SOUTHERN NEVADA REGIONAL PLANNING COALITION

REGIONAL COMMUNITY GREENHOUSE GAS INVENTORY REPORT

PREPARED BY Clark County, NV and Kim Lundgren Associates, Inc.

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ACKNOWLEDGMENTS

This report was prepared by Clark County, NV on behalf of the Southern Nevada Regional Planning Coalition (SNRPC), and is part of the **ALL-IN CLARK COUNTY** initiative to create a sustainable community for the well-being and prosperity of all, today and into the future. The Greenhouse Gas (GHG) Inventory would not have been possible without the time, effort, and dedication of County leadership and staff, the SNRPC Board, and our community partners. The Department of Environment and Sustainability would like to thank the following organizations for their contributions to the development of this plan.

REGIONAL PARTNERS

Boulder City

City of Henderson

City of Las Vegas

City of Mesquite

City of North Las Vegas

Regional Transportation Commission of Southern Nevada

DATA PROVIDERS

Clark County Department of Aviation

NV Energy

Overton Power District

Regional Transportation Commission of Southern Nevada

Republic Services

Silver State Energy Association

Southern Nevada Health District

Southern Nevada Water Authority

Southwest Gas

CONSULTANT

Kim Lundgren Associates, Inc.

INTRODUCTION

This report is part of the All-In Clark County effort to address climate change and create a more sustainable future for all. The focus of this report is to summarize the results of the regional greenhouse gas (GHG) emissions inventory conducted by Clark County on behalf of the SNRPC to understand key sources and mitigation opportunities.

GHGs are naturally occurring compounds that provide a “blanket” in the atmosphere, trapping heat and regulating the Earth’s temperature. However, when fossil fuels (like natural gas, coal, and gasoline) are burned or when materials in landfills decompose, the level of GHGs in the atmosphere increases and the global “blanket” of gases becomes thicker. This has caused an increase in the global average temperature as well as more local extreme weather events, drought, and other climate hazards already being experienced in Nevada.

This GHG emissions inventory report covers calendar year 2019. It includes the three primary GHGs—carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O)—organized by both sector and jurisdiction. GHGs are typically reported in terms of CO_2e equivalents, or CO_2e. This accounting convention normalizes the relative amount of warming produced by different gases with the use of global warming potential (GWP) multipliers. For the non-CO_2 gases included in this inventory, N_2O and CH_4, calculations use GWP values from the Intergovernmental Panel on Climate Change (IPCC) 5th Assessment Report assessed over a 100-year time horizon.

The data used to generate regional GHG emissions estimates were drawn from local and national sources that capture and report activity data from multiple sectors across the county. For additional information about the sources of key input data, emissions factors, methodologies, and limitations, please refer to the Appendix I.

FIGURE 1: Projected Population and Households by Jurisdiction, 2019

Source: U.S. Census Bureau. Quickfacts Statistics, 2019. https://www.census.gov/quickfacts/fact/table/clarkcountynevada/PST045219

The results from this inventory will help lay the foundation for climate action planning and performance tracking by Clark County, SNRPC member agencies, and the incorporated communities within its boundaries. This assessment draws upon guidance from the US Community Protocol[1] and the Global Protocol for Community Scale Emissions[2] Inventories which drives emphasis on GHG sources most relevant for community planning and the standards that communities worldwide use to hold themselves accountable. This report also provides a local, bottom-up measurement of emissions that fulfills the Nevada Climate Initiative's aim to compliment the State of Nevada GHG Inventory and support a range of objectives from different levels of government acting to protect the climate[3].

1 https://icleiusa.org/us-community-protocol/
2 https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities
3 https://climateaction.nv.gov/policies/mmm-ghgs/

GHG EMISSIONS BY SECTOR

Activity-based GHG inventories help us understand the key sources of emissions and identify the most impactful climate mitigation opportunities.

Overview

Activities by Clark County's residents, businesses, and visitors resulted in 29,299,795 $MTCO_2e$ in 2019. This equates to approximately 12.9 $MTCO_2e$ per person, within the region. This regional inventory includes emissions from Boulder City, the City of Henderson, the City of Las Vegas, the City of Mesquite, the City of North Las Vegas, and the unincorporated towns within Clark County.

Although each community has its unique operations and circumstances, it is helpful to compare estimated GHG emissions to those from communities of similar size, population, and climate. For example, the City of Chicago, IL[1] reported emitting approximately 31 million $MTCO_2e$ in 2017. The City of Los Angeles, CA[2] reported emitting approximatively 25 million $MTCO_2e$ in 2018, and King County, WA[3] reported emitting approximately 20 million $MTCO_2e$ in 2019. While comparisons like these are important to provide context against similar entities, it is necessary to note that even though different inventories may follow similar guidance, emissions may vary widely due to the availability and quality of data.

The sectors included in this inventory represent the activities in Clark County that contribute the most to GHG emissions. Categorizing emissions into sectors allows the results to be easily benchmarked with other communities and communicated to the public and decision makers. Reporting by sector also helps identify actions that may have the greatest potential for reducing regional GHGs. The emissions sectors used in this analysis include the following:

- BUILDINGS AND ENERGY
- TRANSPORTATION
- SOLID WASTE
- WASTEWATER
- WATER TREATMENT AND DELIVERY
- AGRICULTURE, FORESTRY, AND OTHER LAND USE

1 https://www.chicago.gov/content/dam/city/progs/env/GHG_Inventory/Chicago-2017-GHG-Report_Final.pdf

2 https://www.lacitysan.org/san/sandocview?docname=cnt058946

3 https://your.kingcounty.gov/dnrp/climate/documents/201907-KingCounty-GHG-Emissions-Analysis.pdf

FIGURE 2. Clark County GHG Sectors and Sources, 2019

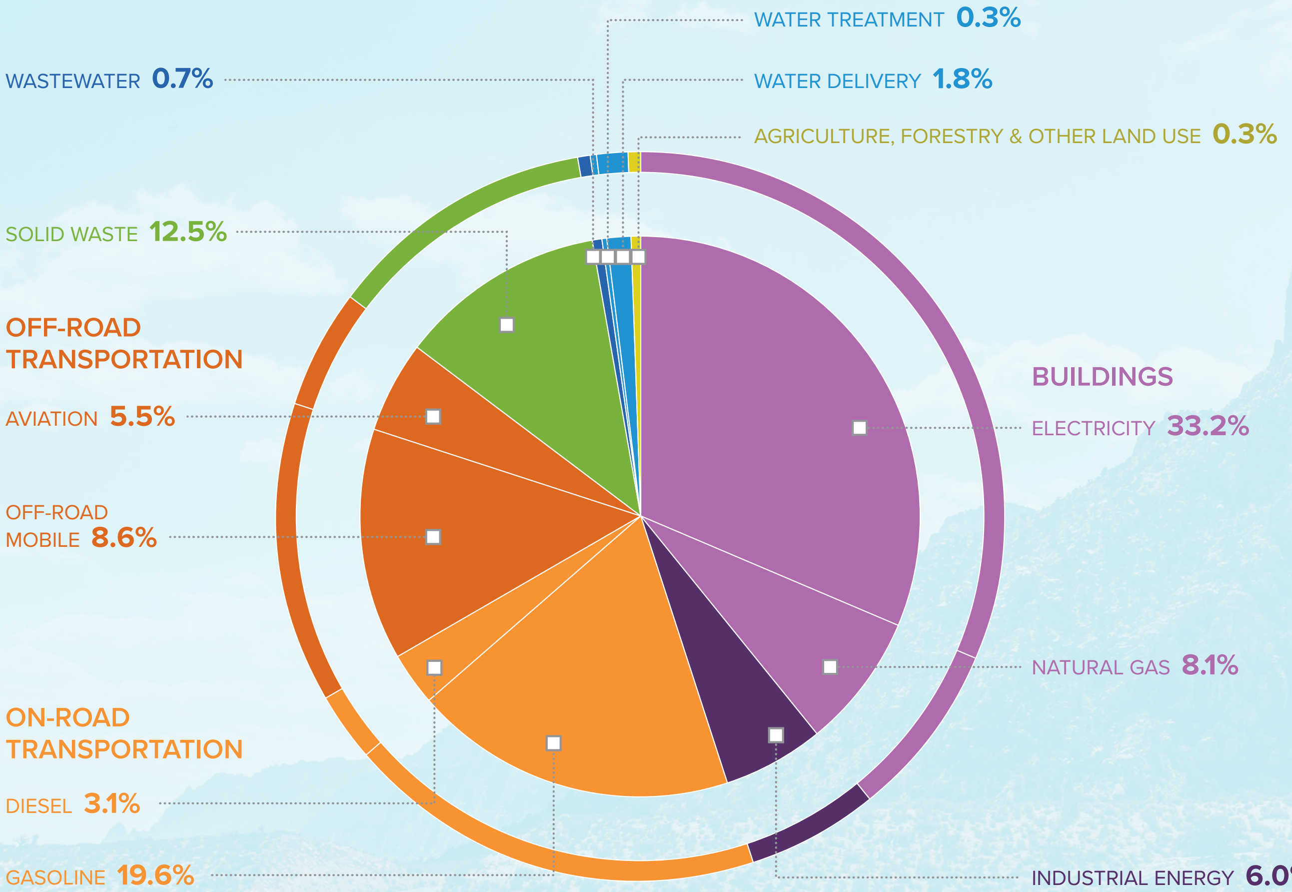


TABLE 1. County-Wide GHG Sectors and Sources, 2019

SOURCE	MTCO2e	% OF TOTAL
Buildings	12,164,255	41.5%
Electricity	9,727,978	33.2%
Natural Gas	2,384,012	8.1%
Fugitive Natural Gas	30,851	0.1%
Propane	19,567	0.1%
Heating Fuels	1,710	0.0%
Wood	136	0.0%
Industrial Energy	1,768,645	6.0%
On-Road Transportation	6,734,219	23.0%
Gasoline	5,747,487	19.6%
Diesel	904,285	3.1%
Electric	8,705	0.0%
CNG	6,483	0.0%
Transit CNG	51,029	0.2%
Transit Biodiesel	16,230	0.1%

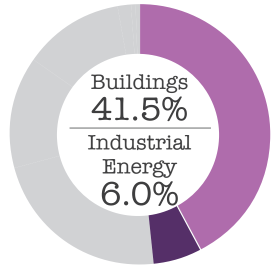
SOURCE	MTCO2e	% OF TOTAL
Off-Road Transportation	4,145,745	14.1%
Off-Road Mobile	2,511,500	8.6%
Aviation	1,608,713	5.5%
Waterborne Navigation	17,589	0.1%
Railways	7,944	0.0%
Solid Waste	3,675,785	12.5%
Landfilled Waste	3,643,275	12.4%
Composted Waste	32,510	0.1%
Wastewater	195,127	0.7%
Process and Fugitive	195,127	0.7%
Water Treatment & Delivery	523,621	1.8%
Water Treatment	81,855	0.3%
Water Delivery	441,767	1.5%
Agriculture, Forestry, & Other Land Use	92,398	0.3%
Grand Total	**29,299,795**	**100.0%**

What Sectors Contribute to Clark County's Regional GHG Emissions?

Energy use from Buildings and the Industrial sector generated the majority of emissions from the region, contributing approximately 48% of total GHG emissions from Clark County. This includes the energy used to heat homes, turn on the lights, and power facilities. The main sources of emissions from these sectors are residential and commercial electricity and natural gas consumption, representing 33% and 8% of regional emissions, respectively. Additionally Industrial energy use, especially industrial natural gas consumption, contributes 6% of overall emissions. The Buildings sector also includes emissions from the use of propane, heating fuels such as fuel oil, and wood in a small number of homes across the region.

The Transportation sector is the second largest GHG emissions sector in Clark County and contributes 37% of regional emissions. This sector includes both emissions from On-Road and Off-Road transportation, which represent 23% and 14% of overall emissions, respectively. On-Road transportation includes the vehicles owned and operated by the region's residents and businesses as well as visiting vehicles traveling through the community. Gasoline consumption from on-road vehicles is the largest emissions source from this sector, contributing 20% of regional emissions. On-road vehicles also include diesel fueled vehicles, electric vehicles, compressed natural gas (CNG) vehicles, and transit buses. The Off-Road Transportation sector includes emissions from off-road mobile vehicles, such as construction and agricultural equipment, aviation, waterborne vehicles, such as recreational boats, and passenger and freight rail travel. The two largest sources for Off-Road Transportation are off-road mobile vehicles and aviation, contributing 9% and 5% of Solid Waste represents the next largest emissions sector for the regional GHG Inventory, contributing 12% of the County's emissions. Landfilled Waste is the largest source of emissions within this sector but the emissions from composted waste is also included. Additional sectors, including Water Treatment and Delivery, and Wastewater and Agriculture, Forestry, and Other Land Use, when aggregated, account for 3% of Clark County's 2019 GHG emissions.

