry Allen Generating Station	Clark	Nevada	745	2035-2046
Las Vegas Generating Station	Clark	Nevada	359	2029-2039
Nevada Cogeneration Associates #1 and #2	Clark	Nevada	191	2023
Saguaro Power Plant	Clark	Nevada	127	2031
Silverhawk Generating Station	Clark	Nevada	664	2039
Sun Peak Generating Station	Clark	Nevada	222	2031
Walter M. Higgins Generating Station	Clark	Nevada	688	2039
Western 102 Power Plant	Storey	Nevada	117	2045

Without any additional changes to Nevada's RPS, electricity generation sector GHG emissions are expected to drop to 5.377 MMTCO2e by 2042 with emissions in 2025 projected to be 11.907 MMTCO2e, and emissions in 2030 projected to be 10.452 MMTCO2e. Before 2030, emissions reductions are largely associated with the expected retirement of the North Valmy Generating Station —

there is a high level of uncertainty regarding whether the facility will retire on its current schedule, which for Unit 1 is a delay of its previously expected shutdown at the end of 2021 (this report assumes that both units will retire in 2025)

Figure 4-5 shows electricity generation sector GHG emissions in Nevada by fuel type projected for 2020 through 2042. From 2039 to 2042, there is a significant reduction in sector emissions. Silverhawk (664 MW), the Walter Higgins Generating Station (688 MW), and the Chuck Lenzie Generating Station (1,465 MW) reach their depreciation-based retirement dates at the end of 2039 according to NV Energy filings most recently approved by the PUCN. The method of projecting these emissions (explained in Appendix A) assumes the closure of these facilities and that wholesale electricity will be purchased to meet any demand not met by renewables or other forms of in-state generation.

Figure 4-5: Electricity Generation Sector Projected GHG Emissions and Emissions by Fuel Type, 2020–2042



These are conservative projections that may slightly overestimate projected emissions. They consider the recently updated RPS and the retirement dates of the fossil fuel fired EGUs operating in Nevada. These projections could be improved in future years with a more complete understanding of the effects of the wholesale market on electricity produced and consumed in Nevada. Again, when projected demand is greater than projected generation, it is assumed that the wholesale market is used to provide coverage. When projected generation is greater than projected demand, the analysis only assumes that EGUs are curtailed until projected generation is equal to projected demand. It is likely however, that wholesale purchases of electricity will sometimes be more cost effective than operating peaker and intermediate load units.

Industry

Figure 5-1: Nevada Net GHG Emissions with Industry Emissions Emphasized and Updated Projections Beginning in 2021, 1990–2042

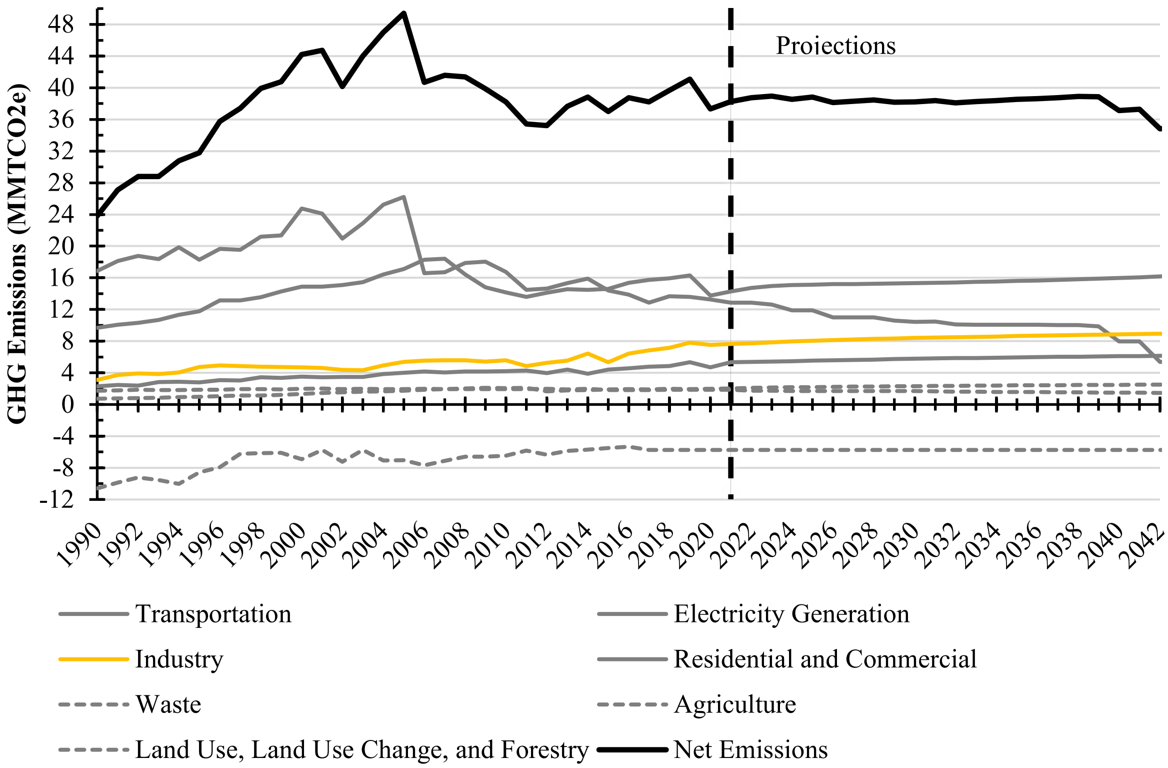
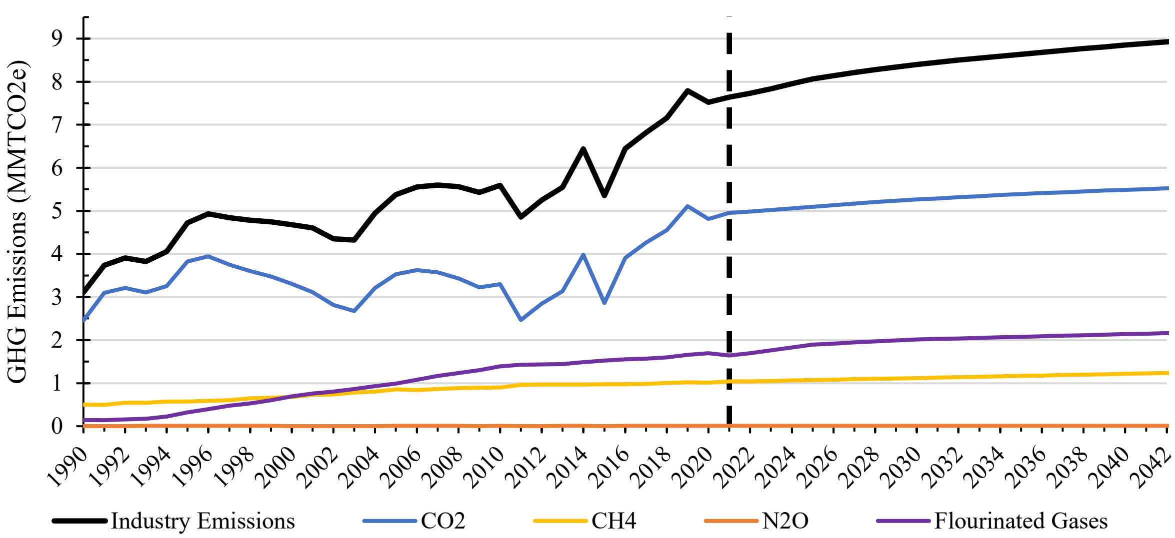


Figure 5-2: Industry GHG Emissions and Emissions by GHG with Projections Beginning in 2021, 1990–2042

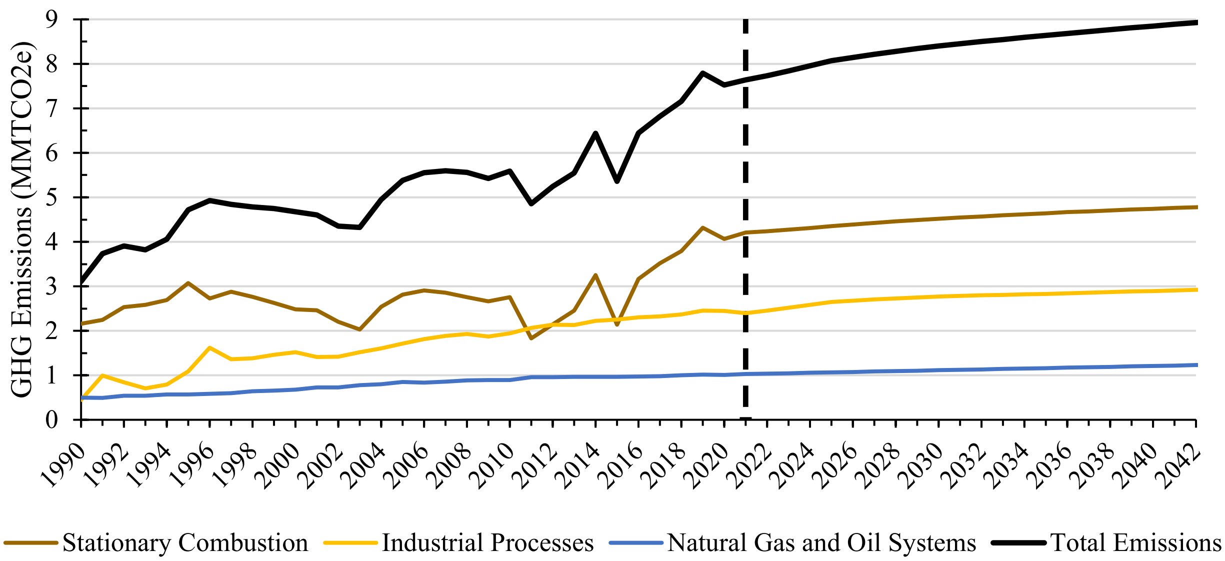


5.1 Overview

Industrial sector GHG emissions for 2020 are estimated to be 7.522 MMTCO2e and accounted for 17.5% of the State's total GHG emissions. This sector includes the emissions from the stationary combustion of fossil fuels utilized by industry (hereafter, stationary combustion), the emissions created as a byproduct of industrial processes (either from the manufacturing process or the usage/consumption of the final product, such as ozone depleting substance, or ODS, substitutes) (hereafter, industrial processes), and the fugitive emissions from natural gas (production, flaring, and transmission) and oil (production refining and transportation) systems (hereafter, natural gas and oil systems). The GHGs emitted in this sector are CO_2, CH_4, N_2O, and fluorinated gases (fluorinated gases includes HFCs, PFCs, and SF_6).[51]

Total industry emissions are illustrated by GHG for 1990 through 2042 in Figure 5-2. Figure 5-3 shows the annual contributions of the three sub-sectors on total industry GHG emissions for 1990 through 2042. Stationary combustion was still the largest sub-sector of industry emissions in 2020 and are projected to remain that way through 2042. Emissions from industry were 5.378 MMTCO2e in 2005 and are projected to be 8.068 MMTCO2e in 2025 and 8.402 MMTCO2e in 2030. As a whole, industry will account for 22% of the gross GHG emissions in Nevada in 2042.

Figure 5-3: Industry GHG Emissions and Emissions by Sub-Sector with Projections Beginning in 2020, 1990-2042



Emissions from the stationary combustion of fossil fuels by industry includes the combustion of natural gas, coal, petroleum products, and wood. There were 4.066 MMTCO2e emissions attributable to this sub-sector in 2020. Emissions from this sub-sector also include some industrial processes (examples include road asphalting or synthetic rubber production) that consume fossil fuels in a manner that permanently stores that fuel into the final product with no emissions into the atmosphere (these potential emissions are subtracted from the sub-sector total). Table 5-1 lists the fossil fuels consumed by this sub-sector and considered by SEDS.

[51] The GWPs of the various HFCs and PFCs are listed in Table 1-1.

Table 5-1: Industrial Stationary Combustion Sub-Sector Fuels Consumed[52]

Fuel Type	Fuel Sub-Type
Coal	Coking Coal Independent Power Coal Coal Other Coal
Natural gas	Natural Gas
Petroleum Products	Distillate Fuel Kerosene LPG Motor Gasoline Residual Fuel Lubricants Asphalt and Road Oil Crude Oil Feedstocks Naphthas < 401 degrees Fahrenheit Other Oils > 401 degrees Fahrenheit Miscellaneous Petroleum Products Petroleum Coke Pentanes Plus Still Gas Special Naphthas Unfinished Oils Waxes Aviation Gasoline Blending Components Motor Gasoline Blending Components
Wood	Wood

Industrial process emissions are the emissions associated with cement manufacturing, lime manufacturing, limestone and dolomite use, soda ash use, urea consumption, ODS substitutes, semiconductor manufacturing, and electric power transmission and distribution systems.[53] Emissions from the industrial process sub-sector accounted for 2.449 MMTCO2e emissions in 2020. The sources of emissions from individual industrial processes are listed in Table 5-2.

Table 5-2: Industrial Process Emissions Sources Detailed[54]

Process	Source of Emissions
Cement Manufacturing	Emissions are produced during the cement clinker production processes.
Lime Manufacturing	Lime is manufactured by heating limestone (or calcium carbonate, $CaCO_3$) in a kiln, creating lime (or calcium oxide, CaO) and CO_2.
Limestone and Dolomite Use	CO_2 is emitted as a by-product from the reaction of limestone or dolomite with the impurities in iron ore and fuels heated in a blast furnace.

