

Appendix H - Greenhouse Gas Emission Calculations

Great River Energy
Otto Tap 115-kV Transmission Line Project
Transmission Line Construction Emission Calculations
Summary

Description	Emissions (tons)					
	NOx	CO	VOC	SO ₂	PM ₁₀	PM _{2.5}
Off-Road Engine Emissions	1.59	0.34	0.09	0.00	0.06	0.06
Unpaved Roads	--	--	--	--	0.29	0.03
Earthmoving	--	--	--	--	4.82	0.51
TOTAL	1.59	0.34	0.09	0.00	5.17	0.59

Great River Energy
 Otto Tap 115-kV Transmission Line Project
 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	70.70	0.00	0.00	70.93
On-Road Engine Emissions	32.65	0.00	0.00	32.65
TOTAL	103.35	0.00	0.00	103.58

^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	28	265

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
 Otto Tap 115-kV Transmission Line Project
 Construction Emission Calculations
 Greenhouse Gas Summary

Greenhouse Gas Emissions From Construction Engines (tons)				
	CO₂	CH₄	N₂O	CO₂e^a
Transmission Line				
Off-Road Engine Emissions	70.70	0.00	0.00	70.93
On-Road Engine Emissions	32.65	0.00	0.00	32.65
Subtotal	103.35	0.00	0.00	103.58
Substation				
Off-Road Engine Emissions	64.97	0.00	0.00	65.18
On-Road Engine Emissions	12.55	0.00	0.00	12.55
Subtotal	77.52	0.00	0.00	77.74
TOTAL	180.87	0.01	0.00	181.32

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

Global Warming Potentials		
CO₂	CH₄	N₂O
1	28	265

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

Great River Energy
 Otto Tap 115-kV Transmission Line Project
 Construction Emission Calculations
 Criteria Pollutant Summary

	Emissions (tons)					
	Criteria Pollutants					
	NOx	CO	VOC	SO₂	PM₁₀	PM_{2.5}
Transmission Line						
Off-Road Engine Emissions	1.59	0.34	0.09	0.00	0.06	0.06
Unpaved Roads	--	--	--	--	0.29	0.03
Earthmoving	--	--	--	--	4.82	0.51
Subtotal	1.59	0.34	0.09	0.00	5.17	0.59
Substation						
Off-Road Engine Emissions	1.41	0.30	0.11	0.00	0.06	0.06
Unpaved Roads	--	--	--	--	0.17	0.02
Earthmoving	--	--	--	--	0.12	0.01
Subtotal	1.41	0.30	0.11	0.00	0.35	0.09
TOTAL	3.00	0.63	0.20	0.00	5.52	0.68

Great River Energy
 Otto Tap 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}	20	60	60	3,000	29
Delivery Trucks - Diesel ^d	1	60	20	185	2.07
Concrete Mixer Trucks - Diesel ^e	4	60	1.5	106	1.19

^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 12 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 CO₂
 1 gal diesel = 10,182 g CO₂

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

Great River Energy
 Otto Tap 115-kV Transmission Line Project
 Transmission Line Construction Emission Calculations
 Fugitive Dust Emissions from Unpaved Roads

Equipment	Quantity ^a	Total Days Used	VMT ^b	W	Emission Factor (lb/VMT) ^c		Emissions (tons)	
					PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
ATV	0	0	0	20	1.73	0.17	0.00	0.00
Backhoe	1	40	20	50	2.62	0.26	0.03	0.00
Bulldozer	0	0	0	20	1.73	0.17	0.00	0.00
Fork Lift	1	40	20	20	1.73	0.17	0.02	0.00
Concrete Mixer Truck	4	6	3	20	1.73	0.17	0.00	0.00
Dump Truck	1	30	15	21	1.77	0.18	0.01	0.00
Excavator	0	0	0	22	1.81	0.18	0.00	0.00
Front End Loader	0	0	0	23	1.85	0.18	0.00	0.00
Manlift/Boom Truck	1	25	13	24	1.88	0.19	0.01	0.00
Pickup Truck	n	360	180	24	1.88	0.19	0.17	0.02
Piping Truck	0	0	0	25	1.92	0.19	0.00	0.00
Skid steer loader	2	60	30	26	1.95	0.20	0.03	0.00
Large Crane	1	15	8	50	2.62	0.26	0.01	0.00
Medium Crane	1	15	8	25	1.92	0.19	0.01	0.00
Hydrovac Truck	1	8	4	33	2.17	0.22	0.00	0.00
Water truck	0	0	0	20	1.73	0.17	0.00	0.00
Welding Machine	0	0	0	20	1.73	0.17	0.00	0.00
TOTAL	--	--	--	--	--	--	0.29	0.03

^a Equipment counts are estimated based current construction plan.