BUILDINGS & ENERGY



OF TOTAL GHG EMISSIONS

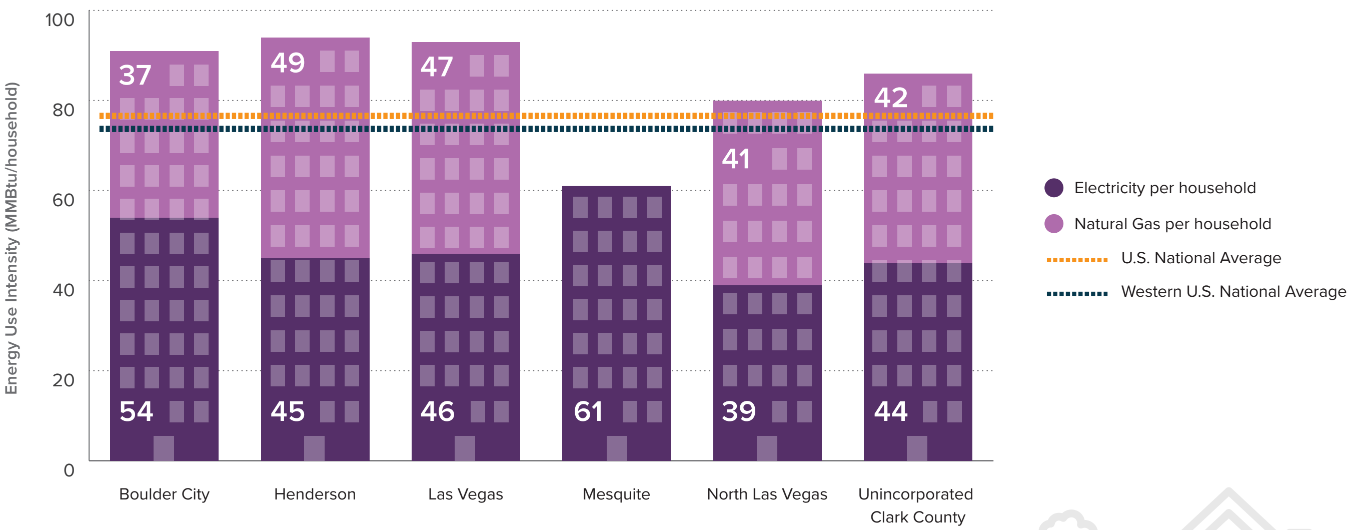
The Buildings and Energy Sector of this inventory includes the purchased electricity used to power homes and commercial buildings, as well as the fossil fuels burned for heating, cooking, and other energy uses in homes, businesses, and industrial facilities. The fossil fuels burned to generate electricity at power plants are not generally accounted for in community-based inventories and are excluded from this assessment.

Energy use from residential and commercial buildings makes up the largest percentage of regional GHG emissions in Clark County, contributing 12,164,255 $MTCO_2e$ in 2019, or 41.5% of total emissions. Emissions from this sector were generated mostly from the use of electricity (80%) and natural gas (20%) in buildings. Electricity is provided to the region by a handful of utilities and energy providers including NV Energy, Overton Power District, and the Silver State Energy Association. Retail natural gas, however, is provided to the region by a single company, Southwest Gas. The remainder of residential and commercial building emissions comes from a small proportion of fugitive emissions from unrepaired leakages of natural gas pipelines, propane, heating fuels, and wood. Without a central data source for residential propane, heating fuels, and wood, emissions from these sources were estimated using census data and state-level fuel consumption rates.

Residential electricity usage (measured per housing unit) is relatively similar across jurisdictions in Clark County though slightly higher in Boulder City and Mesquite, and slightly lower in North Las Vegas. The average residential electricity usage per housing unit in Clark County (13,492 kWh) is slightly higher than the usage for an average single-family home in the western U.S. (10,330 kWh). Residential natural gas usage in Clark County (485 therms), however, is lower than the average home in the western U.S. (544 therms). Residential natural gas usage (measured per customer) shows greater disparities across jurisdictions, with the highest reported usage in Las Vegas and Henderson and the lowest in North Las Vegas. Mesquite does not currently have residential natural gas service.

Industrial energy is also a significant portion of this sector and Clark County's regional GHG Inventory. Industrial natural gas, specifically, contributes 1,768,645 $MTCO_2e$ in 2019, or 6.0% total regional emissions. Natural gas is generally used in industrial facilities for auxiliary power, heating, and materials or chemical production, among others. However, information on Clark County's industrial customers is confidential so it is difficult to determine exactly what this natural gas is consumed for. Natural gas is also used in power plants to generate electricity and many of Southwest Gas' industrial customers are power plants. Because the production of electricity is excluded from this Inventory, this natural gas was removed from the industrial totals using EPA facility level consumption and power data.

FIGURE 4. **Residential Energy Use Intensity by Jurisdiction, 2019**



Average for a Single Family Detached Home in the West:

74.1 MMBTU PER HOUSEHOLD

Average for a Single Family Detached Home in the U.S.:

77.1 MMBTU PER HOUSEHOLD

* EIA Residential Energy Consumption Survey, 2015 https://www.eia.gov/consumption/residential/data/2015/index.php?view=consumption#summary

Renewable Portfolio Standard and Green Energy Supply

There are a variety of methods used to calculate the GHGs generated from electricity, each highlighting different ways to reduce the source. Countries and states, including the State of Nevada, use a geographic approach and account for all the fossil fuels burned within their boundaries to produce electricity, regardless of where that electricity is used. Electricity providers like NV Energy, can use a market-based method and assess GHGs based on the types of energy they buy on consumers behalf. For community inventories, like this one, we estimate electricity emissions based on all of the electricity that is purchased and consumed and the grid average emissions intensity that is derived from all connected generation sources from both in- and out-of-state resources. These perspectives can lead to fairly different results as seen below.

When applied to Clark County, the geographic perspective captures all fossil power plants in the County but excludes the electricity we import from elsewhere. NV Energy's market-based perspective calculates an emissions factor that is one third less than the grid average. This illustrates the impact of the utility working with the State Renewable Portfolio Standard[1] driving over 3,000 MW of renewable energy capacity that is either online now or in development[2]. While much credit is due to NV Energy for actively leading Nevada into a clean energy future, by basing our inventory on the grid average emissions intensity, we recognize the role for everyone in Southern Nevada to go "All-In" on GHG reductions whether that's through installing more solar locally or by saving energy and reducing electricity generation emissions wherever they occur.

1 https://puc.nv.gov/Renewable_Energy/Portfolio_Standard/

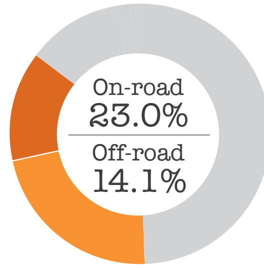
2 https://www.nvenergy.com/cleanenergy/renewable-energy-portfolio

Perspective	Geographic[1]	Grid Average (this inventory)	Market-Based[2]
2019 GHGs ($MTCO_2e$)	8,654,231	9,727,978	6,544,502

1 https://ghgdata.epa.gov/

2 Calculated by applying NV Energy 2019 Power Content Label to all electricity use in Clark County.

TRANSPORTATION



OF TOTAL GHG EMISSIONS

The Transportation Sector includes the GHGs emitted from the movement of people and goods within the community across different modes. This sector is more complex to capture due to the range of modes, vehicles, and fuel types involved. On-road transportation includes roadway transportation by cars, trucks, buses, and vans, and is assessed using travel activity data, vehicle miles traveled (VMT). Off-road transportation includes travel by rail, boat, and plane, as well as ground support equipment for off-road mobile sources. Additionally, transportation is rarely contained within a community boundary, and while boundaries were used for our GHG accounting purposes, it is important to draw on the context from surrounding communities to evaluate transportation within an interconnected region.

Transportation GHG emissions make up 35.7% of total emissions, with 23.0% from on-road transportation and 14.1% from off-road transportation. The majority of on-road transportation emissions come from gasoline (53%) and diesel (8%) powered vehicles. As the second largest contributor to Clark County's regional GHG emissions, the transportation sector represents a significant opportunity for mitigation efforts.

National Average

9,880

VMT PER CAPITA

Eno Center for Transportation. Trends in Per Capita VMT. 2019.

Regional Average

7,283

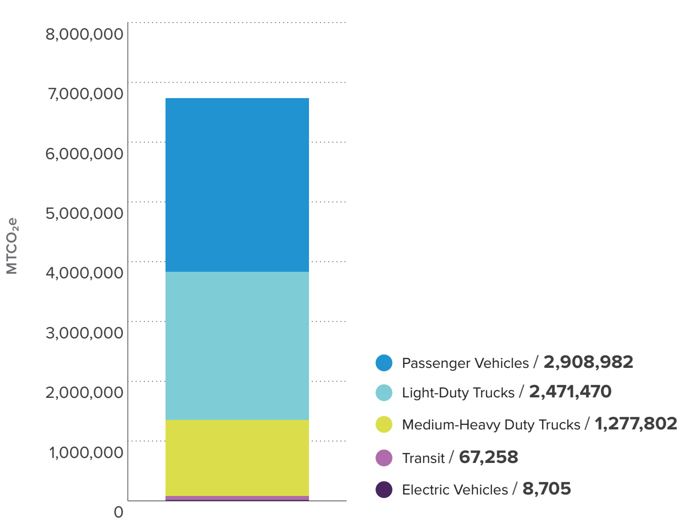
VMT PER CAPITA

Nevada Department of Transportation Highway Performance Monitoring System, Annual VMT, 2019.

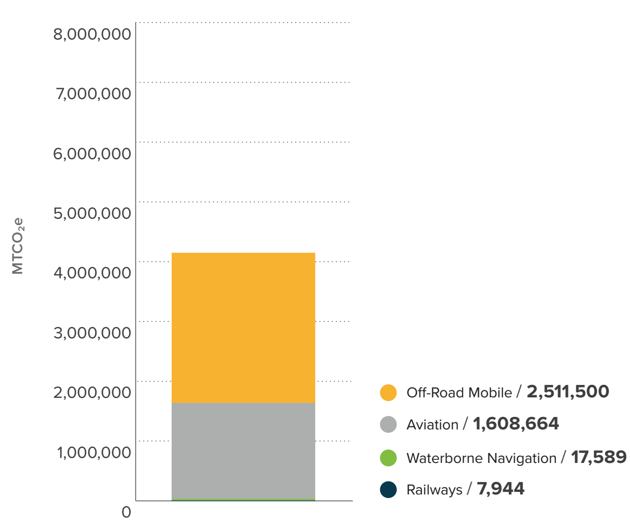
FIGURE 5. County-Wide GHG Emissions from Transportation, 2019

Emissions from electric vehicles (EVs) were estimated based on vehicle registration data and average EV range. These emissions were then removed from building electricity emissions because it is assumed that the electricity used to charge EVs was already accounted for in the purchased electricity consumed at homes and commercial buildings. Hybrid vehicles are not included under the EV classification.

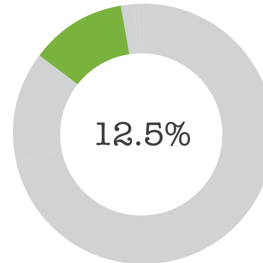
On-Road Transportation



Off-Road Transportation



WASTE



OF TOTAL GHG EMISSIONS

Clark County's Apex Landfill is the largest landfill in the U.S. However, this assessment is focused on all of the waste produced within the County limits rather than all of the waste that is disposed of at the landfill. Disposal or treatment of solid waste can generate GHGs as a result of biological processes in landfill and composting operations. The solid waste sector accounts for 12.5% of total emissions, or 3,675,785 MTCO$_2$e, which is equivalent to powering one coal-fired power plant for one year. The majority of GHG emissions from solid waste come from landfilled waste, accounting for 99.1% of all emissions from the solid waste sector. A small proportion of emissions from this sector come from composted waste, accounting for just 0.9% of emissions within the sector.