[52] ICF International. State Greenhouse Gas Inventory Tool User's Guide for the Stationary Combustion Module. U.S. Environmental Protection Agency; 2019 Dec. https://www.epa.gov/statelocalenergy/state-inventory-and-projection-tool
[53] The SIT considers other industrial processes that are not included in this list as there were zero emissions associated with these processes in Nevada. That is, these processes do not currently exist in-state.
[54] ICF International. State Greenhouse Gas Inventory Tool User's Guide for the Industrial Processes Module. U.S. Environmental Protection Agency; 2020 Dec. https://www.epa.gov/statelocalenergy/state-inventory-and-projection-tool

Process	Source of Emissions
Soda Ash Use	The soda ash production method in some states uses trona (an ore from which natural soda ash is made) and is calcined (an indirect high-temperature processing within a controlled atmosphere) in a rotary kiln and transformed into a crude soda ash that requires further processing. CO_2 and water are generated as a by-product of the calcination process. CO_2 is also released when soda ash is consumed in products such as glass, soap, and detergents.
Urea Consumption	CO_2 is released when urea is consumed.
ODS Substitutes	ODS substitutes are classes of hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) used as alternatives to several classes of ODSs. These alternatives are used in vehicle air conditioning, industrial, residential, and commercial refrigeration and air conditioning, aerosols, solvent cleaning, fire extinguishing, foam production, and sterilization.
Semiconductor Manufacturing	The semiconductor manufacturing process uses multiple long-lived fluorinated gases in the plasma etching and chemical vapor deposition processes and includes the PFCs:CF_4, C_2F_6, and C_3F_8 as well as HFC-23 and SF_6.
Electric Power Transmission and Distribution Systems	Electric power and distribution systems consume SF_6. It is used as an electrical insulator in electricity transmission and distribution equipment such as gas-insulated high-voltage circuit breakers, substations, transformers, and transmission lines.

Fugitive emissions from natural gas (production, flaring, transmission, and distribution) and oil (production, refining, and transportation) systems in Nevada are generally the result of the transmission (the transport through large pipelines) and distribution (the delivery from the pipeline to end users) of natural gas. There is very little natural gas and oil production in Nevada.[55] Emissions from the transmission of natural gas are the result of chronic leaks, compressor station fugitive emissions, compressor station exhaust, vents, and pneumatic devices. Emissions from the distribution of natural gas are the result of chronic leaks, meters, regulators, and sometimes mishaps.[56] Natural gas and oil systems in Nevada accounted for 1.007 MMTCO2e emissions in 2020.

5.2 GHG Emissions, 1990-2020

As industry sector emissions are tied to production and consumption/usage, emissions are driven by increases in population, unless GHG intensive replacements are introduced and widely adopted. Sector emissions are estimated to be 5.378 MMTCO2e for 2005 and 7.522 MMTCO2e for 2020. Figure 5-4 shows industry emissions in Nevada by GHG from 1990 through 2020 and Table 5-3 lists industry GHG emissions in Nevada for select years.

[55] Sources of emissions from the production of natural gas are compressor station fugitive emissions and compressor station exhaust, vents, pneumatic devices, and blowdown. Emissions from oil production and transportation can be the result of pneumatic devices, system components, process vents, starting and stopping reciprocating engines or turbines, and emissions during drilling activities.

[56] ICF International. State Greenhouse Gas Inventory Tool User's Guide for the Natural Gas and Oil Module. U.S. Environmental Protection Agency; 2020 Dec. https://www.epa.gov/statelocalenergy/state-inventory-and-projection-tool

Figure 5-4: Industry GHG Emissions in Nevada by GHG, 1990-2020

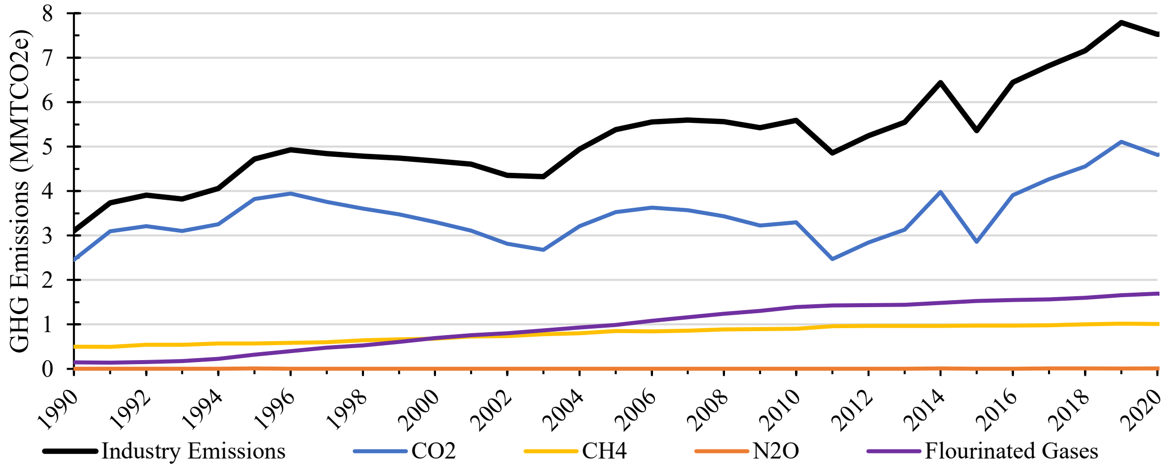


Table 5-3: Industry GHG Emissions in Nevada by GHG, Select Years (MMTCO2e)

GHG	1990	1995	2000	2005	2010	2015	2018	2019	2020
CO_2	2.455	3.825	3.304	3.528	3.295	2.858	4.552	5.107	4.811
CH_4	0.500	0.570	0.678	0.853	0.899	0.971	1.004	1.019	1.012
N_2O	0.005	0.007	0.005	0.006	0.006	0.004	0.008	0.009	0.008
Fluorinated Gases	0.145	0.318	0.691	0.991	1.389	1.524	1.597	1.656	1.691
Total Emissions	**3.105**	**4.721**	**4.678**	**5.378**	**5.589**	**5.358**	**7.160**	**7.790**	**7.522**

5.2.1 Industry Emissions from Stationary Combustion

The stationary combustion of fossil fuels is the largest sub-sector of industry emissions. Figure 5-5 illustrates stationary combustion sub-sector GHG emissions in Nevada by fuel type and Table 5-4 lists stationary combustion sub-sector GHG emissions in Nevada by fuel type for select years. The combustion of petroleum products is both the largest contributor of sub-sector emissions and the most prone to significant year-to-year variability in emissions as shown in Table 5-5, which lists the annual changes in stationary combustion GHG emissions by fuel type from 2015 through 2020.

Figure 5-5: Stationary Combustion Sub-Sector GHG Emissions in Nevada by Fuel Type, 1990-2020 (MMTCO2e)

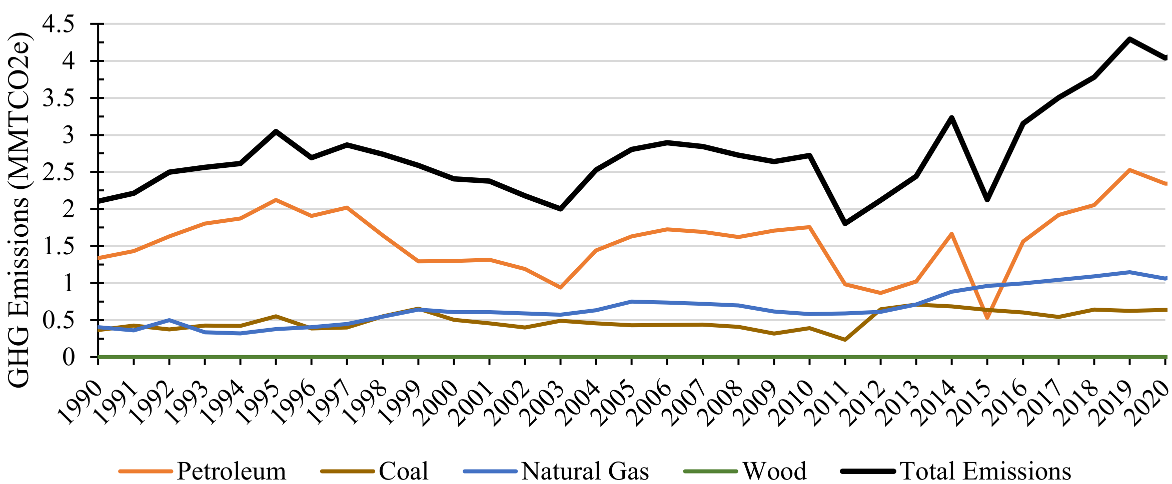


Table 5-4: Stationary Combustion Sub-Sector GHG Emissions in Nevada by Fuel Type, Select Years (MMTCO2e)

Fuel Type	1990	1995	2000	2005	2010	2015	2018	2019	2020
Natural Gas	0.403	0.377	0.605	0.747	0.578	0.959	1.090	1.144	1.061
Coal	0.365	0.549	0.502	0.429	0.391	0.637	0.640	0.624	0.635
Petroleum	1.336	2.120	1.298	1.629	1.753	0.529	2.052	2.526	2.344
Wood	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Emissions	**2.105**	**3.046**	**2.405**	**2.805**	**2.723**	**2.125**	**3.781**	**4.294**	**4.040**

Table 5-5: Annual Change in Stationary Combustion Sub-Sector GHG Emissions in Nevada by Fuel Type, 2015-2020 (MMTCO2e and Percent)

Fuel Type	2015-2016		2016-2017		2017-2018		2018-2019		2019-2020	
Natural Gas	0.035	3.65%	0.050	5.05%	0.046	4.37%	0.054	4.98%	-0.083	-7.22%
Coal	-0.035	-5.50%	-0.060	-9.98%	0.098	18.03%	-0.016	-2.48%	0.012	1.86%
Petroleum	1.031	194.71%	0.359	23.01%	0.133	6.92%	0.475	23.14%	-0.183	-7.23%
Wood	0.000	0	0.000	0	0.000	0	0.000	0	0.000	0
Totals	**1.031**	**48.50%**	**0.349**	**11.06%**	**0.276**	**7.88%**	**0.513**	**13.57%**	**-0.254**	**-5.90%**

5.2.2 Industry Emissions from Industrial Processes

Industrial process sub-sector GHG emissions were estimated to be 2.449 MMTCO2e in 2020. Figure 5-6 illustrates individual industrial process sub-sector GHG emissions in Nevada for 1990 through 2020 and Table 5-6 lists individual industrial process sub-sector GHG emissions in Nevada for select years. As Nevada's population and economy grows, industrial process emissions have continued to grow with it. While the HFC phasedown rule will likely lead to emissions reductions, there is no immediate substitute for many of the final products — cement, and lime — of these industrial processes nor for the ways in which these materials are processed/produced.

Figure 5-6: Industrial Process Sub-Sector GHG Emissions in Nevada by Process, 1990-2020 (MMTCO2e)

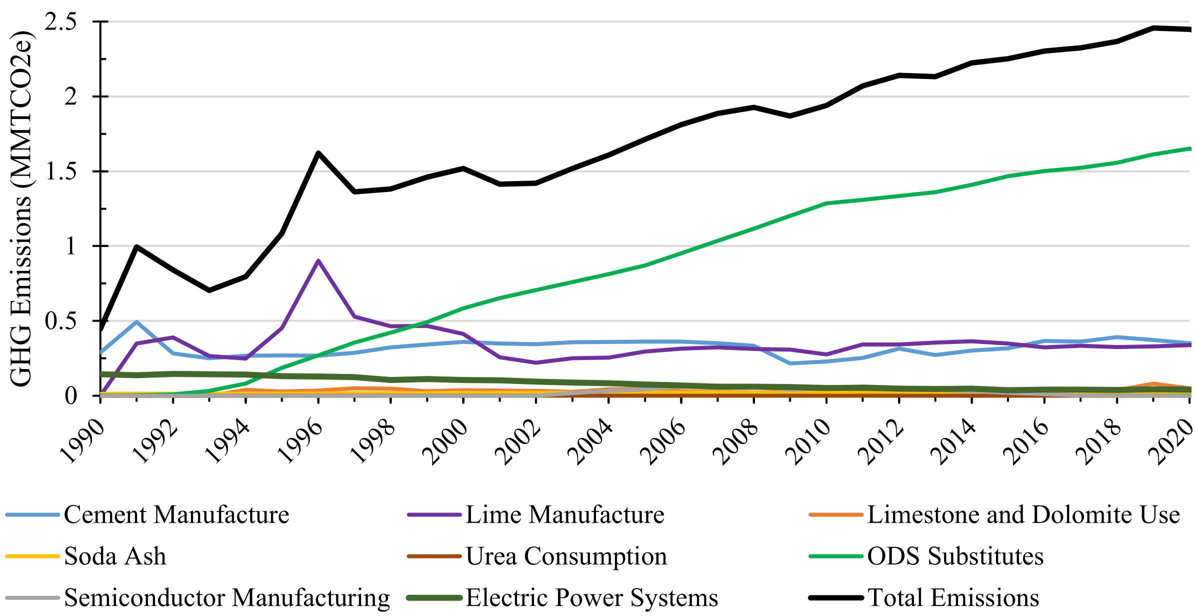


Table 5-6: Industrial Process Sub-Sector GHG Emissions in Nevada by Process, Select Years (MMTCO2e)

Process	1990	1995	2000	2005	2010	2015	2018	2019	2020
Cement Manufacture	0.288	0.270	0.359	0.362	0.229	0.316	0.391	0.372	0.352
Lime Manufacture	0.000	0.451	0.414	0.295	0.276	0.350	0.325	0.330	0.338
Limestone and Dolomite Use	0.000	0.029	0.036	0.045	0.027	0.044	0.037	0.081	0.050
Soda Ash	0.013	0.016	0.019	0.021	0.019	0.018	0.019	0.018	0.019
Urea Consumption	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ODS Substitutes	0.001	0.187	0.584	0.871	1.286	1.467	1.557	1.613	1.651
Aerosols	*0.000*	*0.053*	*0.084*	*0.069*	*0.119*	*0.151*	*0.120*	*0.124*	*0.126*
Fire Extinguishers	*0.000*	*0.000*	*0.001*	*0.003*	*0.005*	*0.008*	*0.010*	*0.010*	*0.011*
Foams	*0.000*	*0.000*	*0.001*	*0.012*	*0.043*	*0.064*	*0.070*	*0.070*	*0.069*
Refrigerators and Air Conditioners	*0.000*	*0.124*	*0.464*	*0.729*	*1.034*	*1.120*	*1.202*	*1.251*	*1.290*
*Solvents**	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Other Applications	*0.001*	*0.010*	*0.034*	*0.059*	*0.085*	*0.124*	*0.155*	*0.157*	*0.155*
Semiconductor Manufacturing	0.000	0.000	0.001	0.044	0.050	0.020	0.001	0.000	0.000
Electric Power Transmission and Distribution Systems	0.144	0.132	0.106	0.076	0.053	0.037	0.039	0.042	0.040
Total Emissions	**0.446**	**1.085**	**1.519**	**1.714**	**1.940**	**2.252**	**2.368**	**2.457**	**2.449**

*ODSS emissions from the use of solvents is reported as part of "Other Applications" emissions.

