



CLIMATE SMART  
MISSOULA



MISSOULA  
COMMUNITY  
GREENHOUSE GAS  
EMISSIONS  
INVENTORY

Missoula, MT | March, 2017

The Missoula community greenhouse gas emissions inventory is a comprehensive account of the sources of carbon emissions in our community for the year 2014. This inventory guides the implementation of the Community Climate Smart Action Plan and measures progress towards our community goal of carbon neutrality by 2050.

Greenhouse  
Gas and Energy  
Conservation  
Team Established

Mayor's Advisory  
Group on  
Climate Change  
and Sustainability  
Established



2000 2001 2002 2003 2004 2005 2006 2007 2008

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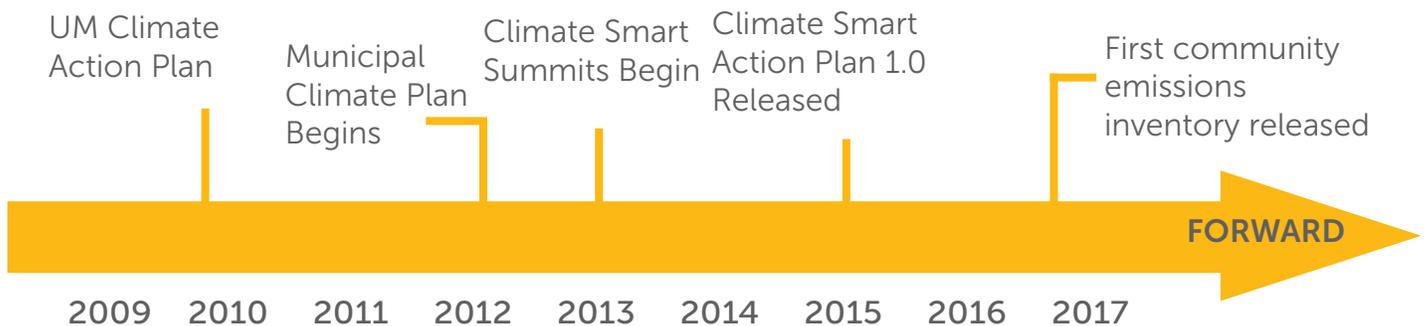
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# FOREWORD & ACKNOWLEDGMENTS

## Mayor John Engen

The City of Missoula feels a sense of urgency around climate change—we recognize it is our responsibility to be a part of energy and climate solutions, and we have commitments in place.

Our 2013 municipal Conservation and Climate Action Plan is grounded in having an understanding of our greenhouse gas emissions with its detailed inventory. Now the Community's Climate Smart Action Plan has a robust baseline carbon inventory, and this will allow us to update this plan and work toward the aspirational goal of carbon neutrality by 2050. That's smart and that's exciting.

Local action to reduce our carbon footprint is imperative for this global issue, and Missoula can and should continue to be out in front of this movement. I whole heartedly thank the many partners who worked to obtain or provide these data and figure out what they mean! Once again, there's no shortage of dedicated community members who continue to get the good work done, and for this we should all be immensely thankful.



John Engen, Mayor

## ACKNOWLEDGMENTS:

### Energy:

Rick Burt, Steve Clawson (NorthWestern Energy)  
Mark Hayden (Missoula Electric Cooperative)

### Transportation:

David Gray (City of Missoula Transportation Department)  
Cris Jensen (Missoula International Airport)  
Jim Lewis (Montana Rail Link)

### Solid Waste:

Jennifer Bernosky,  
Kirk Treece (Republic Services)

### Data Wranglers:

Sean Doty, Chris Essman (City of Missoula Energy Corps Service Members)

### Inventory Review:

Abby Huseth, Hailey Jorgensen, Beth Schenk, Andrew Valainis, Molly White



# INTRODUCTION

**Amy Cilimburg**, Climate Smart Missoula, Director

**Caroline Lauer**, Climate Smart, Program Associate

**Chase Jones**, City of Missoula, Energy Conservation Coordinator



Over the past decade, our community-wide efforts to be part of climate solutions have accelerated. Following multiple community meetings and summits to discuss issues, priorities, and strategies for action, a team of Missoulians crafted a first-ever Community Climate Smart Action Plan, completed in July 2015. We call this plan v1.0 because although a solid plan, it has been without actual greenhouse gas emissions inputs upon which to base our goals and strategies. Our community plan calls for carbon neutrality by 2050. Clearly the actual carbon numbers for Missoula are needed so we know our base line status and how to best measure success. With this initial inventory complete, we will now re-visit this Community Action Plan, inserting emission data and quantifiable measures for which we can strive in the coming decades—Action Plan v2.0 is forthcoming.

