

APPENDIX G

Greenhouse Gass Emission Calculations

Great River Energy
Laketown 115-kV Transmission Line Project
Substation Construction Emission Calculations
Emission Factors for Construction Engines

Equipment	Quantity ^a	Hours per Day	Days per Week	Number of Weeks	Total Hours Used ^b	Max Power (HP)	Load Factor ^c	Loaded Power (HP)	Emission Factors ^{d,e} (g/hp hr)		
									CO ₂	CH ₄	N ₂ O
Backhoe	1	6	3	4	72	75	0.8	60	188.262	0.008	0.002
Bulldozer	1	8	5	4	160	250	1	250	188.262	0.008	0.002
Compactor, Vibratory	1	4	5	5	100	100	1	100	188.262	0.008	0.002
Concrete Mixer Truck	3	5	2	3	90	325	1	325	188.262	0.008	0.002
Concrete Pump	1	10	3	2	60	300	1	300	188.262	0.008	0.002
Dump Truck	3	6	5	5	450	325	0.8	260	188.262	0.008	0.002
Excavator	1	8	5	4	160	138	1	138	188.262	0.008	0.002
Manlift	2	6	4	5	240	50	1	50	188.262	0.008	0.002
Pickup Truck	2	2	5	10	200	150	0.25	38	188.262	0.008	0.002
Skid steer loader	1	8	5	10	400	50	1	50	188.262	0.008	0.002
Large Crane	1	10	2	2	40	15	0.21	3	188.262	0.008	0.002
Medium Crane	1	6	2	5	60	450	0.7	315	188.262	0.008	0.002
Hydrovac Truck	1	4	1	2	8	200	0.59	118	188.262	0.008	0.002
Semitruck/Trailer	1	3	2	2	12	500	0.59	500	188.262	0.008	0.002

^a Equipment counts based on experience with construction of a similar projects.

^b Generally assumes work will occur 7 am - 5 pm, Monday through Friday, for a total of 50 work hours per week over 10 weeks

^c Load Factors from Appendix A of EPA 420_P 04 005, Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling , USEPA, April 2004.

^d EPA 420 P 04 009, Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling Compression Ignition, USEPA, April 2004 Tier 2 Engines.

^e GHG emission factors from Title 40 Subchapter C Part 98 Subpart C Table C-1 and C-2 to Subpart C.

Assumption:

393.5 hp-hr/MMBtu

453.6 g/lb

Great River Energy
Laketown 115-kV Transmission Line Project
Substation Construction Emission Calculations
Emission Estimates from Construction Engines

Equipment	Potential Emissions (tons)			
	CO ₂	CH ₄	N ₂ O	CO ₂ e
Backhoe	8.97E-01	3.64E-05	7.27E-06	9.00E-01
Bulldozer	8.30E+00	3.37E-04	6.73E-05	8.33E+00
Compactor, Vibratory	2.08E+00	8.42E-05	1.68E-05	2.08E+00
Concrete Mixer Truck	6.07E+00	2.46E-04	4.92E-05	6.09E+00
Concrete Pump	3.74E+00	1.52E-04	3.03E-05	3.75E+00
Dump Truck	2.43E+01	9.85E-04	1.97E-04	2.44E+01
Excavator	4.58E+00	1.86E-04	3.72E-05	4.60E+00
Manlift	2.49E+00	1.01E-04	2.02E-05	2.50E+00
Pickup Truck	1.56E+00	6.31E-05	1.26E-05	1.56E+00
Skid steer loader	4.15E+00	1.68E-04	3.37E-05	4.16E+00
Large Crane	2.61E-02	1.06E-06	2.12E-07	2.62E-02
Medium Crane	3.92E+00	1.59E-04	3.18E-05	3.94E+00
Hydrovac Truck	1.96E-01	7.95E-06	1.59E-06	1.97E-01
TOTAL	62.28	2.5E-03	5.1E-04	62.50

Great River Energy
Laketown 115-kV Transmission Line Project
Substation Construction Emission Calculations
Greenhouse Gas Emissions from On Road Construction Traffic

On-Road Vehicles					
	Vehicles per day	Miles per vehicle	Number of Days	Fuel Used (gallons)	CO ₂ Emissions ^a (tons)
Commuter Vehicles - Gasoline ^{b,c}	10	60	50	1,250	12
Delivery Trucks - Diesel ^d	1	60	4	37	0.41
Concrete Mixer Trucks - Diesel ^e	3	60	6	318	3.57

^a Assumes 1 gallon of gasoline = 8,887 grams CO₂ and 1 gallon of diesel = 10,180 g CO₂, per US EPA's "Greenhouse Gas Emissions from a Typical Passenger Vehicle," available online at:
<https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P100U8YT.pdf>

^b Assumes commuters travel 30 miles each way (60 miles round trip) per day, with a fuel economy of 24 miles per gallon, per US EPA and US Department of Energy Fuel Economy data for combined city and highway driving in 2023, available online at:
<https://www.fueleconomy.gov/feg/download.shtml>.

