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Project Title:	Darden Clean Energy Project
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Document Title:	Supplemental Data Response Set 1 - Appendix H SUP DR GHG-1 and Appendix I SUP DR GHG-2
Description:	Supplemental Data Response Set 1 - Appendix H SUP DR GHG-1 Updated Appendix N Table 19 Includes the updated Appendix N Table 19, Annual GHG Emissions, provided in response to SUP DR GHG-1 as Appendix H of Supplemental Response Set 1. Supplemental Data Response Set 1 - Appendix I SUP DR GHG-2 Displaced Energy Production During 35-year Project Life Includes the Displaced Energy Production During 35-year Project Life, original analysis and 2023 CA Power Mix and Increased Renewable Accountability, provided in response to SUP DR GHG-2 as Appendix I of Supplemental Response Set 1.
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Appendix H

SUP DR GHG-1 Updated Appendix N Table 19

Table 19 Annual GHG Emissions

Construction Phase	Project Emissions MT CO_2e			
	Original		Updated	
	36-Month Schedule	18-Month Schedule	36-Month Schedule	18-Month Schedule
Solar Facility, Step-Up Substation and BESS (Option 1), and Gen-Tie, and Utility Switchyard				
Road and Fence Repair	30	30	30	30
Road Reconditioning	130	130	130	130
Solar Panel Washing	124	124	124	124
Vegetation and Pest Management	536	536	536	536
O&M Facility	47	47	47	47
BESS - Battery Cooling	17,415	17,415	17,415	17,415
SF6 - Step-up Substation	1,506	1,506	1,506	1,506
SF6 - Utility Switchyard	837	837	837	837
Subtotal	20,625	20,625	20,625	20,625
Green Hydrogen Facility (Options 1 and 2)				
Green Hydrogen O&M	142,342	142,342	-	-
Construction and Decommissioning				
Amortized Construction	2,752	2,287	2,157	1,784
Amortized Decommissioning	2,752	2,287	2,157	1,784
Combined Operational, Construction and Decommissioning with Options 1 and 2 Green Hydrogen Facility				
Solar Facility, Step-Up Substation and BESS (Option 1), and Gen-Tie, and Utility Switchyard	20,625	20,625	20,625	20,625
Green Hydrogen Facility Site (Options 1 and 2)	142,342	142,342	0	0
Construction & Decommissioning	5,504	4,574	4,314	3,568
Total Operational, Construction, and Decommissioning with Options 1 or 2 Green Hydrogen Facility Site	**168,469**	**167,541**	**24,939**	**24,193**
Annual Displaced Emissions	**504,499**	**504,499**	**457,6439**	**457,643**
Net Project Emissions	**(336,029)**	**(336,958)**	**(432,704)**	**(433,451)**
Alternate Green Hydrogen Facility				
Green Hydrogen O&M	142,342	142,342	-	-
Alternate Green Hydrogen Facility Building	2	2	-	-
Alternate Green Hydrogen Substation (SF_6)	1,506	1,506	-	-

Construction Phase	Project Emissions MT CO_2e			
	Original		Updated	
	36-Month Schedule	18-Month Schedule	36-Month Schedule	18-Month Schedule
Alternate Green Hydrogen Switchyard (SF_6)	502	502	-	-
Subtotal	144,352	144,352	-	-
Combined Operational, Construction, and Decommissioning with Alternate Green Hydrogen Facility				
Solar Facility, Step-Up Substation and BESS (Options 1), and Gen-Tie, and Utility Switchyard	20,625	20,625	-	-
Total Alternate Green Hydrogen Facility	144,352	144,352	-	-
Construction & Decommissioning	5,504	4,574	-	-
Total Operational, Construction, and Decommissioning with Alternate Green Hydrogen Facility Site	170,480	169,552	-	-
Annual Displaced Emissions	**504,499**	**504,499**	**-**	**-**
Net Project Emissions	**(334,019)**	**(334,947)**	**-**	**-**

Note: Parenthetical notation represents negative numbers.
SF_6 = Sulphur hexafluoride; MT = Metric Tons; CO_2e = carbon dioxide equivalent
Source: Appendix N-2.