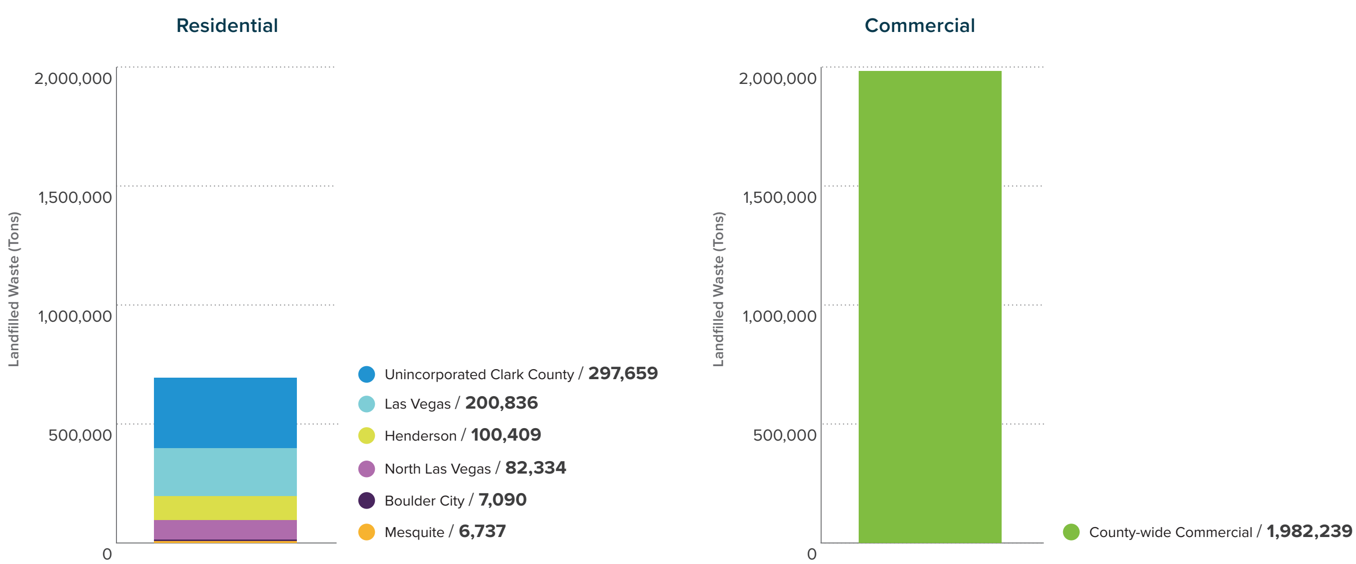
Evaluating where waste comes from is important to understanding which strategies may be used to target the highest generators. Due to differences in data collection across Clark County, we have little detail on how commercial generators in each community contribute to the whole, although we do know the total amount of waste generated.

Clark County sent enough waste to the landfill in 2019 to fill Allegiant Stadium more than

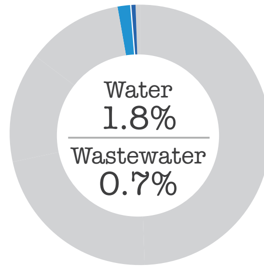
33 TIMES

FIGURE 6. County-Wide Residential and Commercial Solid Waste Across Jurisdictions, 2019

Commercial waste includes all remaining waste that is not accounted for in residential waste collection. This includes waste from businesses, hospitals, and other operations.



WATER & WASTEWATER

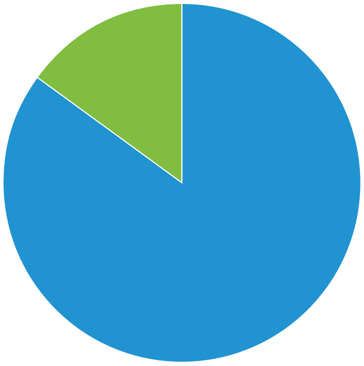


OF TOTAL GHG EMISSIONS

Moving water uses a significant amount of electricity, and the water system in Clark County is spread across several agencies. In addition, due to the scale of Clark County, it is difficult to attribute all of the water system energy to individual communities. Some of the major users, like wastewater treatment plants, are identifiable and are accounted for separately here. However, the energy required to supply water is only known at the regional level. While this captures the majority of energy used in the sector, some of the energy to supply water is likely aggregated in other sectors, particularly any pumping or groundwater extraction that is done by private firms.

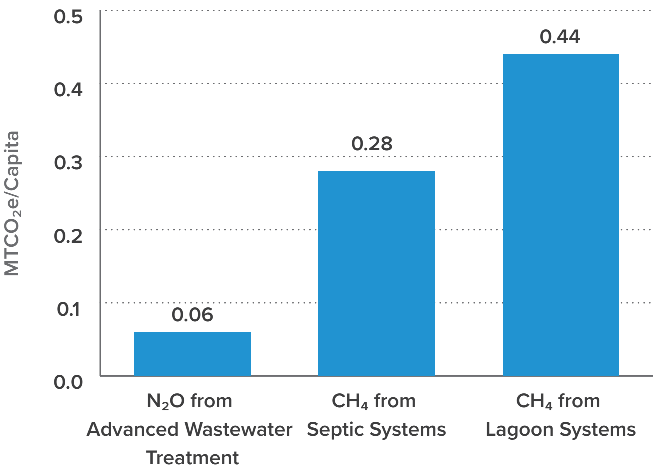
Wastewater treatment is generally a small source of emissions present in all communities, totaling 0.7% of all GHGs in Clark County. Advanced wastewater treatment plants work to remove nitrogen before wastewater is returned to the environment to preserve water quality. These emissions are generally unavoidable and are part of maintaining high water quality as water is returned to Lake Mead. Outside of densely populated areas, passive systems that include septic tanks for individual properties and lagoons that serve small communities are used. These systems create the conditions where methane can form as wastewater breaks down. Per person, these systems create much more emissions, but thankfully they are relatively few across Clark County, making them an overall small source of emissions.

FIGURE 7. County-Wide GHG Emissions from Water-Related Energy, 2019

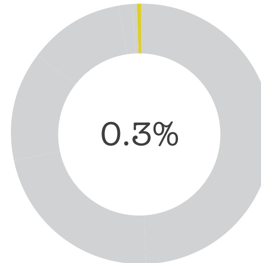


- Water Delivery / **441,767**
- Wastewater Treatment / **81,855**

FIGURE 8. County-Wide GHG Emissions Intensity of Wastewater Systems, 2019



AGRICULTURE, FORESTRY & OTHER LAND USE

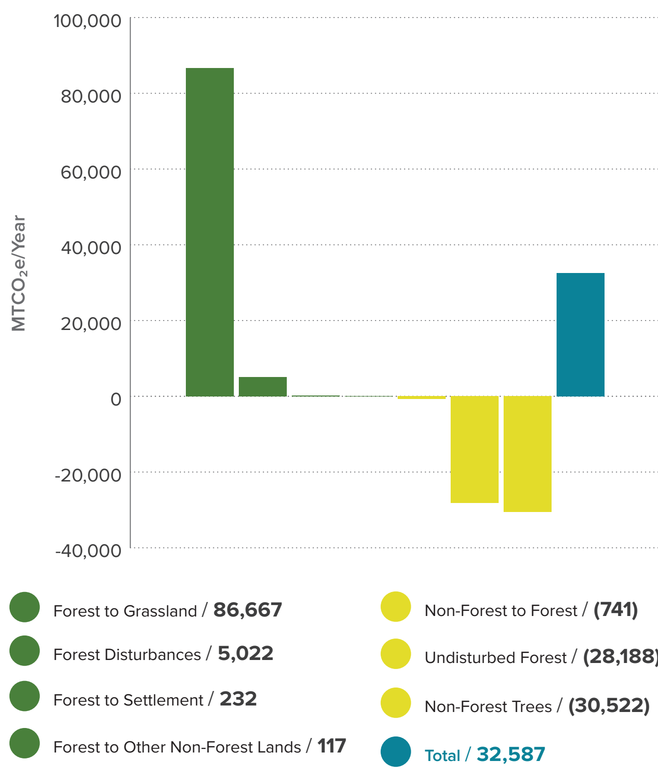


OF TOTAL GHG EMISSIONS

At over 8,000 square miles in size, Clark County land could be a significant source and sink of carbon and other emissions.[1] Several factors were considered in the assessment of GHG activities from this sector, including the amount of emissions relative to other sources, as well as data quality and availability to support meaningful findings. With only around 1,500 acres of land in production agriculture and relatively small numbers of animal husbandry, agriculture emissions in Clark County was deemed insignificant for this inventory.

The data needs to accurately assess carbon from natural and working lands is more challenging than in many other sectors. A complete assessment should include carbon stored in above and below ground biomass and inorganic soils and how those amounts respond when land use type changes. Desert systems have a low potential for sequestration within plant biomass.[2] While some studies have found significant potential for carbon storage in Mojave Desert soils, those same studies also note significant uncertainty about those estimates and the soil processes that control them.[3,4] Until more definitive answers to these questions are available, emissions and sequestration from land use change from the Mojave Desert have been omitted for this inventory.

FIGURE 9. Tree-Related Carbon Emissions and Removals



One area where there is generally better information is the carbon stored within trees. The Land Emissions and Removals Navigator (LEARN)[5] tool from ICLEI-USA was used to evaluate emissions and sequestration related to changes in tree cover. This county-wide assessment illustrates tree losses due to a variety of causes. Only carbon releases have been counted towards the inventory total, though it is interesting to note the ability of tree cover in Clark County to sequester carbon. Especially interesting are the "non-forest trees," including urban trees, which collectively sequester more carbon annually than forested areas in higher elevations.

1 Transform Clark County Master Plan. October 2021. https://www.transformclarkcounty.com/

2 https://www.mdlt.org/wp-content/uploads/2021/04/Carbon-in-CA-Deserts.pdf

3 https://www.nature.com/articles/nclimate2184

4 https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2016GL071198

5 https://icleiusa.org/LEARN/

LIMITATIONS

All activity based GHG inventories are developed from a mix of data sources of different levels of completeness and quality. For an inventory the scale of Clark County, there is an additional challenge of capturing county-wide processes while maintaining detail on the activities that occur within each city. Some data is directly measured, while some is developed from models and other estimates. Models can provide a good starting point for inventories; however, they may not be well suited to long term performance tracking.

TABLE 2. **Regional GHG Inventory Data Limitations**

SOURCE	LIMITATION
Use of Electricity and Natural Gas	Variation in classification of residential and non-residential end uses across utilities limits the ability to summarize use in a detailed way across the region. Levels of aggregation do not support detailed analysis of building performance.
On-Road Transportation	Models do not always capture short term changes well and the Transportation Demand Model will need to be consistently calibrated with real world data to capture year-to-year changes. Mesquite and most of the unincorporated towns in Clark County use different data than the Las Vegas Valley area covered in the RTC Transportation Demand Model. Lack of an official source to track the uptake of electric vehicles and their use patterns.
Off-Road Mobile Sources	All data from the EPA MOVES model does not reflect specific levels of year-to-year construction activity or local improvements to the fleet mix.
Residential Solid Waste Generation	Measured data on residential generation rates are limited to the Republic Services Franchise collection area and lacks detailed material mix characterization.
Commercial Solid Waste Generation	No geographic breakdown available of commercial generators and a lack of detailed material mix characterization.
Land Use Change	Lack of well documented and complete carbon emissions and removal factors for the Mojave Desert.

DATA IMPROVEMENTS

As the All-In Clark County initiative moves forward, mechanisms to address these GHG Inventory limitations, track performance, and account for change will need to be developed. Better data is not just needed to improve GHG calculations, but to inform policies needed to address them equitably.

Within the Buildings Sector:

Regular engagement with energy utilities will need to ensure data is reported consistently and in ways that document growth. This will allow us to separately track the success of energy reduction activities in the existing community and in the addition of new households and businesses.

Similarly, we will need to assess whether the actions we take on new construction are helping Clark County to grow better and at a lower energy demand than at current rates.

Lastly, more data on the variation of energy use patterns across building types would help identify the opportunities that exist for energy conservation and energy efficiency programs.

Within the Transportation Sector:

Tracking of VMTs may begin to take advantage of new data streams from mobile devices and connected vehicles. This type of tracking would allow us to look at trip origins and destinations in a way that captures traditional transportation patterns as well as traffic generated by new delivery-oriented businesses and ride-hailing services. This can inform planning decisions and identify where new mobility options will have the greatest potential impact.

Additionally, construction equipment is likely to be an ongoing significant source of emissions as the County grows. Bottom-up estimates based on the number and type of new construction will yield more actionable information than the existing top-down models.

Within the Solid Waste Sector:

Tracking of solid waste will need to focus on better characterizing the varying quantities of wastes generated by different activities as well as the specific mix of materials in the waste stream from all generators. Achieving this will likely require dedicated periodic studies of specific sectors, as well as mechanisms for tracking flows on a regular basis.

BUILDINGS

TRANSPORTATION

SOLID WASTE

More detailed data will help inform the policies needed to address improvements for these three sectors.

