

APPENDIX BB

SPOT Deepwater Port Greenhouse Gas Emission Calculations

-Page Intentionally Left Blank-

APPENDIX BB. METHODOLOGY

Greenhouse gas (GHG) emissions associated with upstream production and downstream end use of the maximum amount of crude oil that could be exported by the Project were calculated using the following methodology developed in consultation with the United States Environmental Protection Agency.

BB.1. UPSTREAM EMISSIONS

The share of GHG emissions associated with the crude oil proposed to be exported by the Project was calculated using the most recently available annual GHG emission estimates for the U.S. petroleum sector (petroleum systems exploration, production and transportation from 2019) and using the total amount of crude oil produced by the United States in the corresponding calendar year (2019). The ratio of the maximum capacity of crude oil that could be exported by the Project annually to the total amount of crude oil produced by the US in 2019 was used to determine the amount of upstream GHG emissions attributable to the crude oil that would be exported by the Project.

BB.2. DOWNSTREAM EMISSIONS

To calculate the potential GHG emissions associated with end use of the crude oil proposed to be exported by the Project, the analysis was focused on one potential use of the crude oil: refinement into gasoline and subsequent combustion, which represents a worst-case end use from a GHG emission perspective. Crude oil refining GHG emissions for the most recent calendar year (2019) were obtained. The ratio of the maximum capacity of crude oil that could be exported by the Project annually to the total amount of crude oil produced by the United States in 2019 was used to determine the amount of GHG emissions attributable to refining of the crude oil that could be exported by the Project. To determine the GHG emissions associated with the combustion of products refined by the crude oil process, the analysis focused on motor gasoline and distillate fuel oil. The United States Energy Administration estimates of gallons of gasoline and distillate fuel oil produced per barrel of oil were used to determine that total amount of gasoline and distillate fuel oil that could potentially be produced from the crude oil exported by the Project on an annual basis. United States Environmental Protection Agency estimates of GHG emissions associated with combustion of gasoline and diesel from a typical passenger vehicle were used to estimate the annual GHG emissions associated with combustion of gasoline and distillate fuel oil potentially produced by crude oil exported by the Project.

Table BB-1: Input Data—2019 Upstream and Downstream GHG Emissions

Parameter	Value	Reference
Maximum Capacity of the Facility (barrels/yr)	730,000,000	2,000,000 barrels/VLCC * 365 VLCC/year
U.S. Daily Average Supply of Crude Oil in 2019 (barrels/day)	12,299,000	EIA - Petroleum Supply Monthly Archives https://www.eia.gov/petroleum/supply/monthly/archive/
2019 Total U.S. Upstream GHG Emissions (EPA National Inventory)		
Exploration (Metric Ton CO ₂ e)	2,350,000	Greenhouse Gas Inventory Data Explorer - https://cfpub.epa.gov/ghgdata/inventoryexplorer/#energy/naturalgasandpetroleumsystems/allgas/subcategory/all
Production (Metric Ton CO ₂ e)	77,880,000	Greenhouse Gas Inventory Data Explorer - https://cfpub.epa.gov/ghgdata/inventoryexplorer/#energy/naturalgasandpetroleumsystems/allgas/subcategory/all
Transportation (Metric Ton CO ₂ e)	230,000	Greenhouse Gas Inventory Data Explorer - https://cfpub.epa.gov/ghgdata/inventoryexplorer/#energy/naturalgasandpetroleumsystems/allgas/subcategory/all
Total (Metric Ton CO ₂ e)	80,460,000	Greenhouse Gas Inventory Data Explorer - https://cfpub.epa.gov/ghgdata/inventoryexplorer/#energy/naturalgasandpetroleumsystems/allgas/subcategory/all
2019 Total U.S. Downstream GHG Emissions (Refining and Gasoline/Diesel Vehicle Emissions)		
Refining (Metric Ton CO ₂ e)	5,930,000	Greenhouse Gas Inventory Data Explorer - https://cfpub.epa.gov/ghgdata/inventoryexplorer/#energy/naturalgasandpetroleumsystems/allgas/subcategory/all
Vehicle Gasoline Combustion (Metric Ton CO ₂ e/gallon) ^{1,2}	8.89E-03	EPA - https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle#other-than-%20tailpipe
Vehicle Diesel Combustion (Metric Ton CO ₂ e/gallon) ^{1,2}	1.02E-02	EPA - https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle#other-than-%20tailpipe
Gallons of Gasoline produced with One Barrel of Oil	20.0	EIA - https://www.eia.gov/tools/faqs/faq.php?id=327&t=9
Gallons of Diesel produced with One Barrel of Oil	12.0	EIA - https://www.eia.gov/tools/faqs/faq.php?id=327&t=9

1) 1 gram = 1.0E-6 metric tons

2) This assumes insignificant amounts of NO_x and CH₄ in passenger vehicle gasoline and diesel combustion. Therefore, CO₂ emissions provided by EPA are assumed to be CO₂e.