^b Each vehicle is assumed to travel 0.5 mile per day on site.

^c AP-42 Section 13.2.2 Unpaved Roads, dated November 2006, Equations 1a and 2 TOTALS 11.19 1.12 Surface Silt content based on Table 13.2.2 1 construction sites.

Eq 1a: $E = k * (s/12)^a * (W/3)^b$

Eq 2: $E_{ext} = E * [(365-P)/365]$

where:

VMT = Vehicle Miles Traveled

W = Mean Vehicle Weight, tons

S = Mean Vehicle Speed, mph

P = 120 days with at least 0.01 inches rain, EPA's AP-42 Figure 13.2.2-1

s = 8.5 surface material silt content (%) for construction sites, EPA's AP-42 Table 13.2.2-1

E = size-specific emission factor, lb/ VMT

E_{ext} = annual size-specific emission factor extrapolated for natural migration, lb/VMT

Constants	PM	PM ₁₀	PM _{2.5}
k (lb/VMT)	4.9	1.5	0.15
a	0.7	0.9	0.9
b	0.45	0.45	0.45

Great River Energy
 Otto Tap 115-kV Transmission Line Project
 Transmission Line 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)	VOC	CO	NOx	Emission Factors ^{d,e} (g/hp hr)					
												PM ₁₀	PM _{2.5}	SO ₂	CO ₂	CH ₄	N ₂ O
Air Compressor	1	3	4	2	24	80	1	80	0.367	2.366	4.700	0.240	0.240	0.002	188.262	0.008	0.002
Backhoe	1	5	5	8	200	75	0.8	60	0.367	2.366	4.700	0.240	0.240	0.002	188.262	0.008	0.002
Fork Lift	1	5	5	8	200	120	1	120	0.167	0.843	4.335	0.132	0.132	0.002	188.262	0.008	0.002
Concrete Mixer Truck	4	8	3	0.5	48	325	1	325	0.338	0.867	4.100	0.180	0.180	0.002	188.262	0.008	0.002
Dump Truck	1	8	5	6	240	325	0.8	260	0.338	0.867	4.100	0.180	0.180	0.002	188.262	0.008	0.002
Generator	1	5	5	12	300	250	0.5	125	0.167	0.843	4.335	0.132	0.132	0.002	188.262	0.008	0.002
Manlift/Boom Truck	1	8	5	5	200	50	1	50	0.338	0.867	4.100	0.180	0.180	0.002	188.262	0.008	0.002
Pickup Truck	6	8	5	12	2,880	150	0.25	38	0.167	0.843	4.335	0.132	0.132	0.002	188.262	0.008	0.002
Skid steer loader	2	8	5	6	480	50	1	50	0.309	0.748	4.000	0.132	0.132	0.002	188.262	0.008	0.002
Large Crane	1	8	5	3	120	15	0.21	3	0.438	2.161	4.44	0.267	0.259	0.002	188.262	0.008	0.002
Medium Crane	1	8	5	3	120	450	0.7	315	0.3085	0.7475	4.0	0.132	0.128	0.002	188.262	0.008	0.002
Hydrovac Truck	1	8	5	1.5	60	200	0.59	118	0.3085	0.7475	4.0	0.132	0.128	0.002	188.262	0.008	0.002
Semitruck/Trailer	1	8	5	4	160	500	0.59	500	0.167	0.843	4.335	0.132	0.132	0.002	188.262	0.008	0.002

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

^b Generally assumes work will occur 8 am - 4 pm, Monday through Friday, for a total of 40 work hours per week over 12 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
 Otto Tap 115-kV Transmission Line Project
 Transmission Line Construction Emission Calculations
 Fugitive Dust Emissions from Earthmoving Activities