FORECAST OF FUTURE GHGS

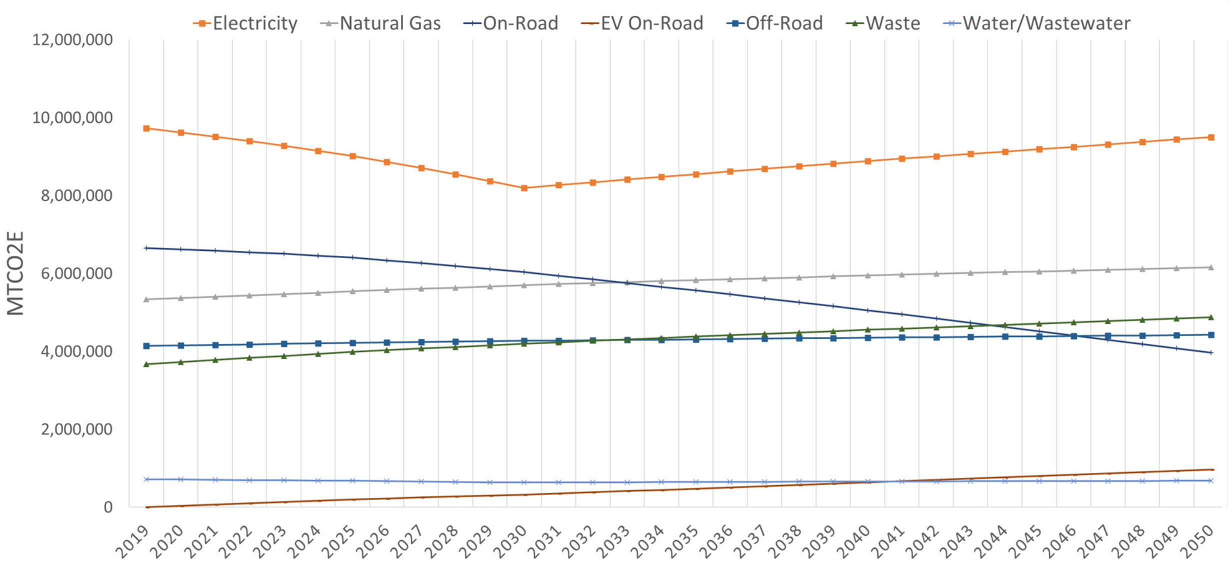
An emissions forecast helps to illustrate the headwinds we'll face as well as trends that we can take advantage of as we develop plans for long term emissions reductions. Developing scenarios over long time periods are far from predictions and should be viewed as a tool to help imagine where we're heading and what else we could achieve through thoughtful planning.

By 2050, Clark County is expected to grow to over 3 million residents adding over 680,000 residents and nearly 350,000 new jobs.[1] Those will result in more energy used, vehicles on the road, and waste generated, putting upward pressure on GHGs. At the same time, the Nevada Renewable Portfolio Standard[2] as well as uptake in electric vehicles will counteract that growth so much that by 2030 we expect a roughly 3% decrease in total emissions. If we stalled on renewable energy deployment at the end of the current RPS requirements, growth would overwhelm those gains and by 2050 we'd expect to see just over 1% increase in emissions. However, it is possible for Clark County to continue to grow while reaching deep reductions in greenhouse gases. If the State of Nevada continues to drive towards 100% renewable electricity, we could achieve a 35% reduction in emissions. As we accelerate the transition to electric vehicles and make smart decisions about how we use energy in buildings, a clean electricity supply creates a platform for local actions to have even more impact. Meeting our energy needs with 100% renewable sources will be much easier if we find ways to use less, which is why All-In Clark County is coordinating with partners throughout Southern Nevada to create a coordinated response that addresses all sources of GHGs in the region.

1 Regional Transportation Commission, Access 2050 Plan, Appendix D. https://www.rtcsnv.com/projects-initiatives/transportation-planning/access-2050-regional-transportation-plan/

2 https://puc.nv.gov/Renewable_Energy/Portfolio_Standard/

FIGURE 10. County-Wide GHG Emissions Business as Usual Forecast, 2019-2050



GHG EMISSIONS BY JURISDICTION

Overview

Clark County consists of numerous jurisdictions, each with unique operations, geographies, and populations. This inventory evaluates GHG emissions from across these jurisdictions to allow for a more comprehensive understanding of what the largest contributors are for each jurisdiction and identify targeted reduction strategies. The areas of jurisdiction studied in this analysis include:

BOULDER CITY

HENDERSON

LAS VEGAS

MESQUITE

NORTH LAS VEGAS

UNINCORPORATED

Unincorporated towns contributed 18,469,387 $MTCO_2e$ and represented the largest share of regional emissions. This area includes municipalities such as Enterprise, Paradise, Moapa, Sunrise, and others. Due to data quality and accounting limitations, some sources of emissions, such as off-road transportation and agriculture, forestry, and other land use were aggregated under this category.

TABLE 3. County-Wide GHG Emissions by Jurisdiction and Sector, 2019

	BOULDER CITY	HENDERSON	LAS VEGAS	MESQUITE	NORTH LAS VEGAS	UNINC. CLARK COUNTY
Sectors	$MTCO_2e$	$MTCO_2e$	$MTCO_2e$	$MTCO_2e$	$MTCO_2e$	$MTCO_2e$
Residential Buildings	56,050	981,515	1,712,751	86,085	564,966	2,477,170
Commercial Buildings	27,930	639,257	1,237,463	86,442	536,310	3,758,315
Industrial Energy		16,713	418,158		211,354	1,122,960
On-Road Transportation	57,117	745,383	1,932,940	57,067	561,329	3,380,382
Off-Road Transportation						2,537,032
Airport		66,448		49	136,438	1,405,779
Solid Waste	9,648	136,637	273,298	9,168	112,040	3,134,994
Wastewater	7,168	21,149	52,719	1,456	16,446	96,189
Water Treatment & Delivery		19,022	30,692		9,740	464,168
Agriculture, Forestry, & Other Land Use						92,398
Grand Total	**157,914**	**2,625,583**	**5,658,020**	**240,267**	**2,148,622**	**18,469,387**

1%

REGIONAL EMISSIONS

1%

REGIONAL POPULATION

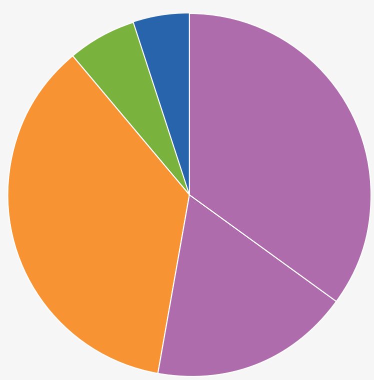
BOULDER CITY

A large portion of GHG emissions in Boulder County come from building energy use, contributing 53.2%. On-road transportation makes the up the second largest share, at 36.2%, while the other sectors represent the remaining 10.6% of emissions are much smaller contributors.

Boulder City emissions were compiled using both local and regional data sources including the Silver State Energy Association for electricity consumption, the Boulder City Landfill for waste generation, and Southwest Gas for natural gas consumption. Further investigation into the large energy consumers in the city will be necessary to accurately capture building sector emissions in the future.

FIGURE 11.

Boulder City GHG Emissions by Sector, 2019



- Residential Buildings / **35% (56,050 $MTCO_2e$)**
- Commercial Buildings / **18% (27,930 $MTCO_2e$)**
- Industrial Energy / **0% (N/A)**
- On-Road Transportation / **36% (57,117 $MTCO_2e$)**
- Airport / **0% (N/A)**
- Solid Waste / **6% (9,648 $MTCO_2e$)**
- Wastewater / **5% (7,168 $MTCO_2e$)**
- Water Treatment & Delivery / **0% (N/A)**

FIGURE 12.

Boulder City: By The Numbers

9.7	91.3	56.7	8.6	1.1
$MTCO_2e$ per capita	Residential MMBtu per Household	Commercial MMBtu per 1,000 sq.ft.	1,000 Vehicle Miles Traveled per capita	Residential Tons of Waste Per Household

11%
REGIONAL EMISSIONS

14%
REGIONAL POPULATION

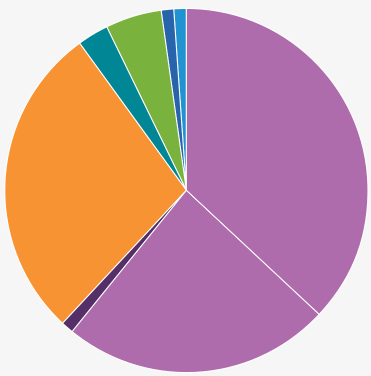
HENDERSON

The majority of GHG emissions in Henderson come from energy used to power buildings, at 62.3%, followed by on-road transportation, contributing 28.4%. Solid waste and aviation emissions both make up the next largest share, at 5.2% and 2.5% respectively.

The City of Henderson collected its data mainly from NV Energy, Southwest Gas, and Republic Services for waste generation. Additionally, Henderson's GHG inventory included emissions from the Henderson Executive Airport, which were calculated using the Federal Aviation Administration's sophisticated Traffic Flow Management System Counts database.

FIGURE 13.

City of Henderson GHG Emissions by Sector, 2019



- Residential Buildings / **37% (981,515 $MTCO_2e$)**
- Commercial Buildings / **24% (639,257 $MTCO_2e$)**
- Industrial Energy / **1% (16,173 $MTCO_2e$)**
- On-Road Transportation / **28% (745,383 $MTCO_2e$)**
- Airport / **3% (66,448 $MTCO_2e$)**
- Solid Waste / **5% (136,637 $MTCO_2e$)**
- Wastewater / **1% (21,149 $MTCO_2e$)**
- Water Treatment & Delivery / **1% (19,022 $MTCO_2e$)**

FIGURE 14.

Henderson: By The Numbers

8.2	94.6	46.8	5.8	0.9
$MTCO_2e$ per capita	Residential MMBtu per Household	Commercial MMBtu per 1,000 sq.ft.	1,000 Vehicle Miles Traveled per capita	Residential Tons of Waste Per Household

24%
REGIONAL EMISSIONS

29%
REGIONAL POPULATION

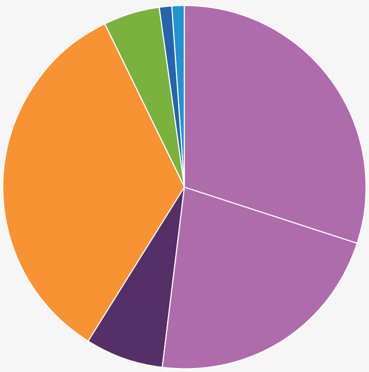
LAS VEGAS

In Las Vegas, the majority of GHG emissions come from buildings and energy use, at 59.5%, and on-road transportation, at 34.2%. Solid waste contributes 4.8% to GHG emissions in Las Vegas, while water treatment and delivery and wastewater each contribute approximately 1% of GHG emissions.

Las Vegas' GHG Inventory was compiled using data from both local and regional sources, including NV Energy for electricity consumption, Southwest Gas for natural gas consumption, and Republic Services for landfilled waste.

FIGURE 15.

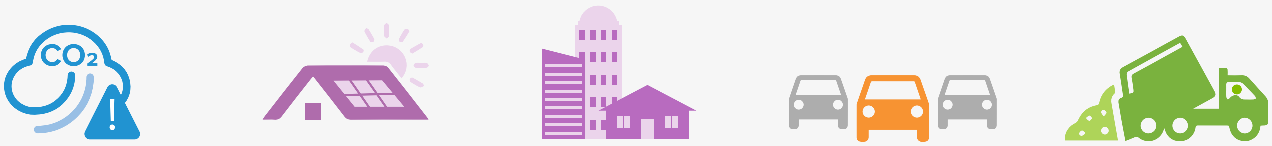
City of Las Vegas GHG Emissions by Sector, 2019



- Residential Buildings / **30% (1,712,751 $MTCO_2e$)**
- Commercial Buildings / **22% (1,237,463 $MTCO_2e$)**
- Industrial Energy / **7% (418,158 $MTCO_2e$)**
- On-Road Transportation / **34% (1,932,940 $MTCO_2e$)**
- Airport / **0% (N/A)**
- Solid Waste / **5% (273,298 $MTCO_2e$)**
- Wastewater / **1% (52,719 $MTCO_2e$)**
- Water Treatment & Delivery / **1% (30,692 $MTCO_2e$)**

FIGURE 16.

Las Vegas: By The Numbers



8.7	93.3	59.8	7.3	1.0
$MTCO_2e$ per capita	Residential MMBtu per Household	Commercial MMBtu per 1,000 sq.ft.	1,000 Vehicle Miles Traveled per capita	Residential Tons of Waste Per Household

1%

REGIONAL EMISSIONS

1%

REGIONAL POPULATION

MESQUITE

More than two-thirds of GHG emissions in Mesquite come from building energy usage, contributing 71.8%. On-road transportation makes up 23.8% of emissions, making it the second largest contributor to Mesquite's GHG emissions. Solid waste and wastewater, the only two other sectors contributing to Mesquite's GHG emissions, make up 3.6% and less than 1% of emissions, respectively.

