

**ClearSky Climate Solutions / Climate Smart Missoula
First United Methodist Church Greenhouse Gas Assessment FY2019**

Total Carbon Footprint: 108.89 Metric Tons CO2e

	Data Provided by FUMC
	Calculated Figure
	Standard Conversion Factor
	Greenhouse Gas (GHG) Figure

On-site Energy Use [1] Metric tons CO2e: 91.63

	Electricity Use	Electric Emission Factor MT	Standard Line Loss	Metric Tons CO2e
Location	kWh	kg CO2/kWh	7.2%	
Church	41,200.00	0.407	1.072	17.98

	Natural Gas Use	Natural Gas Emission Factor	Metric Tons CO2e
Location	therms	kg CO2/therm	
Church	12,455.00	5.914	73.66

Plane Travel [2] Metric tons CO2e: 0.00

Time and distance estimates for <u>one leg</u>	# of round-trip flight legs	Total round-trip distance	Emission Factor for Flight Type	Metric Tons CO2e
		Miles	kg CO2/Passenger Mile	
Short (1.5 hours/ < 281 miles):			0.290	0.00
Medium (2-3 hours/ 281-994 miles):			0.203	0.00
Long (4-6 hours/ > 994 miles):			0.177	0.00

Commuting & Additional Car Travel [3] Metric tons CO2e: 11.79

Congregant commuting	Gallons Used	Emission Factor for Gasoline

Type		Gallons	lb CO2e/Gal
Compact Cars		286.00	24.692
SUVs		286.00	24.692
Van		286.00	24.692
Commuting and/or driving to events		Gallons Used	Emission Factor for Gasoline
Type		Gallons	lb CO2e/Gal
SUV		194.54	24.692
Hotel Stays [4]		Metric tons CO2e:	0.21
		Total Room Nights	Emission Factor for Room Nights
Type of Hotel		#	kg CO2/room/night
Number of hotel room nights in average hotels		7	29.53
Number of hotel room nights in upscale hotels			33.38
Food [5]		Metric tons CO2e:	0.96
	Number of Meals	Avg. Price/Meal	Average Emission Factor for Food
Currency	#	\$	kg CO2/\$
US Dollars	161	5.00	1.195
Garbage [6]		Metric tons CO2e:	0.66
		Metric tons CO2e Avoided:	0.00
	Total	Emission Factor for Garbage	Metric Tons CO2e
Type of Garbage	lbs	kg CO2/lb	
Waste Missoula	3,120	0.21	0.66
Recycling Missoula	0	(0.49)	0.00
Water [7]		Metric tons CO2e:	0.42

	Use	Energy Requirement of Water	Factor MT
Type of Water	gallons	kWh/gallon	kg CO2/kWh
Water Supply	311,601	0.00155	0.436304
Water Treatment	311,601	0.00154	0.436304
Paper [8]		Metric tons CO2e:	2.78
		Metric tons CO2e Avoided:	0.00
	Use	Average Emission Factor for Paper	
Type of Paper	Reams	kg CO2/ream	
100% Post Consumer (Recycled content)	0.00	(2.49)	
30% Post Consumer	0.00	1.00	
0% Post consumer	1,110.00	2.50	
Other Purchases [9]		Metric tons CO2e:	0.45
	Money Spent	Average Emission Factor for Shipping	Metric Tons CO2e
Purchase Type	USD \$ or gallons	kg CO2/\$	
Shipping	\$0	0.257	0.00
Office Supplies	\$1,266	0.355	0.45
Furniture	\$0	0.345	0.00
Printing	\$0	0.477	0.00
Computers	\$0	0.287	0.00
Bottled Water	\$0	0.125 lb CO2/gal	0.00

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Special Events	Metric tons CO2e:	Not Included, Marginal < 1 ton

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[1] Montana average kWh emission factor is 0.000407274 Mt/kWh (EPA E-Grid 2004/2005) and standard line loss for electricity transmission is 7.2% (<http://climatetechnology.gov/library/2003/tech-options/tech-options-1-3-2.pdf>). Electricity data reported through North West Energy bills. Natural gas emits 5.914 kg CO2/therm (<http://eia.doe.gov/oiaf/1605/coefficients.html>). ClearSky assumes that electricity and natural gas consumption are for the entire building and that they are similar to square footage energy intensities for Non-Mall Buildings (www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/detailed_tables_2003.html), where buildings between 10,001 to 100,000 square feet have 11.8 kWh/ft² and 39.8 cf/ft².