Summary of Fugitive Dust Emissions From Earthmoving Activities							
Construction Activity	Daily Material Handling		Average Exposed Area (acres)	Emission Factors ^{b-f} (lb/ton)		Emissions (tons)	
	Construction Rate ^a (ton/day)	Handling Time (days)		PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Topsoil removed by scraper ^g	1,210.0	60	---	0.058	0.006	2.11	0.22
Transmission Line Pole Excavation	13.3	60	---	0.037	0.004	0.01	0.00
Transmission Line Pole Excavation Back Filling	13.3	60	---	0.037	0.004	0.01	0.00
Topsoil replacement	1,210.0	60	---	0.012	0.001	0.44	0.05
Wind erosion of exposed areas ^h	--	60	36.00	0.38	0.040	2.25	0.24
TOTAL						4.82	0.51

Notes and Assumptions:

^a Soil density: 1.25 tons per yard

^b Excavation and loading to storage piles emission factor: AP 42 Section 11.9 Western Surface Coal Mining, Table 11.9 4, July 1998, truck loading by batch dump

^c Topsoil replacement emission factor: AP 42 Section 11.9 Western Surface Coal Mining, Table 11.9 4, July 1998, overburden replacement

^d As worst case, PM₁₀ is set equal to Total Particulate Matter. PM_{2.5} is set to 0.105 times PM₁₀ per Table 11.9 1

^e Emission factor: AP 42 Section 11.9 Western Surface Coal Mining, Table 11.9 4, July 1998, topsoil removal by scraper

^f Wind Erosion Exposed Areas emission factor: AP 42 Section 11.9 Western Surface Coal Mining, Table 11.9 4, July 1998, wind erosion of exposed areas (ton/yr/acre)

^g Conservatively assumes the entire right-of-way is cleared to 1 foot deep, 1.25 tons per cubic yard.

^h Emission factor units are tons/acre*year

Construction Schedule		
Work Days	5	Monday through Friday
Weeks:	12	Substation and transmission line starting Fall 2027, energizing summer 2028
Total Days:	60	

Topsoil Removed by Scraper ^a				
Facility	Total (Acres)	Soil Volume (yd ³)	Soil Weight (ton)	Daily Material Handling Rate (ton/day)
Transmission Line	36	58,080	72,600	1,210
TOTAL	36	58,080	72,600	1,210

^a Conservatively assumes the entire right-of-way is disturbed; 2.9 mile transmission line and 100 foot right-of-way.

Transmission Line Pole Excavations							
Project Segment	Number of Poles ^a	Diameter (ft)	Depth (ft)	Total Volume (ft ³)	Total Volume (yd ³)	Soil Weight (ton)	Daily Material Handling Rate (ton/day)
Transmission Line Pole Excavations	44	5	20	17,279	640	800	13.3
TOTAL				17,279	640	800	13.3

^a Assumes pole every 350 feet of the proposed 2.9 mile transmission line

Great River Energy
 Otto Tap 115-kV Transmission Line Project
 Transmission Line Construction Emission Calculations
 Emission Estimates from Construction Engines