Mesquite's GHG Inventory was compiled using data from both local and regional sources, including Overton Power District for electricity consumption, Southwest Gas for natural gas consumption, and Virgin Valley Disposal for landfilled waste. Additionally, Mesquite's Inventory does not include emissions from Water Treatment & Delivery because data at the county level could not be accurately disaggregated and assigned to the city.

FIGURE 17.

City of Mesquite GHG Emissions by Sector, 2019

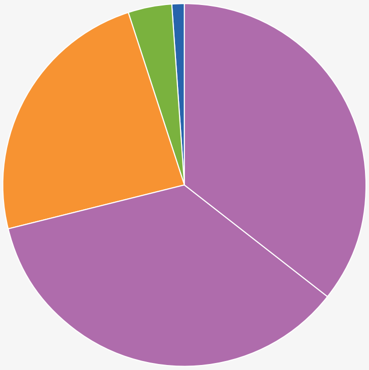
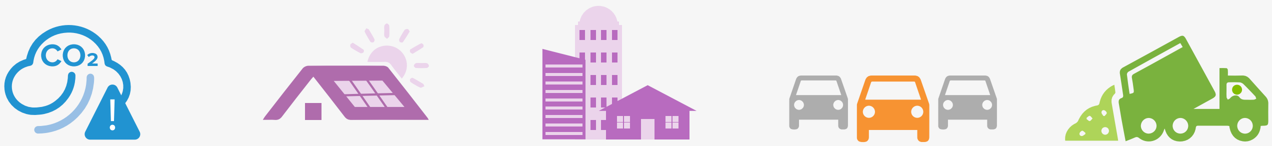


FIGURE 18.

Mesquite: By The Numbers



12.2	60.5	57.1	7.1	0.6
MTCO2e per capita	Residential MMBtu per Household	Commercial MMBtu per 1,000 sq.ft.	1,000 Vehicle Miles Traveled per capita	Residential Tons of Waste Per Household

9%
REGIONAL EMISSIONS

11%
REGIONAL POPULATION

NORTH LAS VEGAS

More than half off of GHG emissions in North Las Vegas come from buildings and energy usage, contributing 61.1%, followed by on-road transportation at 26.1%. Off-road transportation and solid waste make up the next largest shares of GHG emissions, while water treatment and delivery and wastewater both account for small contributions to GHG emissions.

The City of North Las Vegas collected its data mainly from NV Energy, Southwest Gas, and Republic Services for waste generation. Additionally, North Las Vegas' GHG inventory included emissions from the North Las Vegas Airport, which were calculated using the Federal Aviation Administration's sophisticated Traffic Flow Management System Counts database.

FIGURE 19.

City of North Las Vegas GHG Emissions by Sector, 2019

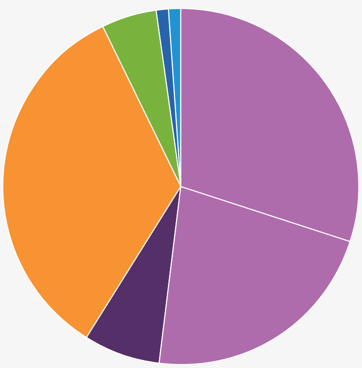
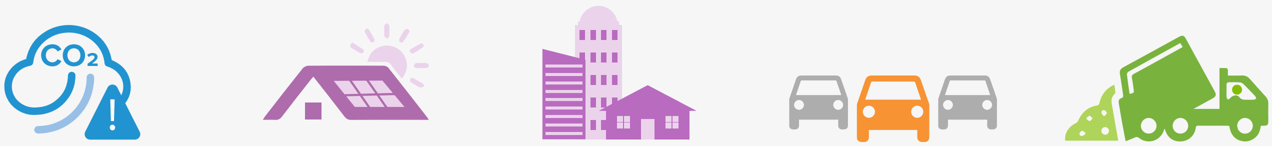
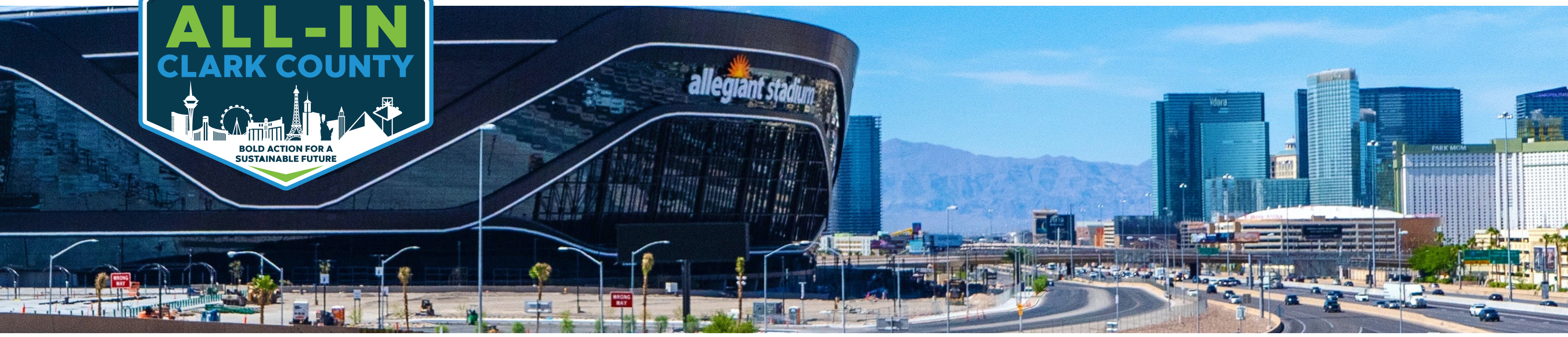


FIGURE 20.

North Las Vegas: By The Numbers



8.5	**80.3**	**43.0**	**5.5**	**1.0**
MTCO2e per capita	Residential MMBtu per Household	Commercial MMBtu per 1,000 sq.ft.	1,000 Vehicle Miles Traveled per capita	Residential Tons of Waste Per Household



55% REGIONAL EMISSIONS

44% REGIONAL POPULATION

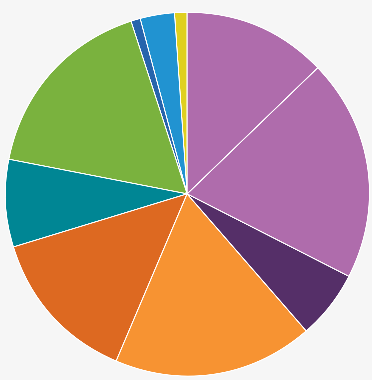
UNINCORPORATED CLARK COUNTY

In Unincorporated Clark County, building-related energy usage makes up 39.8% of GHG emissions, followed by off-road transportation, including aviation emissions, at 21.3%. On-road transportation contributes 18.3% to GHG emissions and solid waste makes up 17.0% of emissions. Water treatment and delivery and wastewater account for 2.5% and less than 1% of GHG emissions respectively. Lastly, agriculture, forestry, and other land use makes up less than 1% of GHG emissions. Unincorporated Clark County is the only jurisdiction in which this data is available.

The Inventory for Unincorporated Clark County included data collected from both local and regional sources including NV Energy, Southwest Gas, Republic Services, and the Silver State Energy Association. All regional data that could not be disaggregated by city, such as off-road mobile emissions, are categorized as Unincorporated Clark County.

FIGURE 21.

Unincorporated Clark County GHG Emissions by Sector, 2019



- Residential Buildings / **13% (2,477,170 $MTCO_2e$)**
- Commercial Buildings / **20% (3,758,315 $MTCO_2e$)**
- Industrial Energy / **6% (1,122,960 $MTCO_2e$)**
- On-Road Transportation / **18% (3,380,382 $MTCO_2e$)**
- Off-Road Transportation / **14% (2,537,032 $MTCO_2e$)**
- Airport / **8% (1,405,779 $MTCO_2e$)**
- Solid Waste / **17% (3,134,994 $MTCO_2e$)**
- Wastewater / **1% (96,189 $MTCO_2e$)**
- Water Treatment & Delivery / **3% (464,168 $MTCO_2e$)**
- Land Use, Land Use Change, & Forestry / **1% (92,398 $MTCO_2e$)**

FIGURE 22.

Unincorporated Clark County: By The Numbers

18.3	**86.7**	**52.6**	**8.3**	**0.9**
MTCO2e per capita	Residential MMBtu per Household	Commercial MMBtu per 1,000 sq.ft.	1,000 Vehicle Miles Traveled per capita	Residential Tons of Waste Per Household

APPENDIX 1: METHODS AND TECHNICAL DOCUMENTATION

Data Sources

The data used to generate regional GHG emissions estimates were drawn from sources that capture activity data from multiple sectors across the county.

This inventory uses 100-year horizon Global Warming Potential values from the IPCC 5th Assessment Report. Except where noted, this inventory follows methods and emissions factors sourced from the US Community Protocol[1] and aligns with the reporting conventions defined by the Global Protocol for Community Scale Emissions Inventories (GPC)[2].

1 https://icleiusa.org/us-community-protocol/

2 https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities

Energy

Electricity

Data Sources

Data Provider	Data Type	City	Categorization
NV Energy	Electricity Consumption	Henderson, Las Vegas, North Las Vegas, Uninc. Clark County	Residential, small commercial, large commercial, streetlights, distribution only SVC, municipal
Boulder City	Electricity Consumption	Boulder City	Residential, residential – master meter, commercial, time of use, Boulder City Hospital, City, Area Lighting, Sports field Lighting
Overton Power District	Electricity Consumption	Mesquite	Residential sales, irrigation sales, commercial and industrial, public street and highway lighting, sales to public authority, sales for resales
EPA eGRID[1]	Regional Electricity Grid Emission Factors	Regional	AZNM Region

Methodology

- Collect activity data from utility providers.
- Multiply electricity consumption by eGRID emission factors to estimate emissions.
- Aggregate estimates to Residential, Commercial, and Municipal (if available) end-use sectors for each city.

1 https://www.epa.gov/sites/default/files/2021-02/documents/egrid2019_summary_tables.pdf

Natural Gas

Data Sources

Data Provider	Data Type	City	Categorization
Southwest Gas	Fuel Consumption	Boulder City Henderson, Las Vegas, Mesquite, North Las Vegas, Uninc. Clark County	Residential, commercial, industrial, irrigation/water pumping, essential agriculture, transportation

Methodology

- Collect activity data from utility providers.
- Multiply natural gas consumption by EPA emission factors.
- Aggregate emissions into Residential, Commercial, and Industrial (if available) end-use sectors for each city.

Fugitive Natural Gas

Data Sources

Data Provider	Data Type	Categorization
Urban Sustainability Directors Network, Regional Fugitive Methane Tool[2]	Estimated distribution loss percentage for Natural Gas leakage	By end-use sector

Methodology

- Identify estimated regional natural gas leakage rates by region and utility provider.
- Multiple leakage rate by natural gas consumption.
- Multiple estimated leakage by EPA emission factors.
- Aggregate emissions into Residential, Commercial, and Industrial (if available) end-use sectors for each city.

Propane

Data Sources

Data Provider	Data Type	Categorization
Energy Information Agency Residential Energy Consumption Survey, 2015[3]	Average end use-consumption by fuel type	West Region - Mixed Dry / Hot Dry
U.S. Census Bureau, 2015-2019 American Community Survey 5-Year Estimates	# of Houses by fuel type	Residential end-use sector, by City

Methodology

- Collect household information from data providers.
- Multiply regional energy use intensity (gallons per household) from the EIA by the U.S. Census Bureau count of houses using that fuel, for each city.
- Multiple consumption estimates by EPA emission factors.
- All emissions categorized as Residential.

2 https://www.usdn.org/products-energy.html#MethaneAccounting

3 https://www.eia.gov/consumption/residential/data/2015/index.php?view=consumption#by%20End%20uses%20by%20fuel

Fuel Oil, Wood

Data Sources

Data Provider	Data Type	Categorization
U.S. Census Bureau, 2015-2019 American Community Survey 5-Year Estimates	# of Houses by fuel type	Residential end-use sector, by City

Methodology

- Collect household information from data providers.
- Estimate a Clark County average energy use per household (MMBtu / household) intensity from propane data.
- Convert the average energy use per household (MMBtu /household) to physical units of Fuel Oil (gallons/household) and Wood (short ton/household).
- Multiply the energy use per household intensity by the U.S. Census Bureau count of houses using fuel oil and wood, for each city.
- Multiple consumption estimates by EPA emission factors.
- All emissions categorized as Residential.

