BIG SKY SNO
(SUSTAINABLITY NETWORK ORGANIZATION)
COMMUNITY GREENHOUSE GAS INVENTORY
SEPTEMBER, 2021, FINAL REPORT

Background

This greenhouse gas emissions inventory for the Big Sky community is an important step forward in taking community action to address the global challenge of climate change.

Naturally occurring gases dispersed in the atmosphere determine the Earth's climate by trapping solar radiation. This phenomenon is known as the greenhouse effect. Overwhelming evidence shows that human activities are increasing the concentration of greenhouse gases and changing the global climate. The most significant contributor is the burning of fossil fuels for transportation, electricity generation and natural gas and liquid propane gas for heating and cooking. Collectively, these gases intensify the natural greenhouse effect, causing global average surface and lower atmospheric temperatures to rise.

This Green House Gas (GHG) inventory provides a picture of greenhouse gas emissions created by the activities of Big Sky residents, businesses, institutions and visitors. This information will allow development of programs and policies to most effectively reduce emissions. In addition, by comparing inventories over time, the community can track the overall achievements of these actions in reducing emissions.

Reducing fossil fuel use in the community can have many benefits in addition to reducing greenhouse gas emissions. More efficient use of energy decreases utility and transportation costs for residents and businesses, retrofitting homes and businesses to be more efficient creates local jobs and money not spent on energy is more likely to be spent at local businesses and add to the local economy.

This inventory is a first step in a process to reduce the Big Sky community carbon footprint.
Next steps are to set an emissions reduction target, conduct a vulnerability assessment, and begin developing a Climate Action Plan (CAP) that will detail solutions to reduce emissions.

Inventory Methodology

This inventory uses the approach and methods provided by the Global Protocol for Community-Scale Emissions (GPC)[1]. The GPC defines what emissions must be reported and how. In addition, this inventory draws on methods from the U.S. Community Protocol[2], which provides more detailed methodology specific to U.S. communities. Inventory calculations were performed using the Clearpath[3] tool, training and assistance was provided by ICLEI – Local Governments for Sustainability, USA and this study and report was completed by Patrick D. Miller, Big Sky SNO participant and Board of Directors member.

Greenhouse gas emissions can be quantified in two ways:

- Measurement-based methodologies refer to the direct measurement of greenhouse gas emissions (from a monitoring system) emitted from a flue of a power plant, wastewater treatment plant, landfill, or industrial facility.
- Calculation-Based methodologies calculate emissions using activity data and emission factors. To calculate emissions accordingly, the basic equation below is:

Activity Data x Emission Factor = Emissions

Emissions sources in this inventory are quantified using Calculation-Based methodologies. Activity data refer to the relevant measurement of energy use or other greenhouse gas-generating processes such as fuel consumption by fuel type, metered annual electricity consumption, and annual vehicle miles traveled.

Known emission factors are used to convert energy usage or other activity data into associated quantities of emissions. Emission factors are usually expressed in terms of emissions per unit of activity data. For example, an emission factor for the generation of electricity is expressed as lbs. CO_2/kwh of electricity; pounds of carbon dioxide emissions per kilowatt hour generated. Emissions are commonly expressed as a CO_2 equivalent or CO_2 e. CO_2 e is a metric measure used to compare the emissions from various greenhouse gases on the basis of their global-warming potential (GWP), by converting amounts of other gases to the equivalent amount of carbon dioxide with the same global warming potential. The primary greenhouse gases that are included in this study and have the most impact on the climate are Carbon Dioxide (CO_2), Methane (CH_4) and Nitrous Oxide (N_2O).

Definition of Greenhouse Gas Protocol Scope 1, 2 and 3

The Greenhouse Gas Protocol defines three components for purposes of developing a GHG inventory:

1. Direct emissions (known as Scope 1): from onsite combustion and mobile sources. In Big Sky, these emissions are from the onsite combustion of Liquid Propane Gas (LPG), Wood and Gasoline/Diesel used in vehicles and other equipment inside the defined study boundary.

[1] http://www.ghgprotocol.org/city-accounting
[2] http://icleiusa.org/publications/us-community-protocol/
[3] http://icleiusa.org/clearpath/

2. Indirect emissions (Scope 2): from purchased electricity and steam. In Big Sky, these emissions are from electricity supplied by Northwest Energy.
3. Optional emissions (Scope 3): from emissions that occur outside of the defined study boundary but are of interest such as transportation to and from Big Sky but outside of the study boundary and landfill emissions for waste generated in Big Sky but landfilled in Logan, MT.

Normally, only Scope 1 and Scope 2 emissions are collected because these are controlled by the owner and can be targeted with specific action plans. While Scope 3 emissions may be of interest in understanding carbon emissions in a supply chain or what is happening around us, the source of these emissions is not owned and cannot be controlled by the user.

Description of the Inventories & Study Assumptions

This GHG Emissions Study is the first to be performed for the Big Sky Community. The study was performed during the year 2020 and early months of 2021 using available data for the calendar years of 2018 and 2019.

Study Boundaries: Because Big Sky has no official political boundaries, the boundaries for the study are defined by the electric service area of the two dedicated substations serving Big Sky. This service area includes all Northwest Energy electric customers on the Mountain (Big Sky Resort, Moonlight and scattered homes), in the Meadow (Meadow Village, Town Center, Spanish Peaks, Yellowstone Club and scattered homes west of the intersection of M64 and US191), and the Canyon along US191 from 10 miles north of the Conoco to 20 miles south of the Conoco.