Equipment	Potential Emissions (tons)									
	VOC	CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	CO ₂	CH ₄	N ₂ O	CO ₂ e
Air Compressor	7.77E-04	5.01E-03	9.95E-03	5.08E-04	5.08E-04	4.23E-06	3.98E-01	1.62E-05	3.23E-06	4.00E-01
Backhoe	4.86E-03	3.13E-02	6.22E-02	3.17E-03	3.17E-03	2.65E-05	2.49E+00	1.01E-04	2.02E-05	2.50E+00
Bulldozer	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Compactor, Vibratory	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fork Lift	4.42E-03	2.23E-02	1.15E-01	3.48E-03	3.48E-03	5.29E-05	4.98E+00	2.02E-04	4.04E-05	5.00E+00
Concrete Mixer Truck	5.82E-03	1.49E-02	7.05E-02	3.10E-03	3.10E-03	3.44E-05	3.24E+00	1.31E-04	2.63E-05	3.25E+00
Concrete Pump	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Dump Truck	2.33E-02	5.96E-02	2.82E-01	1.24E-02	1.24E-02	1.38E-04	1.29E+01	5.25E-04	1.05E-04	1.30E+01
Excavator	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Generator	6.90E-03	3.48E-02	1.79E-01	5.44E-03	5.44E-03	8.27E-05	7.78E+00	3.16E-04	6.31E-05	7.81E+00
Manlift/Boom Truck	3.73E-03	9.55E-03	4.52E-02	1.98E-03	1.98E-03	2.20E-05	2.08E+00	8.42E-05	1.68E-05	2.08E+00
Pickup Truck	1.99E-02	1.00E-01	5.16E-01	1.57E-02	1.57E-02	2.38E-04	2.24E+01	9.09E-04	1.82E-04	2.25E+01
Skid steer loader	8.16E-03	1.98E-02	1.06E-01	3.48E-03	3.48E-03	5.29E-05	4.98E+00	2.02E-04	4.04E-05	5.00E+00
Welding machine	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Large Crane	1.83E-04	9.00E-04	1.85E-03	1.11E-04	1.08E-04	8.33E-07	7.84E-02	3.18E-06	6.36E-07	7.87E-02
Medium Crane	1.29E-02	3.11E-02	1.67E-01	5.50E-03	5.33E-03	8.33E-05	7.84E+00	3.18E-04	6.36E-05	7.87E+00
Hydrovac Truck	2.41E-03	5.83E-03	3.12E-02	1.03E-03	9.99E-04	1.56E-05	1.47E+00	5.96E-05	1.19E-05	1.47E+00
TOTAL	0.09	0.34	1.59	0.06	0.06	0.00	70.70	2.9E-03	5.7E-04	70.93

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

Description	Emissions (tons per year)					
	Criteria Pollutants					
	NOx	CO	VOC	SO ₂	PM ₁₀	PM _{2.5}
Off-Road Engine Emissions	1.41	0.30	0.11	0.00	0.06	0.06
Unpaved Roads	--	--	--	--	0.17	0.02
Earthmoving	--	--	--	--	0.12	0.01
TOTAL	1.41	0.30	0.11	0.00	0.35	0.09

Great River Energy
 Otto Tap 115-kV Transmission Line Project
 Substation 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	64.97	0.00	0.00	65.18
On-Road Engine Emissions	12.55	0.00	0.00	12.55
TOTAL	77.52	0.00	0.00	77.74

^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	28	265

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
 Otto Tap 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}	7	60	50	875	9
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 CO₂
 1 gal diesel = 10,182 g CO₂

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

Great River Energy
 Otto Tap 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)					
									VOC	CO	NOx	PM ₁₀	PM _{2.5}	SO ₂
Backhoe	1	6	3	4	72	75	0.8	60	0.367	2.366	4.700	0.240	0.240	0.002
Bulldozer	1	8	5	4	160	250	1	250	0.309	0.748	4.000	0.132	0.132	0.002
Compactor, Vibratory	1	4	5	5	100	100	1	100	0.338	0.867	4.100	0.180	0.180	0.002
Fork Lift	1	4	5	4	80	120	1	120	0.167	0.843	4.335	0.132	0.132	0.002
Concrete Mixer Truck	3	5	2	3	90	325	1	325	0.338	0.867	4.100	0.180	0.180	0.002
Concrete Pump	1	10	3	2	60	300	1	300	0.338	0.867	4.100	0.180	0.180	0.002
Dump Truck	3	6	5	5	450	325	0.8	260	0.338	0.867	4.100	0.180	0.180	0.002
Excavator	1	8	5	4	160	138	1	138	0.309	0.748	4.000	0.132	0.132	0.002
Manlift/Boom truck	2	6	4	5	240	50	1	50	0.338	0.867	4.100	0.180	0.180	0.002
Pickup Truck	2	2	5	10	200	150	0.25	38	0.167	0.843	4.335	0.132	0.132	0.002
Skid steer loader	1	8	5	10	400	50	1	50	0.309	0.748	4.000	0.132	0.132	0.002
Grader	1	8	5	3	120	35	0.8	28	0.438	2.161	4.44	0.267	0.259	0.002
Large Crane	1	10	2	2	40	15	0.21	3	0.438	2.161	4.44	0.267	0.259	0.002
Medium Crane	1	6	2	5	60	450	0.7	315	0.3085	0.7475	4.0	0.132	0.128	0.002
Hydrovac Truck	1	4	1	2	8	200	0.59	118	0.3085	0.7475	4.0	0.132	0.128	0.002
Semitruck/Trailer	1	3	2	2	12	500	0.59	500	0.167	0.843	4.335	0.132	0.132	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