Consistent sub-sector annual growth in emissions is due to ODS substitutes. Emissions from ODS substitutes have increased year-over-year, every year, since 1990. ODS substitutes, or HFCs, are used as alternatives to several classes of ODSs that are being phased out under the terms of the Montreal Protocol and the Clean Air Act Amendments of 1990. Although not harmful to the ozone layer, they are potent GHGs with GWPs sometimes several orders of magnitude larger than CO_2 (refer to Table 1-1). Table 5-7 lists the lists the annual change of individual industrial process sub-sector GHG emissions in Nevada from 2014 through 2020.

Table 5-7: Annual Change in Industrial Process Sub-Sector GHG Emissions in Nevada by Process, 2015-2020 (MMTCO2e and Percent)

Process	2015 to 2016		2016 to 2017		2017 to 2018		2018 to 2019		2019 to 2020	
Cement Manufacture	0.051	16.09%	-0.005	-1.44%	0.029	8.05%	-0.019	-4.89%	-0.020	-5.43%
Lime Manufacture	-0.027	-7.64%	0.011	3.41%	-0.009	-2.73%	0.005	1.55%	0.008	2.36%
Limestone and Dolomite Use	-0.001	-1.97%	0.001	1.94%	-0.007	-16.06%	0.044	121.65%	-0.031	-38.51%
Soda Ash	0.001	3.80%	-0.001	-2.96%	0.000	0.29%	0.000	-1.64%	0.000	1.90%
Urea Consumption	0.000	0.16%	0.000	-1.77%	0.000	-1.81%	0.000	13.55%	0.000	-5.21%
ODS Substitutes	0.034	2.31%	0.023	1.52%	0.033	2.19%	0.056	3.62%	0.038	2.35%
Aerosols	*-0.010*	*-6.79%*	*-0.010*	*-6.86%*	*-0.011*	*-8.20%*	*0.003*	*2.83%*	*0.002*	*1.69%*
Fire Extinguishers	*0.001*	*8.30%*	*0.001*	*8.03%*	*0.001*	*7.54%*	*0.001*	*7.10%*	*0.001*	*4.81%*
Foams	*0.003*	*4.56%*	*0.001*	*0.78%*	*0.002*	*3.14%*	*0.001*	*1.34%*	*-0.001*	*-1.95%*
Refrigerators and Air Conditioners	*0.029*	*2.60%*	*0.018*	*1.60%*	*0.035*	*2.98%*	*0.049*	*4.06%*	*0.039*	*3.10%*
*Solvents**	*0.000*	*0.00%*	*0.000*	*0.00%*	*0.000*	*0.00%*	*0.000*	*0.00%*	*0.000*	*0.00%*
Other Applications	*0.011*	*9.16%*	*0.013*	*9.44%*	*0.006*	*4.35%*	*0.002*	*1.56%*	*-0.002*	*-1.40%*
Semiconductor Manufacturing	-0.010	-49.37%	-0.010	-94.89%	0.000	3.02%	0.000	-8.72%	0.000	0.00%

Process	2015 to 2016		2016 to 2017		2017 to 2018		2018 to 2019		2019 to 2020	
Electric Power Transmission and Distribution Systems	0.003	7.92%	0.002	5.04%	-0.003	-6.51%	0.003	7.54%	-0.002	-4.95%
Totals	**0.051**	**2.25%**	**0.021**	**0.91%**	**0.044**	**1.88%**	**0.089**	**3.77%**	**-0.008**	**-0.33%**

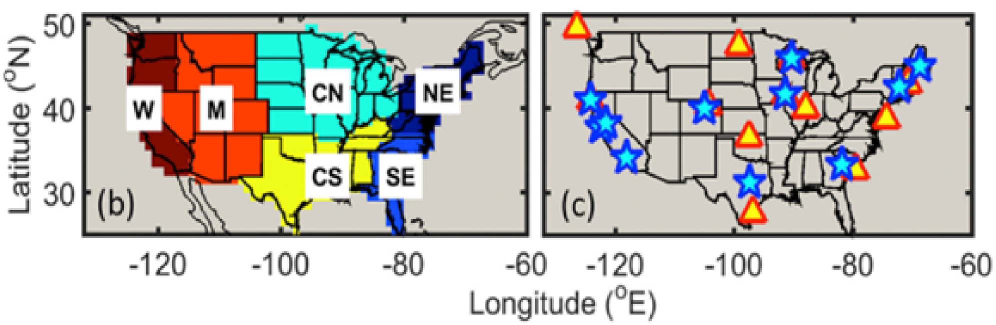
*ODS substitute emissions from the use of solvents is reported as part of "Other Applications" emissions.

5.2.2.1 ODS Substitute Emissions

Beginning in 2022, the SIT's *Industrial Processes* module provides a new, alternate method in reapportioning state-level emissions of ODS substitutes from the national estimate. In this new method, national emissions are disaggregated to individual states through population distribution and then modified with data pulled from a NOAA analysis to better incorporate the varying nature of ODS substitute emissions across the United States. The analysis relies on atmospheric transport models applied to ground-level and air-level measurement samples of various fluorocarbons to estimate emissions over six regions of the contiguous United States.

Uncertainties associated with this reapportionment method based on the referenced study include limitations in geography (Nevada is grouped into the Mountain Region, where emissions estimates rely on air samples collected in Colorado) and time (study uses data collected from 2008-2014). Uncertainty is also inherent when developing emissions estimates through atmospheric transport modeling. Figure 5-7 illustrates the grouping of the contiguous States into regions, with the Mountain Region indicated in red, and the various locations of ground-level measurements (blue stars) and air-level measurements (yellow triangles) used in the study.[57]

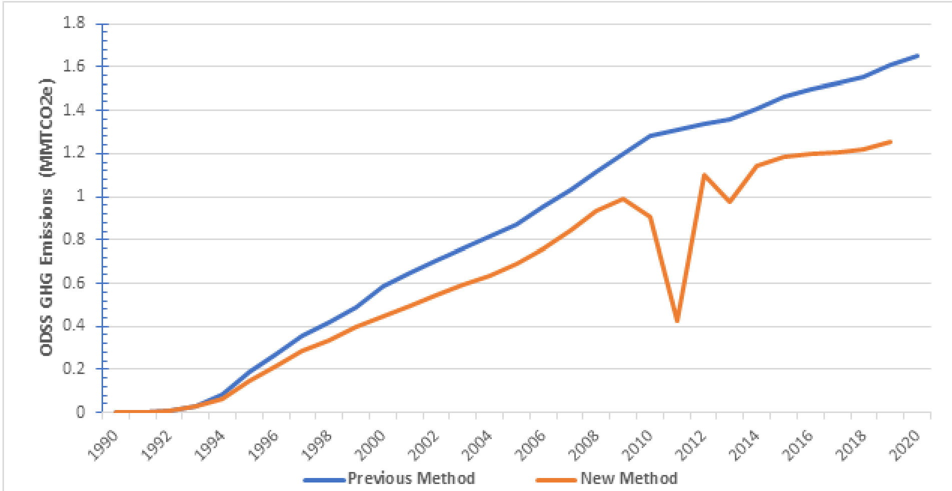
Figure 5-7: Study Regions and Sampling Locations



As shown in Figure 5-8, application of the new reapportioning method results in substantial decreases in ODS substitutes emissions for Nevada, as opposed to the method used in previous reporting that strictly disaggregates national emissions to individual states by population distribution only. As stated previously, it is expected that true statewide ODS substitutes emissions in Nevada are larger than what is apportioned strictly by population due to the State's increasingly hot and dry climate, warranting a larger reliance on air conditioning compared to the national average. The new reapportionment method provides estimates that are lower for Nevada, and also shows a highly variable emissions profile from 2008 to 2014 that does not agree with the overall trend and may indicate a possible gap between study-level emissions and inventory forecasting. For the purpose of this report, the more conservative approach is used and ODS substitutes emissions remain to be estimated by population until further confirmation of the new method is provided.

[57] Considerable Contribution of the Montreal Protocol to Declining Greenhouse Gas Emissions from the United States. Hu, L., et al.; 14 Aug 2017. https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2017GL074388

Figure 5-8: Nevada ODS Substitute (ODSS) Emissions Comparison



5.2.3 Industry Emissions from Natural Gas and Oil Systems

Natural gas and oil systems sub-sector GHG emissions were estimated to be 1.007 MMTCO2e in 2020. Due to the absence of a coal industry in Nevada and the limited natural gas and oil production that does take place, fugitive emissions from natural gas and oil systems represent a small portion of total GHG emissions. Transmission and distribution of natural gas are the major sources of GHG emissions in this sub-sector. Nevada is both a net importer of natural gas (and oil) as well as a "throughway" for natural gas passing through Nevada from where it is produced to where it is used. Table 5-8 lists natural gas and oil systems sub-sector GHG emissions in Nevada by fuel type for select years and Table 5-9 lists the annual change in natural gas and oil systems GHG emissions by fuel type from 2015 through 2020.

Table 5-8: Natural Gas and Oil Systems Industry Sub-Sector GHG Emissions in Nevada by Fuel Type, Select Years (MMTCO2e)

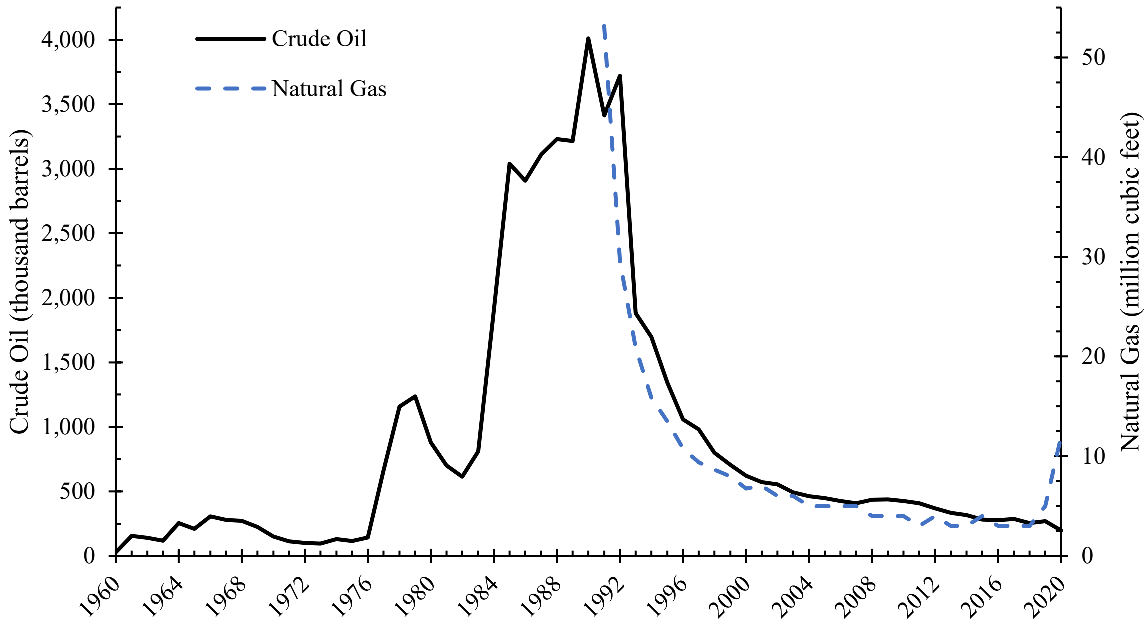
Fuel Type	1990	1995	2000	2005	2010	2015	2018	2019	2020
Natural Gas	0.414	0.538	0.661	0.839	0.887	0.964	0.997	1.011	1.005
Production	*0.000*	*0.000*	*0.001*	*0.001*	*0.001*	*0.001*	*0.015*	*0.016*	*0.017*
Transmission	*0.237*	*0.296*	*0.326*	*0.414*	*0.385*	*0.445*	*0.446*	*0.446*	*0.446*
Distribution	*0.177*	*0.241*	*0.333*	*0.424*	*0.501*	*0.517*	*0.535*	*0.549*	*0.559*
Oil	0.083	0.028	0.014	0.010	0.009	0.004	0.003	0.003	0.002
Total Emissions	**0.497**	**0.566**	**0.675**	**0.849**	**0.896**	**0.968**	**0.999**	**1.014**	**1.007**