Table BB-2: 2019 Upstream GHG Emissions—Crude Oil Exploration, Production, and Transportation

Crude Oil Exploration Emissions	
2019 U.S. Total Crude Oil Exploration Emissions (Metric Ton CO ₂ e)	2,350,000
2019 Total Production - % that could be exported by SPOT	0.16
2019 Total Exploration Emissions from crude oil that could be exported by SPOT (Metric Ton CO ₂ e)	382,145
Crude Oil Production Emissions	
2019 U.S. Total Crude Oil Production Emissions (Metric Ton CO ₂ e)	77,880,000
2019 Total Production - % that could be exported by SPOT	0.16
2019 Total Production Emissions from crude oil that could be exported by SPOT (Metric Ton CO ₂ e)	12,664,444
Crude Oil Transportation Emissions	
2019 U.S. Total Crude Oil Transportation Emissions (Metric Ton CO ₂ e)	230,000
2019 Total Production - % that could be exported by SPOT	0.16
2019 Total Transportation Emissions for % of oil that could be exported by SPOT (Metric Ton CO ₂ e)	37,401
Total Upstream GHG Emissions 2019 for % of oil that could be exported by SPOT (Metric Ton CO₂e)	13,083,991

Table BB-3: 2019 Downstream GHG Emissions, Diesel Vehicle Combustion, and Gasoline Vehicle Combustion

Crude Oil Refining Emissions	
U.S. 2019 Total Crude Oil Refining Emissions (Metric Ton CO ₂ e)	5,930,000
2019 Total Production - % that could be exported by SPOT	0.16
2019 Total Refining Emissions for % of oil that could be exported by SPOT (Metric Ton CO ₂ e)	964,306
2019 Passenger Vehicle Emissions - Gasoline and Diesel Produced from % of Crude Oil that could be exported by SPOT	
Total Gasoline Produced by crude oil that could be exported by SPOT (gal)	14,600,000,000
Total Diesel Produced by crude oil that could be exported by SPOT (gal)	8,760,000,000
Gasoline Vehicle Emissions from crude oil that could be exported by SPOT (Metric Ton CO ₂ e)	129,750,200
Diesel Vehicle Emissions from crude oil that could be exported by SPOT (Metric Ton CO ₂ e)	89,176,800
Total Downstream GHG Emissions 2019 for % of oil that could be exported by SPOT (Metric Ton CO₂e)	219,891,306

Table BB-4: Estimated Social Cost of Upstream GHG Emissions (CO₂e) for the Maximum Capacity of Crude Oil that could be Exported by the Project—2025 to 2050

Year	5% Average Discount Rate	3% Average Discount Rate	2.5% Average Discount Rate
2025	\$ 222,427,840	\$ 732,703,472	\$ 1,085,971,217
2026	\$ 227,661,436	\$ 748,404,261	\$ 1,101,672,006
2027	\$ 232,895,032	\$ 764,105,049	\$ 1,117,372,795
2028	\$ 238,128,628	\$ 779,805,838	\$ 1,133,073,583
2029	\$ 243,362,225	\$ 795,506,627	\$ 1,148,774,372
2030	\$ 248,595,821	\$ 811,207,415	\$ 1,164,475,161
2031	\$ 256,446,215	\$ 824,291,406	\$ 1,182,792,747
2032	\$ 264,296,609	\$ 837,375,396	\$ 1,201,110,334
2033	\$ 272,147,004	\$ 850,459,387	\$ 1,219,427,921
2034	\$ 279,997,398	\$ 863,543,378	\$ 1,237,745,508
2035	\$ 287,847,793	\$ 876,627,368	\$ 1,256,063,095
2036	\$ 295,698,187	\$ 892,328,157	\$ 1,274,380,681
2037	\$ 303,548,581	\$ 908,028,945	\$ 1,292,698,268
2038	\$ 311,398,976	\$ 923,729,734	\$ 1,311,015,855
2039	\$ 319,249,370	\$ 939,430,523	\$ 1,329,333,442
2040	\$ 327,099,764	\$ 955,131,311	\$ 1,347,651,029
2041	\$ 334,950,159	\$ 970,832,100	\$ 1,365,968,615
2042	\$ 342,800,553	\$ 986,532,889	\$ 1,384,286,202
2043	\$ 350,650,947	\$ 1,002,233,678	\$ 1,402,603,789
2044	\$ 358,501,342	\$ 1,017,934,466	\$ 1,420,921,376
2045	\$ 366,351,736	\$ 1,033,635,255	\$ 1,439,238,963
2046	\$ 376,818,928	\$ 1,049,336,044	\$ 1,454,939,751
2047	\$ 387,286,121	\$ 1,065,036,832	\$ 1,470,640,540
2048	\$ 397,753,313	\$ 1,080,737,621	\$ 1,486,341,329
2049	\$ 408,220,506	\$ 1,096,438,410	\$ 1,502,042,117
2050	\$ 418,687,698	\$ 1,112,139,198	\$ 1,517,742,906