Appendix I

SUP DR GHG-2 Displaced Energy Production During 35-year Project Life

Darden Renewable Energy Project

Displaced Energy Production during 35-year Project life (Original Analysis)

Annual Energy Production		Annual Average Solar Radiation Hours/Day/Year
Grid Size (MW)	1150	
Total hrs/year	8,760	
% Operational time [1]	*22%*	5.38
Operational hours/year	1,964	
KWh produced per year	2,258,255,000	
Assumed Heat Rate (Btu/KWh)	10,000	
Annual Fuel Equivalent (MMBtu)[2]	22,582,550	

CA Power Mix[3]		Annual Fuel Displacement (MMBtu)
Coal[4]	3.00%	677,477
Large Hydro	9.20%	2,077,595
Natural Gas[4]	37.90%	8,558,786
Nuclear	9.30%	2,100,177
Oil	0.00%	0
Other (petroleum coke/waste heat)	0.20%	45,165
Renewables	33.60%	7,587,737
Unspecified sources of Power	6.80%	1,535,613
Total	**100.0%**	**22,582,550**

Annual Pollutant Displacement[4]

Natural Gas Turbine Emissions

Pollutant	AP-42 Emission Factor (lb/MMBtu)[5]	Controlled Emission Factor (lb/MMBtu)	Controlled Emissions (lb)	Controlled Emissions (ton)	AP-42 Emission Factor Source Notes[5]
NO_2	0.099	0.099	847,320	423.66	Table 3.1-1, lean premix; Assume SCR Control Efficiency
CO	0.015	0.015	128,382	64.19	Table 3.1-1, lean premix; Assume Ox. Cat. Control Efficiency
PM_{10}	0.0047	0.0047	40,226	20.11	Table 3.1-2a, PM (condensible)
$PM_{2.5}$	0.0019	0.0019	16,262	8.13	Table 3.1-2a, PM (filterable)
SO_2	0.0034	0.0034	29,100	14.55	Table 3.1-2a
CO_2	110	110	941,466,510	470,733.25	Table 3.1-2a

Coal Combustion Emissions

Pollutant	AP-42 Emission Factor (lb/ton)[6]	Controlled Emission Factor (lb/ton)	Emissions (lb)[7]	Emissions (ton)	AP-42 Emission Factor Source Notes[6]
NOx	12	12	338738	169.37	Table 1.1-3 pulverized coal, wall fired, bituminous coal NSPS
CO	0.5	0.5	14114	7.06	Table 1.1-3 pulverized coal, wall fired, bituminous coal NSPS
PM_{10}[8]	0.46	0.084	2371	1.19	Table 1.1-4, PC-fired dry bottom wall-fired, scrubber control
$PM_{2.5}$[8]	0.12	0.06	1694	0.85	Table 1.1-4, PC-fired dry bottom wall-fired, scrubber control
SO_2[9]	2.85	0.57	16090	8.05	Table 1.1-3 pulverized coal, wall fired, bituminous coal NSPS
CO_2	6040	6040	170498253	85,249.13	Table 1.1-20
Total NMHC	0.06	0.06	1694	0.85	Table 1.1-19; assumed all hydrocarbons are reactive
CH_4	0.04	0.04	1129	0.56	Table 1.1-19
N_2O	0.03	0.03	847	0.42	Table 1.1-19

Total Displaced Emissions Associated With Direct Combustion

Pollutant	tons/year[8]	tons/lifetime (35 years)		
ROG (NMHC)	1	30		
NO_X	593	20,756		
CO	71	2,494		
PM_{10}	21	745		
$PM_{2.5}$	9	314		
SO_X	23	791		
CO_2E (Metric Ton)	504,499	17,657,464	504,320.96	17651233.68

Notes:

1. Operational time is based on annual average solar radiation hours per day per year (5.38) for the project area. Source: solardirect.com (https://www.solardirect.com/archives/pv/systems/gts/gts-sizing-sun-hours.html)
2. The Project is assumed to displace existing power generation equivalent to the current power mix each year of operation.
3. CA Power Mix assumptions are based on data from the 2021 Total System Electric Generatin Table. https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/2020-total-system-electric-generation
4. Combustion of natural gas and coal for power are of the greatest concern related to the generation of criteria pollutants and GHG emissions, therefore only fuel displacement of natural gas and coal due to electricty production from the Solar Scarlet facility are considered in this assessment.
5. EPA Air Pollution Emission Factors AP-42 Section 3.1, Stationary Gas Turbines
6. EPA Air Pollution Emission Factors AP-42 Section 1.1, Bituminous and Subbituminous Coal Combustion
7. Coal characteristics used for conversion: Assumed coal heat content = 24 MMBtu/ton
8. Total particulate matter (CPM-TOT) is expressed in terms of coal ash content therefore emission factor is determined by multiplying % ash content of coal (assumed to be 20% herein) by value listed in Table 1.1-4. Organic fraction of particulate matter is 20% of total CPM-TOT (Table 1.1-5) and listed as controlled emission factor.
9. SO_x emission factor calculated by multiplying the weight percent of sulfur (assumed to be 7.5%) by the value listed in Table 1.1-3
10. CO_2E volumes are in metric tons rather than short (US) tons

Darden Renewable Energy Project

Displaced Energy Production during 35-year Project life (2023 CA Power Mix and Increased Renewable Accountability)

Annual Energy Production		Annual Average Solar Radiation Hours/Day/Year
Grid Size (MW)	1150	
Total hrs/year	8,760	
% Operational time [1]	*22%*	5.38
Operational hours/year	1,964	
KWh produced per year	2,258,255,000	
Assumed Heat Rate (Btu/KWh)	10,000	
Annual Fuel Equivalent (MMBtu)[2]	22,582,550	

CA Power Mix[3]		Annual Fuel Displacement (MMBtu)
Coal[4]	1.77%	399,711
Large Hydro	11.70%	2,642,158
Natural Gas[4]	36.56%	8,256,180
Nuclear	9.34%	2,109,210
Oil	0.01%	2,258
Other (petroleum coke/waste heat)	0.07%	15,808
Renewables	36.86%	8,323,928
Unspecified sources of Power	3.69%	833,296
Total	**100.0%**	**22,582,550**

Annual Pollutant Displacement[4]

Natural Gas Turbine Emissions

Pollutant	AP-42 Emission Factor (lb/MMBtu)[5]	Controlled Emission Factor (lb/MMBtu)	Controlled Emissions (lb)	Controlled Emissions (ton)	AP-42 Emission Factor Source Notes[5]
NO_2	0.099	0.099	817,362	408.68	Table 3.1-1, lean premix; Assume SCR Control Efficiency
CO	0.015	0.015	123,843	61.92	Table 3.1-1, lean premix; Assume Ox. Cat. Control Efficiency
PM_{10}	0.0047	0.0047	38,804	19.40	Table 3.1-2a, PM (condensible)
$PM_{2.5}$	0.0019	0.0019	15,687	7.84	Table 3.1-2a, PM (filterable)
SO_2	0.0034	0.0034	28,071	14.04	Table 3.1-2a
CO_2	110	110	908,179,831	454,089.92	Table 3.1-2a