Table 5-9: Annual Change in Natural Gas and Oil Systems Sub-Sector GHG Emissions in Nevada by Fuel Type, 2015-2020 (MMTCO2e and Percent)

Fuel Type	2015 to 2016		2016 to 2017		2017 to 2018		2018 to 2019		2019 to 2020	
Natural Gas	0.004	0.44%	0.006	0.58%	0.023	2.35%	0.014	1.44%	-0.006	-0.63%
Production	*0.000*	*25.00%*	*0.000*	*0.00%*	*0.014*	*940.00%*	*0.001*	*5.77%*	*0.000*	*1.82%*
Transmission	*0.001*	*0.12%*	*0.000*	*-0.09%*	*0.000*	*0.03%*	*0.000*	*-0.02%*	*0.000*	*0.00%*
Distribution	*0.003*	*0.66%*	*0.006*	*1.17%*	*0.009*	*1.66%*	*0.014*	*2.54%*	*0.010*	*1.74%*
Oil	0.000	3.37%	0.000	-1.72%	-0.001	-27.81%	0.000	-1.92%	-0.001	-26.87%
Totals	**0.004**	**0.46%**	**0.006**	**0.58%**	**0.022**	**2.22%**	**0.014**	**1.43%**	**-0.007**	**-0.71%**

The production of natural gas and oil in Nevada peaked in the early 1990's. Natural Gas production peaked in 1991, the EIA's first year of recorded commercial production estimates, at 53 million cubic feet and oil production in Nevada peaked in 1990 when the State produced just more than 4 million barrels. From 2005 through 2019 production in the industry has been relatively stagnant with natural gas production averaging roughly 4 million cubic feet per year and oil production averaging roughly 350,000 barrels per year. Natural Gas production shows an uptick in 2020, with 12 million cubic feet produced. However, preliminary data indicates that production was back to 4 million cubic feet in 2021. Figure 5-9 shows EIA historical production estimates of natural gas and oil in Nevada from 1960 through 2020.[58]

Figure 5-9: EIA Historical Natural Gas and Oil Production Estimates for Nevada, 1960-2020



5.3 Projected Emissions, 2021-2042

Industry GHG emissions in Nevada are projected to continue to increase through 2042 with emissions in 2025 projected to be 8.068 MMTCO2e, emissions in 2030 projected to be 8.402 MMTCO2e, and emissions in 2042 projected to reach 8.929 MMTCO2e. Figure 5-10 illustrates industry GHG emissions projections in Nevada by GHG from 2020 through 2042. Figure 5-11 illustrates industry emissions projections by sub-sector and shows that future increases in sector emissions will be the result of minor, but steady increases in stationary combustion and industrial process emissions. It is also worth noting that these projections do not account for the phasedown of production and consumption of ODS substitutes included in the second federal coronavirus relief bill, the Consolidated Appropriations Act, 2021.

[58] U.S. Energy Information Administration State Energy Data System [accessed 2021 Oct 20]. https://www.eia.gov/state/seds/

Figure 5-10: Industry GHG Emissions Projections in Nevada by GHG, 2021-2042

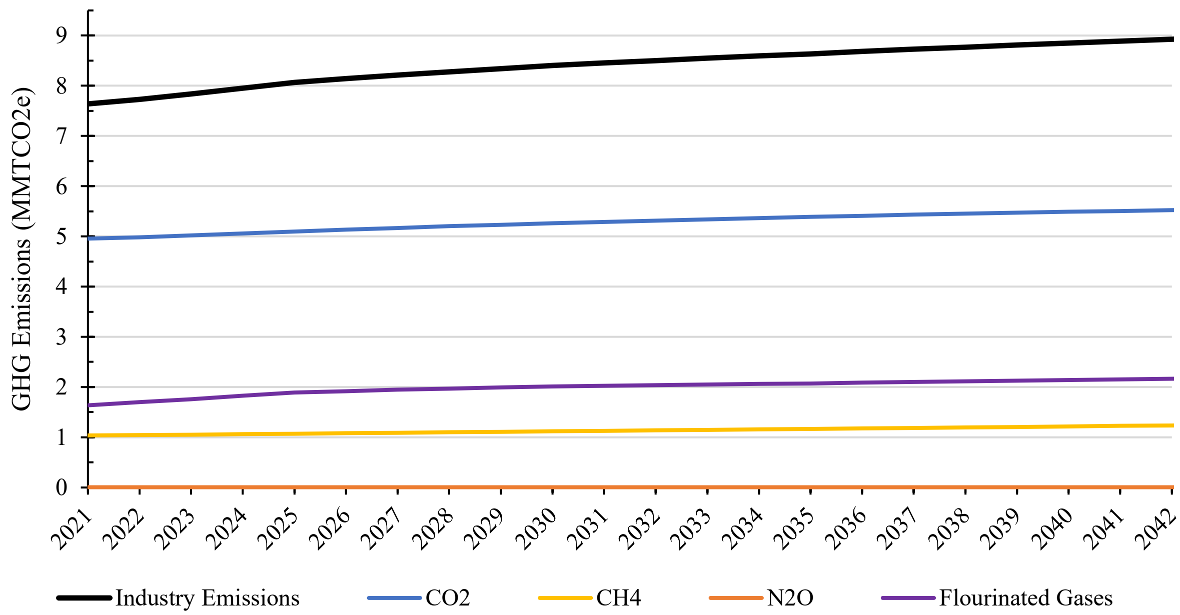
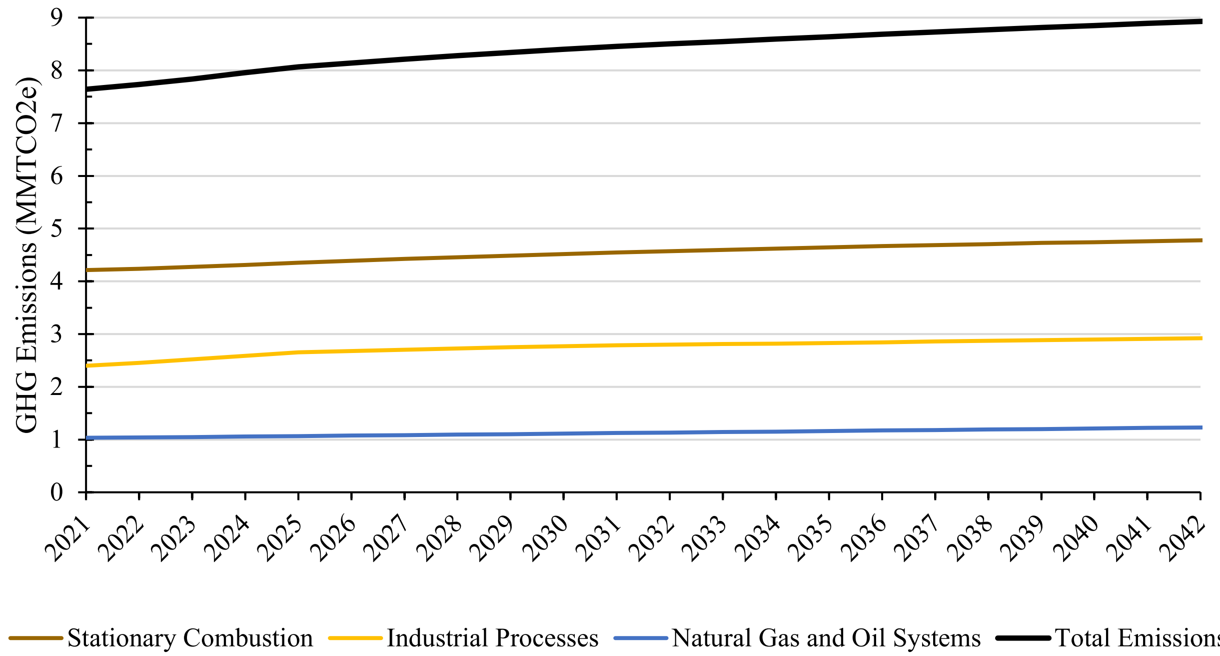


Figure 5-11: Industry GHG Emissions Projections in Nevada by Sub-Sector, 2021-2042



Statement of Policies that Could Achieve Reductions in Projected Greenhouse Gas Emissions by Sector

As required by NRS 445B.380, this section identifies policy options organized by sector that could achieve reductions in projected GHGs. NDEP coordinated with the Nevada Governor's Office of Energy (GOE), Public Utilities Commission of Nevada (PUCN), Nevada Department of Transportation (NDOT), and the Nevada Department of Motor Vehicles (DMV) in identifying these policies. NDEP also reviewed policies adopted or under consideration by U.S. Climate Alliance (USCA) states included in the USCA 2022 Annual Report.[59]

It is important to note that this is not a list of recommendations. Individual policies listed herein need further evaluation to determine whether additional planning, legal review, economic impact and cost-benefit analyses, regulation, and/or legislation may be required prior to implementation. As provided for in the *2020 State Climate Strategy*,[60] important metrics for policy evaluation include GHG emission reduction potential, climate justice considerations, budgetary and economic implications, and implementation feasibility.

Policies are not listed in order of priority or feasibility. Some policies will directly reduce GHG emissions; other policies, programs, and investments listed may provide indirect GHG emission reduction benefits by supporting those policies that directly reduce emissions.

6.1 Economy-Wide Policies

In addition to the sector-specific policies, comprehensive economy-wide programs need further evaluation to determine what may be appropriate for Nevada's GHG emissions profile.

Implement Market-Based Mechanisms

Carbon pricing mechanisms have been effectively implemented across the U.S., both regionally and/or at the state level, to reduce GHG emissions while providing resources to support climate mitigation and adaptation programs. Various models have been designed and implemented in other states and regions, and these options can be explored for determining which market-based mechanism(s) may work best for Nevada.

Integrate Social Cost of GHG Emissions in Planning

The social cost of greenhouse gases (SC-GHG) can be used in planning efforts (such as regional transportation and land use planning) to provide a monetary value for SC-GHG emissions that result from a particular action taken by an agency, including projects, programs, or policies. SC-GHG is the monetary value of the net harm to society associated with adding an amount of GHG emissions to the atmosphere in a given year. Or conversely, SC-GHG can be viewed as the net benefit to society associated with removing/avoiding a set amount of GHG emissions in a given year. In principle, it includes the value of all climate change impacts, including, but not limited to, changes in net agricultural productivity, property damage from increased floods, wildfires, other natural disaster risks, disruption of energy systems, risks

[59] U.S. Climate Alliance. 2022 Annual Report. [accessed 2022 Nov 17]. http://www.usclimatealliance.org/annual-report

[60] https://climateaction.nv.gov/our-strategy/

of conflict, environmental migration, and ecosystem services. SC-GHG emissions in Nevada should reflect the societal value of reducing GHG emissions by one metric ton of CO_2 equivalent emissions.

6.2 Governance

Adopt Lead-by-Example Programs for State and Local Governments

State agencies can demonstrate leadership in reducing GHG emissions within their activities and operations. Options for these programs range from sector-specific reductions across state executive branch agencies (examples include state-owned building efficiency and fleet electrification), to agency-specific actions and planning initiatives. Lead-by-example program options include:

- Adopt a coordinated, interagency economy-of-scale procurement program for state, county, municipalities, and school district fleets to support low and zero emission vehicle (LEV and ZEV, respectively) acquisitions that achieve a reduction in individual unit costs.
- Require climate mitigation goals, resilience to impacts of climate change, environmental justice, or other climate policies to be considered in all State planning.
- Require consideration of climate mitigation goals, resilience to impacts of climate change, and SC-GHG emissions (including consideration of environmental justice) in all state funded capital investments.
- Implement "buy clean" procurement policies for State agencies that establish maximum allowable global warming potential thresholds for certain construction materials.

Establish A Clean Energy Workforce Development Program

Increase training and education around employment and business recruitment opportunities, climate action policies, and new energy efficiency technologies to equip the next generation workforce with the skills and knowledge needed to reach the statewide GHG emissions reduction goals.

Establish State Climate Governance Structure Centered on Equity, Environmental Justice, and Economic Recovery

While this would not directly mitigate GHG emissions, coordination across the Executive Branch and throughout the state is imperative to optimize investments in mitigation policy and support the resilience of communities and natural resources. Many states have adopted novel governance models that also integrate equity, environmental justice, and economic recovery[61].

6.3 Transportation

POLICY ENACTED: Adopt Light Duty Vehicle Emissions Standards

In 2021, Nevada adopted California light-duty vehicle emission standards, established though a waiver application allowable under Section 177 of the Clean Air Act (CAA), for model year 2025 and later new motor vehicles and new motor vehicle engines produced and delivered for sale in the State. In total, 15 states including Nevada have adopted ZEV standards and 17 states including Nevada have adopted LEV standards. These new Nevada requirements include:

[61] See for instance, Oregon Global Warming Commission, https://www.keeporegoncool.org/tighger, and New Mexico's Climate Change Task Force, https://www.climateaction.nm.gov/who-we-are/.