^c Assumes commuters will travel for 10 weeks, 5 days a week.

^d Assumes delivery trucks travel 30 miles each way (60 miles round trip) per day, with a fuel economy of 6.5 miles per gallon, industry average.

^e Assumes concrete mixer trucks travel 30 miles each way (60 miles round trip) per day, with a fuel economy of 3.4 miles per gallon, industry average.
<http://ascpro0.ascweb.org/archives/cd/2012/paper/CPRT221002012.pdf#:~:text=The%20National%20Ready%20Mix%20Concrete%20Association%20%28NRMCA%29%20in,average%203.4%20miles%20per%20gallon%20of%20diesel%20fuel.>

1 short ton =	907,185	grams
1 gal gasoline =	8,887	g CO ₂
1 gal diesel =	10,182	g CO ₂

Commuter Vehicle MPG=	24
Delivery Trucks (Diesel) MPG=	6.5
Concrete Mixer Truck MPG=	3.4

Great River Energy
 Laketown 115-kV Transmission Line Project
 Substation Construction Emission Calculations
 Summary

Greenhouse Gas Emissions From Construction Engines (tons)				
Description	CO ₂	CH ₄	N ₂ O	CO ₂ e ^a
Off-Road Engine Emissions	62.28	0.00	0.00	62.50
On-Road Engine Emissions	16.22	0.00	0.00	16.22
TOTAL	78.51	0.00	0.00	78.72

^a CO₂e = carbon dioxide equivalent. Includes global warming potentials from 40 CFR 98 Table A-1.

Global Warming Potentials		
CO ₂	CH ₄	N ₂ O
1	25	298

Source: 40 CFR 98 Table A-1: <https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-98#Table-A-1-to-Subpart-A-of-Part-98>

Great River Energy
Laketown 115-kV Transmission Line Project
Transmission Line Construction Emission Calculations
Emission Factors for Construction Engines

Equipment	Quantity ^a	Hours per	Days per	Number of	Total Hours	Max Power	Load	Loaded	Emission Factors ^{d,e} (g/hp hr)		
		Day	Week	Weeks	Used ^b	(HP)	Factor ^c	Power (HP)	CO ₂	CH ₄	N ₂ O
Air Compressor	1	2	5	16	160	80	1	80	188.262	0.008	0.002
Backhoe	1	8	5	8	320	75	0.8	60	188.262	0.008	0.002
Bulldozer	1	8	5	4	160	250	1	250	188.262	0.008	0.002
Compactor	1	4	5	6	120	300	1	300	188.262	0.008	0.002
Compactor, Vibratory	1	4	5	6	120	100	1	100	188.262	0.008	0.002
Fork Lift	1	5	5	16	400	120	1	120	188.262	0.008	0.002
Concrete Mixer Truck	5	5	5	4	500	325	1	325	188.262	0.008	0.002
Concrete Pump	1	10	5	1	50	300	1	300	188.262	0.008	0.002
Dump Truck	1	5	5	8	200	325	0.8	260	188.262	0.008	0.002
Excavator	1	8	5	4	160	138	1	138	188.262	0.008	0.002
Generator	1	5	5	16	400	250	0.5	125	188.262	0.008	0.002
Manlift	2	8	5	4	320	50	1	50	188.262	0.008	0.002
Pickup Truck	5	2	5	16	800	150	0.25	38	188.262	0.008	0.002
Skid steer loader	2	10	5	16	1,600	50	1	50	188.262	0.008	0.002
Welding machine	1	8	5	3	120	35	0.8	28	188.262	0.008	0.002
Large Crane	1	10	5	1	50	15	0.21	3	188.262	0.008	0.002
Medium Crane	1	10	5	4	200	450	0.7	315	188.262	0.008	0.002
Hydrovac Truck	1	8	2	2	32	200	0.59	118	188.262	0.008	0.002
2-inch Water Pump	1	3	5	4	60	5	0.69	3	188.262	0.008	0.002

^a Equipment counts based on experience with construction of a similar projects.

^b Generally assumes work will occur 7 am - 7 pm, Monday through Saturday, for a total of 72 work hours per week over 20 weeks

^c Load Factors from Appendix A of EPA 420_P 04 005, Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling , USEPA, April 2004.

^d EPA 420 P 04 009, Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling Compression Ignition, USEPA, April 2004 Tier 2 Engines.

^e GHG emission factors from Title 40 Subchapter C Part 98 Subpart C Table C-1 and C-2 to Subpart C.

