

Washington State Agency Greenhouse Gas Calculator

Contents and Notes

Agency:	Central Washington University
Year:	2018

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COMMENTS:

Comments on 1-General Agency Information	
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Comments on 2 - Building Energy Use	
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Comments on 3 - Fleet Energy Use	
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Washington State Agency Greenhouse Gas Calculator

General Agency Information Worksheet #1

Agency	Central Washington University
Calendar Year	2018
Project Lead	Jeremiah Eilers
Phone	509-929-0224
E-mail	Jeremiah.Eilers@cwu.edu

Total # of Employees	1,474.0
Total # of Students, Patients, etc. (if applicable)	16,547.0

Agency Owned Space (Sq. Ft.)	3,453,211
Space leased in a DES owned building (Sq. Ft.)	0
Space leased from another state agency (Sq. ft.)	0
Space leased in a privately owned building (Sq. ft.)	0
Total Space (Sq. Ft)	3,453,211

Agency: Central Washington University
 cy: 2018

Instructions:

ALL REPORTERS must complete Table 1. This table calculates electricity emissions using the regional EF. Regional EF for electricity is based on Fuel Mix Disclosure data from the Department of Commerce. Include all electricity purchased even market-based electricity; that is, electricity purchased from 'green' contracts.
 'Green' Market-Based Electricity: If some or all of your electricity is under a 'green contract' then also complete Table 2. The emission factor for market based electricity should be provided by the contract, typically a low value or zero. Provide documentation in the Contents and Notes worksheet.

Table 1: Total Annual Energy Use in Building and Fixed Equipment CWU -(Buildings, Generators, Central Heating/Cooling)		Agency Owned Space	Privately Leased Space	Total	GHG Emissions	Building Data Set Using Regional Electricity EF - This must be completed for all purchased electricity including market-based 'green' electricity contracts		
Emissions Source	Fuel	Fuel Use	Fuel Use	Total Fuel Use	Total Emissions MT CO2e	Fossil MT CO2 (CO2e)	MT CH4 (CO2e)	MT N2O (CO2e)
STATIONARY COMBUSTION	Natural Gas (Therms)	3,517,306		3,517,306.0	18,765.1	18,662.8	7.9	94.3
	Fuel Oil (Gallons)	12,482		12,482.0	127.7	127.4	0.1	0.2
	Propane (Gallons)	2,109		2,108.6	12.0	11.9	0.0	0.0
	Wood (short tons)	0		0.0	0.0	0.0	0.0	0.0
	Diesel (gallons) (used in fixed generators)	2,583		2,582.7	26.8	26.7	0.0	0.0
	Biodiesel (100%, gallons) (Used in fixed generators)	0		0.0	0.0	0.0	0.0	0.0
	Gasoline (gallons) (used in fixed generators)	0		0.0	0.0	0.0	0.0	0.0
	Ethanol (100%, gallons) (Used in fixed generators)	0		0.0	0.0	0.0	0.0	0.0
	Aviation Gasoline (gallons) (Used in fixed equipment)	0		0.0	0.0	0.0	0.0	0.0
	Jet fuel (gallons) (Used in fixed equipment)	0		0.0	0.0	0.0	0.0	0.0
Total GHG:					18,931.5	18,828.9	8.0	94.6

PURCHASED ENERGY	Electricity Use (kWh) (regional EF)	54,434,275		54,434,275.0	10,879.8	10,824.6	5.1	50.0
		Purchased Steam (Million lbs - Mlbs)	0		0.0	0.0	0.0	0.0
Total GHG:					10,879.8	10,824.6	5.1	50.0