- Low Emission Vehicle (LEV) standards that set vehicle manufacturer GHG and criteria pollutant emissions standards for new passenger cars and light-duty trucks; and
- Zero Emission Vehicle (ZEV) standard that creates a credit-based program for vehicle manufacturers that requires an increasing percentage of ZEVs.

Adopt Next Generation Vehicle Emission Standards

- Evaluate adoption of the California Air Resources Board Advanced Clean Cars II (ACC II) regulation, which establishes a credit-based program with the goal of 100% of all new light-duty vehicles be electric or plug-in hybrid electric by 2035.

  NDEP and DMV have proposed an initial agency draft regulation for adoption of ACC II regulations[62], and may consider further evaluation in parallel with other Clean Air Act (CAA) Section 177 states. Adoption and achievement of these more aggressive standards may require additional support to ensure access to ZEVs and charging infrastructure.

- Adopt California's Advanced Clean Truck Program to reduce engine emissions and increase electrification of medium- and heavy-duty vehicles. The Program requires manufacturers of vehicles of weight Classes 2b through 8 to sell zero-emission trucks as an increasing percentage of their total sales from model year 2024 to model year 2035.

Adopt Low-Carbon Fuel Standards

Low-Carbon Fuel Standards (LCFS) are a way to establish a requirement for a reduction in the carbon intensity of fuels over a given timeframe for a given sector of the market. LCFS can be fuel- and technology-neutral and assess the lifecycle carbon emissions of fuels. States have employed different approaches that could be considered in Nevada, including:

- Require a 20% carbon reduction in transportation fuels by the year 2030.
- Adopt rules requiring a 10% reduction in carbon intensity of transportation fuels over a 10-year period.
- Reduce lifecycle energy GHG emissions by 10% below 2010 levels by 2025.

Implement State Car Allowance Rebate System ("Cash for Clunkers")

Adopt a program similar to the federal Car Allowance Rebate System, colloquially known as "cash for clunkers" enacted under the 2008 American Recovery and Reinvestment Act, that provides financial incentives for vehicle owners to trade in older, less fuel-efficient vehicles and replace them with new low or zero emission vehicles.

[62] https://www.leg.state.nv.us/Register/2022Register/R154-22P.pdf

POLICY ENACTED: Close Emissions Inspection Loopholes for Classic Cars License Plates

In 2021, the Nevada Legislature adopted AB 349,[63] changing the special license plate program. The legislation, beginning in 2023, requires all vehicles in the program to obtain special insurance in order to obtain and retain their classic rod or classic vehicle license plate. Vehicles in the program cannot be driven for general transportation purposes or exceed 5,000 miles during the immediately preceding year, or vehicles will be subject to emission control testing requirements similar to other vehicles in Nevada.

Reduce Vehicle Miles Traveled (VMT) and Expand Mass Transit

A number of options exist to expand the use of non-single-occupant vehicle trips, including, but not limited to, carpooling, transit, micro-transit bicycling, and walking. A strategy could be adopted to further assess and reduce VMT in Nevada. Options to be considered include:

- Expand regional transit services through increases in trip frequency, service areas, and improved reliability while also providing greater incentives to increase transit service use.
- Adopt a statewide transportation demand management program for large employers, requiring employers to actively participate in minimizing vehicle trips created by their business.
- Adopt pricing strategies such as increasing fuel taxes to reduce single-occupant vehicle usage/driving of personal vehicles.
- Adopt parking pricing strategies such as implementing parking charges for parking lots of a certain size in select communities, while providing lower parking costs for carpools and vanpools to encourage the use of these services.
- Adopt a statewide parking policy or policy limited to larger counties that eliminates or precludes minimum parking requirements and discourages single-occupant vehicle use and encourages the use of carpools, vanpools, and other modes of high-occupancy vehicle travel.
- Adopt land use policies that discourage more-impactful development and encourage less-impactful development, such as transportation impact fees based on projected increases/decreases in VMT and supports mixed use, high density, and/or infill development.
- Evaluate a requirement for high-occupancy vehicle lanes, rather than general purpose lanes, for any proposed highway expansion.

6.3.1 Complex Climate Challenges: Transportation Transformation

The transportation sector is currently Nevada's greatest source of GHG emissions. A two-pronged approach to reduce transportation demand, particularly in urban areas, while significantly increasing the percentage of low- and zero-emissions vehicles on Nevada roads can dramatically reduce transportation-related GHG emissions while advancing the State's economic recovery and rebuilding post-COVID. There are also tangible benefits to the health and safety of Nevadans as air quality would be improved as tailpipe emissions are reduced.

Achieving Nevada's net-zero GHG emissions by 2050 goal will require major changes to the State's transportation system, as well as shifts in travel patterns and personal transportation choices. This in turn will require various degrees of buy-in across Nevada's urban and rural communities. Ameliorating GHG emissions will also necessitate a more-strategic approach to Nevada's investment in transportation

[63] https://www.leg.state.nv.us/App/NELIS/REL/81st2021/Bill/7897/Overview

infrastructure that includes consideration of the multiple cascading impacts of climate change. Other states are already navigating these issues and succeeding in building modern, low-emissions, climate-resilient transportation systems while accelerating consumer adoption of clean vehicles and alternative transportation options.

Transportation has a significant environmental impact and contributes to climate change beyond the direct impact of GHG emissions from internal combustion engines. This comes in the form of tire dust, urban heat island impacts resulting from expansive parking lots, and more. Further, as seen during the early days of the COVID-19 pandemic, reducing the total volume of miles driven on a daily basis has an impact on emissions and can help in achieving GHG reduction goals.

To date, the State of Nevada has invested $705,217 in GOE Renewable Energy funds and $3,470,085 in VW Settlement funds toward electric vehicle charging infrastructure along Nevada's five major corridors (I-80, I-15, US 50, US 93, and US 95). Further, NDOT is slated to receive an additional $38 million for electric vehicle charging infrastructure from the Infrastructure Investment and Jobs Act.

Additional programs and initiatives should be explored to support widespread adoption of Nevada's new clear car standards and to support further transportation electrification efforts. These include:

- Provide outreach and education on the benefits of ZEV ownership and the positive health outcomes of transportation electrification.
- Promote existing and evaluate additional ZEV incentives and rebate programs.
- Support electric utility electric vehicle infrastructure planning.
- Review and determine potential changes to electric rate structure to support more ZEV deployment.
- Improve infrastructure in homes and businesses to facilitate the transition to ZEVs.
- Support installation of charging infrastructure in existing facilities.
- Require inclusion of EV charging infrastructure in new residential, commercial, and industrial settings.
- Establish a planning process to develop robust ZEV infrastructure for all vehicle types across a broad set of stakeholders, including:
    - A ZEV infrastructure planning process developed and implemented by an electric utility or rural electric cooperative;
    - Incentivize and increase the development of workplace charging infrastructure for electric vehicles at existing commercial and industrial facilities;
    - Incentivize and increase the development of charging infrastructure for electric vehicles for all types of existing residences, including those in underserved and rural areas;
    - Incentivize and increase electric vehicle readiness for the new built environment by facilitating the addition of charging infrastructure for electric vehicles in new residential, commercial, and industrial settings;
    - Support increased development of electric vehicle charging infrastructure at state, county, and local government buildings; and
    - Incentivize and encourage the purchase of ZEV's that will utilize this infrastructure.
- Promote awareness and utilization of existing ZEV incentive and rebate programs.

6.4 Electricity Generation

Adopt a Mandatory Renewable Portfolio Standard (RPS) of 100% By or Before 2050

In 2019, the Nevada Legislature passed SB 358, which requires that by 2030, 50% of electricity sold to the State must come from renewable sources. SB 358 also declares that it is State policy to become a leading producer and consumer of clean and renewable energy, with the 2050 goal of all energy sold by providers of electric service to come from renewable sources.

- Provide support to customers willing to invest in additional incremental renewable energy and/or energy storage resources to ensure they receive electric service from 100% renewable energy resources each hour.

Transition from Fossil Fuel-Fired Electricity Generation to Clean Energy Sources

- Enact a freeze on the approval or construction of any new fossil fuel-fired electricity generating sources.
- Accelerate retirement of remaining coal-fired electric generating units (EGUs) operating in Nevada, including merchant and load-serving plants.

Require GHG Reduction Plans and Prioritize Decarbonization in Utility Integrated Resource Plans

- Move towards EGUs that have lower carbon intensity as placeholders in integrated resource plan (IRP) proceedings to ensure that IRPs consider GHG emission goals. This will improve the accuracy of future projections of GHG emissions and can occur in the absence of new legislation.
- Prioritize decarbonization in IRP proceedings as part of, or in addition to, the low-carbon base case.

Prioritize Energy Efficiency and Demand Response Programs

- Prioritize demand-side management programs that reduce electricity usage during periods of time when renewable generating facilities cannot be relied upon (when the sun is not shining, for example).
- Prioritize demand-response programs that shift load to periods of time when renewable resources can be relied upon to serve the load.
- Provide incentives for the purchase of distributed energy storage at homes and business.
- NEW Prioritize utility-scale energy/battery storage programs to support peak-energy demand.

6.4.1 Complex Climate Challenges: Transmission Planning and Grid Modernization

Power-sector issues extend beyond Nevada’s borders. As Nevada is also geographically located between large urban and economic centers across the West, it serves as a transmission “hub” that plays a critical role in the delivery of electricity for the region. Consequently, transmission and distribution grid planning and modernization is a West-wide effort and the influence of climate change across these western states must be considered in managing both current and future supply and demand.

Support Efforts to Clean and Modernize the Electricity Grid
Modernizing and upgrading the grid is essential to strengthening the transition of electricity systems while supporting increasing demands posed by transportation and building electrification, resilience of climate impacts of extreme weather, and operating on 100% renewable resources.

The system must be optimized for a changing supply and demand profile with technologies that provide the flexibility and optimization, without undue strain on the grid, to integrate increasing distributed energy resources, renewable energy resources, and electric vehicles. It must also be capable of serving as a platform to allow flexibility and the integration of non-wire solutions such as demand- and supply-side software and hardware resources; and ensure the grid is optimized for additional opportunities to reduce GHG emissions. The policies listed below may provide indirect GHG emission reduction benefits by supporting policies that directly reduce emissions.

- **Strengthen Grid Resilience**

Provide for the analysis of and/or initiatives to support a modernized grid resilient to future disruptive events, including natural disasters and climate change driven extreme weather, while ensuring that Nevada continues to rate high on the grid modernization index.

In 2019, the Nevada Legislature adopted SB 329, requiring electric utilities to triennially submit a Natural Disaster Protection Plan (NDPP) to the PUCN (NRS 704.7983). The NDPP must identify service territory areas subject to a heightened threat of a fire or other natural disasters, propose and describe cost-effective protocols in mitigating wildfire or other natural disasters, and describe procedures in restoring the distribution system in the event of a natural disaster.

- **Join a Regional Energy Market**

Evaluate regional markets as new tools to integrate more renewables into the grid to realize more renewable efficiency gains.

In 2021, the Nevada Legislature adopted SB 448, which includes a requirement that the PUCN require transmission providers to join a regional transmission organization by January 1, 2030 (NRS 704.79886). Transmission providers are granted the ability to apply to waive or delay this requirement. An RTO enables automated procurement and dispatch in real time to serve regional demand using least-cost resources and can be used to integrate more renewables into the grid to realize more renewable efficiency gains.

6.5 Residential and Commercial

Adopt Energy Codes for Net-Zero Buildings
Bolstering energy codes is a key step towards achieving net-zero buildings. In July 2021, Nevada adopted the 2021 International Energy Conservation Code (IECC) and included additional guidance for "electric vehicle-ready" codes should municipalities choose to integrate them into their codes. Additional steps that can be taken include:

- Adopt a stretch code that improves energy efficiency in new construction by 20% above the currently adopted IECC.

- Assist state, county, and municipal government agencies with the adoption, implementation, and compliance with the most recently published IECC on a three-year cycle.
- Support the renovation of existing homes and businesses to reduce their energy demand and make their homes more energy efficient.
- Require all new affordable housing developments to operationally invest in net-zero GHG emissions and support retrofit of affordable housing for rooftop solar, on-site energy storage, vehicle charging, and heat pumps.
- Use low-carbon materials in new construction and retrofits, and reuse materials and structures where possible, to reduce embodied GHG emissions.
- Establish a comprehensive on-site energy efficiency program that can be utilized by residential, commercial, and public-sector buildings to increase energy efficiency. The program should include occupant engagement and provide techniques for the occupants to increase efficiencies throughout the space.

Transition from Residential and Commercial Use of Gas

Planning for the transition from fossil fuels in buildings should consider the following options:

- Provide support for the conversion of fossil fuel-dependent appliances to renewable energy-sourced electric alternatives such as stoves, water heaters, and furnaces.
- Provide support to increase renewable energy-sourced electrification of the built environment for new construction as well as for existing buildings, both residential and commercial, to switch from fossil fuels to all electric.
- Evaluate a freeze or limitation on the installation of gas lines to newly constructed homes and businesses.
- Establish "electric ready" requirements for homes to support EV charging, electric appliances, and on-site solar and battery storage.
- Consider the role of low-carbon fuels in communities that face challenges in electrification.