[2] Emissions factors for short, medium, and long (0.2897, 0.2028, 0.177 kg CO2/mile, respectively) are taken from the World Resources Institute GHG Protocol for Mobile Sources (<http://www.ghgprotocol.org/>). Short flights are up to 281 miles, medium flights are 281 to 994 miles, long flights are greater than 994 miles (single-leg distances). We also include a Radiative Forcing Index of 2.7 (IPCC 2007). 1000 kg equals 1 metric ton. Some itineraries were reported by the client, for other flights presented without itinerary information we used www.kayak.com to recreate the itinerary. The distance of flights was determined using milecalc.com.

[3] An average gasoline car emits 1.097 lbs CO₂ per vehicle mile, an average local bus emits 0.2359 lbs CO₂ per passenger mile (due to MIM reporting protocols, passenger miles in this case are assumed to be equal to the length of car commute for the employee NOT the actual distance the actual bus route), an average taxi (assumed to be similar to a carpool) emits 0.5072 lbs CO₂ per passenger mile. If homeWORD employees or board members reported fuel efficiencies (MPG) for their car travel, we calculated actual emission factors from 24.692 lbs CO₂e per gallon of gasoline (including upstream and downstream emissions). These factors are reported in the (Argonne GREET Fleet Footprint Calculator 1.0) and (US EPA Climate Leaders by way of WRI GHG Protocol Spreadsheet for Mobile Sources (April 2003)). 2205 lbs equals 1 metric ton. homeWORD employees reported number of work days in each commute mode, commute mode of transport, round-trip mileage of mode of transport, and fuel efficiencies (MPG) of modes where known.

[4] Emissions associated with a one night stay in a hotel room are calculated at 29.53 kg CO₂ per room per day for an average hotel. For upscale hotels, emissions are calculated at 33.38 kg CO₂ per room per day (Environmental Protection Agency). Number of person-hotel-nights provided by client. 1000 kg equal 1 metric ton.

[5] Emission factors are used from the Cascadia Seattle climate partnership CO₂ Tool. ClearSky assumes that meal cost of \$5/ea. Number of meals provided by FUMC. 1000 kg equals 1 metric ton.

[6] Emission factors for waste is 420 kg CO₂/2000 lbs and for recycling -970 kg CO₂/2000 lbs (Cascadia Seattle climate partnership CO₂ Tool) and 1000 kg equals one metric ton. NOTE: EPA's emission factors for recycling activities are based on Waste Generation Reference Point and therefore assign all of the benefits of recycling to the waste generator. Recycling markets, however, require active participation by the manufacturer and recycled product producer. Accordingly the Cascadia tool splits the benefit among these three parties (1/3, 1/3, 1/3).

[7] Emission factors for water supply is 1.55 kWh/1000 gallons and for water waste is 1.54 kWh/1000 gallons (Cascadia Seattle climate partnership CO₂ Tool). Montanas average kWh emission factor is 0.407 kg CO₂/kWh (EPA E-Grid 2004/2005) and standard line loss for electricity transmission is 7.2% (<http://climatetechnology.gov/library/2003/tech-options/tech-options-1-3-2.pdf>). NOTE: EPA's emission factors for recycling activities are based on Waste Generation Reference Point and therefore assign all of the benefits of recycling to the waste generator. Recycling markets, however, require active participation by the manufacturer and recycled product producer. Accordingly the Cascadia tool splits the benefit among these three parties (1/3, 1/3, 1/3).

[8] Emission factors for paper is 1 kg CO₂/ream for 30% Recycled paper and -2.49 kg CO₂/ream for 100% recycled paper (Cascadia Seattle climate partnership CO₂ Tool). NOTE: EPA's emission factor for manufacturing recycled paper is more than virgin paper, however the avoided GHG emissions from raw material acquisition and manufacturing are far more. This makes the emission factor negative. EPA bases recycling on Waste Generation Reference Point and therefore assign all of the benefits of recycling to the waste generator. Recycling markets, however, require active participation by the manufacturer and recycled product producer. Accordingly the Cascadia tool splits the benefit among these three parties (1/3, 1/3, 1/3).

[9] Emission factors for shipping is 0.257 kg CO₂/\$, for computers is 0.287 kg CO₂/\$, for office supplies 0.3554 kg CO₂/\$, and for furniture 0.3086 kg CO₂/\$ (Cascadia Seattle climate partnership CO₂ Tool). For printing we use 0.477 kg CO₂/(1997) (Carnegie Mellon University Green Design Institute, 2008 EIO-LCA, US 1997 Industry Benchmark model [internet], avail from: www.eiolca.net, accessed 1/1/08). We assume that sign printing is similar to other printing. A study conducted in Wellesly college figured emissions associated with delivery of water was an average of 0.125 lb CO₂/gallon (0.00055-0.29 lb CO₂/gallon) (http://www.wellesley.edu/Economics/Sneeringer/econ_228/WaterPurchasingPaper.pdf).