APPENDIX I:
GHG Emission Calculations

Lake Wilson Solar Energy Center - Green House Gas Emmissions Estimate

Murray County, MN
6-Feb-23

Construction Phase

Typical onsite construction staff levels will depend on the number of concurrent tasks being performed and the phasing of the Project.

Equipment Type	No. of Equipment	Days	Duration (hours/day)	Fuel Consumption (gal/hour)	Fuel Type	Est. Total Gallons	Notes/Assumptions[1]
Bulldozer	2	40	8	7.6	Diesel	4,864	Caterpillar D6T Medium Load
Grader/scraper	2	240	8	5.6	Diesel	21,504	Caterpillar 140M Medium Load
Backhoe	2	200	8	3.1	Diesel	9,920	Caterpillar 422F2 Low Load
Vibratory compactor	4	124	8	5	Diesel	19,840	Caterpillar CS56/CP56 High Load
100 HP Tractors	5	160	8	7	Diesel	44,800	Mowing, sitework, trench backfill
Dump Truck	2	60	8	10	Diesel	9,600	Tandem Axle 10-14 CY
Excavator	4	160	8	8.1	Diesel	41,472	Caterpillar 336D Medium Load
Concrete truck and boom	6	30	8	12	Diesel	17,280	Primarily Substation
High-reach bucket truck	0	0	0	0	Diesel	-	
Semitruck/trailer	6	120	8	10	Diesel	57,600	Standard size and weight semitruck for equipment deliveries (non-peak)
Semitruck/trailer	12	120	8	10	Diesel	115,200	Standard size and weight semitruck - volume during peak delivery of modules and racking
Tracked Loader	3	80	8	4	Diesel	7,680	953 Tracked Loader
Skid steer	4	124	8	3.3	Diesel	13,094	Caterpillar 299D Medium Load
Fork lift (all terrain)	8	154	8	2.9	Diesel	28,582	JLG 1255 Medium Load or telehandler
Pile driver	7	124	8	7.1	Diesel	49,302	Vermeer PD10 Medium/High Load
Truck-mounted auger/drill	0	0	0	0	Diesel	-	
Medium duty crane	2	30	4	18.8	Diesel	4,512	120T RT Telescopic Crane (This may end up being a 90 ton RTC or work split the a 120 & 90 ton)
Watering truck	4	200	9	11	Diesel	79,200	
Generator	10	124	8	1	Gasoline	9,920	Honda EB10000 Half Load Average
Light-duty pickup truck (on-site)	20	220	8	3.6	Gasoline	126,720	
ATVs	42	124	8	0.4	Gasoline	16,666	Club Car 4 Seater ATV
Construction contractor vehicles (commute to/from site)	150	240	1.2	2.5	Gasoline	108,000	Assume bulk of the workforce lives in either Marshall, MN or Worthington, MN. Both are a 40 minute one way drive, 80 min round trip. 75% carpool and weighted average for duration
GAS TOTAL						**261,306**	
DIESEL TOTAL						**524,451**	

Operation Phase

Equipment Type	No. of Equipment	Days/Year	Duration (hours/day)	Fuel Consumption (gal/hour)	Fuel Type	Est. Total Gallons	Notes/Assumptions[1]
Light-duty pickup truck (commute to/from site) - 3 full time staff	3	260	0.5	2.5	Gasoline	975	3 Solar Technicians performing maintenance checks.
ATV (on-site) - 4 full time staff	2	48	8	0.4	Gasoline	307	Inverter Checks Twice/Yr. Assume 48 Inverters and maintenance checks at 2/day (48 days) for 1 Crew of 2. 2nd Crew of 2 will perform Tracker Maintenance in the same duration of 48 days at 5 trackers/day.
O&M contractor vehicles (commute to/from site)	1	12	0.5	2.5	Gasoline	15	2 HV Technicians assumed from either Marshall or Worthington, MN, 80mn round trip.
O&M contractor vehicles (on-site)	1	12	8	1	Gasoline	96	1 HV Contractor performing monthly checks on Substation. 1 full 8hr day for Monthly Maintenance. Vehicle is parked at Substation and not used for maintenance checks.
BESS Emergencey Generator - 500kW	2	12	0.5	18.8	Diesel	226	Manufacturer manual and NFPA 110 require exercising the generator set at least once a month for 30 minutes under not less than 30% of the nameplate. Fuel consumption used here is at 50% load.
BESS Emergencey Generator - 250 kW	1	12	0.5	10.8	Diesel	65	Manufacturer manual and NFPA 110 require exercising the generator set at least once a month for 30 minutes under not less than 30% of the nameplate. Fuel consumption used here is at 50% load.
GAS TOTAL (per year)						**1,393**	
DIESEL TOTAL (per year)						**290**	

[1]Equipment and fuel use estimates provided by Westwood Profesisonal Services Inc.

Construction		**KG of CO2 per Gallon Diesel**	**KG of CO2 per Gallon Gas**	**Total KG**
Total Diesel	524,451	10.19		5,344,158
Total Gas	261,306		8.80	2,299,489

Total- KG	7,643,647	Conversion Factor KG to Tons
Total - Tons	8,426	0.00110231

Annual Operation		**KG of CO2 per Gallon Diesel[1]**	**KG of CO2 per Gallon Gas[2]**	**Total KG**
Total Diesel	290	10.19		2,959
Total Gas	1,393		8.80	12,260
Retail electrcity[3]	54,000 kwH			23,360

Total- KG	38,579	Conversion Factor KG to Tons
Total - Tons[4]	43	0.00110231

[1] EIA "Carbon Dioxide Emissions Coefficients" https://www.eia.gov/environment/emissions/co2_vol_mass.php

[2] https://www.eia.gov/environment/emissions/co2_vol_mass.php

[3] Energy estimate based on a similar sized oeprating project from an Invenergy affiliate. CO2 equivalent gotten from EPA data: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

[4] This is an initial estimate based on the current energy mix in the U.S. As we move forward with new regulations, increased renewables and use of electric vehicles, this estimate can reasonably be expected to decrease drastically and trend towards zero over the operational life of the Project.