Implement a Statewide Benchmarking Program

Energy benchmarking is a continuous process of analyzing the current performance of a building and comparing it to a standard baseline to determine progress toward energy and water efficiency targets. The Energy Star program can be used to track water and energy consumption within the built environment. Within a year of program implementation, a benchmark is established and the energy efficiency measures identified through an energy audit are prioritized and implemented to reach specific goals. The program, available to public and private buildings, provides a challenge and reward mechanism for buildings that participate and achieve the GHG emissions reduction goals set forth within the program.

Require Residential Energy Labeling and Energy Audits

Such audits would require an energy audit be performed and provided to buyers during the purchase of a residence, similar to an appraisal or home inspection. The audit provides potential owners the opportunity to negotiate implementing energy audit measures before closing occurs. This will increase awareness of efficiency measures available to the buyer along with the cost/benefit of implementing the measures to allow further insight into total home ownership costs. Other similar consideration could include:

- Adopt disclosure documents for potential property purchasers or renters to include overall estimated cost of operating the home or business to include energy and transportation costs (similar to what is currently provided with new appliances).

POLICY ENACTED: Adopt Appliance and Equipment Efficiency Standards
In 2021, the Nevada Legislature passed AB 383,[64] requiring GOE to adopt appliance efficiency standards through regulation for certain appliances sold in this State. On and after July 1, 2023, new regulated appliances may not be sold, leased, or rented in Nevada unless it meets or exceeds the minimum standards of energy efficiency established by GOE. On December 14, 2022, GOE approved a regulation to establish appliance efficiency standards. The regulation requires additional review and approval by the Legislative Commission prior to becoming effective.

Expand the Property-Assessed Clean Energy (PACE) Program
An evaluation of the effectiveness of adopting a statewide residential PACE program should be conducted to determine the scope of expansion of the program.

Expand Energy Savings Performance Contracting
Utilize energy saving performance contracting to identify opportunities for energy conservation measures and implement measures with the largest effect on reducing GHGs. Performance contracting is well suited for large commercial buildings as well as state-, county-, and city-owned or -leased buildings.

Explore Opportunities to Fund Investments in Clean Energy

- Establish a revolving loan fund to be utilized by state and local government to improve the energy-efficiency of existing government building stock. Loan funds could be repaid through the realized energy savings which could be collected back into the account and used to further energy-efficiency measures across the existing building stock.
- Provide enhanced support through the Nevada Clean Energy Fund for implementation of renewable energy, energy storage systems, and energy-efficiency measures in residential and commercial structures.
- Establish a loan program with local credit unions to offer low-cost, long-term financing for energy efficiency and renewable energy improvements for residential properties.
- Collaborate with utility companies, local municipalities, and rural cooperatives to utilize on-bill financing for energy-efficiency improvements in both residential and commercial properties.

6.5.1 Complex Climate Challenges: Green Buildings and Land Use

Net-zero or low-carbon buildings is a nationwide conversation focused on increased efficiency in the built environment, reducing GHG emissions, and improving the performance of existing and future building stock. Increased efficiency in the built environment is recognized globally as a necessary step to aid in reducing GHG emissions while achieving significant cost savings for building owners/occupants. ***Without a comprehensive suite of policies that dramatically increase the efficiency of both existing and new buildings in Nevada, the State will not reach the net-zero emissions goal by 2050.***

[64] https://www.leg.state.nv.us/App/NELIS/REL/81st2021/Bill/7985/Overview

Policy options to optimize efficiency include building performance standards, beneficial electrification, alternative financing for the low- and moderate-income (LMI) communities, and education surrounding green building practices. However, the State has limited authority when it comes implementing building efficiency policies. Much of the responsibility along with enforcement is executed and handled by local governments or authorities having jurisdiction.

Land-use decisions should consider evolving and emerging climate impacts. As Nevada grows and urban areas in particular expand to meet the demands of a growing population, communities and infrastructure will be increasingly exposed to climate-driven natural hazards. Beyond wildfire, for example, flooding also poses a risk. Both Reno and Las Vegas already experience urban flooding and are particularly vulnerable to increases in the frequency and size of flood events as the climate warms. When communities prioritize infill and smart growth instead of sprawl to meet new demands, significant GHG emission reductions can be achieved as well as limiting increases in the urban "heat island" effect.

6.6 Industry

Policies focused on increasing the energy efficiency of commercial buildings and renewable power generation will support reduction of GHG emissions in the industrial sector. Additional strategies tailored to industry should:

- Support the implementation of energy efficient technologies and practices; including more efficient ways to light and heat industrial facilities and run equipment.
- Implement more stringent controls to capture and prevent the release of industrial process emissions.
- Support fuel switching to less carbon intense fuels for stationary combustion sources.

Adopt "Buy Clean" Standards

These are regulations and procurement policies that create maximum allowable global warming potential (GWP) thresholds for certain construction materials (e.g., low-carbon concrete). This can be coupled with programs that promote the production of industrial products from recycled or renewable materials, rather than producing new products from raw materials.

Reduce, Capture, and Recycle Ozone-Depleting Substance Substitutes including Hydrofluorocarbons (HFCs)

The AIM Act of 2021, directs EPA to phase down production and consumption of HFCs by 85% over the next 15 years and support transition to alternatives. On October 5, 2021, EPA issued the first regulation under the Act, which establishes baseline levels, an initial methodology for allocating and trading HFC allowances for 2022 and 2023, and creates a compliance and enforcement system. State policies supporting these efforts could include:

- Evaluate replacement, capture, and recycling (or other measures) that reduce the usage of ozone-depleting substance (ODS) substitutes above threshold amounts.
- Adopt regulations requiring tracking, reporting, and reducing the use of HFCs.
- Enact building codes that require the use of low-GWP refrigerants.

- Establish a GWP limit for new and existing industrial equipment, including stationary refrigeration, and air conditioning.

Adopt More Stringent Controls on Emissions from Oil and Natural Gas Exploration, Production, Transmission, and Distribution Systems

Different strategies are being implemented by states to reduce methane emissions from the oil and gas sectors. These include:

- Ban routine natural gas flaring and venting and reduce fugitive methane emissions from both new and existing facilities, requiring new detection, testing, repair, reporting, and recordkeeping requirements.
- Require oil and gas operators to capture natural gas waste.
- Incorporate environmental justice as a consideration in facility siting.
- Adopt a clean heat standard, a policy establishing GHG reduction targets for gas distribution utilities. The standard would direct utilities to develop cost-effective plans toward meaningful reductions in emissions resulting from delivering fuel to homes and businesses.

6.7 Waste

Utilize Biogas Recovered from Landfills and Wastewater Treatment Facilities for Transportation

Promote the use of biogas recovered from landfills and wastewater treatment facilities for transportation needs, rather than for electricity generation, where renewable alternatives for electricity generation are already present or can be adopted.

Food Waste and Landfill Sustainability Practices to Reduce Methane Emissions

- Utilize Landfill Methane Outreach Program data to identify active and retired landfills.
- Adopt practices that reduce waste production and increase diversion of organic waste.
- Support construction of anaerobic digesters and landfill-gas-to-energy (LFGTE) practices of captured methane (CH_4) emissions.

Expand Efforts to Convert Fugitive Methane (CH_4) Emissions to CO_2

- Provide incentives for flaring and LFGTE practices in solid waste landfills and wastewater treatment plants.

6.8 Land Use, Land Use Change, and Forestry

Decrease Risk of Catastrophic Wildfire Events

Promote and implement land management practices that decrease the risk of catastrophic wildfire events. Such efforts must include comprehensive planning to create more resilient landscapes to prevent wildland fires, and during restoration efforts after fire events.

<u>Expand Urban Forestry Programs</u>

- Adopt requirements for increased tree coverage when constructing residences and commercial buildings to increase canopy coverage that also reduce urban heat-island. Strictly enforced requirements will help reduce the urban heat island effect as a driver of record setting temperature increases in Las Vegas and Reno.
- Support urban reforestation and management to ensure appropriate investments in landscaping and shade trees that are climate appropriate and consider water supply and other parameters.

Although the carbon sequestration opportunities of the vast majority of Nevada's landscapes are uncertain, the broader ecosystem service benefits of conserving natural lands and ensuring appropriate, smart development can support rebalancing of the climate system and resilience of natural resources. Strategies include:

- Refine understanding of the carbon sequestration potential of natural and working lands. The Nevada Division of Natural Heritage has contracted with the Desert Research Institute to conduct a review of carbon flux potential for natural and working lands in Nevada in a report targeted for completion in 2023.
- Establish and prioritize state land conservation goals.
- Promote land management practices that increase carbon sequestration by natural lands that are typical and/or native to Nevada.
- Expand specific programs (nursery programs, for example) to restore and enhance habitats, including important wetland habitats.
- Expand existing efforts to protect sagebrush habitat through the use of the Sage Grouse Protection Conservation Credit System to include carbon sequestration co-benefits.
- Enhance targeted forest biomass utilization with stringent emissions controls. Targeted programs, like in Lake Tahoe, include co-benefits such as reducing wildfire risk and managing invasives.

6.9 Agriculture

Although the carbon sequestration and land management opportunities of the vast majority of Nevada's landscapes are uncertain, best practices in land management provide opportunities to ensure carbon sequestration potential is optimized on Nevada's working lands. Strategies include:

- Establish and promote a statewide healthy soils program.
- Support opportunities to sequester carbon through land restoration and retirement, thereby removing highly erodible or environmentally sensitive land from agricultural production.
- Promote "no-till" and "low-till" farmland management practices to protect soil from erosion.
- Promote hedgerow, windbreaks, and shelterbelts best practices to protect soil from erosion.
- Promote and provide incentives for the adoption of silvopasture practices.
- Promote practices to reduce emissions from enteric fermentation.
- Promote manure and nitrogen fertilizer management practices.

6.10 Policies Enacted

In addition to being included in each of the sectors above, the table below includes a summary of policies included in past inventories that have been completed. Based on available information, NDEP included the effect of these policies on GHG emission reduction into the emission projections included in this GHG inventory.

Emission Sector	Name	Description	Lead Agencies
Transportation	Adopt Light-Duty Vehicle Emission Standards	October 2021, Clean Cars Nevada rulemaking sets emission standards for model year 2025 and later light-duty vehicles offered in sale in Nevada starting in 2024	NDEP and DMV
	Close Classic Car Emission Loophole	June 2021, AB 349 requires insurance coverage for vehicles with “Classic Car” and “Classic Rod” license plates	DMV
Residential and Commercial	Adopt Appliance and Equipment Efficiency Standards	June 2021, AB 383 requires adoption of regulations for energy efficiency of certain appliances. December 2022, GOE approves a regulation to establish appliance efficiency standards. The regulation requires additional review and approval by the Legislative Commission prior to becoming effective.	GOE

Appendix A: Methodology

Introduction

This Appendix includes the description of the methodologies used to estimate historical and projected emissions for the Sectors included in this Report.

Transportation

Historical Emissions

Transportation sector GHG emissions are the result of fossil fuel combustion and, to a much lesser extent, the byproducts (CH_4 and N_2O) of fossil fuel combustion. Historical emissions are quantified using SEDS data and one SIT module. Fuel consumption estimates provided by SEDS are used to estimate historical CO_2 emissions from the combustion of fossil fuels. CO_2 emissions are the direct result of the combustion of fuel and are determined by analyzing the type and quantity of fuel combusted. Emissions from fossil fuel combustion also include all of the carbon in fuels that are either immediately oxidized or are oxidized within a period of less than 20 years. That means that in addition to CO_2, estimates include gases like carbon monoxide (CO) and short-lived compounds that decompose quickly.

The *CH_4 and N_2O Emissions from Mobile Combustion* module estimates CH_4 and N_2O emissions (the byproducts of fossil fuel consumption) by applying emission factors to individual vehicle control technologies that exist on certain model years of certain vehicle/equipment types. The module then estimates vehicle/equipment Vehicle Miles Travelled (VMT)/usage and allocates VMT/usage across an estimated age distribution for each of the types of vehicle/equipment. As there is currently no better estimate of statewide VMT for all highway vehicles in Nevada[65], this report uses the default VMT estimates used in the *CH_4 and N_2O Emissions from Mobile Combustion* module.[66] These estimates are based on national averages prepared by the Federal Highway Administration (FHWA) in their *Highway Statistics* series[67] and utilize EPA's mobile emissions inventory guidance.

CH_4 emissions are influenced by fuel composition, combustion conditions, and control technologies. Depending on the control technologies used, CH_4 emissions may also result from hydrocarbons passing uncombusted or partially combusted through the engine and can then be affected by any post-combustion control of hydrocarbon emissions, such as catalytic converters. For highway vehicles, conditions favoring high CH_4 emissions include aggressive driving, low speed operation, vehicle idling, and cold weather

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[65] Assembly Bill 483 of the 2019 Nevada Legislative Session directed the Nevada Department of Motor Vehicle to conduct a pilot program to gather and report data on annual VMT from all vehicles registered in Nevada, with few exceptions. Once there is historical fuel consumption data reported for the same time period as the mileage reports, NDEP may be able to refine CH_4 and N_2O emissions estimates for the state.

[66] Improved estimates of VMT in Nevada, in addition to accurate vehicle registration information, would be necessary to improve emissions estimates. Additionally, the *CH_4 and N_2O Emissions from Mobile Combustion* module includes a method for estimating CO_2 emissions using a similar method. Analyzing the potential impact of policies affecting highway vehicles registered or sold in Nevada would likely depend on this module and the improved data necessary for it to be accurately run.

[67] Policy and Governmental Affairs: Office of Highway Policy Information Highway Statistics Series. U.S. Department of Transportation, Federal Highway Administration. [accessed 2021 Oct 25]. https://www.fhwa.dot.gov/policyinformation/statistics.cfm

operation. Minimum amounts of CH_4 emissions are achieved when hydrogen, carbon, and oxygen are present in the ideal combination for complete combustion.