Table 2: Total Annual Energy Use in Buildings and Fixed Equipment		Agency Owned Space	Privately Leased Space	Total	GHG Emissions	Building Data Set Using Market Based Electricity EF. May also include electricity purchased that is not under 'market-based' green contract.		
Emissions Source	Fuel	Fuel Use	Fuel Use	Total Fuel Use	Total Emissions MT CO2e	Fossil MT CO2 (CO2e)	MT CH4 (CO2e)	MT N2O (CO2e)
STATIONARY COMBUSTION	Natural Gas (Therms)	0	0	0.0	0.0	0.0	0.0	0.0
	Fuel Oil (Gallons)	0	0	0.0	0.0	0.0	0.0	0.0
	Propane (Gallons)	0	0	0.0	0.0	0.0	0.0	0.0
	Wood (short tons)	0	0	0.0	0.0	0.0	0.0	0.0
	Diesel (gallons) (used in fixed generators)	0	0	0.0	0.0	0.0	0.0	0.0
	Biodiesel (100%, gallons) (Used in fixed generators)	0	0	0.0	0.0	0.0	0.0	0.0
	Gasoline (gallons) (used in fixed generators)	0	0	0.0	0.0	0.0	0.0	0.0
	Ethanol (100%, gallons) (Used in fixed generators)	0	0	0.0	0.0	0.0	0.0	0.0
	Aviation Gasoline (gallons) (Used in fixed equipment)	0	0	0.0	0.0	0.0	0.0	0.0
	Jet fuel (gallons) (Used in fixed equipment)	0	0	0.0	0.0	0.0	0.0	0.0
Total GHG:					0.0	0.0	0.0	0.0

PURCHASED ENERGY	Electricity Use (kWh) (regional EF)	0	0	0.0	0.0	0.0	0.0	0.0
		Electricity Use (kWh) (market based EF)	0	0	0.0	0.0	0.0	0.0
		Purchased Steam (Million lbs - Mlbs)	0	0	0.0	0.0	0.0	0.0
Total GHG:					0.0	0.0	0.0	0.0

Washington State Agency Greenhouse Gas Calculator

Fleet Energy Use #3

Agency: Central Washington University

required

optional

CY: 2018

Table 5: Total Annual Fleet Energy Use and GHGs		Activity Data		Emissions		
Mobile Source Fuels	Fuel	Fuel Use (gal)	Biofuel %	Total Emissions (MT CO2e)	Fossil CO2 (MT CO2e)	Biofuel CO2 (MT CO2e)
Light / Heavy Duty On-Road and Off Road Motor Vehicles	Gasoline (FMD / Motorpool Pumps / Business Travel)	66,667	9.7%	529	529	37
	Diesel:					
	Retail Purchases	0	0.4%	0	0	0
	WSDOT Fueling Stations	0	15.0%	0	0	0
	Bulk purchase (FMD Fuel Tank)	6,149	15%	53	53	9
	Propane	0	0%	0	0	0
	Total:	0		582	582	46
Ferries	Diesel	0		0	0	0
	Electricity (Shorepower) (kWh)	0		0	0	0
	Total:	0		0	0	0
Boats	Gasoline	0		0	0	0
	Diesel	0		0	0	0
	Total:	0		0	0	0
Aircraft	Aviation Gasoline (Flight Tech Program)	70,974	0%	590	590	0
	Jet Fuel	0		0	0	0
	Total:	70,974		590	590	0
Total:		70,974		1,172	1,172	46

Washington State Agency Greenhouse Gas Calculator
Greenhouse Gas Emissions Summary #5

Agency Central Washington University
CY: 2018

Table 14: Total Annual Agency GHG Emissions with Regional EF for Electricity	Percent of Total Emissions	Total Emissions MT CO2e
BUILDING ENERGY USE		
Stationary Combustion (Buildings, Generators, Central Heating/Cooling)	61.1%	18,931.5
Purchased Electricity - Regional EF	35.1%	10,879.8
Purchased Steam	0.0%	0.0
TOTAL BUILDING ENERGY USE GHG EMISSIONS*	96.2%	29,811.3
FLEET ENERGY USE		
Mobile Source Fuels (FMD Fuel Tanks / Motorpool Pumps)	1.9%	581.9
Ferry	0.0%	0.0
Boat	0.0%	0.0
Air (Flight Tech Program)	1.9%	589.8
TOTAL FLEET GHG EMISSIONS	3.8%	1,171.7
TOTAL EMISSIONS	100%	30,983.0

* Note this does not include energy use in buildings owned by Dept. of Enterprise Services.