Electricity Consumption: GHG emissions from the use of electricity is calculated as the annual metered consumption (kwh's) x the electric generation emissions rate for each year (CO_2 e in lbs./kwh). All of this data was provided by Northwest Energy (NWE).

Liquid Propane Gas (LPG) Consumption – Residential & Commercial: LPG is provided in Big Sky by several small companies which have not provided actual residential and commercial delivered quantities. Therefore, this study has used State of Montana and Gallatin County statistics on how homes are heated and updated Census fuel use data to determine an average annual LPG use per residential and commercial establishment.

Industrial Electricity and LPG Consumption: Electricity consumption at the Yellowstone Club (YC) is centrally metered (all electricity is delivered through one meter). Because of this, NWE has classified YC as an industrial customer, the only industrial customer in Big Sky, with the result that we have classified all the actual electrical use for all of the YC (residential and commercial) as Industrial.

The Big Sky Resort (BSR) electricity consumption is classified by NWE as commercial. However, BSR conducted a GHG emissions study for the 12 months of November 1, 2018 to October 31, 2019 which has been used in this study as the actual 2019 data. No study has been done for 2018 so an estimate was made based on other resort data. This 2018 and 2019 data has

been moved from the commercial classification to the industrial classification so that industrial now includes YC and BSR data.

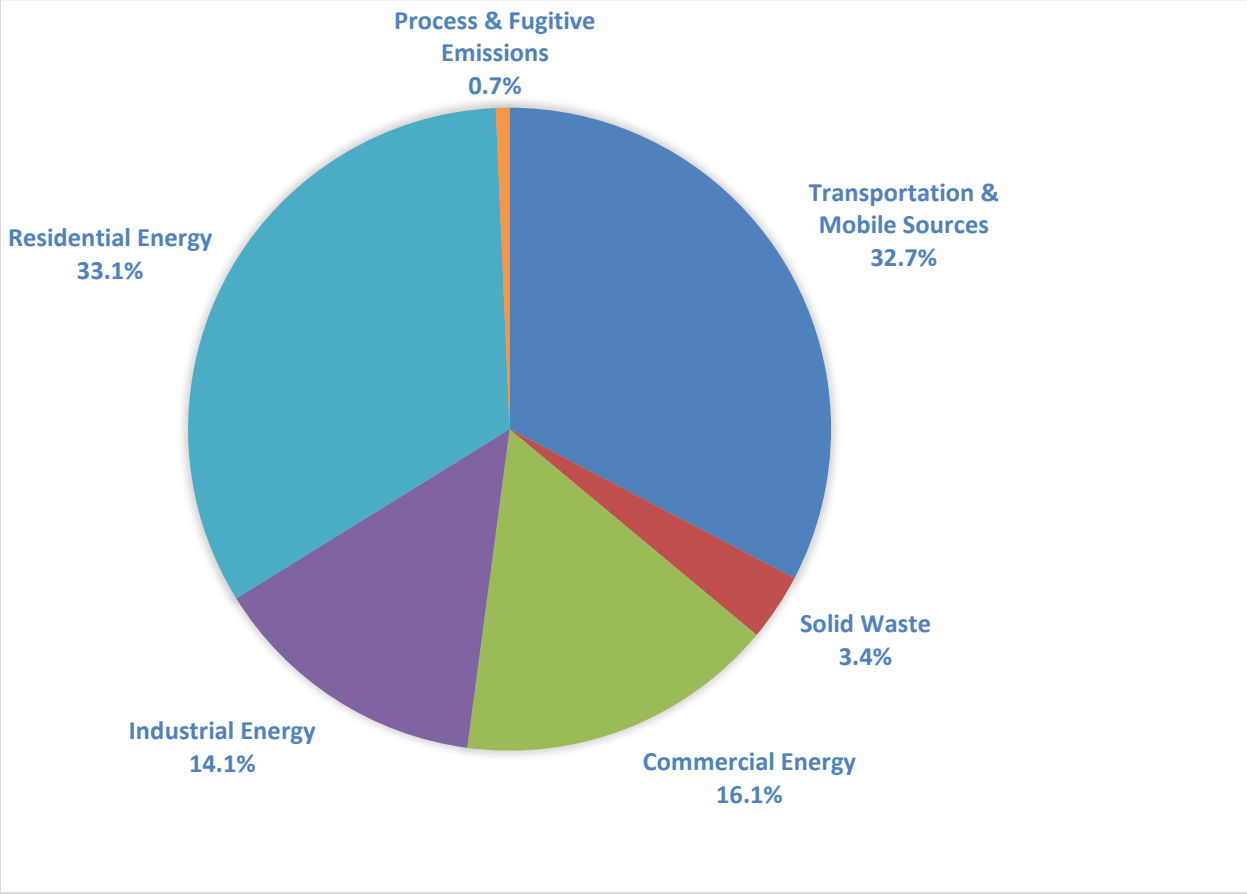
YC provided actual LPG use for both study years. The 2019 BSR study reported actual LPG use and an estimate was made for 2018 use.