1. The social cost of carbon was calculated from the time of estimated start of operations until 2050. Social cost of carbon estimates are not currently available beyond 2050 (IWG 2021).

2. The social cost of carbon is calculated based on CO₂e emission estimates (IWG 2021).

Table BB-5: Estimated Social Cost of Downstream GHG Emissions (CO₂e) for the Maximum Capacity of Crude Oil that could be Exported by the Project—2025 to 2050

Year	5% Average Discount Rate	3% Average Discount Rate	2.5% Average Discount Rate
2025	\$ 3,738,152,203	\$ 12,313,913,138	\$ 18,250,978,401
2026	\$ 3,826,108,725	\$ 12,577,782,706	\$ 18,514,847,969
2027	\$ 3,914,065,248	\$ 12,841,652,273	\$ 18,778,717,536
2028	\$ 4,002,021,770	\$ 13,105,521,840	\$ 19,042,587,103
2029	\$ 4,089,978,292	\$ 13,369,391,407	\$ 19,306,456,670
2030	\$ 4,177,934,815	\$ 13,633,260,975	\$ 19,570,326,238
2031	\$ 4,309,869,598	\$ 13,853,152,281	\$ 19,878,174,066
2032	\$ 4,441,804,382	\$ 14,073,043,587	\$ 20,186,021,895
2033	\$ 4,573,739,166	\$ 14,292,934,893	\$ 20,493,869,723
2034	\$ 4,705,673,949	\$ 14,512,826,199	\$ 20,801,717,551
2035	\$ 4,837,608,733	\$ 14,732,717,505	\$ 21,109,565,380
2036	\$ 4,969,543,517	\$ 14,996,587,072	\$ 21,417,413,208
2037	\$ 5,101,478,300	\$ 15,260,456,639	\$ 21,725,261,037
2038	\$ 5,233,413,084	\$ 15,524,326,207	\$ 22,033,108,865
2039	\$ 5,365,347,867	\$ 15,788,195,774	\$ 22,340,956,694
2040	\$ 5,497,282,651	\$ 16,052,065,341	\$ 22,648,804,522
2041	\$ 5,629,217,435	\$ 16,315,934,908	\$ 22,956,652,351
2042	\$ 5,761,152,218	\$ 16,579,804,476	\$ 23,264,500,179
2043	\$ 5,893,087,002	\$ 16,843,674,043	\$ 23,572,348,008
2044	\$ 6,025,021,786	\$ 17,107,543,610	\$ 23,880,195,836
2045	\$ 6,156,956,569	\$ 17,371,413,177	\$ 24,188,043,665
2046	\$ 6,332,869,614	\$ 17,635,282,744	\$ 24,451,913,232
2047	\$ 6,508,782,659	\$ 17,899,152,312	\$ 24,715,782,799
2048	\$ 6,684,695,704	\$ 18,163,021,879	\$ 24,979,652,366
2049	\$ 6,860,608,748	\$ 18,426,891,446	\$ 25,243,521,934
2050	\$ 7,036,521,793	\$ 18,690,761,013	\$ 25,507,391,501

1. The social cost of carbon was calculated from the time of estimated start of operations until 2050. Social cost of carbon estimates are not currently available beyond 2050 (IWG 2021).

2. The social cost of carbon is calculated based on CO₂e emission estimates (IWG 2021).

-Page Intentionally Left Blank-