Los Cerritos Wetlands Oil Consolidation and Restoration Project

Greenhouse Gas Mitigation White Paper

May 30, 2017

I. Introduction

The Greenhouse Gas (GHG) Assessment for the Los Cerritos Wetlands Oil Consolidation and Restoration Project ("Project") Environmental Impact Report (EIR) has identified a significant GHG impact. With implementation of GHG-reducing measures, the Project is able to mitigate its GHG impact to a less than significant level. Specifically, GHG emissions will be mitigated through a combination of: (1) Project design features; (2) Operational characteristics; and (3) Retiring GHG allowances and offsets per the AB 32 Cap-and-Trade regulation.

This white paper summarizes the findings of the GHG Assessment prepared for the Project by Greve & Associates, describes the unique California GHG regulations that mitigate certain GHG emissions, and identifies the mitigation measures that the Project proposes to implement to reduce its GHG impacts to less than significant.

II. Project EIR GHG Significance Threshold

The South Coast Air Quality Management District (SCAQMD) has adopted GHG significance thresholds for Stationary Sources, Rules and Plans. The threshold utilizes a tiered approach, with a screening significance threshold of 10,000 MT CO_2EQ for industrial projects. Because this project most closely resembles the types of industrial projects used by SCAQMD under its industrial definition, the 10,000 MT CO_2EQ per year will be used as the significance threshold for this project's EIR. The SCAQMD methodology recommends that total construction emissions be amortized over a 30-year period or the project's expected lifetime if it is less than 30 years.

III. What are the calculated GHG emissions from the project?

As detailed in the sections below the Project GHG emissions exceed the 10,000 MT CO_2EQ per year significance threshold cited above, thus requiring identification and implementation of feasible mitigation measures to reduce, if possible, the impact to less than significant.

a. Construction

Per the Project's GHG Assessment there are nine phases of construction with Table 1, below, showing the GHG emissions by phases and then annualized over 30 years in accordance with the EIR GHG significance threshold methodology.

TABLE 1. GHG Emissions for Construction (Metric Tons Per Year)

	CO2	CH4	N2O	CO2EQ
1. Demolition/Site Prep	202.6	0.1	0.0	203.8
2. Well Cellars	771.6	0.1	0.0	774.7
3. Process Equipment	1027.7	0.2	0.0	1031.7
4. Tank Construction	58.2	0.0	0.0	58.5
5. Off-Site Construction	331.7	0.1	0.0	333.2
6. Office/Warehouse	100.5	0.0	0.0	101.0
7. Wetlands Restoration	646.8	0.2	0.0	650.0
8. Turbine Commission	206.6	0.0	0.0	206.6
Subtotal	3,345.7	0.7	0.0	3,359.6
9. Landfill Excavation	414.6	0.0	0.0	415.6
Total Construction Emissions (Metric Tons)	3,760.3	0.7	0.0	3,775.2
Averaged Over 30 Years (Metric Tons Per Year)	125.3	0.0	0.0	125.8

b. Operations

Per the Project's GHG Assessment there are five areas of operational emissions with Table 2, below, showing the GHG emissions broken down for those areas. Those five areas consist of the oil production operations at two sites, Pumpkin Patch Site and LCWA Site; the Visitors Center on the Synergy Oil Field Site; and the power generation from both the gas turbines that will be constructed on the LCWA Site and the electrical power usage from SCE.