N_2O formulation in internal combustion engines is not yet well understood, and data on these emissions are limited. It is understood that N_2O emissions form via two distinct processes: (1) cold temperature starts of vehicles equipped with catalytic converters; as the catalyst in a catalytic converter heats up, N_2O levels decrease. (2) N_2O is formed when nitrogen oxide (NO) interacts with combustion intermediates such as imidogen (NH) and cyanate (NCO). Only small amounts of N_2O are produced as engine-out emissions. N_2O from highway vehicles are primarily formed by the first process.

Projections

CO_2 emissions for the transportation sector are projected using the AEO's Reference case and, when appropriate, alternative statistical methods that consider Nevada-specific historical consumption provided by SEDS. Because the AEO aggregates projected fuel consumption at the regional level,[68] significant discrepancies at the state level between historical and future consumption can sometimes occur. CH_4 and N_2O emissions are projected using a linear trend of historical emissions.

Electricity Generation

Historical Emissions

Electricity generation sector GHG emissions are the result of fossil fuel combustion and (to a much lesser extent) the byproducts (CH_4 and N_2O) of fossil fuel combustion. Historical emissions for all three GHGs are quantified using fuel consumption estimates included in the SEDS data. For CO_2, emissions are the direct result of the combustion of fuel and are determined by analyzing the type and quantity of fuel combusted. CO_2 emissions from fossil fuel combustion also include all of the carbon in fuels that are either immediately oxidized or are oxidized within a period of less than 20 years. That means that in addition to CO_2, it includes gases like CO and short-lived compounds that decompose quickly.

Estimates for CH_4 and N_2O emissions (the byproducts of fossil fuel consumption) are determined by applying emission factors for the individual fuel types (such as coal, distillate fuel/petroleum, and natural gas) to annual fuel consumption (provided by the EIA). CH_4 and N_2O emissions vary with the type of fuel burned, the size and age of the combustion technology, the maintenance and operating conditions of the combustion equipment, and the types of pollution control technologies installed.

CH_4 emissions are generally the product of incomplete combustion. More are released when combustion temperatures are relatively low. Larger, higher efficiency EGUs tend to reach and sustain higher temperatures and are thus less likely to emit CH_4. Emissions can range well above the average for EGUs that are improperly maintained or poorly operated. Similarly, during start-up periods, combustion efficiency is lowest, causing emissions to be higher than periods of standard operation. N_2O is produced from the combustion of fuels and emissions are dependent on the combustion temperature. The highest N_2O emissions occur at a combustion temperature of 1,340 degrees Fahrenheit (1,000 degrees Kelvin)

[68] Nevada is in the "Mountain" region. The "Mountain" region includes Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming.

while N_2O emissions are negligible for combustion temperatures below 980 or above 1,700 degrees Fahrenheit (below 980 and above 1,200 degrees Kelvin).

Projections

Projected emissions in the sector are determined using state and power plant level data. The EIA's AEO does not consider the most recent IRPs filed by the utilities considered in this report and the region level projections provided by the AEO are not easily disaggregated to the state level for this sector. CO_2 emissions from coal- and natural gas-fired EGUs are projected using a method developed by NDEP that depends on historical, unit-level electricity generation and emissions data as well as the existing policies and regulations affecting the future of those units.[69,70] Information was gathered from the following sources:

- EIA Form 923[71] and EIA Form 860[72] for unit level net generation, fuel consumption, reported retirements, and nameplate capacity;
- EPA Air Markets Program Data (AMPD)[73] and the Emissions and Generation Resource Integrated Database (eGRID)[74] for CO_2 emissions, gross generation, heat input, and EGU nameplate capacity;
- NV Energy's 2019-2038 IRP[75] submitted to the PUCN for sales projections, power purchase agreements, supply side plans, and reported remaining useful lives of their fossil fuel-fired fleet[76];
- Idaho Power's 2019 IRP[77] for information on North Valmy Generating Station[78]; and
- The updated RPS specified in NRS 704.7821.

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[69] CH_4 and N_2O emissions are projected by considering projected CO_2 emissions against the historical CO_2, CH_4, and N_2O emissions.
[70] CO_2 emissions associated with the combustion of petroleum products was projected using a linear trend of 2015 through 2019 historical emissions. Petroleum-based CO_2 emissions accounted for less than 0.08% of sector emissions in 2019.
[71] Form EIA-923. U.S. Energy Information Administration. [accessed 2022 Nov 22]. https://www.eia.gov/electricity/data/eia923/
[72] Form EIA-860. U.S. Energy Information Administration. [accessed 2022 Nov 22]. https://www.eia.gov/electricity/data/eia860/
[73] Air Markets Program Data. U.S. Environmental Protection Agency. [accessed 2022 Nov 22]. https://campd.epa.gov/
[74] Emissions and Generation Resource Integrated Database. U.S. Environmental Protection Agency; 2021 Feb 23. [accessed 2021 Oct 13]. https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid
[75] Nevada Power Company d/b/a NV Energy and Sierra Pacific Power Company d/b/a NV Energy. Joint 2022-2041 Integrated Resource Plan, for the three year Action Plan period 2022-2024, and the Energy Supply Plan period 2022-2024. Public Utilities Commission of Nevada. 2021 Jun 1; Docket 21-06001, Amended Filing. [accessed 2021 Oct 13]. http://puc.nv.gov/
[76] In considering retirement dates for Nevada's existing fossil fuel-fired EGUs, the analysis looked at planned retirement dates (as submitted to the EIA), depreciation-based retirement dates (as included in the utility IRP and approved by the PUCN), and the remaining useful life of the EGUs (as determined using an historical average of similarly sized and operated EGUs when the first two options are unavailable).
[77] Idaho Power Company. Idaho Power Integrated Resource Plan 2019 Second Amended. 2020 Oct. [accessed 2021 Oct 13]. https://www.idahopower.com/energy-environment/energy/planning-and-electrical-projects/our-twenty-year-plan/
[78] North Valmy Generating Station is co-owned by NV Energy and Idaho Power.

EIA and EPA data are combined to create a single set of CO_2 emissions and net electricity generation from fossil fuel-fired electricity generators in Nevada. While there is some overlap, not all EGUs operating in Nevada are required to report data in the same way to EIA and EPA, so multiple sources of data need to be compiled in order to get an accurate accounting of emissions and generation. Future emissions and generation are estimated using unit-level averages from the compiled historical dataset. NV Energy's IRP is applied to the dataset and units scheduled for closure are zeroed out from the year following closure.

For EGUs within NV Energy's control, the RPS and NV Energy's base-case sales projections are applied to the projected net generation to find instances where projected generation is greater than projected demand; this is done for both Sierra Pacific Power Company (SPPC) and Nevada Power Company (NPC) projections.[79] When this happens, NDEP simulates fossil fuel peaker and intermediate load units (as identified by NV Energy in their IRP) being curtailed until generation is equal to projected demand by reducing generation from these types of units. Reduced emissions due to the reduced generation are estimated using the utility's average emission rates for SPPC and NPC peaker and intermediate load units. For years when projected demand is greater than projected generation, it is assumed that the wholesale market (that is, generally, electricity generated outside of Nevada) is used to provide coverage.

For EGUs outside of NV Energy's control — apart from TS Power — that is, EGUs owned by Nevada Gold Mines LLC (Western 102), Southern California Public Power Authority (Apex Generating Station), and San Diego Gas and Electric Company (Desert Star Energy Center), no additional steps for projecting emissions beyond the historical average have been taken. For TS Power, it is assumed that the power plant's conversion from a strictly coal-fired facility to a dual fueled, coal- and natural gas-fired facility will be completed by 2023. In the sector-wide projections, it is assumed that TS Power, starting in 2023, operates 50% of the year using coal (January through April and November and December) and 50% of the year using natural gas (May through October). This results in a 17% reduction in facility emissions, or 170,000 metric tons of CO_2 per year.

While this method of projecting emissions may exclude the minor emissions associated with smaller electric generating facilities and some renewable energy providers (for example, geothermal power plants), it currently provides an accurate estimate of electricity generation sector GHG emissions in Nevada through 2040.

Industry

Industry Emissions from Stationary Combustion

Stationary combustion sub-sector GHG emissions are the result of fossil fuel combustion and (to a much lesser extent) the byproducts (CH_4 and N_2O) of fossil fuel combustion. Historical emissions for all three GHGs are quantified using fuel consumption estimates included in the SEDS data. For CO_2, emissions are the direct result of the combustion of fuel and are determined by analyzing the type and quantity of fuel combusted. CO_2 emissions from fossil fuel combustion also include all of the carbon in fuels that are

[79] While NV Energy can now report a single IRP to the PUCN for SPPC and NPC, they provide plans for each of the companies in the single report.

either immediately oxidized or are oxidized within a period of less than 20 years. That means that in addition to CO_2, it includes gases like CO and short-lived compounds that decompose quickly.

Estimates for CH_4 and N_2O emissions (the byproducts of fossil fuel consumption) are determined by applying emission factors for the individual fuel types (such as coal, distillate fuel/petroleum, and natural gas) to annual fuel consumption (provided by the EIA). CH_4 and N_2O emissions vary with the type of fuel burned, the size and age of the combustion technology, the maintenance and operating conditions of the combustion equipment, and the types of pollution control technologies installed. The quantity of fossil fuels used for non-energy consumption in a manner that permanently stores the final product with no emissions into the atmosphere are also considered. The emissions that would be associated with these fossil fuels are considered sequestered emissions and are subtracted from the sub-sector total. Examples include the use of liquified petroleum gas for the production of solvents and synthetic rubber and oil to produce asphalt.

CH_4 emissions are generally the product of incomplete combustion. More are released when combustion temperatures are relatively low. Larger, higher efficiency combustion units tend to reach and sustain higher temperatures and are thus less likely to emit CH_4. Emissions can range well above the average for units that are improperly maintained or poorly operated. Similarly, during start-up periods, combustion efficiency is lowest, causing emissions to be higher than periods of standard operation. N_2O is produced from the combustion of fuels and emissions are dependent on the combustion temperature. The highest N_2O emissions occur at a combustion temperature of 1,340 degrees Fahrenheit (1,000 degrees Kelvin) while N_2O emissions are negligible for combustion temperatures below 980 or above 1,700 degrees Fahrenheit (below 980 and above 1,200 degrees Kelvin).

Stationary combustion GHG emissions are projected using the EIA's AEO and additional assumptions about future fuel consumption when the disaggregated regional AEO fossil fuel consumption data results in inconsistencies with the historical dataset. Fuel consumption estimates are then subjected to the same quantification method as historical fuel consumption.

Industry Emissions from Industrial Processes

Generally, the SIT's *Industrial Processes* module estimates GHG emissions by either (1) considering the amount of a material produced (produced materials in Nevada being cement, lime, limestone, dolomite, and for a short period of time semiconductors) and applying an emission factor to the processes resulting in an estimate of emissions, or (2) by attributing emissions to the usage/consumption of a material (limestone, dolomite, soda ash, urea, ODS substitutes, and electric power transmission and distribution systems), either directly by knowing the quantity of the material used/consumed in the state and applying an emission factor, or indirectly by knowing the amount of the material used/consumed nationally, applying an emission factor, and prorating emissions based on a state's population or, in the case of semiconductor manufacturing, the value of a state's semiconductor shipments.[80]

For production-based industrial process GHG emissions, projections use the post-Great Recession historical average to estimate emissions. For usage/consumption-based industrial process GHG emissions,

[80] ODS substitute emissions, which are quantified by prorating national emissions (which are themselves reported as a blend of multiple HFCs), currently use IPCC Fourth Assessment Report GWPs.

projections first estimate the usage/consumption of the GHG and then apportion emissions based on end-use estimates of the final product. For the use of limestone, dolomite, soda ash and the consumption of urea, historical estimates are projected using a linear trend.

For ODS substitutes and electric power transmission and distribution systems, historical emissions are based on U.S. ODS substitute emissions apportioned to Nevada using national and state population estimates. Projections are based on the EPA's *Global Non-CO_2 Greenhouse Gas Emission Projections and Mitigation: 2015-2050*, released in October 2019. The report includes updated U.S. projections through the year 2050. However, in this report, the model used to project U.S. emissions under existing policy only incorporates transition to low-cost, low-GWP alternative to reflect compliance with rules finalized through the Significant New Alternatives Policy (SNAP) Program. In August of 2017 and April of 2019, the U.S. Court of Appeal for the District of Columbia Circuit vacated SNAP Program Rule 20 and Rule 21, respectively. It is also important to note that ODS substitute emissions projections are currently highly uncertain due to the recently finalized HFC phasedown rule, which is not considered in the projections. The Phasedown of Hydrofluorocarbons: Establishing the Allowance Allocation and Trading Program under the American Innovation and Manufacturing (AIM) Act, which the U.S. Congress directed EPA to prepare in the 2021 Consolidated Appropriations Act, will phase down HFC emissions in the United States by 85% over the next 15 years.[81,82]

Unfortunately, and regardless of the choice of national dataset, the current method of estimating and projecting ODS substitute emissions in Nevada is very likely underestimating emissions. As Nevada's already arid environment is experiencing the effects of climate change sooner and in more significant ways than other parts of the country (leading to a higher frequency of weather extremes, including heatwaves), using national estimates and Nevada's population to apportion emissions is likely leading to underestimates of both ODS substitute usage and the associated emissions. More accurately estimating these emissions will require efforts to further characterize the presence and usage of ODS substitutes in Nevada. Adoption of AB 254 in the 2021 Nevada legislative session authorized the State Environmental Commission to adopt additional regulations necessary to quantify emissions resulting from ODS substitutes and information related to the types, sales, uses and disposal of products and equipment that use ODS substitutes. NDEP expects to evaluate rulemaking in 2023, and more Nevada-specific information on ODS substitute emission projections are anticipated to be available for future inventory reports.