Coal Combustion Emissions

Pollutant	AP-42 Emission Factor (lb/ton)[6]	Controlled Emission Factor (lb/ton)	Emissions (lb)[7]	Emissions (ton)	AP-42 Emission Factor Source Notes[6]
NOx	12	12	199856	99.93	Table 1.1-3 pulverized coal, wall fired, bituminous coal NSPS
CO	0.5	0.5	8327	4.16	Table 1.1-3 pulverized coal, wall fired, bituminous coal NSPS
PM_{10}[8]	0.46	0.084	1399	0.70	Table 1.1-4, PC-fired dry bottom wall-fired, scrubber control
$PM_{2.5}$[8]	0.12	0.06	999	0.50	Table 1.1-4, PC-fired dry bottom wall-fired, scrubber control
SO_2[9]	2.85	0.57	9493	4.75	Table 1.1-3 pulverized coal, wall fired, bituminous coal NSPS
CO_2	6040	6040	100593969	50,296.98	Table 1.1-20
Total NMHC	0.06	0.06	999	0.50	Table 1.1-19; assumed all hydrocarbons are reactive
CH_4	0.04	0.04	666	0.33	Table 1.1-19
N_2O	0.03	0.03	500	0.25	Table 1.1-19

Total Displaced Emissions Associated With Direct Combustion

Pollutant	tons/year[8]	tons/lifetime (35 years (Static))	tons/lifetime (35 years (Increased Renewable))
ROG (NMHC)	0	17	
NO_X	509	17,801	
CO	66	2,313	
PM_{10}	20	704	
$PM_{2.5}$	8	292	
SO_X	19	657	
CO_2E (Metric Ton)	457,643	16,017,506	4,113,714

Notes:

1. Operational time is based on annual average solar radiation hours per day per year (5.38) for the project area. Source: solardirect.com (https://www.solardirect.com/archives/pv/systems/gts/gts-sizing-sun-hours.html)
2. The Project is assumed to displace existing power generation equivalent to the current power mix each year of operation.
3. CA Power Mix assumptions are based on data from the 2021 Total System Electric Generatin Table. https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/2023-total-system-electric-generation
4. Combustion of natural gas and coal for power are of the greatest concern related to the generation of criteria pollutants and GHG emissions, therefore only fuel displacement of natural gas and coal due to electricty production from the Solar Scarlet facility are considered in this assessment.
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7. Coal characteristics used for conversion: Assumed coal heat content = 24 MMBtu/ton
8. Total particulate matter (CPM-TOT) is expressed in terms of coal ash content therefore emission factor is determined by multiplying % ash content of coal (assumed to be 20% herein) by value listed in Table 1.1-4. Organic fraction of particulate matter is 20% of total CPM-TOT (Table 1.1-5) and listed as controlled emission factor.
9. SO_x emission factor calculated by multiplying the weight percent of sulfur (assumed to be 7.5%) by the value listed in Table 1.1-3
10. CO_2E volumes are in metric tons rather than short (US) tons

Darden Renewable Energy Project

Displaced Energy Production during 35-year Project life (2023 CA Power Mix and Increased Renewable Accountability)

Offset based on Increased Renewable Percentage

Year	Renewable %	Change in %	reduction per year	Non Renewable %	Total MT GHG	GHG per %
2023	36.86%			63.14%	457,643	7248.068333
2024	40.17%			59.83%	433,683	
2025	43.47%			56.53%	409,723	
2026	46.78%			53.22%	385,763	
2027	50.08%			49.92%	361,803	
2028	53.39%			46.61%	337,843	
2029	56.69%			43.31%	313,883	
2030	60%	23.1400%	0.033057143	40.00%	289,923	
2031	66.00%			34.00%	246,434	
2032	72.00%			28.00%	202,946	
2033	78.00%			22.00%	159,458	
2034	84.00%			16.00%	115,969	
2035	90%	30%	0.06	10.00%	72,481	
2036	91.00%			9.00%	65,233	
2037	92.00%			8.00%	57,985	
2038	93.00%			7.00%	50,736	
2039	94.00%			6.00%	43,488	
2040	95%	5%	0.01	5.00%	36,240	
2041	96.00%			4.00%	28,992	
2042	97.00%			3.00%	21,744	
2043	98.00%			2.00%	14,496	
2044	99.00%			1.00%	7,248	
2045	100%	5%	0.01	0.00%	0	

*Beyond 2045 would be equal to 2045

Total Offset over 35 years 4,113,714