Appendix E

Emissions Calculations

Elk Creek Solar, LLC
Elk Creek Solar Project
Construction and Operating Emission Calculations
Summary

Emisisons From Construction Equipment	
Description	**Emissions (tons per project) Greenhouse Gas (CO_2e)**
Off-Road Engine Emissions	1,764
Construction Worker Vehicles	962
Construction Delivery Vehicles	224
Construction Equipment	**2,949**

Emissions From Equipment Fabrication	
Description	**Emissions (tons per year) Greenhouse Gas (CO_2e)**
Equipment Fabrication	15,556

Operating Emissions	
Description	**Emissions (tons per year) Greenhouse Gas (CO_2e)**
Electricity Use - O&M Building	8
Commuter Vehicles - Gasoline	8
Maintenance Trucks - Diesel	0
Total Operating Emissions	**17**

Elk Creek Solar, LLC
Elk Creek Solar Project
Construction and Operating Emission Calculations
Emission Factors for Construction Engines

Off-Road Construction Engines

Equipment	Quantity [a]	Hours per Day	Number of Days	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_2O
Air Compressor	0	0	0	0	80	1	80	188.262	0.008	0.002
ATV	42	8	124	41,664	20	0.5	10	188.262	0.008	0.002
Backhoe	2	8	240	3,840	75	0.8	60	188.262	0.008	0.002
Bulldozer	2	8	40	640	250	1	250	188.262	0.008	0.002
Compactor	0	0	0	0	300	1	300	188.262	0.008	0.002
Compactor, Vibratory	4	8	124	3,968	100	1	100	188.262	0.008	0.002
Fork Lift	8	8	154	9,856	120	1	120	188.262	0.008	0.002
Concrete Mixer Truck	6	8	30	1,440	325	1	325	188.262	0.008	0.002
Concrete Pump	0	0	0	0	300	1	300	188.262	0.008	0.002
Dump Truck	2	8	60	960	325	0.8	260	188.262	0.008	0.002
Excavator	4	8	160	5,120	138	1	138	188.262	0.008	0.002
Front End Loader	3	8	80	1,920	196	1	196	188.262	0.008	0.002
Generator	10	8	124	9,920	250	0.5	125	188.262	0.008	0.002
Guided Bore Machine	0	0	0	0	150	0.8	120	188.262	0.008	0.002
Light Tower	0	0	0	0	50	1	50	188.262	0.008	0.002
Manlift	0	0	0	0	50	1	50	188.262	0.008	0.002
Pickup Truck	20	8	220	35,200	150	0.25	38	188.262	0.008	0.002
Piping Truck	0	0	0	0	300	1	300	188.262	0.008	0.002
Skid steer loader	4	8	124	3,968	50	1	50	188.262	0.008	0.002
Water truck	4	9	200	7,200	100	0.5	50	188.262	0.008	0.002
Welding machine	0	0	0	0	35	0.8	28	188.262	0.008	0.002
Grader	2	8	240	3,840	35	0.8	28	188.262	0.008	0.002
Large Crane	0	0	0	0	15	0.21	3	188.262	0.008	0.002
Medium Crane	2	4	30	240	450	0.7	315	188.262	0.008	0.002
Fuel Truck	0	0	0	0	200	0.59	118	188.262	0.008	0.002
Hydrovac Truck	0	0	0	0	200	0.59	118	188.262	0.008	0.002
Road Bore Machine	0	0	0	0	260	0.79	205	188.262	0.008	0.002
6-inch Water Pump	0	0	0	0	30	0.69	21	188.262	0.008	0.002
4-inch Water Pump.	0	0	0	0	10	0.69	7	188.262	0.008	0.002
2-inch Water Pump	0	0	0	0	5	0.69	3	188.262	0.008	0.002
Pile Driver	7	8	124	6,944	49	1	49	188.262	0.008	0.002
100 HP Tractor	5	8	160	6,400	100	0.21	100	188.262	0.008	0.002
Light Tower	0			0	50	1	50	188.262	0.008	0.002

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

[b] Hours based on estimates from similar project.

[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.