Hazardous Air Pollutants from Construction

HAP	Fraction of VOC	Emissions (tpy)
Benzene	0.02	0.031
Formaldehyde	0.118	0.184
Acetaldehyde	0.053	0.083
1,3 butadiene	0.002	0.003
Acrolein	0.003	0.005
Total HAPs		0.305

0.002545458 MMBtu/ hp-hr

CO2	CH4	N2O
73.96	0.003	0.0006 kg/MMBtu
73960	3	0.6 g/MMBtu
188.262049	0.00763637	0.00152727 g/hp-hr

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

Equipment	Potential Emissions (tons)						CO ₂ e
	VOC	CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	
Backhoe	1.75E-03	1.13E-02	2.24E-02	1.14E-03	1.14E-03	9.52E-06	8.99E-01
Bulldozer	1.36E-02	3.30E-02	1.76E-01	5.80E-03	5.80E-03	8.82E-05	8.33E+00
Compactor, Vibratory	3.73E-03	9.55E-03	4.52E-02	1.98E-03	1.98E-03	2.20E-05	2.08E+00
Concrete Mixer Truck	1.09E-02	2.79E-02	1.32E-01	5.80E-03	5.80E-03	6.45E-05	6.09E+00
Concrete Pump	6.71E-03	1.72E-02	8.14E-02	3.57E-03	3.57E-03	3.97E-05	3.75E+00
Dump Truck	4.36E-02	1.12E-01	5.29E-01	2.32E-02	2.32E-02	2.58E-04	2.44E+01
Excavator	7.51E-03	1.82E-02	9.74E-02	3.20E-03	3.20E-03	4.87E-05	4.60E+00
Manlift/Boom truck	4.48E-03	1.15E-02	5.42E-02	2.38E-03	2.38E-03	2.65E-05	2.50E+00
Pickup Truck	1.38E-03	6.97E-03	3.58E-02	1.09E-03	1.09E-03	1.65E-05	1.56E+00
Skid steer loader	6.80E-03	1.65E-02	8.82E-02	2.90E-03	2.90E-03	4.41E-05	4.16E+00
Large Crane	6.08E-05	3.00E-04	6.17E-04	3.71E-05	3.60E-05	2.78E-07	2.62E-02
Medium Crane	6.43E-03	1.56E-02	8.33E-02	2.75E-03	2.67E-03	4.17E-05	3.94E+00
Hydrovac Truck	3.21E-04	7.78E-04	4.16E-03	1.37E-04	1.33E-04	2.08E-06	1.97E-01
TOTAL	0.11	0.30	1.41	0.06	0.06	0.00	65.18

Global Warming Potentials		
CO ₂	CH ₄	N ₂ O
1	28	265

Source: Title 40 Part 98 Table A-1.

Hazardous Air Pollutants from Construction Engines	
Species	Emissions (tpy)
Benzene	0.00
Formaldehyde	0.00
Acetaldehyde	0.00
1,3 butadiene	0.00
Acrolein	0.00
Total HAPs	0.00

Great River Energy
 Otto Tap 115-kV Transmission Line Project
 Substation Construction Emission Calculations
 Fugitive Dust Emissions from Unpaved Roads