TABLE 2. GHG Emissions for Operations (Metric Tons Per Year)

	CO2	CH4	N2O	CO2EQ
Pumpkin Patch	603	0.8	0.0	621
Visitor Center	606	0.2	0.0	611
LCWA Site	499	1.2	0.0	529
Turbines @ LCWA	67,581	0.0	0.0	67,581
SCE Power	1,011	0.0	0.0	1,014
Total Operational Emissions	70,300	2	0	70,356

IV. What are the project design features incorporated in the Project that reduce GHG emissions?

There are a number of specific project design features that serve to reduce the project's GHG emissions. Project design features are those measures or design characteristics of the proposed project that the project proponent has voluntarily offered to implement which will reduce or avoid potentially significant environmental impacts. Compared to the relatively simpler process of only using electricity from SCE, these features come with an added cost of multi-millions of dollars, all borne by the project proponent. Absent implementation of these features, there would be significant increases in the GHG emissions that would otherwise result from the Project.

a. Microgrid Design and Solar PV

The Project proposes to include as part of its overall design and energy production strategy a microgrid and installation of solar PV modules. The decision to utilize a microgrid and solar PV modules as part of the project's energy system is a design feature which helps to reduce the GHG emissions from the proposed project and is voluntarily being offered and implemented by the project proponent.

The project intends to construct and operate its own microgrid by designing the production facilities in such a manner that the microgrid can capture energy produced by the oil production operations (i.e., natural gas) and redistribute that energy elsewhere in the system. This project design feature (i.e., the microgrid) controls integration of multiple energy sources and uses to maximize efficiency, environmental benefits, cost savings and reliability. The energy source components will include an SCE grid connection, four 4.5 MW gas turbines with heat recovery steam generators for cogeneration and potential generation of 18 MW, and renewable solar photovoltaic with generation potential of 158 kW. The microgrid system will provide all of the energy needed for the facilities including drilling rigs and supporting equipment, pumps, two electric vehicle charging stations, and other equipment.

GHG reductions are provided by the microgrid because it allows for the real-time integration of clean and renewable energy sources with energy efficiency controls on energy using equipment. The microgrid can match the cleanest energy sources with the cleanest, most efficient energy uses.

b. **Turbine Use**

The Project's oil production process will result in natural gas production. In many oil fields, the natural gas produced as a byproduct of oil production is shipped off-site and used elsewhere for energy production, and electricity is purchased from SCE to run the oil field equipment. Instead of adopting that option, the Project decided to use gas turbines on-site to generate power to run the oil field equipment. The gas turbines would be fueled by the natural gas that is produced on-site. Use of that natural gas as a source of power to run the Project turbines is highly efficient as compared to other power options for oil production operations. This translates into a significant reduction in GHG emissions. Without the Project's use of turbines, the natural gas may be burned in water heaters and space heaters in homes, sold to a power company to combust and generate power (less efficiently), or combusted by other sources. The point is that without ability to capture and re-use the natural gas generated by the Project, the natural gas would be combusted offsite and added to the GHG emissions generated.

The manner in which the gas turbines help reduce overall GHG impacts is best explained by providing a comparison of the project without turbines against the proposed project with turbines. If the project proponent had not decided to include the turbines for electrical generation and natural gas re-capture, the project would have had to purchase power from SCE. SCE's generation of power to run the equipment for the Project would generate between 40,058 and 53,720 MTCO2EQ/Yr of GHG emissions as shown in the Project's GHG Assessment. In addition to the GHG emissions that would be generated by SCE's power generation, the Project will produce natural gas as a byproduct of oil production. That natural gas will not be used on site, and will be shipped offsite to be used to generate power elsewhere in the region or state. For example, natural gas produced by the Project could be placed into the regional natural gas distribution system, and used as a source of energy for domestic use, such as being burned in homes for space heating. Using CalEEMod, the estimate is that 90,255 MTCO2EQ/Yr of GHG emissions could be generated by space heating. Therefore, the total of GHG emissions that might be generated if the turbines were not used is 143,975 MTCO2EQ/Yr. This is more than twice as high as the emissions generated by the Project for power generation. This analysis is summarized in Table 3.