On-road Transportation

Passenger Vehicles – Gasoline, Diesel, CNG

Data Sources

Data Provider	Data Type	Categorization
Regional Transportation Commission (RTC) of Southern Nevada, Access 2050 Transportation Demand Model[4]	Average daily vehicle miles traveled by road segment	Urban area of the Las Vegas Valley
NV-DOT TRINA[5]	Average daily vehicle miles traveled by road segment	City of Mesquite
NV-DOT 2020 Annual Vehicle Miles of Travel Report (2019 data)[6]	Average daily vehicle miles traveled by county and roadway type	All of Clark County by road facility type
Impact NV[7]	Number of EVs registered in Clark County	All of Clark County
US Community Protocol	Average fuel mix share, default emissions factors.	N/A
Clark County Department of Environment and Sustainability	Vehicle mix categorization	All of Clark County

Methodology

Attribution of Activity by Jurisdiction

VMT by model segment was attributed to jurisdictions containing them using GIS. Many model segment features either crossed a jurisdiction boundary or ran along a boundary creating a need for several transformations to extract data.

- Model segments were given a small buffer in order to create some area dimension that would overlap jurisdictions.
- A one-to-many spatial join was performed on the RTC model segment .KMZ file to append the names of jurisdictions to intersecting segments and creating duplicate segments where it intersected with two or three jurisdictions.

4 https://www.rtcsnv.com/projects-initiatives/transportation-planning/access-2050-regional-transportation-plan/

5 https://www.arcgis.com/apps/webappviewer/index.html?id=278339b4605e4dda8da9bddd2fd9f1e9

6 https://www.dot.nv.gov/home/showpublisheddocument/18093/637369676400370000

7 https://impact-nv.org/

- Segments with attributes were exported to .csv files where duplicates were identified by counting instances of unique segment IDs. Average daily VMT from each segment was divided by the duplicate count and thus assigning 50% of VMT to each segment that appeared in 2 jurisdictions and 1/3 to segments that crossed into three jurisdictions.
- Average daily VMT was scaled up to annual VMT and then summarized within each jurisdiction by the road classification of the model segment.
- VMT within the City of Mesquite was split using an identical procedure applied to 2019 HPMS data segments.

Remaining VMT in unincorporated Clark County that is outside of both the RTC model area and Mesquite city limits was determined as the difference between full county-wide VMT and VMT within the urban areas already accounted for.

- Approximate number of registered EVs in the county were obtained from ImpactNV[8]. These were assumed to travel the national average miles per year for passenger vehicles to estimate total EV VMT.
- EV VMT was subtracted evenly across each jurisdiction in proportion to each jurisdictions' share of county-wide passenger miles.
- Vehicle type distribution was assigned to VMT using the distribution by facility type classification used by Clark County Department of Air Quality for other analyses. All roads within the RTC Model area were considered 'Urban'.
- Unincorporated VMT was assigned to facility type and vehicle types on the relative proportion of rural restricted and unrestricted roadways.
- Fuel type classification and average fuel economies were then assigned to VMT by vehicle classification to calculate fuel use of gasoline and diesel which was then used to calculate emissions.
- EVs were assumed to have an average fuel economy of 100 miles per gallon equivalent which was used to estimate total kWh used. This electricity was assumed to be primarily charged from residential charging and was then subtracted from residential electricity attributable to buildings.

Transit

Fuel Use from RTC service operations were obtained reports to the National Transit Database which provided a record of both biodiesel and compressed natural gas used in the fleet. Fuel use was attributed to jurisdictions in the RTC service territory area using GIS.

- Spatial join of jurisdiction names to transit stops.
- Transit stop ID by jurisdiction were matched to trip tables obtained from the RTC GTFS record[9] which resulted in a total number of transit vehicle stops in each jurisdiction which was used to apportion biodiesel and CNG use among jurisdictions.
- Biodiesel and CNG emissions were calculated using standard emissions factors for volume of fuel. The quantity of diesel used in the calculation of CO_2 was reduced by 5% to account for the B5 biodiesel blend which reduced fossil diesel use by 5%.
- Total volume of CNG used by RTC was reduced from the total CNG fuel volume reported in by SW Gas. Additional CNG reported by SW Gas was also included and summarized with other medium and heavy-duty trucks.

The Las Vegas Monorail provides electric-powered light rail transit along the resort corridor in unincorporated Clark County. Total electricity for traction power was obtained from the Las Vegas Convention and Visitors Authority and emissions were calculated with eGRID emissions factors. Monorail electricity was subtracted out of commercial electricity use in unincorporated Clark County to prevent double counting.

8 https://impact-nv.org/interactive/transportation.html

9 https://transitfeeds.com/p/rtc-southern-nevada/47

Off-road Transportation

Aviation

Data Sources

Data Provider	Data Type	Categorization
Federal Aviation Administration Traffic Flow Management System Counts & Aviation System Performance Metrics[10]	Departure & arrival counts	By airport and aircraft type
International Civil Aviation Organization Airport Air Quality Manual[11]	Landing & take-off emission factors	By aircraft type

Methodology

Emissions are based on the Landing and take-off portions of the flights, not the entirety of emissions during a flight. This approach is comprehensive includes all flights but excludes Military aircrafts.

- Calculate total departures and arrivals by aircraft with the FAA TFMSC data to calculate total operations at each airport. Exclude military operations from count.
- Crosswalk FAA aircraft types with ICAO aircraft types.
- Multiply FAA total operations by aircraft by the landing & take off emission factors from ICAO to estimate emissions by aircraft at each airport.
- Sum aircraft emissions by each airport and assign emissions to the respective city.

Non-Road Mobile

Data Sources

Data Provider	Data Type	Categorization
US EPA MOVES Model[12]**, Using Clark County Defaults**	Modeled CO_2, CH_4, N_2O	By fuel and source type

Methodology

Non-Road Mobile sources were obtained from the US EPA MOVES Model run for Clark County using model defaults. The MOVES model is a downscaled attribution model that combines national scale statistics on the number of engines in various non-road uses and attributes them by county according to relative levels of employment in industries relying on those type of equipment. MOVES model runs give a good estimation of the relative magnitude of these sources but are not sensitive to local variation as might be expected with year-to-year fluctuations in construction activity. MOVES export results provide no geographic detail and were summarized at the county-wide scale.

10 https://aspm.faa.gov/

11 https://www.icao.int/environmental-protection/Documents/Publications/FINAL.Doc%209889.Corrigendum.en.PDF

12 https://www.epa.gov/moves

Railways

Data Sources

Data Provider	Data Type	Categorization
Bureau of Transportation Statistics, Freight Analysis Framework[13]	Tons of rail freight moving though the Las Vegas terminal	By fuel and source type
Clark County GIS[14]	Miles of freight rail tracks	All of Clark County
EPA Emissions Factors Hub[15]	Emissions Factors for ton-miles of rail freight	N/A

Bureau of Transportation Statistics

Methodology

- Total Tons from the Freight Analysis Framework were multiplied by the total rail mileage in Clark County to estimate total Ton-miles.
- Ton-Miles were multiplied by EPA emission factors to estimate emissions.

Solid Waste

Landfilled Waste

Data Sources

Data Provider	Data Type	Categorization
Republic Services	Residential MSW Collection	By jurisdiction: Las Vegas, North Las Vegas, Henderson, Unincorporated Clark County
Mesquite Landfill	Waste deposited generated in Nevada	N/A
Boulder City Landfill	Waste deposited generated in Boulder City	N/A
Southern Nevada Health District 2019 Recycling Report[16]	Total MSW generated and disposed by landfill in Clark County	N/A
US EPA WARM Model Documentation[17]	Methane generation potential and lifetime landfill gas capture rates.	N/A

Methodology

GHGs in solid waste were calculated using a methane commitment approach of ultimate generation potential from waste disposed in the inventory year.

Generation was developed from several sources to obtain a complete accounting of solid waste in Clark County.

- Republic Services provided record of waste collected from residential properties by jurisdiction (Unincorporated Clark County, North Las Vegas, Las Vegas, and Henderson) under the franchise agreement covering the Las Vegas Valley urban area.
- Total disposal at Boulder City and Mesquite Landfills was obtained from direct reports from those landfills. Boulder City Landfill included a breakdown by generator type, providing a record of residential versus commercial generation.
- Mesquite total waste was split between residential and commercial generation by calculating an average waste generation per household from Republic Service collection and Boulder City and applying it to households in Mesquite. While the Mesquite

13 https://www.bts.gov/faf

14 https://www.clarkcountynv.gov/government/departments/geographic_info_systems/index.php

15 https://www.epa.gov/sites/default/files/2021-04/documents/emission-factors_apr2021.pdf

16 https://media.southernnevadahealthdistrict.org/download/solid-waste/2019-SNHD-Recycling-Report.pdf

17 https://www.epa.gov/warm/documentation-chapters-greenhouse-gas-emission-energy-and-economic-factors-used-waste-reduction

landfill records separate waste generated from Arizona from Nevada, no additional geographic breakdown of Nevada sources is available, and the landfill likely collects small amounts of waste from unincorporated county generators in the area as well.
- Commercial generation of solid waste from the unincorporated Clark County, Las Vegas, North Las Vegas, and Henderson was estimated as the difference between all previously accounted for MSW and the total county-wide generation rate.
- Construction and Demolition waste was excluded from these totals since it is largely inert in landfills.

The emissions factor applied was obtained from the documentation of the US EPA WARM tool in order to limit the calculation to gross methane generation at a landfill. Due to a lack of specific material type characterization, factors for “mixed MSW” were used. Methane generation potential was obtained from Exhibit 6-7 and lifetime landfill gas capture rate was obtained from Exhibit 6-11 using the value for MSW in a dry landfill with aggressive landfill gas collection.

Residential Composted Waste

Data Sources

Data Provider	Data Type	Categorization
Southern Nevada Health District 2019 Recycling Report[18]	Tons of waste managed by composting	No additional geographic detail

Methodology

- Tons of green waste and food waste obtained from the recycling report were multiplied by standard emissions factors. No geographic breakdown was attempted.

Water Treatment and Delivery

Data Sources

Data Provider	Data Type	Categorization
Silver State Energy Association	Metered electricity use for wastewater treatment	Las Vegas, North Las Vegas, Henderson, and Southern Nevada Reclamation District
Silver State Energy Association	Metered electricity use for potable water treatment and distribution	Southern Nevada Water Authority
NV Energy	Electricity use for “Other Water Pumping”	N/A

Methodology

Energy related to water treatment and delivery was obtained from electric utility providers. The Silver State Energy Association provided usage figures for wastewater treatment facilities from the cities of Las Vegas, North Las Vegas, Henderson, and Southern Nevada Reclamation District in the unincorporated county. In addition, SSEA provided a total value for electricity use by the Southern Nevada Water Authority, however disaggregation among jurisdictions was not possible.

NV Energy included a user class of “Other Water Pumping”, however further descriptions of the specific end use was not available.

- Water energy was multiplied by eGRID emissions factors to calculate emissions from this source.

18 https://media.southernnevadahealthdistrict.org/download/solid-waste/2019-SNHD-Recycling-Report.pdf

Wastewater

Data Sources

Data Provider	Data Type	Categorization
US Census	Population	By City or Census Designated place
Clark County GIS[19]	Properties with Septic Systems	N/A

Methodology

All Population-Based Methods were used for this section.

Advanced Wastewater Treatment Systems

- Populations contributing to advanced waste water treatment plants in each jurisdiction were sourced from the US Census. These were supplemented with additional calculations to account for the large visitor population. Rather than total number of visitors, this estimate attempted to account for the consistent 'visitor load' that exists at any given time. Number of rooms and average occupancy rate from Las Vegas Convention and Visitors Authority[20] were used to calculate additional tourism population contributing to wastewater generation.
- Populations were applied to standard methods for nitrogen from nitrification/denitrification treatments and effluent discharge.

Passive Wastewater Treatment Systems

- Lagoon based systems were identified in the Las Vegas Water Reclamation Annual Report and populations utilizing those systems were estimated from census records of the community each system was associated with.
- Records of properties served by septic systems was obtained from Clark County GIS records. Each system was classified by the jurisdiction it resides in and assumed 2.5 people utilize each system to calculate population on septic systems.

Agriculture, Forestry, Land Use

Data from USDA indicates that there are approximately 1,500 acres of row crop agriculture and less than 2,000 cattle in Clark County. This level of activity would account for relatively few GHGs compared to other sources and agriculture was therefore deemed 'de minimis' and omitted.

Land Use change was also omitted due to inconclusive data on emissions and removal factors associated with Mojave Desert scrubland.

Data Sources

Data Provider	Data Type	Categorization
ICLEI Land Emissions and Removal Navigator (LEARN)	GHG released and sequestered by conversion of land to/from forest, forest remaining forest, and trees outside of forest.	County-wide

Methodology

Export from the ICLEI LEARN tool provided gross emissions from tree loss. No other adjustments have been applied. Sequestration from trees is included as an information item.