Table 15: Total Annual Agency GHG Emissions with Market Based EF for Electricity	Percent of Total Emissions	Total Emissions MT CO2e
BUILDING ENERGY USE		
Stationary Combustion	0.0%	0.0
Purchased Electricity - Regional EF	0.0%	0.0
Purchased Electricity- Market Based EF	0.0%	0.0
Purchased Steam	0.0%	0.0
TOTAL BUILDING ENERGY USE GHG EMISSIONS*	0.0%	0.0
FLEET ENERGY USE		
Mobile Source Fuels	49.7%	581.9
Ferry	0.0%	0.0
Boat	0.0%	0.0
Air	50.3%	589.8
TOTAL FLEET GHG EMISSIONS	100.0%	1,171.7
TOTAL EMISSIONS	100%	1,171.7

Subtotal MT 32,154.7

Table 16: GHG Emissions by Scope (Regional EF for Electricity)		
Scope	Total (MT CO2e)	%
Scope 1 (Direct)	20,103.2	64.9%
Scope 2 (Indirect)	10,879.8	35.1%

Table 17: GHG Emissions by Scope (Market Based EF for Electricity)		
Scope	Total (MT CO2e)	%
Scope 1 (Direct)	1,171.7	100.0%
Scope 2 (Indirect)	0.0	0.0%

Table 18: % of GHG Emissions by Source (Regional EF for Electricity)	
Source of Greenhouse Gas Emissions	Percent of Greenhouse Gas Emissions
Stationary Combustion	61%
Purchased Electricity Regional EF	35%
Purchased Steam	0%
fleet energy	2%
Ferry	0%
Boat	0%
Air	2%

Table 19: % of GHG Emissions by Source (Market-Based EF for Electricity)	
Source of Greenhouse Gas Emissions	Percent of Greenhouse Gas Emissions
Stationary Combustion	0%
Purchased Electricity Regional EF	0%
Purchased Electricity Market Based EF	0%
Purchased Steam	0%
fleet energy	50%
Ferry	0%
Boat	0%
Air	50%

**Washington State Agency Greenhouse Gas Calculator
Emissions Factors Worksheet #7 (For your reference only)**

		Per Unit Energy, Mass or Volume					
Source	Fuel	CO2		CH4		N2O	
Stationary Sources	Natural gas	5.306	kg/therm	0.09	g/therm	0.09	g/therm
	Fuel Oil	10.21	kg/gallon	0.196	g/gallon	0.042	g/gallon
	Diesel	10.35	kg/gallon	0.0966	g/gallon	0.0552	g/gallon
	Biodiesel (100%)	9.6	kg/gallon	0.0896	g/gallon	0.0512	g/gallon
	Gasoline	9.13	kg/gallon	0.0875	g/gallon	0.05	g/gallon
	Ethanol (100%)	5.48	kg/gallon	0.0588	g/gallon	0.0336	g/gallon
	Wood	1639.62	kg/short ton	143.03	g/short ton	90.74	g/short ton
	Propane	5.66	kg/gallon	0.273	g/gallon	0.0546	g/gallon
	Aviation Gasoline	8.31	kg/gallon	1.32	g/gallon	0.072	g/gallon
	Jet Fuel	10.11	kg/gallon	1.485	g/gallon	0.081	g/gallon

Source: The Climate Registry, 2016 default emission factors

Emissions Per MMBtu					
CO2		CH4		N2O	
53.06	kg/MMBtu	1.0	g/MMBtu	1.0	g/MMBtu
72.93	kg/MMBtu	1.4	g/MMBtu	0.3	g/MMBtu
73.96	kg/MMBtu	0.7	g/MMBtu	0.4	g/MMBtu
73.84	kg/MMBtu	0.7	g/MMBtu	0.4	g/MMBtu
70.22	kg/MMBtu	0.7	g/MMBtu	0.4	g/MMBtu
68.44	kg/MMBtu	0.7	g/MMBtu	0.4	g/MMBtu
93.8	kg/MMBtu	9.3	g/MMBtu	5.9	g/MMBtu
61.46	kg/MMBtu	3	g/MMBtu	0.6	g/MMBtu
69.25	kg/MMBtu	3	g/MMBtu	0.6	g/MMBtu
72.22	kg/MMBtu	3	g/MMBtu	0.6	g/MMBtu

https://www.epa.gov/sites/production/files/2015-11/documents/emission-factors_nov_2015.pdf