Elk Creek Solar, LLC

Elk Creek Solar Project

Construction and Operating Emission Calculations

Emission Estimates from Construction Engines

Equipment	Potential Emissions (ton/yr)			
	CO_2	CH_4	N_2O	CO_2e
ATV	86.46	3.5E-03	7.0E-04	86.76
Backhoe	47.81	1.9E-03	3.9E-04	47.98
Bulldozer	33.20	1.3E-03	2.7E-04	33.32
Compactor, Vibratory	82.35	3.3E-03	6.7E-04	82.63
Fork Lift	245.44	1.0E-02	2.0E-03	246.28
Concrete Mixer Truck	97.12	3.9E-03	7.9E-04	97.45
Dump Truck	51.80	2.1E-03	4.2E-04	51.98
Excavator	146.63	5.9E-03	1.2E-03	147.13
Front End Loader	78.10	3.2E-03	6.3E-04	78.36
Generator	257.33	1.0E-02	2.1E-03	258.21
Pickup Truck	273.93	1.1E-02	2.2E-03	274.87
Skid steer loader	41.17	1.7E-03	3.3E-04	41.31
Water truck	74.71	3.0E-03	6.1E-04	74.96
Grader	22.31	9.1E-04	1.8E-04	22.39
Medium Crane	15.69	6.4E-04	1.3E-04	15.74
Pile Driver	70.61	2.9E-03	5.7E-04	70.85
100 HP Tractor	132.81	5.4E-03	1.1E-03	133.27
TOTAL	**1,757.48**	**7.1E-02**	**1.4E-02**	**1,763.51**

Global Warming Potentials		
CO_2	CH_4	N_2O
1	25	298

Source: Title 40 Part 98 Table A-1.

Elk Creek Solar, LLC
Elk Creek Solar Project
Construction and Operating Emission Calculations
Emissions Estimates for Construction Commuters and Delivery Vehicles

On-Road Vehicles					
	Vehicles per day	**Miles per vehicle**	**Number of Days**	**Gallons Used per Project**	**CO_2 Emissions Tons**
Commuter Vehicles - Gasoline [b]	150	60	240	98,182	962
Delivery Trucks - Diesel [c]	18	60	120	19,938	224

[a] Assumes 1 gallon of gasoline = 8,887 grams CO_2 and 1 gallon of diesel = 10,180 g CO_2, 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 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.

1 short ton = 907,185 grams

Elk Creek Solar, LLC
Elk Creek Solar Project
Construction and Operating Emission Calculations
Emissions from Equipment Fabrication

	Solar - Utility [a] g CO2e / kWh	Elk Creek Solar Panel Fabrication Emissions g CO_2e / year	tons CO_2e / year
Direct Emissions	0	0	0
Infrastructure and Supply Chain Emissions	42	14,112,000,000	15,556
Biogenic CO2 emissions and Albedo Effect	0	0	0
Methane Emissions	0	0	0
Lifecycle emissions, including Albedo Effect (median)	42	14,112,000,000	15,556

[a] Intergovernmental Panel on Climate Change. 2014. Working group 3, Annual report 5, Annex III: Technology-specific Cost and Performance Parameters. Available online at: https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_annex-iii.pdf Accessed April 2023.

Assumptions:

Elk Creek Power Generation	336,000,000	kWh	
Conversion:	1 short ton =	907,185	grams
Project Lifetime	30	years	

Elk Creek Solar, LLC
Elk Creek Solar Project
Operating Emission Calculations
Emissions from Facility Operation

	kWh / month	kWh / year	GHG Emissions [a] tons CO_2e / year
Electricity Use - O&M Building	1,350	16,200	7.7

[a] Greenhouse gas emissions calculated using US EPA's Greenhouse Gas Equivalencies Calculator, available online at: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.

	Vehicles per day	Fuel Usage gal/vehicle/week	Fuel Usage gal/year	GHG Emissions [a] tons CO_2e / year
Commuter Vehicles - Gasoline [b]	6	16	851	8.3
Maintenance Trucks - Diesel [c]	2	1	43	0.5

[a] Assumes 1 gallon of gasoline = 8,887 grams CO_2 and 1 gallon of diesel = 10,180 g CO_2, 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 six commuters travel 30 miles each way (60 miles round trip) per day, with a fuel economy of 22.0 miles per gallon, 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

[c] Assumes two trucks travel 10 miles on site each 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 of trucks in 2023, available online at: https://www.fueleconomy.gov/feg/download.shtml.