Total Emissions Analysis

2018 GHG Emissions Results

2018 emissions for all sectors are shown in **Figure 1** below. Residential Energy is the largest contributor to Big Sky's emissions in 2018, contributing 33.1% of overall emissions while Transportation & Mobile Sources was a close second at 32.7%. Commercial Energy contributed 16.1% of all emissions and Industrial Energy (Yellowstone Club and Big Sky Resort) was 14.1% of all emissions. Solid Waste collection and disposal is 3.4% Process & Fugitive Emissions is 0.7%.

Figure 1: 2018 Emissions by Sector



Emissions detail for 2018 is provided in **Table 1** below which presents the data by Sector and Fuel or Source, provides annual usage data and the resulting emissions as a CO_2 (Carbon Dioxide) Equivalent, written as CO_2 e.

CO_2 e emissions in Table 1 are listed in Metric Tons for the calendar year 2018 and are the result of generating electricity, burning liquid propane gas (LPG), utilizing gasoline and diesel fuels for transportation, hauling and landfilling solid waste and a small number of fugitive emissions which are inadvertent releases or leakage of LPG. Total CO_2 e emissions for 2018 are calculated to be**145,181** Metric Tons.

Table 1: 2018 Emissions by Sector, Fuel or Source

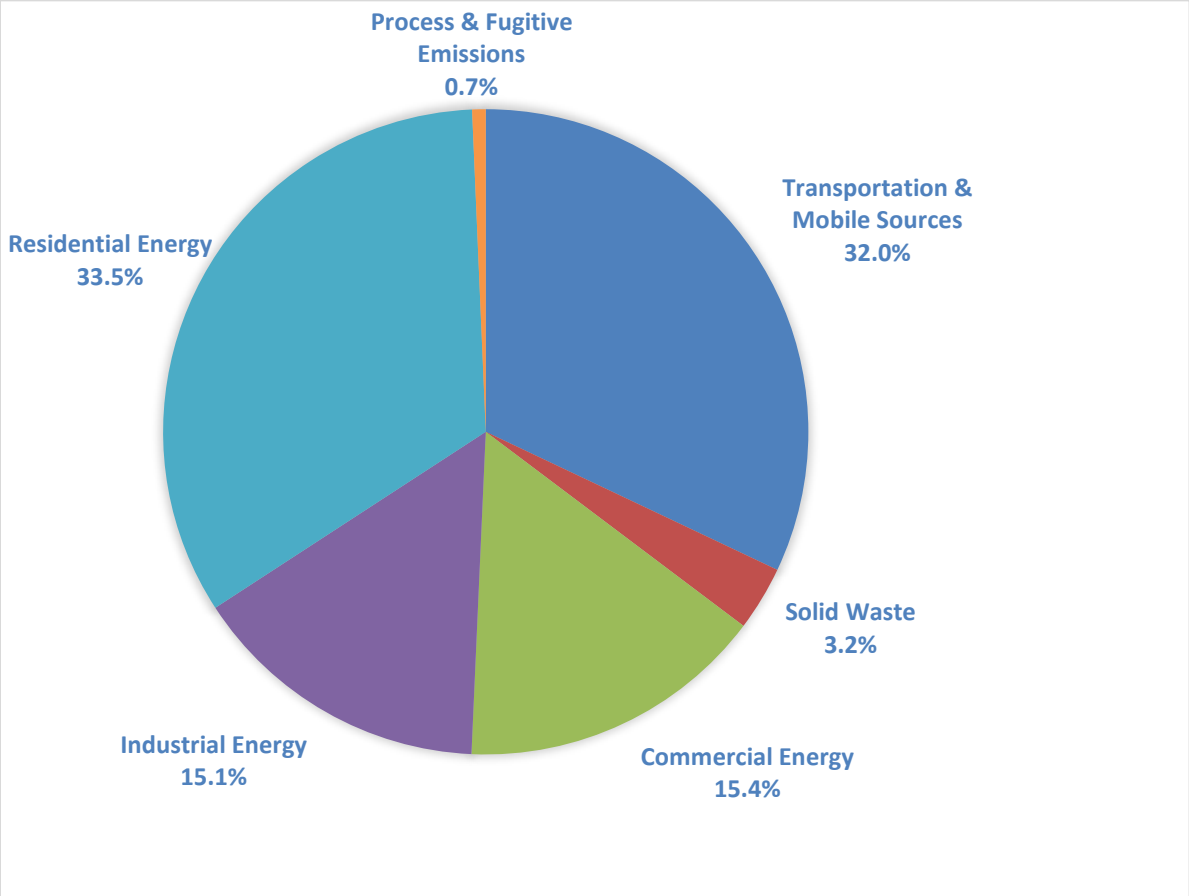
Sector	Fuel or Source	Usage	Usage Units	CO2 e Emissions	% of Total
Residential Energy	Electricity	64,577,749	kWh	26,685	
Residential Energy	LPG	3,663,245	Gallons	21,425	
Residential Energy Total				**48,110**	**33.1%**
Commercial Energy	Electricity	30,315,589	kWh	12,526	
Commercial Energy	LPG	1,842,401	Gallons	10,776	
Commercial Energy Total				**23,302**	**16.1%**
Industrial Energy	Electricity	38,968,820	kWh	16,102	
Industrial Energy	LPG	741,389	Gallons	4,322	
Industrial Energy Total				**20,424**	**14.1%**
Transportation & Mobile Sources	Gasoline	75,772,796	VMT	36,043	
Transportation & Mobile Sources	Diesel	8,419,200	VMT	11,389	
Transportation & Mobile Sources Total				**47,432**	**32.7%**
Solid Waste	Waste to Landfill	3,797	Tons	4,774	
Solid Waste	Other			142	
Solid Waste Total				**4,916**	**3.4%**
Process & Fugitive Emissions	Other			997	
Process & Fugitive Emissions Total				**997**	**0.7%**
Total 2018 CO2 Emissions - Metric Tons				**145,181**	