TABLE 3. Potential GHG Emissions Generated Without Turbines (MTCO2EQ/Yr)

	GHG Emissions
SCE Emissions	53,720
Residential Space Heating	90,255
Total Emissions	143,975

Proposed Project Power Emissions, including SCE	68,595
Percent Lower with Project	52%

Per this illustration, use of the turbines for the Project can provide a large GHG emission savings when compared to the alternative of using only SCE electricity and selling all the natural gas for use elsewhere.

c. **Turbine Selection**

Another project design feature of the Project that reduces GHG emissions is the selection of turbines that will produce substantially lower GHG and other emissions as compared to standard turbines. As an example, the Project may use the Mercury 50 model turbine from Solar Turbines, or similar. This example is summarized in Table 4.

TABLE 4. CO2 Emissions per Year- Project Turbine Alternatives

Turbine Manufacturer/Model	CO2 Emissions per Year (Metric Tons CO2/kW/yr)
Solar Turbines / Mercury 50	4.74
Solar Turbines / Mars 100	5.58
Benefit, Project Use of Low Emission Turbines	15% Cleaner

The emission-reducing benefits of the cleaner turbine can be even higher for other pollutants like NOx. Being mindful of balancing turbine cost with the priority of low GHG and other emissions, the Project will use turbines that produce low emissions and help reduce EIR-identified emission impacts below levels of significance.

d. **Turbine Design – Cogeneration System**

Both the United States Environmental Protection Agency and California Air Resources Board promote the pollution-reducing efficiency of cogeneration systems and encourage their expanded use.

Most oil production facilities of the type proposed do not utilize cogeneration. The use of cogeneration represents the utilization of advanced technology and an additional capital expense, and the proposed project has included the use of cogeneration as a project design feature to minimize greenhouse gas emissions.

The primary focus of the cogeneration process will be to heat oil and water, and cool gas as part of the oil production/separation process. The water reclaimed from this process is injected back into the oil production formation, and the gas and oil is sold for use and further processing, respectively. As the oil/water mixture enters the separation chamber it is heated and chemicals may be applied to enhance separation. Gas coming off of this process is cooled to remove water and heavy hydrocarbons. Without cogeneration, natural gas would be combusted in a boiler to heat the oil/water mixture. With cogeneration, waste heat from the turbine exhaust is used to heat the oil/water mixture rather than being exhausted to the atmosphere. Again, without cogeneration, refrigeration units powered by electricity would be utilized. With cogeneration, the steam from the turbines powers the refrigeration units.

Therefore, without cogeneration additional greenhouse gases would be generated by the combustion of natural gas for heating and by electric consumption for cooling. These additional emissions were calculated. SPEC Services (email dated December 20, 2016) estimated that 41,160 kwh per day would be needed for cooling and that 480 mscfd (thousand standard cubic feet per day) of natural gas would need to be combusted for heating. Emission factors in CalEEMod (version 2016.3.1) were used to calculate the GHG emissions from electrical consumption. Emission factors from the U.S. Environmental Protection Agency ("Compilation of Air Emission Factors, AP-42", https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emission-factors) were used to compute emissions from the combustion of natural gas for heating. The results are presented in the Table 5 below, provides the additional greenhouse gas emissions for heating and cooling and the total additional emissions without cogeneration.

TABLE 5. Emissions With and Without Cogeneration (metric tons per year)

	CO2EQ
Additional Heating Emissions	9,541
Additional Cooling Emissions	4,804
Additional Emissions Without Cogen	14,345
Power Emissions with Cogen and SCE	68,595
Power Emissions Without Cogen	82,941
Percent Increase Without Cogen	21%

The table's data indicates that 14,343 metric tons per year of equivalent carbon dioxide (MTCO2EQ/Yr) would be generated if cogeneration was not used. Without cogeneration, an additional 21% of GHG emissions would be generated. Therefore, the use of cogeneration as a design feature of the Project results in a significant GHG emission savings.

e. Synergy Oil Field Curtailed Operations

Finally, Project partner Synergy Oil has committed to curtail its operations if the Project is approved and upon issuance of building permits which will significantly reduce GHG emissions. Once the proposed Project receives the necessary building permits, Synergy has committed as a project design feature to reduce the baseline oil production by 75%. In addition, any trucking of oil off-site will be eliminated since all produced oil would be processed at the Pumpkin Patch Site and pumped through new pipes to refineries. To further reduce emissions from current oil operations, the Project provides for a phase out of the 53 existing oil wells as follows: within the first 20 years after project implementation (essentially measured from the issuance of the certificate of occupancy of the new office building on the Pumpkin Patch site), 50% of the existing wells would be removed. At the end of 40 years, the remaining 50% of wells would be removed from the existing Synergy Oil Field and City sites.