19 https://www.clarkcountynv.gov/government/departments/geographic_info_systems/index.php

20 https://www.lvcva.com/research/visitor-statistics/

Business as Usual Forecast Methods

GHG emissions forecasts are a tool for planning purposes as opposed to a prediction of future emissions. They should broadly capture trends that are likely to occur to inform long term planning while balancing against making many assumptions.

The overall approach to this forecast was to use performance indicators developed from inventory data and project forward levels of emissions generating activities with expected changes in the denominator of the indicator. For example, an indicator of electricity use per household was developed with data from the inventory. Combining that data with projections of the growth in number of households is used to calculate total future household electricity use.

Emissions are subsequently calculated from projected activities using the same approach as was applied in the inventory with some modifications where needed to account for expected changes in the carbon intensity of the activity, as we expect with lower carbon intensity electricity in the future.

Activity Projections

Residential Energy

Both electricity and natural gas consumption in residential energy is projected using energy use per household indicators derived from inventory data projected forward in terms of the number of projected households. Projecting forward the average performance from each community assumes the relative mix of current housing types and efficiencies is what will continue to occur in each community. Changes to performance levels will be explored in future scenarios. Initial performance indicators were developed from aggregate consumption over the total number of dwelling units within each community as reported in the Clark County Property Assessor's database.

Data Source	Data Type	Categorization
Access 2050 Appendix D – Regional Forecast Planning Variables[21], Table 7	Household projections in terms of dwelling units	By Jurisdiction
Mesquite Master Plan, Appendix A - Housing Needs Assessment	Projected New Households by 2024	Mesquite only

Commercial Energy

Both electricity and natural gas consumption in commercial energy is projected using energy use per commercial floor area indicators derived from inventory data projected forward in terms of the number of projected jobs in each community and the accompanying building area needed to support those jobs. Projecting forward the average performance from each community assumes the relative mix of commercial building types and efficiencies is what will continue in each community. Changes to performance levels will be explored in future scenarios. Initial performance indicators were developed from aggregate consumption over the total square feet of building space within each community as reported in the Clark County Property Assessor's database.

Data Source	Data Type	Categorization
Access 2050 Appendix D – Regional Forecast Planning Variables, Table 17	Employment projections in terms of total jobs	By Jurisdiction
Mesquite Master Plan, Appendix A - Housing Needs Assessment	Employment projections in terms of total jobs by 2024	Mesquite only

21 RTC ACCESS 2050: Appendix D Regional Forecasts Planning Variables. https://assets.rtcsnv.com/wp-content/uploads/sites/4/2020/12/08103239/Appendix-D-Regional-Forecasts-Planning-Variables.pdf

On-Road Transportation

Projections of on road transportation within Clark County follow the "no-build" scenario of the Access 2050 in order to incorporate the impact of the "build" scenario as well as other improvements to the regional transportation system as part of future scenarios developed in climate planning processes. For necessary simplification, the rate of growth in average per capita VMT was applied to population growth in each community and distributed across the mix of passenger and commercial vehicle types operating in each community as opposed to modeling changes to different classes of on-road transportation independent from each other.

Changes to fuel economy and the carbon intensity of each road mile are important dynamics to capture in a forecast. At this time it appears that most of the improvements in vehicle fuel economy from 2019 going forward will be predominantly from shifts towards electric vehicles rather than improvements to the fuel economy of combustion powered vehicles. The share of miles by electric vehicles in each vehicle class for business as usual reflect the "medium" adoption case defined by the NREL Electrification futures report, cited below. This conservative estimate reflects a future where EV technologies continue to grow, but in the absence of dedicated support to expand their share in Southern Nevada reaching 59% of passenger miles, 57% of light duty trucks, 26% of medium duty trucks and 9% of heavy trucks by 2050. VMT miles were re-allocated from the respective fuel sources in each class to EVs and total transportation electricity was calculated using current average energy use per mile. Emissions from electricity use were calculated using the projected cleaner electricity factors applied to all other electricity use.

Other transportation sources such as emissions from transit were increased using the average overall rate of population growth in each community and aviation emissions were increased linearly across all airports using the expected growth rate in regional jobs as a proxy for tourism.

Data Source	Data Type	Categorization
Access 2050 Appendix D – Regional Forecast Planning Variables, Table 17	Population projections	By Jurisdiction
Access 2050 Appendix E – Travel Demand Model Methodology and Air Quality Conformity Analysis. Table 51	Current and projected 2050 "No Build" VMT per Capita. (18.5 and 20.1, respectively)	Applied County-Wide
National Renewable Energy Lab Electrification Futures Study: Scenarios of Electric Technology Adoption and Power Consumption for the United States. Figure 6.3[22]	Long term projections for EV share of on-road miles using the "Medium" uptake scenario	Applied County-Wide for Passenger Cars, Light Trucks, Medium and Heavy Duty Trucks

Solid Waste

Residential solid waste generation was scaled simply by the rate of increased population in each jurisdiction. Commercial solid waste generation was increased at the rate of employment increases at the county-wide scale. No alterations in diversion practices or landfill gas controls were assumed under business as usual.

Data Source	Data Type	Categorization
Access 2050 Appendix D – Regional Forecast Planning Variables, Table 17	Population projections	By Jurisdiction

22 https://www.nrel.gov/docs/fy18osti/71500.pdf

Wastewater

Solid waste generation was scaled simply by the rate of increased population in each jurisdiction. This was applied to both residential and commercial solid waste evenly and no alterations in diversion practices or landfill gas controls were assumed under business as usual.

Data Source	Data Type	Categorization
Access 2050 Appendix D – Regional Forecast Planning Variables, Table 17	Population projections	By Jurisdiction

Sectors Held Constant

Several sectors were held constant for this analysis due to lack of generalizable growth projections in the levels of activities as the rates are not necessarily tied to the same type of growth factors as described above. These include off-road vehicles, forest gains and losses, and small fuel uses like propane and wood.

Grid Carbon Intensity

Emissions associated with electricity consumption are a significant portion of Clark County's current emissions and will play a dynamic role in determining future total GHGs from the region as more renewable energy balances against population and job growth as well as shifts in the greater reliance on electricity for transportation and other uses.

For business as usual, projections should incorporate changes that are guaranteed to happen while leaving room for further policy development to be explored in planning scenarios. For this analysis the State of Nevada Renewable Portfolio Standard was applied to increase the share of non-emitting resources to 50% by 2030. A detailed model of pathways was beyond the scope of this analysis and this change was modeled with simple assumptions. In addition, the RPS regulates supplier mix rather than the grid average generation mix which was used in the baseline inventory. To approximate the impact of RPS compliance on grid carbon intensity the rate of change between the 2019 level of non-emitting resources at 33% and 50% by 2030 was calculated as 1.5% improvement per year. This factor was applied to reduce grid carbon intensity over the period.

No additional change in the carbon intensity of the grid is assumed beyond 2030. The change in grid carbon intensity at 1.5% per year was enough to create a net decrease in GHGs of 2.9% by 2030. Without that continued downward pressure, GHG trends immediately begin to rise as growth in electricity use is rising from both population increases as well as from electric vehicles. Emissions in 2040 would only be 0.49% below 2019 and by 2050 growth in activities will bring emissions to a 1.1% net increase above 2019.

Summary

This forecast represents on possible future for Clark County. Recent history and the COVID 19 pandemic illustrate that the future is highly uncertain however this analysis should adequately capture the major drivers of expected changes to greenhouse gas emissions in the region over that period with sufficient detail to take the first steps in prioritizing local action and advocacy across government to meet the long-term emissions reduction targets of the communities within Clark County and the State of Nevada.

APPENDIX 2: STATE AND LOCAL INVENTORY COMPARISON

GHG inventories can be performed at many different levels, ranging from national to state level, community-wide to corporate-wide, even down to a personal household inventory. Inventories developed at these different scales present information in a variety of different formats due to variations in data collection, reporting requirements, and inventory guidance, among other factors. The inventories may also emphasize different aspects of the GHG accounting process or results according to the developer's ability to reduce emissions. Clark County and Southern Nevada's inventory is unique because its emissions make up a significant portion of GHGs that occur within the State of Nevada. This leads to natural questions about how the results of an inventory performed at each level relate to one another. Many parts of the inventories for Clark County and the State of Nevada are similar, however, there are important differences that need to be considered when drawing conclusions about how the two compare. Additionally, the GHG's from some sectors are assessed, organized and reported in fundamentally different ways in order to inform different audiences, which makes some sectors not directly comparable. This document provides an overview of the major differences between the GHG inventories for Clark County and the State of Nevada to guide the interpretation of the relationship between them.

Differences In Scale

Jurisdictional GHG inventories seek to both create a complete accounting of GHG generating sources and activities from within an area as well as provide policy and action-relevant information to decision makers working for that jurisdiction. For example, states are interested in knowing the sources of energy that it relies on to maintain adequate supply and inform the development of resources within the state. At a local level, understanding emissions from energy use activities can be more relevant since the tools for local government, businesses, and households tend to focus more on managing energy demand. While there are exceptions on both sides, the difference is strong enough to warrant different emphasis on how results are summarized.

Approaching and inventory from different scales also leads to practical decisions on which data sources to use. Data on fossil fuel sources for electricity production are already summarized at the state level allowing for a complete accounting of all energy uses from a relatively small number of sources. However, this data can be difficult to accurately disaggregate at a local level meaning that local data must be obtained from a variety of data providers, each with unique methods of data collection, categorization, and reporting. In many cases this makes it difficult for community scale inventories to consistently separate end-use emissions across all energy types.

Differences In Reporting Frameworks

The Global Protocol for Community Scale Greenhouse Gas Inventories (GPC)[1] is the core guiding document that describes how local inventory data should be organized and reported. For local inventories, this promotes a consistent emissions profile across communities and allows for better peer comparisons of both consumption and emissions. The guidance also addresses the potential double counting among individual sources that are used by multiple communities.

Figure 1 below is taken from Table 6.1 of the GPC and it illustrates the organization of stationary energy data for these purposes. The State of Nevada accounts for GHGs from the production of electricity within its borders. Because all other states use the same approach, all U.S. power plants are accounted for and none are double counted. States can therefore use a relatively simple data collection process and organize their data using only the first column of Figure 1.

1 WRI ICLEI C40. Global Protocol for Community-Scale Greenhouse Gas Inventories, v1.1. https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities

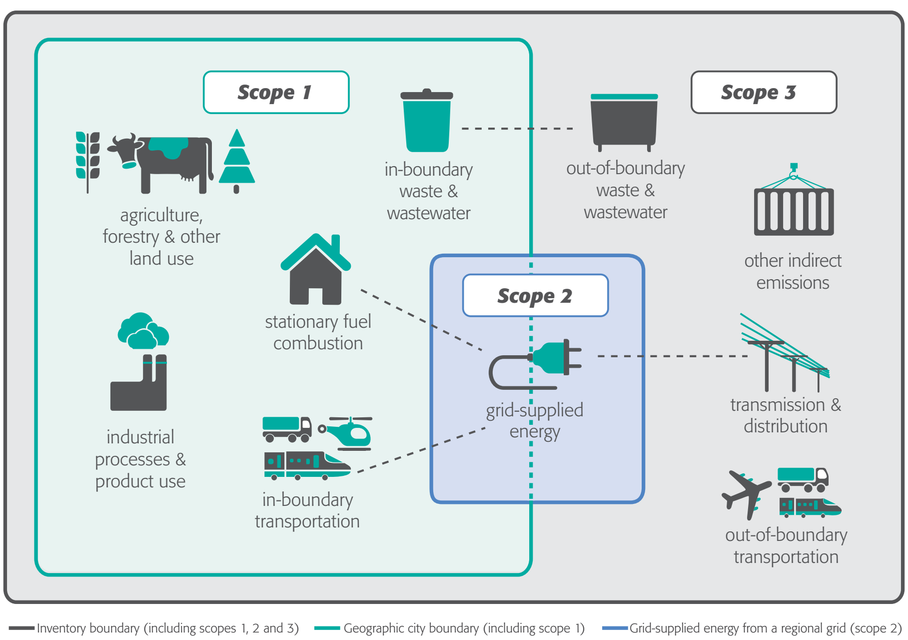
Figure 1. Example GPC Reporting Structure for Stationary Energy[2]

GHG Emission Source	Scope 1	Scope 2	Scope 3
STATIONARY ENERGY	Emissions from fuel combustion and fugitive emissions within the city boundary	Emissions from consumption of grid-supplied energy consumed within the city boundary	Transmission and distribution losses from the use of grid-supplied energy
Residential buildings	I.1.1	I.1.2	I.1.3
Commercial and institutional buildings and facilities	I.2.1	I.2.2	I.2.3
Manufacturing industries and construction	I.3.1	I.3.2	I.3.3
Energy industries	I.4.1	I.4.2	I.4.3
Energy generation supplied to the grid	I.4.4		
Agriculture, forestry and fishing activities	I.5.1	I.5.2	I.5.3
Non-specified sources	I.6.1	I.6.2	I.6.3
Fugitive emissions	1.7.1, 1.8.1		

Sources required for BASIC reporting
+ Sources required for BASIC+ reporting
Sources included in Other Scope 3
Sources required for Scope 1 (territorial) total but not for BASIC/BASIC+ reporting (*italics*)
Non-applicable emissions

At the local level, businesses and households rely on power that comes from a variety of locations including some within the community, some within the state, as well as some imported from out of state. The emissions can be attributed to both users of electricity as well as producers of electricity. The shared nature of grid supplied electricity created a need for a scopes framework to organize how electricity is accounted for. By placing all electricity into a Scope 2 category, the energy can be both associated with which sectors are using it and create separation from how it is accounted for at the point of generation in the Scope 1 column. Double counting is avoided by not requiring accounting of energy supplied to the grid, indicated in Figure 1 by the purple shading for I.4.4, as well as ensuring that any aggregation across jurisdictions do not sum across scopes. The scopes framework as applied to community inventories is depicted visually below and is covered in greater depth in the GPC document.