The City's expertise in conducting greenhouse gas inventories (which they have conducted for municipal operations and inform the City's Conservation and Climate Action plan), clearly allowed us to complete this community inventory effort. We are pleased to be able to use a state of the art carbon calculator, ClearPath, a tool that we use for the City's effort and will be used for future inventories.

We are grateful to all those who have contributed data to these efforts, helped populate the ClearPath calculator, and reviewed our efforts and report. In particular, NorthWestern Energy provided the inventory with aggregate data of electric and natural gas usage that was specific to our community boundary. This was the first time our community has been able to utilize such data, and we're excited to use these today and in the future, allowing us to make robust decisions about our community energy consumption. See facing page for the full list of all those who assisted.

We look forward to working with all members of our community to reduce our carbon footprint and build a healthier and more resilient Missoula. Onward to carbon neutrality!

Thank you,  
Amy, Chase,  
and Caroline



# EXECUTIVE SUMMARY

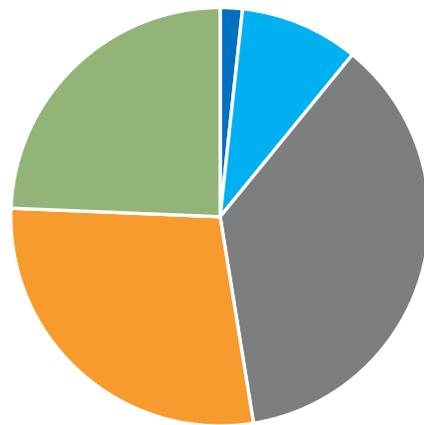
Missoula's first community greenhouse gas emissions inventory measures the collective carbon footprint for the Missoula community. Defining the community boundary was the first step, and all collected data is specific to the boundary, different from the city limits boundary (see map, p.6).

Adhering to the U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, we collected various data points in the transportation, energy (residential, commercial, and industrial), and waste sectors. By utilizing the ICLEI ClearPath tool and its numerous emissions calculators, the carbon emissions were calculated for each sector from the raw data that was collected from various entities.

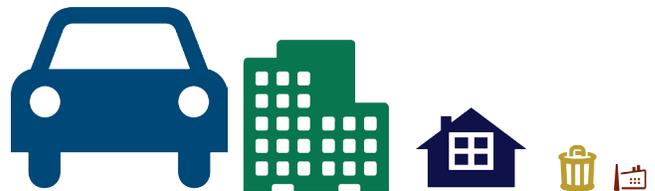
Our overall footprint is **913,250 metric tons (MT) CO<sub>2</sub>e**. Given the 2014 population data for this area (84,239 individuals, 35,399 households), this is ~10.84 MT CO<sub>2</sub>e/person. We are presently researching how our emission numbers compare, both individually and collectively, to other like-sized U.S. communities. It appears we're a bit better than average, but it's a challenge to ensure we're comparing apples to apples. Look for further discussion about this in 2017. And for comparison, the City of Missoula's municipal operations for 2014 were 8645 MT CO<sub>2</sub>e (less than 1% of this total), with slightly different emissions data available and utilized.

Transportation is largest sector (**333,986 MT CO<sub>2</sub>e**), followed by commercial energy (**257,526 MT CO<sub>2</sub>e**), and residential energy (**222,354 MT CO<sub>2</sub>e**), with solid waste (**83,749 MT CO<sub>2</sub>e**) and industrial energy (**15,635 MT CO<sub>2</sub>e**) as the two smaller emitters.