The GHG reductions associated with this commitment are shown as "Curtailed Emissions" in Table 7 below.

V. What are the operational characteristics that provide GHG emissions reductions?

There are a number of operational characteristics that affect the calculation of GHG emissions in different ways. Like the project design features described above, all of the operational characteristics described below provide important GHG reductions. These characteristics show how the Project reduces GHG and other pollutants by improving energy generation and consumption.

a. California Energy Supply Loading Order – Displacement of Higher Polluting Energy

As described in this white paper the Project's installation of a microgrid and turbines provides a major reduction in GHG emissions compared to comparable oil production facilities and supporting energy systems. An additional benefit comes from the system-wide energy supply loading order used by California. That loading order provides California with the cleanest, low GHG energy supply possible from all sources, tiering the supply preference from energy efficiency to renewable wind/solar to cleaner (and later dirtier) natural gas and other fossil fuel power plants, in that order.

In short this loading order means the energy provided by the Project's relatively low GHG microgrid and turbines will offset dirtier energy from California's energy system that would otherwise be used by the Project. California Energy Commission staff describe this benefit in part in a December 2016 analysis of GHG emissions and mitigation for a proposed power plant, per the following two quotes-

> "Given that natural gas-fired generation is needed for reliable system operation, the development and operation of new facilities to replace aging plants … is not only necessary for system and local reliability, such development serves to reduce GHG emissions from the electricity sector."

> "Any assessment of the impact of a new power plant on system-wide GHG emissions must begin with the understanding that electricity generation and demand must be in balance at all times; the energy provided by any new generation resource simultaneously displaces exactly the same amount of energy from an existing resource or resources. The GHG emissions produced by [the new plant] are thus not incremental additions to system-wide emissions, but are offset by reductions in GHG emissions from those generation resources that are displaced."

b. **GHG Benefits of Project-Sourced Oil Supply Compared to Other Oil Fields**

About 35 percent of the oil used in California comes from California oil and gas reservoirs. There are a number of strategic and environmental benefits associated with oil and gas that is sourced and used in California. These benefits include energy security, reliability, local sustainability (e.g., local source/local use), and reduced transport-related environmental risk and GHG emissions.

Another way California-sourced oil/gas reduces GHG emissions is via California's AB 32 regulations which include control of oil and gas production facilities. As an example, in March 2017 CARB approved the most comprehensive regulation worldwide for oil and gas production-related methane.

As exhibited in the following Table 6, according to CARB the carbon intensity for crude oil production and transport is significantly lower in the Project-associated oil field compared to oil supplied to California refineries from other areas of the state, United States, and world.

TABLE 6. Carbon Intensity of Crude Oil Production and Transport – California Refineries

Region of Oil Production	Carbon Intensity Value (gCO_2e/MJ)
Seal Beach (Project-related oil field)	5.08
Average, All Oil Refined in California	11.98
Benefit, Seal Beach compared to All Refined Oil	57% Cleaner

VI. What is Cap-and-Trade and why is the project captured by this California program?

a. **California Global Warming Solutions Act (AB 32)**

Because the Project GHG emissions trigger a requirement for compliance with AB 32 regulations it is important to understand the applicable regulations and their relation to GHG mitigation. It is also important to understand that GHGs are not like other pollutants with localized impacts. GHG by its very name is an impact that is global in nature, so the focus of GHG mitigation often extends well beyond the local level.