Assumption:

393.5 hp-hr/MMBtu

453.6 g/lb

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Laketown 115-kV Transmission Line Project
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Equipment	Potential Emissions (tons)			
	CO ₂	CH ₄	N ₂ O	CO ₂ e
Air Compressor	2.66E+00	1.08E-04	2.15E-05	2.67E+00
Backhoe	3.98E+00	1.62E-04	3.23E-05	4.00E+00
Bulldozer	8.30E+00	3.37E-04	6.73E-05	8.33E+00
Compactor	7.47E+00	3.03E-04	6.06E-05	7.50E+00
Compactor, Vibratory	2.49E+00	1.01E-04	2.02E-05	2.50E+00
Fork Lift	9.96E+00	4.04E-04	8.08E-05	1.00E+01
Concrete Mixer Truck	3.37E+01	1.37E-03	2.74E-04	3.38E+01
Concrete Pump	3.11E+00	1.26E-04	2.52E-05	3.12E+00
Dump Truck	1.08E+01	4.38E-04	8.75E-05	1.08E+01
Excavator	4.58E+00	1.86E-04	3.72E-05	4.60E+00
Generator	1.04E+01	4.21E-04	8.42E-05	1.04E+01
Manlift	3.32E+00	1.35E-04	2.69E-05	3.33E+00
Pickup Truck	6.23E+00	2.53E-04	5.05E-05	6.25E+00
Skid steer loader	1.66E+01	6.73E-04	1.35E-04	1.67E+01
Welding machine	6.97E-01	2.83E-05	5.66E-06	7.00E-01
Large Crane	3.27E-02	1.33E-06	2.65E-07	3.28E-02
Medium Crane	1.31E+01	5.30E-04	1.06E-04	1.31E+01
Hydrovac Truck	7.84E-01	3.18E-05	6.36E-06	7.86E-01
TOTAL	138.23	5.6E-03	1.1E-03	138.70

Great River Energy
Laketown 115-kV Transmission Line Project
Transmission Line Construction Emission Calculations
Greenhouse Gas Emissions from On Road Construction Traffic

On-Road Vehicles					
	Vehicles per day	Miles per vehicle	Number of Days	Fuel Used (gallons)	CO ₂ Emissions ^a (tons)
Commuter Vehicles - Gasoline ^{b,c}	25	60	80	5,000	49
Delivery Trucks - Diesel ^d	0	60	0	0	0
Concrete Mixer Trucks - Diesel ^e	5	60	20	1,765	19.81

^a Assumes 1 gallon of gasoline = 8,887 grams CO₂ and 1 gallon of diesel = 10,180 g CO₂, per US EPA's "Greenhouse Gas Emissions from a Typical Passenger Vehicle," available online at: <https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockkey=P100U8YT.pdf>

^b Assumes commuters travel 30 miles each way (60 miles round trip) per day, with a fuel economy of 24 miles per gallon, per US EPA and US Department of Energy Fuel Economy data for combined city and highway driving in 2023, available online at: <https://www.fueleconomy.gov/feg/download.shtml>.

^c Assumes commuters will travel for 16 weeks, 5 days a week.

^d Assumes delivery trucks travel 30 miles each way (60 miles round trip) per day, with a fuel economy of 6.5 miles per gallon, industry average.

^e Assumes concrete mixer trucks travel 30 miles each way (60 miles round trip) per day, with a fuel economy of 3.4 miles per gallon, industry average.
<http://ascpro0.ascweb.org/archives/cd/2012/paper/CPRT221002012.pdf#:~:text=The%20National%20Ready%20Mix%20Concrete%20Association%20%28NRMCA%29%20in,average%203.4%20miles%20per%20gallon%20of%20diesel%20fuel.>

1 short ton =	907,185	grams
1 gal gasoline =	8,887	g CO ₂
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Commuter Vehicle MPG=	24
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Concrete Mixer Truck MPG=	3.4

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 Transmission Line Construction Emission Calculations
 Summary

Description	Greenhouse Gas Emissions From Construction Engines (tons)			
	CO ₂	CH ₄	N ₂ O	CO ₂ e ^a
Off-Road Engine Emissions	138.23	0.01	0.00	138.70
On-Road Engine Emissions	68.79	0.00	0.00	68.79
TOTAL	207.02	0.01	0.00	207.49

^a CO₂e = carbon dioxide equivalent. Includes global warming potentials from 40 CFR 98 Table A-1.

Global Warming Potentials		
CO ₂	CH ₄	N ₂ O
1	25	298

Source: 40 CFR 98 Table A-1: <https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-98#Table-A-1-to-Subpart-A-of-Part-98>

Great River Energy
Laketown 115-kV Transmission Line Project
Construction Emission Calculations
Greenhouse Gas Summary

Greenhouse Gas Emissions From Construction Engines (tons)				
	CO ₂	CH ₄	N ₂ O	CO ₂ e ^a
Transmission Line				
Off-Road Engine Emissions	138.23	0.01	0.00	138.70
On-Road Engine Emissions	68.79	0.00	0.00	68.79
Subtotal	207.02	0.01	0.00	207.49
Substation				
Off-Road Engine Emissions	62.28	0.00	0.00	62.50
On-Road Engine Emissions	16.22	0.00	0.00	16.22
Subtotal	78.51	0.00	0.00	78.72
TOTAL	285.52	0.01	0.00	286.21

40 CFR 98 Table A-1.

Global Warming Potentials		
CO ₂	CH ₄	N ₂ O
1	25	298

<https://www.ecfr.gov/current/title-40/chapter->