Equipment	Quantity ^a	Total Days Used	VMT ^b	W	Emission Factor (lb/VMT) ^c		Emissions (tons)	
					PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Backhoe	1	12	6	50	2.62	0.26	0.01	0.00
Bulldozer	1	20	10	20	1.73	0.17	0.01	0.00
Fork Lift	1	20	10	20	1.73	0.17	0.01	0.00
Concrete Mixer Truck	3	18	9	20	1.73	0.17	0.01	0.00
Dump Truck	3	75	38	21	1.77	0.18	0.03	0.00
Excavator	1	20	10	22	1.81	0.18	0.01	0.00
Manlift/Boom Truck	2	40	20	24	1.88	0.19	0.02	0.00
Pickup Truck	2	100	50	24	1.88	0.19	0.05	0.00
Skid steer loader	1	50	25	26	1.95	0.20	0.02	0.00
Large Crane	1	4	2	50	2.62	0.26	0.00	0.00
Medium Crane	1	10	5	25	1.92	0.19	0.00	0.00
Hydrovac Truck	1	2	1	33	2.17	0.22	0.00	0.00
TOTAL	--	--	--	--	--	--	0.17	0.02

^a Equipment counts are estimated based current construction plan.

^b Each vehicle is assumed to travel 0.5 mile per day on site.

^c AP-42 Section 13.2.2 Unpaved Roads, dated November 2006, Equations 1a and 2 TOTALS 11.19 1.12 Surface Silt content based on Table 13.2.2 1 construction sites.

Eq 1a: $E = k * (s/12)^a * (W/3)^b$

Eq 2: $E_{ext} = E * [(365-P)/365]$

where:

VMT = Vehicle Miles Traveled

W = Mean Vehicle Weight, tons

S = Mean Vehicle Speed, mph

P = 120 days with at least 0.01 inches rain, EPA's AP-42 Figure 13.2.2-1

s = 8.5 surface material silt content (%) for construction sites, EPA's AP-42 Table 13.2.2-1

E = size-specific emission factor, lb/ VMT

E_{ext} = annual size-specific emission factor extrapolated for natural migration, lb/VMT

Constants	PM	PM ₁₀	PM _{2.5}
k (lb/VMT)	4.9	1.5	0.15
a	0.7	0.9	0.9
b	0.45	0.45	0.45

Miles traveled per day

0.5

0.5

Great River Energy
 Otto Tap 115-kV Transmission Line Project
 Substation Construction Emission Calculations
 Fugitive Dust Emissions from Earthmoving Activities

Summary of Fugitive Dust Emissions From Earthmoving Activities							
Construction Activity	Daily Material Handling		Average Exposed Area (acres)	Emission Factors ^{b-f} (lb/ton)		Emissions (tons)	
	Construction Rate ^a (ton/day)	Handling Time (days)		PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
	Topsoil removed by scraper ^g	40.3	50	---	0.058	0.006	0.06
Topsoil replacement	40.3	50	---	0.012	0.001	0.01	0.00
Wind erosion of exposed areas ^h	--	50	1.00	0.380	0.040	0.05	0.01
TOTAL						0.12	0.01

Notes and Assumptions:

^a Soil density: 1.25 tons per yard

^b Excavation and loading to storage piles emission factor: AP 42 Section 11.9 Western Surface Coal Mining, Table 11.9 4, July 1998, truck loading by batch dump

^c Topsoil replacement emission factor: AP 42 Section 11.9 Western Surface Coal Mining, Table 11.9 4, July 1998, overburden replacement

^d As worst case, PM₁₀ is set equal to Total Particulate Matter. PM_{2.5} is set to 0.105 times PM₁₀ per Table 11.9 1

^e Emission factor: AP 42 Section 11.9 Western Surface Coal Mining, Table 11.9 4, July 1998, topsoil removal by scraper

^f Wind Erosion Exposed Areas emission factor: AP 42 Section 11.9 Western Surface Coal Mining, Table 11.9 4, July 1998, wind erosion of exposed areas (ton/yr/acre)

^g Assumes the entire workspace is cleared to 1 foot deep, 1.25 tons per cubic yard.

^h Emission factor units are tons/acre*year

Construction Schedule	
Work Days	5
Weeks:	10
Total Days:	50

Topsoil Removed by Scraper ^a				
Facility	Total (Acres)	Soil Volume (yd ³)	Soil Weight (ton)	Daily Material Handling Rate (ton/day)
Substation	1	1,613	2,017	40
TOTAL	1	1,613	2,017	40

^a Conservatively assumes the entire 1-acre parcel is disturbed.