2019 GHG Emissions Results

2019 emissions for all sectors are shown in **Figure 2** below. Residential Energy remains the largest contributor to Big Sky's emissions in 2019, contributing 33.5% of overall emissions while Transportation & Mobile Sources was a close second at 32.0%. Commercial Energy contributed 15.4% of all emissions and Industrial Energy (Yellowstone Club and Big Sky

Resort) was 15.1% of all emissions. Solid Waste collection and disposal is 3.2% Process & Fugitive Emissions is 0.7%.

Figure 2: 2019 Emissions by Sector



Emissions detail for 2019 is provided in **Table 2** below which presents the data by Sector and Fuel or Source, provides annual usage data and the resulting emissions as a CO_2 equivalent, written as CO_2 e. CO_2 e emissions in Table 2 are listed in Metric Tons for the calendar year 2019 and are the result of generating electricity, burning LPG, utilizing gasoline and diesel fuels for transportation, hauling and landfilling solid waste and a small number of fugitive emissions which are inadvertent releases or leakage of propane gas. Total CO_2 e emissions for 2019 are calculated to be **153,159** Metric Tons.

Table 2: 2019 Emissions by Sector, Fuel or Source

Sector	Fuel or Source	Usage	Usage units	CO2 e Emissions	% of Total
Residential Energy	Electricity	70,290,584	kWh	29,301	
Residential Energy	LPG	3,764,291	Gallons	22,016	
Residential Energy Total				**51,317**	**33.5%**
Commercial Energy	Electricity	31,929,277	kWh	13,310	
Commercial Energy	LPG	1,766,463	Gallons	10,331	
Commercial Energy Total				**23,641**	**15.4%**
Industrial Energy	Electricity	42,189,347	kWh	17,586	
Industrial Energy	LPG	953,589	Gallons	5,559	
Industrial Energy Total				**23,145**	**15.1%**
Transportation & Mobile Sources	Gasoline	79,452,653	VMT	37,222	
Transportation & Mobile Sources	Diesel	8,828,073	VMT	11,847	
Transportation & Mobile Sources Total				**49,069**	**32.0%**
Solid Waste	Waste to Landfill	3,824	Tons	4,809	
Solid Waste	Other			143	
Solid Waste Total				**4,952**	**3.2%**
Process & Fugitive Emissions	Other			1,035	
Process & Fugitive Emissions Total				**1,035**	**0.7%**
Total 2019 CO2 Emissions - Metric Tons				**153,159**	

2018 – 2019 Emissions Trends

Table 3 below compares 2019 emissions by sector and fuel/source to emissions calculated for 2018. 2019 total emissions for the Big Sky community show an annual increase of 5.5% compared to 2018.

Table 3: 2018 – 2019 Emissions Trends

Sector	Fuel or Source	2018 Emissions	2019 Emissions	Metric Tons Change	% Change
Residential Energy	Electricity	26,685	29,301	2,616	9.8%
Residential Energy	LPG	21,425	22,016	591	2.8%
Residential Energy Total		**48,110**	**51,317**	**3,207**	**6.7%**
Commercial Energy	Electricity	12,526	13,310	784	6.3%
Commercial Energy	LPG	10,776	10,331	(445)	-4.1%
Commercial Energy Total		**23,302**	**23,641**	**339**	**1.5%**
Industrial Energy	Electricity	16,102	17,586	1,484	9.2%
Industrial Energy	LPG	4,322	5,559	1,237	28.6%
Industrial Energy Total		**20,424**	**23,145**	**2,721**	**13.3%**
Transportation & Mobile Sources	Gasoline	36,043	37,222	1,179	3.3%
Transportation & Mobile Sources	Diesel	11,389	11,847	458	4.0%
Transportation & Mobile Sources Total		**47,432**	**49,069**	**1,637**	**3.5%**
Solid Waste	Waste to Landfill	4,774	4,809	35	0.7%
Solid Waste	Other	142	143	1	0.7%
Solid Waste Total		**4,916**	**4,952**	**36**	**0.7%**
Process & Fugitive Emissions	Other	997	1,035	38	3.8%
Process & Fugitive Emissions Total		**997**	**1,035**	**38**	**3.8%**
Total CO_2 e Emissions - Metric Tons		**145,181**	**153,159**	**7,978**	**5.5%**

Analysis – Residential & Commercial

The number of occupied residential housing units within the Big Sky community boundary is calculated as the sum of the number of residential electric customers served by Northwest Energy plus the number of housing units within the Yellowstone Club since those homes are not separately metered. For 2018 this total is 4,426 units; for 2019 this total is 4,614 units, an increase of 4.2%.

The number of commercial units within the Big Sky community boundary is the number of commercial electric customers served by Northwest Energy. For 2018 this total is 1,019; for 2019 this total is 977 (Note: The Big Sky Resort (BSR) is classified by NWE as a commercial electric customer, but this study and report categorizes them as Industrial).