Figure 2. The GHG Accounting Scopes Framework for Communities[3]



2 WRI ICLEI C40. Global Protocol for Community-Scale Greenhouse Gas Inventories, v1.1. Table 6.1. https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities

3 WRI ICLEI C40. Global Protocol for Community-Scale Greenhouse Gas Inventories, v1.1. Figure 3.1. https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities

Another topic related to scopes and electricity is the selection of an emissions factor that represents the carbon intensity of the electricity used. A description of how different emissions factors applied to electricity use in Clark County is included in the Buildings and Energy section in the main body of this report. For this appendix it is worth noting that GPC Section 6.5.1 states that local inventories "shall use a location-based emissions factor", which is what was done for this inventory. The location-based method is best able to capture the true carbon impacts of how energy is used, accounting for both in-state and out-of-state resources that are utilized for serving electricity demand. At present the only source for emissions factors which meet the definition of a location-based method is US EPA eGRID[4].

These factors are the largest contributors to differences observed in the relative proportions of different sectors when comparing the two inventories. In particular, the way electricity is organized from the point of generation at the state level to the point of use within buildings at the county level. The figure below illustrates how simply moving electricity emissions out of the broad buildings category makes the relative proportion of sources between the two inventories very similar.

Figure 3 : State of Nevada 2017 GHG Inventory Results

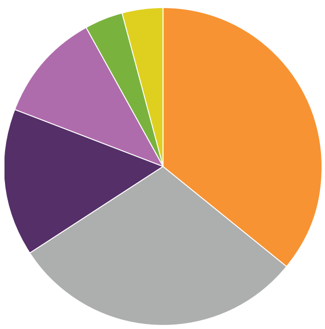
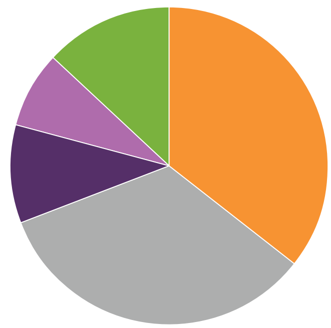


Figure 4 : Clark County 2019 GHG Inventory Results



While the relative contribution of sectors in this view are similar, there are still some significant differences within some sectors. These differences are attributable to a combination of whether the same specific sources are included or not, primarily in the industry and agricultural sectors; or differences in the calculation approaches used at different scales, such as in the waste sector. The following tables describe key differences in calculation approaches between the two inventories that should be considered when comparing results.

Grid Electricity

	NDEP – State of Nevada	Clark County
Primary Data	Fuels combusted within the state for the purposes of electricity generation from EIA	Use of grid electricity by households and businesses within Clark County.
Calculation Approach	Calculations based on direct emissions from fuels combusted.	Calculations based on the annual average carbon intensity of electricity supplied to the regional electric grid.
Comparison	As noted previously, neither approach provides perfect information about electricity. NDEP's approach captures fossil fuel electricity generation within the state comprehensively. The local perspective accounts for emissions associated with the use of electricity, regardless of the point of generation. Both perspectives only partially capture the impact of in-state renewable energy development as well as RPS requirements for suppliers. However, the impacts of both types of actions will become more apparent as renewable energy begins to dominate in terms of electricity supply within the state and what is added to the electric grid. While the results are similar in terms of their relative contribution, this is somewhat coincidental as the addition or subtraction of a single power plant from within the State boundary could have a significant effect on results of that scale, but may not show up from consumption perspective depending on how the plant is connected to the grid.	

4 https://www.epa.gov/egrid

Stationary Combustion

	NDEP – State of Nevada	Clark County
Primary Data	Fuels combusted within the state for residential and commercial buildings as well as industrial process energy from EIA	Fuels combusted within the county for residential and commercial buildings as well as industrial process energy from SW Gas, supplemented with EIA data for non-utility delivered fuels.
Calculation Approach	Calculations based on direct emissions from fuels combusted.	Calculations based on direct emissions from fuels combusted.
Comparison	This sector is largely analogous between both inventories, with the exception of combustion of specialty fuels other than natural gas may not be fully captured in local data.	

On-Road Transportation

	NDEP – State of Nevada	Clark County
Primary Data	In-State Fossil Fuel Consumption from US Energy Information Administration	Vehicle Miles Traveled from a combination of Regional Transportation Commission and Highway Performance Monitoring System
Calculation Approach	Direct conversion of fuels to GHGs	Fuel use and GHGs estimated using local vehicle mix classifications and national average fuel economy
Comparison	Local estimation should be representative of the portion of statewide transportation fuels sold within Clark County, noting that some fuels sold within the county are ultimately consumed during travel outside the county and vice versa. Some differences may also result from assumptions in fuel economy applied to the VMT based approach. The vehicle-mile activity approach also allows for estimations of electric vehicles within the sector.	

Aviation

	NDEP – State of Nevada	Clark County
Primary Data	Loading of aviation fuels onto aircraft within the state from the US Energy Information Administration.	Record of total flight operations from airports in Clark County from the Federal Aviation Administration.
Calculation Approach	Direct conversion of fuels to GHGs.	Calculations based on emissions factors for each landing and take-off operation (LTO) by aircraft class.
Comparison	Calculating aviation emissions are complex since much of the emissions that occur happen outside of the jurisdiction. Two available options tie this activity to a geographic area. Counting fuel loaded on to aircraft within the area gives a good approximation of the size of the sector. Interviews with Clark County aviation officials indicated that many short-haul flights do not refuel locally between flights and the fuel loading approach would miss a significant number of flights. Using the LTO approach, GHGs are associated with the number of flights in an area which may be easier to obtain data for in the future. In addition, LTO based calculations can be more relatable to other issues of concern like local air quality and noise analysis when considering actions that impact levels of aviation. Neither approach will capture emissions from aviation perfectly. Other possible approaches include the full length of flights, however detailed characterization of the origin-destination pairs for all flights to the region was beyond the scope of the project.	

Other Off-Road Mobile

	NDEP – State of Nevada	Clark County
Primary Data	In-State Fossil Fuel Consumption from US Energy Information Administration	US EPA MOVES Model, Non- Road module
Calculation Approach	Off-road transportation emissions are calculated along with all other transportation fuels based on total fuels used in the state	The EPA MOVES Model is based primarily on estimates of the number of equipment pieces operating within a region based on the local employment of industries that use various types of off road equipment.
Comparison	No direct comparison of this sector is possible as the NDEP inventory does not detail the split between on-road and off-road transportation. Off-road emissions are a significant component of the Clark County transportation sector and the amount of fuel used even if low precision is likely to make the two sectors more comparable since all transportation activities are included in both estimations.	

Solid Waste

Solid waste emissions from landfills are a unique source for both scales of inventories due to the way landfill methane is generated over the span of decades from the date when the waste was deposited. GHGs can be assessed in terms of the emissions from a landfill that result from historical waste deposits. The former approach is a useful perspective when considering the benefit of improved landfill gas capture controls and site improvements. The latter method places greater emphasis on the emissions associated with waste generation and can better inform strategies to reduce waste and increase and diversion practices.

	NDEP – State of Nevada	Clark County
Primary Data	Historical waste-in-place from a combination of NDEP internal data and US EPA Landfill Methane Outreach Program	Waste collected and landfilled within Clark County in 2019
Calculation Approach	Inventory-Year GHGs from historical waste deposits using a first order decay model and or landfill emissions monitoring systems.	Future GHGs from inventory-year waste deposits calculated using factors derived from first order decay model equations.
Comparison	Each approach provides fundamentally different perspectives on the direct impact of landfilled solid waste. Results between the two perspectives are not comparable even though they share many of the same underlying modeling assumptions about how municipal solid waste generates methane in a landfill environment.	

Industrial Process and Product Use

In the chart above NDEP estimates of GHGs from Industry make up 15% as opposed to 10% within Clark County. A significant explanation for that difference is due to the absence of industrial process emissions in the Clark County Inventory, whereas both scales include stationary combustion by industrial facilities. One other limitation within stationary combustion is that Clark County only includes natural gas used for industrial uses as a comprehensive source of other fuel use is unavailable at the county level.

One additional change with respect to natural gas is the treatment of fugitive emissions. Whereas NDEP includes all parts of the natural gas infrastructure that exists within the state, including production transmission and distribution, the Clark County inventory limits itself to only leakage within the local distribution system.

	NDEP – State of Nevada	Clark County
Primary Data	National emissions of industrial process emissions	Not Estimated – Not Required by Protocol
Calculation Approach	Assumed proportion of national totals based on a combination of the State's share of the national population and share of economic activity in industries that are large sources	Not Estimated – Not Required by Protocol
Comparison	Bottom-up methods for local estimation of ozone depleting substances (ODS) / hydrofluorocarbon (HFCs) are not well established and facility level reporting of these gases are not common except for very large emitters. Top-down attribution of industry related releases to local facilities risks significant error, especially if the number of facilities is relatively small and specific activities at a facility are not well characterized. Estimation of HFCs from distributed sources in cooling and refrigeration equipment is possible but would require extensive surveys to characterize the mix of this equipment within the area. Due to the challenges of data collection in this area and relatively limited authority most local governments have over these sources, Industrial Process and Product Use emissions are not required by protocol and were not included here.	

Agriculture

Agricultural emissions make up a significant part of the NDEP Inventory, however these activities are limited in Southern Nevada and were not estimated from this inventory.

	NDEP – State of Nevada	Clark County
Primary Data	Nevada specific crop and animal husbandry statistics from the National Agriculture Statistics Service	Nevada specific crop and animal husbandry statistics from the National Agriculture Statistics Service
Calculation Approach	Count of livestock and acres of agriculture production multiplied by standard average emissions factors.	Not Estimated – Agriculture was deemed "de minimis" in Clark County
Comparison	A review of data for Clark County from the National Agriculture Statistics Service confirmed that agricultural activities within the county are both small relative to the State of Nevada and small overall compared to other activities and thus omitted.	

Forestry & Other Land Use

Land use change is difficult to assess at both scales due mainly to the lack of published emissions and removal factors that are representative of the unique mix of vegetation in the working and natural lands in Nevada. Both inventories note these areas that need additional study to incorporate confidently. Emissions and sequestration from forest land specifically has been better studied and is included in each inventory. The percentage of forested land within Clark County is much smaller than that of the State of Nevada and forest related carbon flux is a much smaller sector at the local scale. However, the approaches to calculations in both cases are similar and the assessment of forests in Clark County should be representative of their proportion of the State of Nevada's forests.

	NDEP – State of Nevada	Clark County
Primary Data	US Forest Service Forest Inventory and Analysis (FIA) Research Program direct samples	Emissions and Removal factors derived from FIA research applied to cover changes in the USDA National Landcover dataset.
Calculation Approach	Up-scaled FIA measurements within the state to cover all forested areas	FIA Derived emissions and removal factors applied to the average annual change between forest and non-forest land, forest remaining forests, and urban trees
Comparison	Conceptually these approaches should provide comparable results as they are both grounded in the FIA research program and are primarily driven by the area of forest at each scale. Both approaches incorporate fire disturbance as well. Settlement soils and agricultural soils were not considered in Clark County again due to their relatively limited area in Southern Nevada. Landfill sequestration from yard trimmings and food scraps were also not considered as historical convention in local inventories focuses attention on gross GHGs.	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