Industry Emissions from Natural Gas and Oil Systems

The *Emissions from Natural Gas and Oil Systems* module estimates emissions from every step of the production through to the delivery of natural gas and oil. Generally, the module considers every activity where the fossil fuel is transferred from one containment vessel to another in the production to delivery process and applies an emission factor associated with leakages that occur during that transference. As an example, for the transmission of natural gas, the module considers the miles of gathering pipeline, number

[81] Final Rule - Phasedown of Hydrofluorocarbons: Establishing the Allowance Allocation and Trading Program under the AIM Act. U.S. Environmental Protection Agency. [accessed 2021 Dec 1]. https://www.epa.gov/climate-hfcs-reduction/final-rule-phasedown-hydrofluorocarbons-establishing-allowance-allocation

[82] The HFC phasedown rule was finalized in October 2021 and is therefore not considered in this report's emissions projections.

of processing stations, number of LNG storage compressor stations, miles of transmission pipeline, number of gas transmission compressor stations, and the number of gas storage compressor stations before applying emissions factors and estimating emissions.

Projections for natural gas and oil systems emissions use a modified version of the projection tool's methods to project emissions through 2041. That is, a linear trend of only post-recession emissions is used to project future emissions rather than a linear trend of the entirety of the historical dataset. This change in method results in more accurate near-term sub-sector emissions estimates.

Appendix B: Energy Flows

The U.S. Department of Energy's Lawrence Livermore National Laboratory studies the interconnection of energy, fuel sources, outputs, and GHG emissions. Their series of energy flow charts present the complex relationship between sources of energy and their final end-use.[83] Figure B-1 (on the next page) is Lawrence Livermore National Laboratory's flow chart estimation of energy consumption in Nevada in 2019. The illustration presents their estimation (using EIA's State Energy Data System as inputs) of all the energy consumed in Nevada, in units of trillions of British Thermal Units (BTUs), with the widths of the bands in the flow chart being linearly proportional to the quantities of energy moving through the system and being consumed by the four economic sectors in Nevada that consume fossil fuels (that is, transportation, electricity generation, industry, and residential and commercial). The boxes on the right represent the final disposition of the energy; either Rejected Energy, which is wasted energy lost through heat loss, friction, or other inefficiencies, or Energy Services, which represents the energy that has been consumed for a beneficial purpose.

Figure B-2 illustrates Lawrence Livermore National Laboratory's flow chart estimation of energy-related CO_2 emissions in Nevada in 2017 (the most recent year of their CO_2 estimates). Presenting the same fuel sources, this flow chart illustrates CO_2 emissions, in million metric tons (MMT), and connects the economic sectors where emissions ultimately occur to their fossil fuel sources. Notice that because of the different approaches and methodologies used to derive CO_2 emissions, sector totals do not equal the estimates otherwise included in this report for 2018.

Looking at both figures together, the prevalence of natural gas and petroleum as the two largest sources of energy-related emissions is evident. However, the figures also clearly illustrate an opportunity to expand the use of zero and near-zero emission renewable energy sources in Nevada through increasing electrification. By replacing activities that currently depend on fossil fuels with electric equivalents (electric cars, stoves, and heating being some examples) and then further increasing our dependence on renewable energy sources to generate electricity, Nevada can reduce GHG emissions and decarbonize.

This overview of energy flows does not portray all of the complexities of these sectors, nor does it illustrate the many ways in which GHG emissions can be reduced through energy efficiency gains. However, through Lawrence Livermore National Laboratory's energy flow charts, the interrelated nature of energy systems, carbon dioxide emissions, and Nevada's potential opportunities to decarbonize is made clearer.

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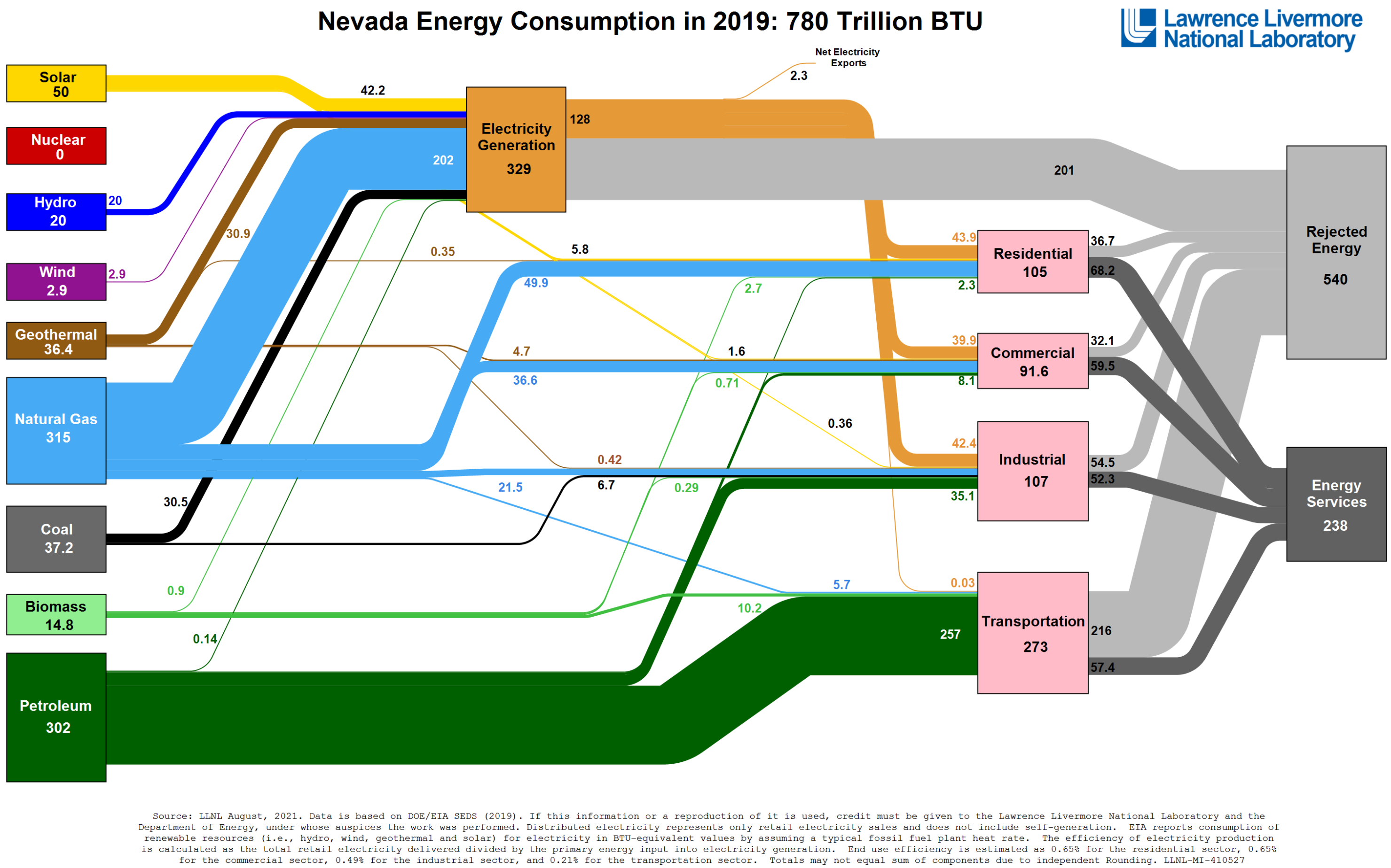
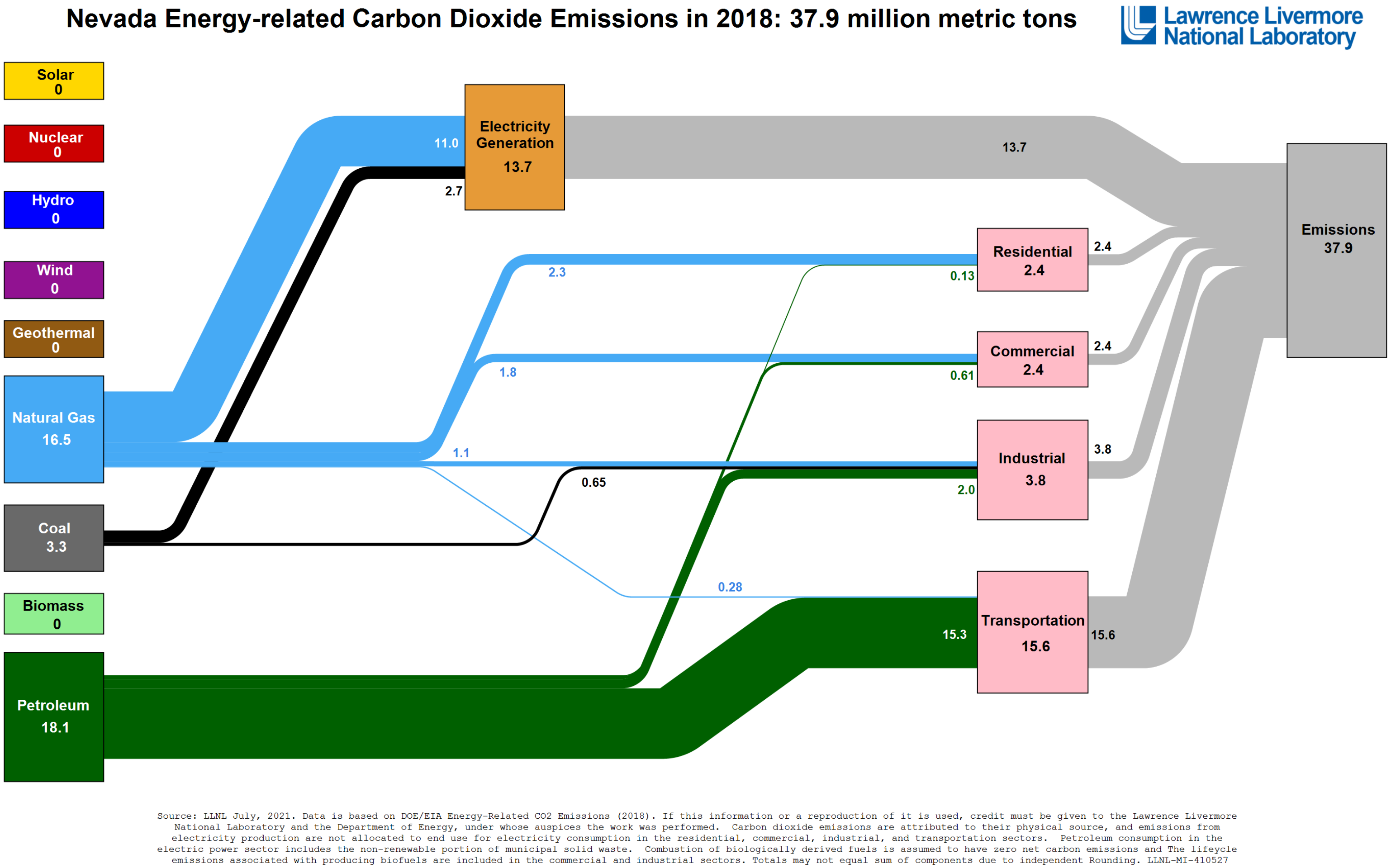
[83] LLNL Flow Charts. Lawrence Livermore National Laboratory. [accessed 2020 Nov 2]. https://flowcharts.llnl.gov/

Figure B-1: Estimated Nevada Energy Consumption in 2019: 780 Trillion BTU[84]



[84] Source: LLNL August 2021. Data is based on DOE/EIA SEDS (2019). If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory on the Department of Energy, under whose auspices the work was performed. Distributed electricity represents only retail electricity sales and does not include self-generation. EIA reports consumption of renewable resources (i.e., hydro, wind, geothermal and solar) for electricity in BTU-equivalent values by assuming a typical fossil fuel plant heat rate. The efficiency of electricity production is calculated as the total retail electricity delivered divided by the primary energy input into electricity generation. End use efficiency is estimated as 0.65% for the residential sector, 0.65% for the commercial sector, 0.49% for the industrial sector, and 0.21% for the transportation sector. Totals may not equal sum of components due to independent rounding errors. LLNL-MI-410527

Figure B-2: Estimated Nevada Energy-Related Carbon Dioxide Emissions in 2018: 37.9 MMTCO2e[85]



[85] Source: LLNL July 2021. Data is based on DOE/EIA Energy-Related CO2 Emissions (2018). If this information or a reproduction of it is used, credit must be given to the Lawrence Livermore National Laboratory on the Department of Energy, under whose auspices the work was performed. Carbon emissions are attributed to their physical source, and emissions from electricity production are not allocated to end use for electricity consumption in the residential, commercial, industrial, and transportation sectors. Petroleum consumption in the electric power sector includes the non-renewable portion of municipal solid waste. Combustion of biologically derived fuels is assumed to have zero net carbon emissions and the lifecycle emissions associated with producing biofuels are included in the commercial and industrial sectors. Totals may not equal sum of components due to independent rounding. LLNL-MI-410527