Table 4 below presents the 2018 and 2019 residential and commercial carbon footprint (Metric Tons per housing or business unit) and the change in that number from 2018 to 2019. For residential emissions, this analysis reveals that while residential energy total emissions increased substantially (6.7% from Table 3) over this period, much of that increase was due to the addition

of 188 housing units in that one-year period. Table 4 reveals that the residential carbon footprint increased by only 2.3%.

Commercial energy total emissions increased by 1.5% (from Table 3) from 2018 to 2019, but the number of commercial establishments decreased by 42 over this period resulting in a carbon footprint increase of 5.8%.

Table 4: Residential & Commercial Carbon Footprint

	2018	2018	2018	2019	2019	2019	
	Metric Tons	Number	**MT/Unit**	Metric Tons	Number	**MT/Unit**	**%**
Use Category	**Emissions**	**Units**	**Footprint**	**Emissions**	**Units**	**Footprint**	**Change**
Residential	48,110	4,426	**10.9**	51,317	4,614	**11.1**	**2.3%**
Commercial	23,302	1,019	**22.9**	23,641	977	**24.2**	**5.8%**

Population estimates for the Big Sky community in 2018 and 2019 are not readily available and are difficult to estimate. The 2020 census reported that the permanent population of Big Sky was 3,098 in 2018 and 3,058 in 2019, but no data has been gathered for this study on the secondary home population and visitor statistics which continue to increase. GHG Emission studies normally report residential study results per resident as a useful reference for setting GHG emission goals, but this has not been attempted in this inventory study.

Analysis – Industrial

As stated earlier in this report, electricity consumption at the Yellowstone Club (YC) is centrally metered (all electricity is delivered through one meter) and consequently NWE has classified YC as an Industrial customer, the only industrial customer in Big Sky. Therefore, all the actual electrical use for all of the YC (residential and commercial) has been classified as Industrial in this study.

The Big Sky Resort (BSR) electricity consumption is classified by NWE as Commercial. However, BSR conducted a GHG emissions study for the 12 months of November 1, 2018, to October 31, 2019, which has been used in this study as the actual 2019 data. No study has been done for 2018 so an estimate was made based on other resort data. This 2018 and 2019 data has been moved from the commercial classification to the industrial classification so that industrial now includes YC and BSR data only. YC provided actual LPG use for both study years. The 2019 BSR study reported actual LPG use and an estimate was made for 2018 use.

Table 3, above, summarizes 2018 – 2019 emissions trends and shows that Industrial emissions from the use of electricity increased during this period by 9.2%, about the same as the increase of Residential emissions from the use of electricity of 9.8%. Industrial emissions from the use of LPG are much less than from the use of electricity, but the increase in those emissions during this period is almost the same as the increase in electricity emissions; a 1,237 Metric Ton (28.6%) increase which is mostly the result of heating more space at the resorts. Total emissions for this Industrial sector increased by 13.3%, the largest percentage increase of all sectors.

Analysis – Solid Waste and Process & Fugitive Emissions

Table 3, above, summarizes 2018 – 2019 emissions trends and emissions data for collecting, hauling and landfilling solid waste and a small number of fugitive emissions which are inadvertent releases or leakage of LPG**.**

Solid Waste emissions as a total of all emissions is small; 3.4% in 2018 and 3.2% in 2019 (tables 1 and 2; Figures 1 and 2). Also, solid waste emissions did not change much over this two-year period, increasing only 0.7%. As discussed in the beginning of this report, landfilling of Big Sky waste is done outside of our defined study boundaries and is considered to be a Greenhouse Gas Protocol Scope 3 emission. However, it is important to recognize that these emissions are the result of collecting, transporting, but mostly landfilling 3,796 tons of waste in 2018 and 3,824 tons of waste in 2019.

Process and Fugitive Emissions is the smallest of the sectors totaling only 0.7% of all Big Sky emissions in both 2018 and 2019 (tables 1 and 2; figures 1 and 2). This small number of fugitive emissions are an estimate of inadvertent releases or leakage of LPG while performing truck deliveries, storing and utilizing of over 6 million gallons of LPG each year .

Analysis – Transportation & Mobile Sources

Transportation emissions are about the same as residential energy emissions and about the same as commercial and industrial emissions combined (tables 1 and 2; figures 1 and 2). Transportation emissions included in this study are for vehicle transportation inside the defined Big Sky community boundary. Transportation outside that boundary, such as from Bozeman/Belgrade to the North community boundary and from West Yellowstone to the South community boundary, have been calculated but are not included in this inventory.

The Clearpath tool uses annual Vehicle Miles Traveled (VMT), inputs for Montana regarding vehicle type, age, and fuel (gasoline, diesel, and electric), and then calculates the emission factors as grams of CO_2 e per Vehicle Mile Traveled (VMT).

Vehicle Miles Traveled (VMT) has been calculated using Montana Department of Transportation Average Annual Daily Traffic (AADT) data which is the total volume of vehicle traffic of a road segment for a year divided by 365. The equation for converting AADT into VMT is:

$$\text{VMT/year} = \text{AADT} \times \text{segment distance in miles} \times 365 \text{ days/year}$$

Table 5 below includes a description of each segment, the MDT identification number of the devise that collected the data, the segment length, the AADT data for each segment and the VMT/year used in the 2018 and 2019 studies.