## Community Emissions, by Sector



Transportation | 37%  
Commercial Energy | 28%  
Residential Energy | 24%  
Solid Waste | 9%  
Industrial Energy | 2%



## Community Emissions in Relative Size



## 1. Transportation, 37%

The transportation sector accounts for all car, bus, truck, train, and plane travel within our boundary. Examples of data that were collected are, vehicle miles traveled, airline flights and fuel consumption.

## 2. Commercial Energy, 28%

The commercial energy sector accounts for all electricity and natural gas usage in commercial units within our boundary. This includes myriad businesses, the City, the University of Montana and more (> 7000 accounts).

## 3. Residential Energy, 24%

The residential energy sector accounts for all electricity and natural gas usage, as well as wood burning stoves, in residential units (both home-owned and rentals) within our boundary.

## 4. Solid Waste, 9%

The solid waste sector accounts for all emissions from waste that is currently in the landfill and waste that is newly deposited in the landfill.

## 5. Industrial Energy, 2%

The industrial energy sector accounts for all electricity and natural gas usage from a handful of large industrial clients within our boundary.

## How do we compare?

For these sectors, we can assess our numbers relative to others. Our 2014 transportation numbers average 3.97 MT CO<sub>2</sub>e/person, which puts us a little lower (and better) than the US average of 4.7 MT CO<sub>2</sub>e/person. Our residential energy sector also appears slightly lower than the US average on a per capita basis. Our waste diversion rates are higher than many communities. Finally, commercial and industrial energy vary too much by size and type to compare.

# METHODOLOGY

## Boundary Definition

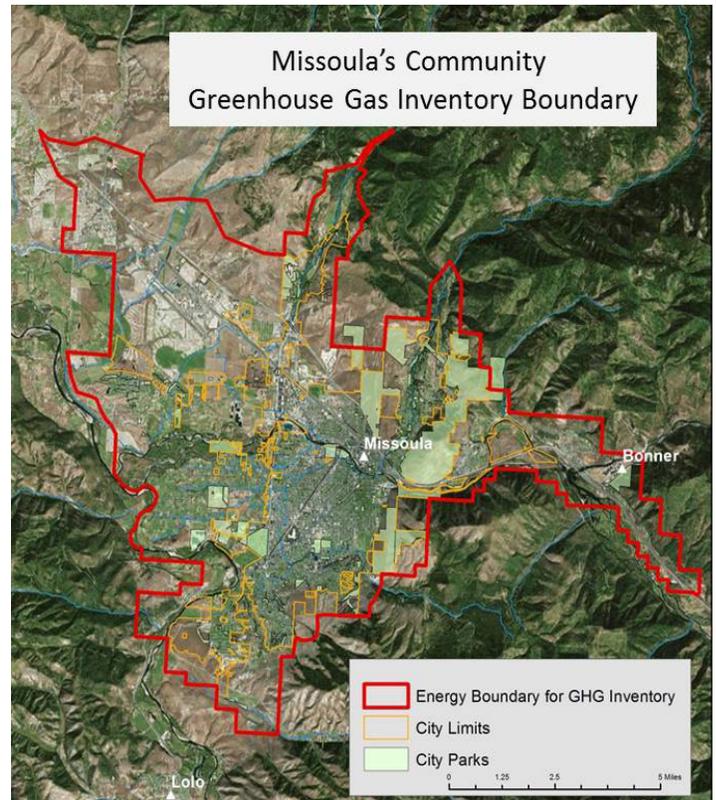
Rather than be limited by the boundaries of city limits, the community inventory boundary represents a more complete picture of Missoula's footprint. Our boundary is based largely off of the Metropolitan Planning Organization (MPO) boundary. This boundary may change over time. The temporal boundary of the inventory is the 2014 calendar year.

## Protocol Adherence

This inventory adheres to the 2013 U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions, a detailed document with cutting-edge methodologies and best practices that allow for easy comparison over time and across communities.

## Data Collection

Data for the inventory was collected by the City of Missoula and Climate Smart Missoula in partnership with NorthWestern Energy, Republic Waste Services, Missoula Electric Co-Op, Montana Rail Link, Mountain Line Transportation, Missoula International Airport and Missoula County. We look forward to continue working with these partners well into the future.



2014 Community Emissions Inventory Boundary

## Emissions Calculators

This inventory utilized the ICLEI USA ClearPath community emissions calculator. The tool offered a clear and complete set of resources to perform a US Community Protocol compliant greenhouse gas emissions inventory. (See appendix for list of greenhouse gases measured.)