The California Global Warming Solutions Act (a.k.a. AB 32) directs the California Air Resources Board ("CARB") to do the following:

- On or before June 30, 2007, CARB shall publish a list of discrete early action measures for reducing GHG emissions that can be implemented by January 1, 2010;
- By January 1, 2008, establish the statewide GHG emissions cap for 2020, based on CARB's calculation of statewide GHG emissions in 1990 (an approximately 25 percent reduction in existing statewide GHG emissions);

- Also by January 1, 2008, adopt mandatory reporting rules for GHG emissions sources that "contribute the most to statewide emissions" (Health & Safety Code § 38530);
- By January 1, 2009, adopt a scoping plan that indicates how GHG emission reductions will be achieved from significant GHG sources through regulations, market mechanisms, and other strategies;
- On or before January 1, 2010, adopt regulations to implement the early action GHG emission reduction measures;
- On or before January 1, 2011, adopt quantifiable, verifiable, and enforceable emission reduction measures by regulation that will achieve the statewide GHG emissions limit by 2020; and
- On January 1, 2012, CARB's GHG emissions regulations become operative.
- On January 1, 2020, achieve 1990 levels of GHG emissions.

b. GHG Emissions Tracking and Reporting

CARB Mandatory Reporting Regulations (December 2007). Under AB 32, CARB promulgated regulations (https://www.arb.ca.gov/cc/reporting/ghg-rep/regulation/mrr-regulation.htm) to govern mandatory greenhouse gas emissions reporting for certain sectors of the economy, most dealing with approximately 94 percent of the industrial and commercial stationary sources of emissions. Regulated entities include electricity generating facilities, electricity retail providers, oil refineries, hydrogen plants, cement plants, cogeneration facilities, and industrial sources that emit over 10,000 metric tons of CO2 from stationary source combustion.

Because of these regulations, the Project is required to provide detailed annual reports to CARB about its facility-wide GHG emissions.

c. California Air Resources Board Cap-and-Trade Regulation

The AB 32 Scoping Plan identifies a Cap-and-Trade program as one of the strategies California will employ to reduce the greenhouse gas (GHG) emissions that cause climate change. Under Cap-and-Trade, an overall limit on GHG emissions from capped sectors will be established, and facilities subject to the cap will be able to trade permits (allowances) to emit GHGs. The program started on January 1, 2012, with an enforceable compliance obligation beginning with the 2013 GHG emissions for GHG emissions from stationary sources. Projects comply with Cap-and-Trade by using three methods: obtain allowances by purchasing them; obtain freely allocated industry assistance allowances, and; offsets. The petroleum and natural gas sector is covered for stationary and related combustion, process vents and flare emissions when the total emissions from these sources exceed 25,000 MTCO2e per year. Suppliers of natural gas and transportation fuels that generate combustion emissions are also covered by Cap-and-Trade.

Cap-and-Trade is designed to reduce the emissions from a substantial percentage of GHG sources (about 80% of GHG emissions will come under the program) within California through a market trading system. The system would reduce GHG emissions by reducing the available GHG "allowances" over time up until the year 2020. The program beyond the year 2020 has not been designed yet, but the program is intended to extend beyond that timeframe. Facilities are required to obtain an "allowance", either through purchasing at auction or through freely allocated "industry assistance" allowances from CARB, for each MTCO2e of GHG they emit. CARB issues the "industry assistance" allocations for free for a number of industries. These are based, in part, on a pre-defined "benchmark" of GHG emissions per unit of production.

For the oil recovery production sector, allowances are provided as a function of the amount of crude oil produced, thereby establishing, in effect, a level of efficiency in regard to GHG emissions for that sector. Other sectors are also allocated allowances based on their own respective activities. If an operation within the sector operates less efficiently than the specified "benchmark", thereby receiving an insufficient number of "free" allowances to cover their emissions, they would be required to implement efficiency improvements or purchase additional allowances from the CARB auction. Some availability of "offsets" is also included in the program which can be obtained from specific, allowable offset programs, such as GHG reduction projects related to forestry, livestock, and ozone depleting chemicals. Offsets outside of these three options are not allowed at this time. The first group of sectors began trading in allowances in 2012. That group includes the oil and gas sector as well as most stationary sources. A second group began the program in 2015, which would include the transportation fuels sector. CARB auctioned about 23 million allowances in November 2012 to be used for the 2013 year.