Table 5: Annual VMT Calculations using AADT Data

2018 Segment Description		**Distance**	**AADT**	**VMT**	**VMT/Year**
Bozeman/Belgrade to Northern Boundary	16-4-003	31	6,760	209,560	76,489,400
Northern Boundary to Conoco (Hwy 64)	16-4-003	10	6,760	67,600	24,674,000
Conoco to Meadow Village and Town Center	16-4-004	6	8,521	51,126	18,660,990
TC to Yellowstone Club and Spanish Peaks	50%	5	2,991	14,955	5,458,575
Town Center to Big Sky Resort and Moonlight	16-4-005	10	2,539	25,390	9,267,350
Conoco to 320 Ranch	16-4-002	12	5,966	71,592	26,131,080
320 Ranch to Southern Boundary (Black Butte)	16-4-001	8	2,114	16,912	6,172,880
Total VMT				**440,223**	**166,854,275**
Gasoline	**Total**	**In-Boundary**			**Out-Boundary**
90%	150,168,848	75,772,796			74,396,052
Diesel					
10%	16,685,428	8,419,200			8,266,228
2019 Segment Description	**TCS #**	**Distance**	**AADT**	**VMT/Day**	**VMT/Year**
Bozeman/Belgrade to Northern Boundary	16-4-003	31	6,975	216,225	78,922,125
Northern Boundary to Conoco (Hwy 64)	16-4-003	10	6,975	69,750	25,458,750
Conoco to Meadow Village and Town Center	16-4-004	6	9,202	55,212	20,152,380
TC to Yellowstone Club and Spanish Peaks	55%	5	3,631	18,155	6,626,575
Town Center to Big Sky Resort and Moonlight	16-4-005	10	2,580	25,800	9,417,000
Conoco to 320 Ranch	16-4-002	12	6,079	72,948	26,626,020
320 Ranch to Southern Boundary (Black Butte)	16-4-001	8	2,125	17,000	6,205,000
Total VMT				**475,090**	**173,407,850**
Gasoline	**Total**	**In-Boundary**			**Out-Boundary**
90%	156,067,065	79,452,653			76,614,413
Diesel					
10%	17,340,785	8,828,073			8,512,713
Percent Growth - 2018 to 2019	**3.93%**	**4.86%**			**2.98%**

Figures 3 and 4 below diagram the AADT data used in the 2018 (figure 3) and 2019 (figure 4) studies.