ICLEI USA is a recognized leader in local sustainability, and their ClearPath tool offers a comprehensive approach to measuring community emissions.



Ronni Flannery, photo

## Sectors

Data was collected by the sector categories of transportation, residential, commercial, industrial energy, and solid waste. Additional categories, such as process and fugitive emissions, were deemed outside the scope of this inventory because activity data were not readily available but may be included in future iterations. Within each sector, inventory records detailed specific energy consumption data to better organize and understand the community's consumption data. For example, "residential energy" is comprised of aggregate data from NorthWestern Energy electric and natural gas accounts, Missoula Electric Co-Op aggregate data, and wood burning stove data. By specifying data in this manner, we are able to better target reduction strategies, goals, and potential partners. A full list of inventory records by sector is available in the appendix.

## eGRID & EPA

Our electricity consumption (residential, commercial, and industrial) was paired with the eGRID geographic emissions factors to ensure that our emissions are as accurate as possible for our particular energy mix.

EPA emission factors were used for transportation and waste calculations.





# TRANSPORTATION

Measuring all car, bus, truck, train, and plane travel within our community boundary, transportation represents 37% of our overall carbon footprint.

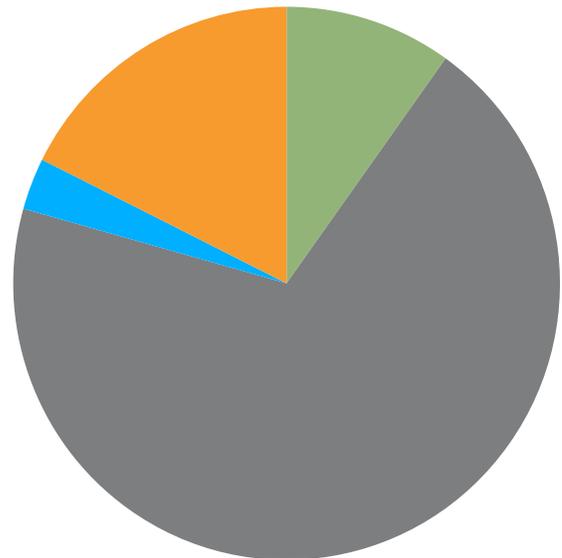
The transportation sector accounts for the largest portion of community emissions, emitting 333,986 MT of CO<sub>2</sub>e. (See Appendix for specific activity data)

Within the transportation sector, the Metropolitan Planning Office (MPO) provided data on diesel and gasoline on-road use, Missoula International Airport provided passenger and freight fuel data, and Montana Rail Link provided fuel use data within our emissions boundary. Our “on road” gasoline use, meaning all gasoline used by passenger cars, trucks, and motorcycles, is responsible for 72% of all transportation emissions, or 22% of our total community emissions. Approximately half of gasoline use is from passenger vehicles (60.6%), and light trucks account for roughly a third of gasoline use (32.5%). Motorcycles comprise the remaining 6.9% of gasoline use.

## Gasoline emissions, by mode of transit represented in relative size



## Transportation Emissions, by Source



On Road Gasoline | 72%  
 On Road Diesel | 15%  
 Montana Rail Link | 10%  
 Airport | 3%



# COMMERCIAL ENERGY

Including all electricity and natural gas usage from commercial accounts, this sector is the second largest contributor to the community carbon footprint and accounts for 28% of the overall total.

The emissions in this sector are produced by the electricity and natural gas usage in the commercial sector, such as the restaurants, offices, retail, hospitals, and other businesses within the boundary. This also includes the City of Missoula and the University of Montana.