VII. Is the project able to fully mitigate its GHG emissions?

Yes. In complying with the Cap-and-Trade regulation the Project more than mitigates its GHG emissions. All of the additional Project design features and operational characteristics described above provide an even higher level of assurance for full GHG mitigation.

a. EIR Net Change in GHG Emissions

Table 7 shows the net change in GHG emissions in the Project's GHG Assessment after adjusting for the Project's commitment to reduce oil production from the existing 53 oil wells. The table shows that with the reduction from the Project's commitment to reduce and eliminate the operations of the 53 existing wells, 53,590 metric tons of GHG emissions will remain relative to the Project EIR's significance threshold of 10,000 metric tons.

TABLE 7. Change in GHG Emissions (MTCO2EQ/Yr)

Activity	First 20 Years	Years 20 to 40	After 40 Years
Operational Emissions	70,356	70,356	70,356
Annualized Construction Emissions	126	126	
New Annualized Emissions	70,482	70,482	70,360
Curtailed Emissions	16,871*	19,558*	22,211*
Project Emissions	53,611	50,924	48,145

*Within two years after issuance of the certificate of occupancy for the new office building on Pumpkin Patch, the project will reduce baseline oil production by 75% from existing wells. This will result in a reduction of 16,871 MTCO2EQ/year. With the phase out of 50% of the existing 53 wells by year 20, the cumulative reduction is 19,558 MTCO2EQ year. After 40 years from issuance of the certificate of occupancy, GHG emissions from all 53 of the existing wells will be curtailed.

b. Regulatory Mitigation – AB 32 and Cap-and-Trade

As described above California's AB 32 GHG mitigation program includes a Cap-and-Trade regulation threshold of 25,000 metric tons of GHG. Because the Project exceeds that threshold, it must comply with CARB's Cap-and-Trade regulation. In addition, the Project may be subject to additional reporting requirements and GHG reduction and trading requirements as these regulations continue to evolve.

i. California Air Resources Board AB 32 Cap-and-Trade Allowances/Offsets

Because the Project will comply with AB 32 and CARB's Cap-and-Trade regulation it will be required to retire GHG allowances or offsets equal to the Project's GHG emissions. Retiring the GHG allowances or offsets means the Project has to acquire them through a number of means carefully controlled by CARB, including the purchase of allowances in CARB-controlled auctions with variable and increasing cost, according to projections and decreasing supply.

Regarding the amount of required allowances/offsets the Cap-and-Trade regulation uses measured facility-wide GHG emissions as annually reported to CARB. Per Table 2 above the annual measured operational/facility-wide GHG emissions are calculated to be 70,356 metric tons. (Note that this is worst case with turbines at 100%. In many years the turbines are projected to reduce output, so impact and mitigation will be lower.) For comparison, the annual GHG emissions calculated per EIR protocols shows GHG emissions of 53,611 metric tons, which accounts for both construction and operational emissions. This means the Cap-and-Trade regulation will require the Project to mitigate GHG emissions beyond the amount identified per EIR protocols and in the Project EIR.

TABLE 8. CARB Cap-and-Trade GHG Mitigation Compared to Project EIR GHG Emissions

GHG Emission/Mitigation Source	CO2 Emissions/Mitigation (Metric Tons CO2EQ/Year)
EIR Construction and Operations GHG Emissions	53,611
CARB Cap-and-Trade Mitigation	(70,356)
Excess GHG Mitigation with Cap-and-Trade	(16,745)

Thus, CARB's Cap-and-Trade regulation provides GHG mitigation beyond the GHG emissions amount identified in the Project EIR GHG Assessment.