Figure 3: 2018 AADT Study Inputs

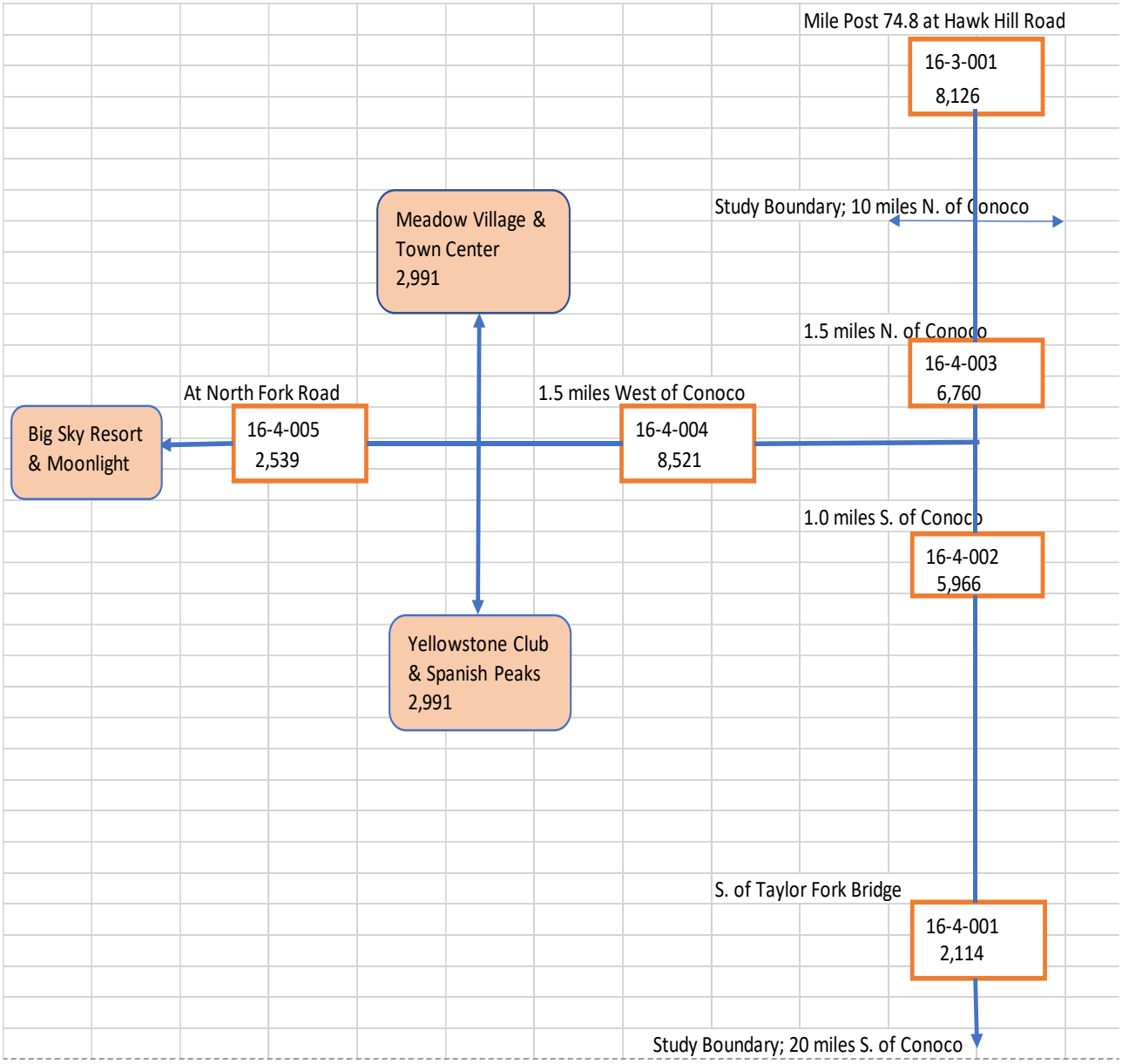


Figure 4: 2019 AADT Study Inputs

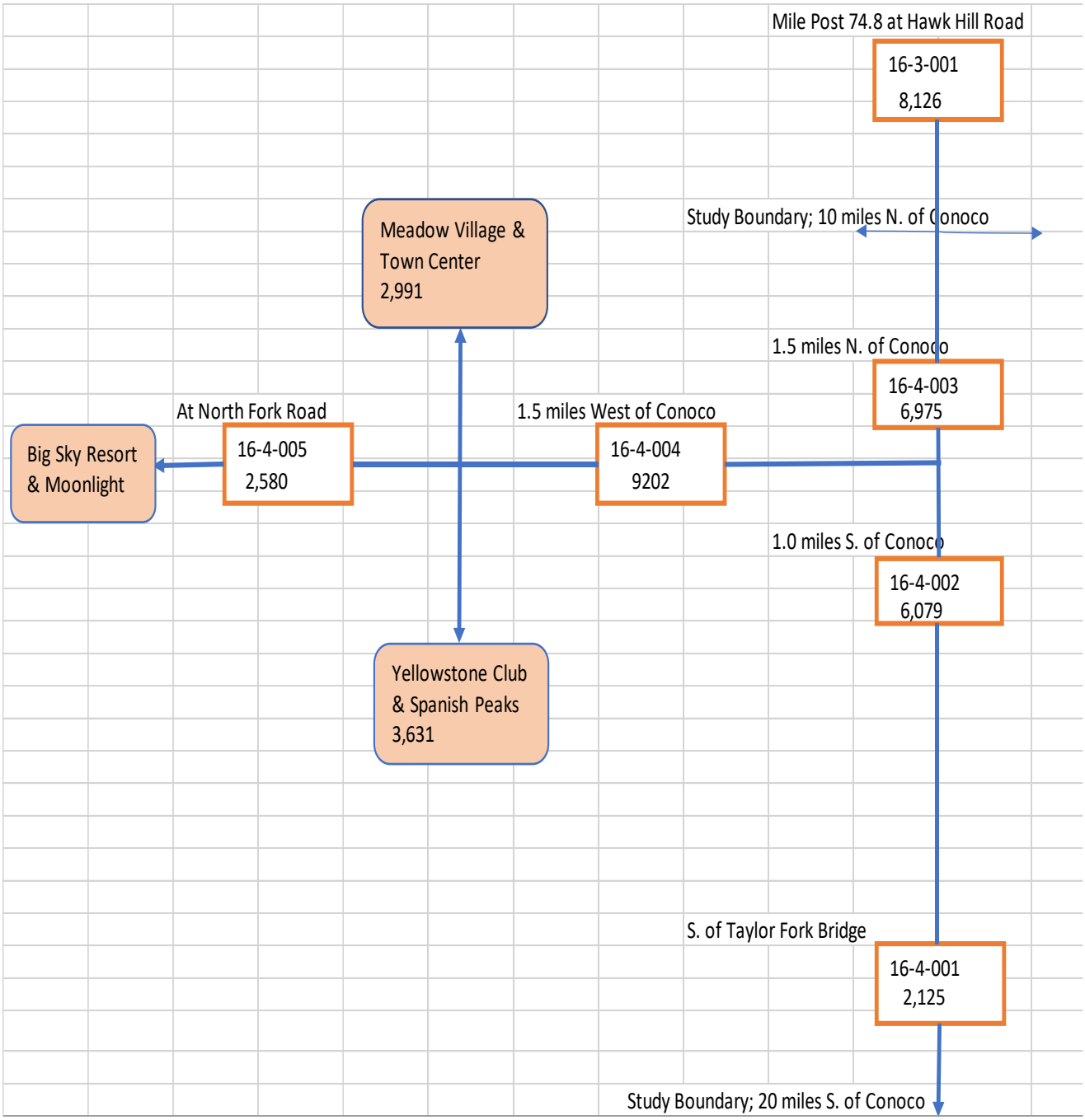


Table 6 below summarizes the changes in VMT and total transportation emissions from 2018 to 2019. VMT values are for in-boundary travel and are taken from Table 5; total emissions are taken from Table 3. Note that, while vehicle miles traveled increased by 4.9%, total transportation emission increased by only 3.5%. This result is due to ever increasing efficiencies in automobiles and light trucks in newer models; as older models are retired and new models replace them, emissions per mile are reduced.