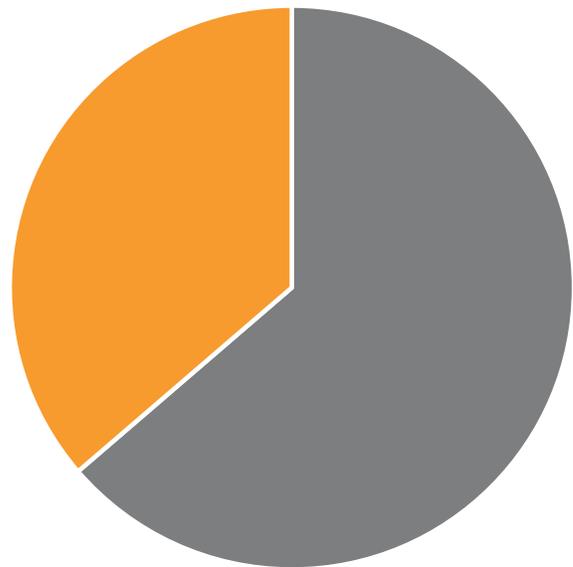
Representing 28% of our overall carbon emissions footprint, commercial energy is the second largest contributor to the community emissions with 257,525.71 MT CO<sub>2</sub>e.

**257,525.71 MT**  
**CO<sub>2</sub>e**

is the amount of emissions we would save if we took half of Missoula's cars off the road for a year



## Commercial Energy Emissions, by Source



Electricity | 64%  
Natural Gas | 36%



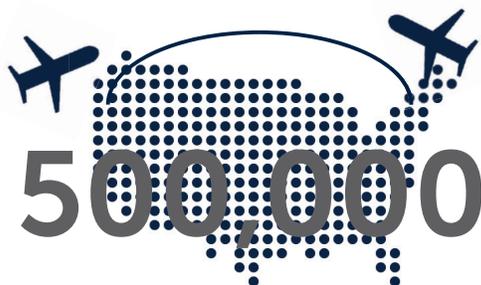
# RESIDENTIAL ENERGY

Accounting for all electricity and natural gas usage within residential units, this sector is the third largest contributor to the community carbon footprint and accounts for 24% of the overall total.

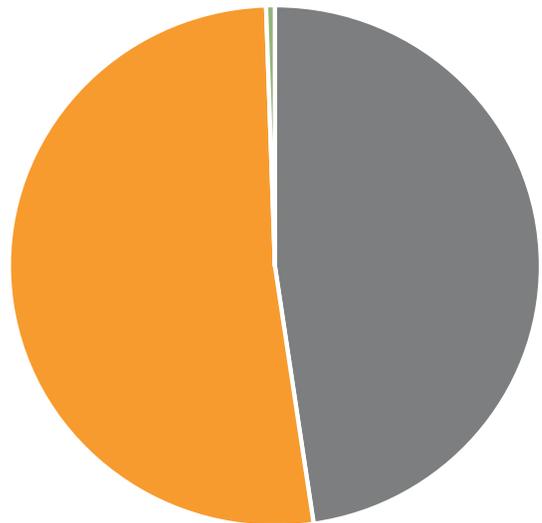
Within the residential energy sector, we measured natural gas and electricity usage from NorthWestern Energy, electricity usage from the Missoula Electric Cooperative, and wood burning stoves from the Missoula City-County Health Department. Wood stoves contribute less than .1% of the total, with electric and natural gas consumption nearly even.

Residential energy use is an important piece of the pie, and to date there has been no comprehensive community-wide effort to reduce energy use from residences, whether owner-occupied or rental homes. Climate Smart Missoula aims to change that with efforts to encourage more solar energy, enhanced "green building" for new and remodeled homes, and our 10% energy challenge to reduce energy use. There's so much we can do together.

**Total Residential Emissions is Equivalent to 500,000 Cross Country Flights (on Average)**



## Residential Energy Emissions, by Source



**Natural Gas | 52%**  
Electricity | 48%  
Wood Burning Stoves | <.1%



# SOLID WASTE

Accounting for the emissions from waste that is currently in the landfill and for waste that will be deposited into the landfill, the solid waste sector represents 9% of our overall footprint and is the 4th largest sector.

Data for the waste sector was collected through a collaborative partnership with Republic Waste Services and mandatory reporting that the Missoula landfill provides for the EPA. The data from Republic Services (in tons of waste) represents the emissions from new waste that is deposited into the landfill, while the EPA data represents emissions from waste that is already at the landfill.

The emissions from existing waste, data provided by the EPA, represents waste that was collected in the past but continues to emit. Emissions from new waste, data provided by Republic, represents waste that was collected in 2014 that will continue to emit into the future.