Conversion
1 therm=100,000 BTU
0.14 MMBtu/gallon
0.138 MMBtu/gallon
0.128 MMBtu/gallon
0.125 MMBtu/gallon
0.084 MMBtu/gallon
15.38 mmBtu/short ton
0.091 Mmbtu/gallon

Global Warming Potentials (GWP)	
(100 year time horizon)	
CO2	1
CH4	25
N2O	298
HFCs	140-11,700
PFCs	6,500-9,200
SF6	22,800
Source:	

IPCC 2007 Fourth Assessment Report, Table 2.14

		Per Unit Energy, Mass or Volume			
Source	Fuel	CO2	CH4	N2O	
Purchased Energy	Purchased Electricity	0.199	kg / kwh	3.76E-03	g / kwh
	Department of	438.4	lbs CO2 / MWh	8.3	lbs CH4 / GWh
	Purchased Electricity Market Based Contract,	0	kg/kwh	0	g / kwh
	Purchased Steam (Seattle Steam)	0.0707	MT CO2e/Mib		

Source: *Seattle Steam

Emissions Per MMBtu		
CO2	CH4	N2O
67.85	kg/MMBtu	1.94 g/MMBtu
		1.6 g/MMBtu
0.077	MT CO2e/MM Btu	

Conversions
1 KWH = 3412 BTU

0

		CO2					
Source	Fuel	Per Unit Volume		Per Unit Energy		Other	
Fleet	Gasoline	8.78	kg CO2 / gal	70.22	kg CO2 / MMBTU		
	Ethanol (E100)	5.75	kg CO2 / gal	68.44	kg CO2 / MMBTU		
	Diesel	10.21	kg CO2 / gal	73.84	kg CO2 / MMBTU		
	Biodiesel (B100)	9.45	kg CO2 / gal	73.96	kg CO2 / MMBTU		
	CNG	6.84	kg CO2 / gge	53.06	kg CO2 / MMBTU	0.054	kg CO2/sef
	LPG	5.68	kg CO2 / gal	61.71	kg CO2 / MMBTU		
	Propane	5.72	kg CO2 / gal	62.87	kg CO2 / MMBTU		
	Butanol	6.58	kg CO2 / gal	64.97	kg CO2 / MMBTU		
	Residual Fuel Oil (#5 & #6)	11.27	kg CO2 / gal	75.1	kg CO2 / MMBTU		
	Aviation Gasoline	8.31	kg CO2 / gal	69.26	kg CO2 / MMBTU		
Jet fuel	9.75	kg CO2 / gal	72.23	kg CO2 / MMBTU			

Source: https://www.epa.gov/sites/production/files/2015-11/documents/emission-factors_nov_2015.pdf

CH4													
Light Duty Onroad		Heavy Duty Onroad		Onroad		Offroad		Boats		Ferries		Aircraft	
0.0172	g / mile	0.0326	g / mile	3.93E-04	kg CH4 / gal	0.5	g / gal	0.6	g / gal	0.6	g / gal	NA	
0.055	g / mile	0.197	g / mile	2.67E-04	kg CH4 / gal	NA		NA		NA		NA	
0.001	g / mile	0.0051	g / mile	4.39E-04	kg CH4 / gal	0.58	g / gal	0.74	g / gal	0.74	g / gal	NA	
0.0005	g / mile	0.005	g / mile	4.04E-04	kg CH4 / gal	NA		NA		NA		NA	
0.737	g / mile	1.966	g / mile	1.23E-04	kg CH4 / gge	NA		NA		NA		NA	
0.037	g / mile	0.066	g / mile	9.66E-05	kg CH4 / gal	NA		NA		NA		NA	
NA		NA		9.60E-05	kg CH4 / gal	NA		NA		NA		NA	
NA		NA		1.09E-04	kg CH4 / gal	NA		NA		NA		NA	
NA		NA		NA		NA		0.11	g / gal	0.11	g / gal	NA	
NA		NA		NA		NA		NA		NA		7.05	g / gal
NA		NA		NA		NA		NA		NA		0.27	g / gal