Table 6: Transportation 2018 – 2019 Trends

Description	2018	2019	% Change
Vehicle Miles Traveled (VMT/year In-Boundary)	84,191,996	88,280,726	4.9%
Total Transportation Emission (Metric Tons)	47,432	49,069	3.5%

CONCLUSIONS AND NEXT STEPS

Conclusions and Comments

In addition to the tables and figures previously presented, the following table 7 presents the change in CO_2e emissions over the two-year study period by emission source. Table 8 shows 2019 emissions by emission source.

Table 7: Emissions by Source; 2018 – 2019 Trends

	2018	2019	Metric Tons	
Emission Source	CO_2e Total	CO_2e Total	Change	% Change
Electricity from NWE	55,313	60,197	4,884	8.8%
LPG	36,523	37,906	1,383	3.8%
Transportation	47,432	49,069	1,637	3.5%
Waste & Fugitive	5,913	5,987	74	1.3%
Total	**145,181**	**153,159**	**7,978**	**5.5%**

Table 8: 2019 Emissions by Source

Emission Source			CO_2e Total	
Electricity from NWE	144,409,208	kWh	60,197	39.3%
LPG	6,484,343	Gallons	37,906	24.7%
Transportation	88,280,726	VMT	49,069	32.0%
Waste & Fugitive	3,824	Tons	5,987	3.9%
Total			**153,159**	

Conclusions and comments from this GHG Emissions Study are:

- **Green Energy Supply:** North Western Energy is the only electric utility serving the Big Sky community, providing electricity to residential, commercial, and industrial customers. In 2019, emissions from electricity use alone accounted for 39.3% of the Big Sky community GHG emissions (Table 8), and electricity from NWE is the fastest growing emissions source; 8.8% per year (Table 7). Future Climate Action Plan content should focus on lowering electricity related emissions by advocating for a continued reduction in carbon- based generation in favor of new green power projects.

- **Energy Efficient Buildings:** It is estimated that more than half of our Big Sky carbon footprint is the result of heating, cooling and otherwise running buildings using electricity provided by North Western Energy and liquid propane gas (LPG) provided by multiple independent suppliers (Table 2). This includes almost all of residential and commercial emissions and an estimated half of the industrial (resorts) emissions. Future Climate Action Plan content should focus on the design and construction of new high-performance buildings and energy saving investments in existing buildings.

- **Reduced Transportation Emissions:** Emissions resulting from transportation in 2019 represent 32.0% of all emissions (Table 8), the second leading contributor to the Big Sky carbon footprint. It is enlightening to learn that a small community like Big Sky, with only a 3,058 permanent population in 2019, could drive gasoline and diesel-powered vehicles a total of 88,280,726 in-boundary miles in that one year (Tables 6 & 8). Of course, the permanent population didn't drive all of those miles; visitors, part time home owners and contractors account for most of the travel. Future Climate Action Plan content should focus on this sector realizing that tourism and construction will not decrease in the near future. Opportunities to reduce our transportation carbon footprint might be found in initiatives involving carpooling, busing, local housing and the natural aging of old vehicles in favor of new, energy efficient, ones.

- **Dealing with Big Sky Community Growth:** Residential housing units grew from 4,426 in 2018 to 4,614 in 2019; an increase of 188 units or 4.2% (Table 4). During this same period, total residential carbon emissions grew by 6.7% (Table 3). When communities like Big Sky and organizations like Big Sky SNO strive for carbon neutrality or net zero goals, it is difficult to find solutions for 6-7% annual growth. For this reason, it is recommended that future climate action plans use carbon footprint goals that take into account that new housing units, hotels and other commercial establishments will be added each year for many years to come. The impact of looking at a carbon footprint when setting goals can be seen in the Residential sector (Tables 3 & 4) where the carbon emissions grew by 6.7% over the study period, but the Residential carbon footprint grew by only 2.3%. (2018 = 10.9 MT/housing unit; 2019 = 11.1 MT/housing unit).

Next Steps

Based on this GHG Emission Study findings, the next steps for Big Sky SNO and the Big Sky community are to establish an emission reduction target and then a Climate Action Plan (CAP) for mitigation and adaptation.

Emissions reduction targets are expressed as a percentage reduction, compared to base year emissions, and include both short-term and long-term targets. Many communities are expressing their goals in terms of carbon neutrality or net zero by a specified target year (commonly 2050). A goal of carbon neutrality/net zero means the community would reduce emissions to as near zero as possible, and then use accounting mechanisms to offset the remaining emissions with

emissions reductions somewhere else; carbon credits or Offsets are popular mechanisms used for this purpose . In addition to the long-term target, the Big Sky community should set intermediate targets to provide a regular measure of progress. The first target should give a few years for climate action plan measures to begin to take effect. Thus, if a climate action plan is adopted in 2021, 2025 may be a good initial target year. An additional intermediate target between the first target and 2050 is also recommended (2035 is a common target year). In general, short-term and intermediate targets should fall on a linear path toward the long-term target.

In addition to the above steps, it is recommended that Big Sky SNO complete a re-inventory at least once every four years. This will allow the community to track effectiveness of the climate action plan and progress towards the emissions reduction targets (see the GHG Emissions Reduction Process map below).

Figure 5: GHG Emissions Reduction Process