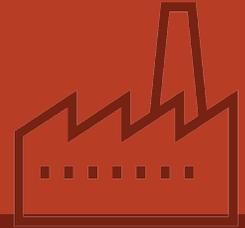
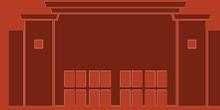
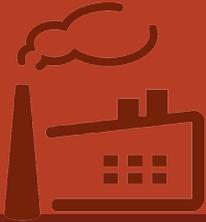
Missoula currently diverts (i.e. recycles or reuses) 22% of its waste from the landfill, which is lower than the national average of 35%, according to the Missoula Zero Waste Resolution. Climate Smart Missoula is excited to partner with Zero Waste Missoula, Home ReSource, and the City of Missoula to continue to make improvements and ensure that our community reduces, reuses, and recycles heading to Zero Waste by 2050.



## Solid Waste Emissions, by Source



Emissions from New Waste | 51%  
Emissions from Existing Waste | 49%



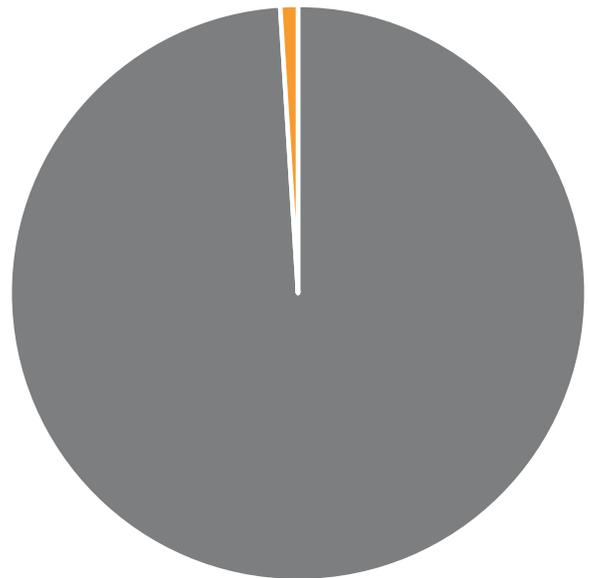
# INDUSTRIAL ENERGY

Including all electricity and natural gas usage from industrial accounts, this sector is the smallest contributor to the community carbon footprint and accounts for 2% of the overall total.

This sector measured electricity and natural gas usage by NorthWestern Energy’s industrial energy accounts, as well as electricity usage information from Missoula Electric Cooperative’s industrial customers. The industrial energy sector consists of all facilities and equipment used for producing, processing, or assembling goods.

In total, these accounts emit 15,635.7 MT CO<sub>2</sub>e.

### Industrial Emissions, by Source



Electricity| 99%  
Natural Gas| 1%



# MOVING FORWARD



The release of Missoula’s community emissions inventory is a critical step in better understanding our community’s energy footprint and tailoring responses that are custom to our community’s needs, goals, and opportunities.

We believe that data, together with community input, are critical to making decisions about the best paths to reduce our carbon footprint. We are committed to tracking these carbon emissions numbers in order to evaluate the effectiveness of our efforts as we move forward.

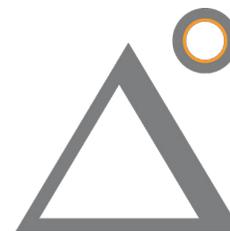
While no community inventory is fully comprehensive, these efforts aim to provide as complete a picture of greenhouse gas emissions associated with a community as is feasible. Yet, we recognize that not everything is incorporated in this inventory. For example, it is beyond the scope of this inventory to measure consumption-based activities. We hope to be able to include these in the future.

The results and data from this inventory will be thoroughly integrated into our existing Climate Smart Community Action Plan and will inform subsequent updates of the plan. Using data driven strategies, we are committed to reducing our emissions and meeting our goal of carbon neutrality by 2050. Or sooner!

Every three to five years, we will release a similar update to our community emissions status. Now that we’ve undergone this process, we’re confident that these reports can be released soon after the closing of the calendar year for which we are reporting.