Emission Factors for Greenhouse Gas Inventories (last modified April 2014)

		N2O													
Source	Fuel	Light Duty Onroad		Heavy Duty Onroad		Onroad		Offroad		Boats		Ferries		Aircraft	
Fleet	Gasoline	0.0038	g / mile	0.0177	g / mile	7.86E-05	kg N2O / gal	0.22	g / gal	0.224	g / gal	0.224	g / gal	NA	
	Ethanol (E100)	0.067	g / mile	0.175	g / mile	5.33E-05	kg N2O / gal	NA		NA		NA		NA	
	Diesel	0.0015	g / mile	0.0048	g / mile	8.77E-05	kg N2O / gal	0.26	g / gal	0.448	g / gal	0.448	g / gal	NA	
	Biodiesel (B100)	0.001	g / mile	0.005	g / mile	8.07E-05	kg N2O / gal	NA		NA		NA		NA	
	CNG	0.05	g / mile	0.175	g / mile	1.37E-05	kg N2O / gge	NA		NA		NA		NA	
	LPG	0.067	g / mile	0.175	g / mile	9.66E-06	kg N2O / gal	NA		NA		NA		NA	
	Propane	NA		NA		9.60E-06	kg N2O / gal	NA		NA		NA		NA	
	Butanol	NA		NA		1.09E-05	kg N2O / gal	NA		NA		NA		NA	
	Residual Fuel Oil (#5 & #6)	NA		NA		NA		NA		0.6	g / gal	0.6	g / gal	NA	
	Aviation Gasoline	NA		NA		NA		NA		NA		NA		0.11	g / gal
	Jet fuel	NA		NA		NA		NA		NA		NA		0.31	g / gal

5-Emissions Factors

Conversion Factors Worksheet #8

Mass			
1 pound (lb)	453.6 grams (g)	0.4536 kilograms (kg)	0.0004536 metric tons (tonne)
1 kilogram (kg)	2.205 pounds (lb)		
1 short ton (ton)	2,000 pounds (lb)	907.2 kilograms (kg)	
1 metric ton (tonne)	2,205 pounds (lb)	1,000 kilograms (kg)	1.102 short tons (tons)

Volume			
1 cubic foot (ft ³)	7.4805 US gallons (gal)	0.1781 barrel (bbl)	
1 cubic foot (ft ³)	28.32 liters (L)	0.02832 cubic meters (m ³)	
1 US gallon (gal)	0.0238 barrel (bbl)	3.785 liters (L)	0.003785 cubic meters (m ³)
1 barrel (bbl)	42 US gallons (gal)	158.99 liters (L)	0.1589 cubic meters (m ³)
1 liter (L)	0.001 cubic meters (m ³)	0.2642 US gallons (gal)	
1 cubic meter (m ³)	6.2897 barrels (bbl)	264.2 US gallons (gal)	1,000 liters (L)

Energy			
1 kilowatt hour (kWh)	3,412 Btu (Btu)	3,600 kilojoules (KJ)	
1 megajoule (MJ)	0.001 gigajoules (GJ)		
1 gigajoule (GJ)	0.9478 million Btu (mmBtu)	277.8 kilowatt hours (kWh)	
1 Btu (Btu)	1,055 joules (J)		
1 million Btu (mmBtu)	1.055 gigajoules (GJ)	293 kilowatt hours (kWh)	
1 therm (therm)	100,000 Btu (Btu)	0.1055 gigajoules (GJ)	29.3 kilowatt hours (kWh)
100 ft ³ of natural gas (scf)	1.03 therm (therm)	1,030 Btu (Btu)	

Other	
Kilo	1,000
Mega	1,000,000
Giga	1,000,000,000
Tera	1,000,000,000,000
Molecular Weight of C	12
Molecular Weight of CO ₂	44
1 metric ton of carbon	44/12 metric tons of CO ₂