As mentioned, our cumulative emissions number (just shy of 1 million MT CO<sub>2</sub>e) for 2014 appears to put us in the “not bad, but plenty to do” category. We may be putting less carbon pollution into the atmosphere than some of our neighbors around the country, but the fact of the matter is that in the ensuing years and decades, we *all* need to do more. To stave off the worst of climate change, we’ll even need to find ways to be “carbon positive” in our own communities (think more solar and more trees). We believe there are myriad opportunities to use less energy and use it smarter. We can continue building a bikeable and walkable community where people drive fewer miles alone. Our built environment—from homes, to businesses big and small, to our handful of larger manufacturing industries—plays a critical role in the quest to use less energy and add more renewables to the mix. And importantly, there are the co-benefits of the local jobs needed to get this work done.

This is the first step in a long journey, and we need your help moving forward to boldly and quickly reduce emissions. We hope you’ll join us on our mission to make Missoula more Climate Smart.



**CLIMATE SMART**  
**MISSOULA**

# APPENDIX

## a. Overall Emissions

Sector	MT of CO <sub>2</sub> e	Percentage of Overall Total
Transportation	333,986	37%
Commercial Energy	257,525	28%
Residential Energy	222,354	24%
Solid Waste	83,749	9%
Industrial Energy	15,635	2%

## b. Transportation Emissions

Inventory Record	MT of CO <sub>2</sub> e	Percentage of Sector Total
On Road Gasoline	240,599	72%
On Road Diesel	50,539	15%
Montana Rail Link Line-Haul	30,555	9%
Montana Rail Link Switchyard	1,385	< 1%
Airport Passenger Jet Fuel	9,558	3%
Airport Passenger AvGas	816	< 1%
Airport Freight Jet Fuel	215	< 1%

# APPENDIX

## c. Residential Energy Emissions

Inventory Record	MT of CO <sub>2</sub> e	Percentage of Sector Total
NorthWestern Energy Natural Gas	115,833	52%
NorthWestern Energy Electricity	98,014	44%
Missoula Electric Co-Op Wood Burning Stoves	8,684	3%
NorthWestern Energy Landlord/Tenant Natural Gas	1,190	< 1%
NorthWestern Energy Landlord/Tenant Electricity	188	< 1%
	71	< 1%

## d. Commercial Energy Emissions

Inventory Record	MT of CO <sub>2</sub> e	Percentage of Sector Total
NorthWestern Energy Electricity	159,491	62%
NorthWestern Energy Natural Gas	90,345	35%
Missoula Electric Co-Op	4,317	2%
NorthWestern Energy Interdepartmental Natural Gas	3,165	1%
NorthWestern Energy Interdepartmental Electricity	207	< 1%

# APPENDIX

## e. Solid Waste Emissions

Inventory Record	MT of CO <sub>2</sub> e	Percentage of Sector Total
Republic Services Solid Waste Landfill	42,322	52%
Missoula Landfill EPA Facility Emissions	41,427	48%

## f. Industrial Energy Emissions

Inventory Record	MT of CO <sub>2</sub> e	Percentage of Sector Total
NorthWestern Energy Electricity	50,640	66%
NorthWestern Energy Natural Gas	25,717	33%
Missoula Electric Co-Op	440	1%

## g. eGRID 2012 NWPP Region Emission Rates

Greenhouse Gas	lbs/Unit
CO <sub>2</sub>	665.75 lbs/MWh
CH <sub>4</sub>	12.60 lbs/GWh
N <sub>2</sub> O	10.38 lbs/GWh

# APPENDIX

## h. eGRID 2012 NWPP Region Resource Mix

Resource	% of Mix
Coal	24.5%
Oil	0.35%
Gas	10.65%
Other Fossil	0.13%
Nuclear	3.25%
Hydro	52.22%
Biomass	1.10%
Wind	7.03%
Solar	0.004%
Geothermal	0.65%
Other unknown/ purchased fuel	0.12%

## i. Not Included in Inventory

The following items were not included in the inventory because activity data were not readily available: consumption, process and fugitive emissions.

## j. Resources & Links

eGRID: <https://www.epa.gov/energy/egrid>

ICLEI ClearPath: <http://icleiusa.org/clearpath/>

This Report: <http://www.missoulaclimate.org/inventory-and-metrics.html>