Assessment of Energy Intensity and Greenhouse Emissions of Proposed Poseidon Huntington Beach Desalination Plant and Water Supply Alternatives

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September 30, 2016

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1.0 Executive Summary

This report reviews the energy intensity and greenhouse gas emissions associated with the grid power demand of the proposed Poseidon Huntington Beach desalination plant and alternatives, including the purification of recycled water and conservation, to assure local water reliability. The electric "grid reliability" impacts of the desalination plant are assessed in the context of electricity supply limitations of the Los Angeles Basin. Finally, the effectiveness of Poseidon's proposed carbon neutral strategy is examined. Recommendations are provided for alternative approaches that would fully address the local grid reliability impacts of the desalination plant while concurrently offsetting all carbon emissions associated with the grid power used to operate the plant. Major findings of this report are:

- Water demand in Orange County Water District service territory has declined 30 percent, about 150,000 acre-feet per year since Poseidon first proposed a desalination plant for Huntington Beach in 1999. This is about three times the 56,000 acre-feet per year potable water production of the proposed desalination plant.
- OCWD's production of purified recycled water to recharge the groundwater basin, via the Groundwater Replenishment System indirect potable reuse project, has increased from zero in 1999 to 103,000 acre feet per year in 2015.
- OCWD anticipates expanding production of purified recycle water to 128,000 acre-feet per year in 2022.
- The energy intensity of ocean water desalination is more than four times greater than that of purified recycled water.
- As a result, the carbon footprint of ocean water desalination is more than four times greater than that of purified recycled water.
- The proposed desalination plant will emit about 96,000 tons per year of carbon dioxide in the first year of operation.
- The approach Poseidon has proposed to achieve carbon neutrality, the purchase of offset credits, will not address the local grid reliability impacts of adding the 30.34 MW of load in the LA Basin.
- The cost of carbon credits is likely to be substantially higher than the $10 metric ton assumed as an economically reasonable offset cost ceiling by Poseidon.
- SCE is under regulatory mandate to have at least another 300 MW of energy storage under contract by 2020.
- At least 30 MW of battery storage at the Huntington Beach Generating Station site is necessary to offset the grid reliability impacts of the desalination plant.
- The contract price of power purchase agreements for solar projects in California has dropped well below the utility wholesale power cost.
- Local solar power should be developed by Poseidon in sufficient quantity to fully offset the carbon footprint of desalination plant operations and support local grid reliability.

2.0 Introduction

Orange County Coastkeeper contracted Powers Engineering to provide a technical assessment of the energy intensity, in terms of kilowatt-hours per acre-foot of water (kWh/AF), and associated greenhouse gas (GHG) emissions with a range of actual and potential water supply options for Orange County. These water supply options evaluated include:

- Conservation
- Potable reuse
- Desalination
- Colorado River water transfers
- State Water Project water transfers

State Water Project and Colorado River Aqueduct water imports are used as the baseline for comparison purposes in this analysis. The overwhelming majority of the potable water utilized in Orange County Water District (OCWD) service territory is supplied from groundwater sources, replenished through natural processes and purified recycled water, with most of the remainder consisting of imported water provided by the Metropolitan Water District. In contrast, the majority of potable water consumed in Southern California as a whole is imported water. For this reason, the energy intensity and carbon dioxide (CO_2) emissions associated with water imports are used as baseline values in this report.[1]

3.0 Description of Proposed Desalination Project

Poseidon proposes to build and operate a 50 million gallons per day (mgd) desalination plant on the property of the Huntington Beach Generating Station (HBGS) in Huntington Beach, California. There are two operational steam boilers on the property, Units 1 and 2, with a combined capacity of 430 MW. Units 1 and 2 use seawater in a once-through cooling (OTC) configuration for power plant cooling. These units are currently operated infrequently and are currently scheduled to comply with the state's once-through cooling phase-out policy by December 2020.[2] If a replacement power project is built at the site it will not utilize an OTC cooling system.[3,4]

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[1] Greenhouse gases, carbon emissions, and CO_2 are used as interchangeable synonyms in this report.

[2] California Energy Commission , *Tracking Progress: Once-Through Cooling Phase-Out*, February 9, 2016, Table 1, p. 3. 2015 capacity factors of Huntington Beach Units 1 and 2 (through September 2015): Unit 1 = 20.7%; Unit 2 = 17.7%.

[3] SCE Application A.14-11-012, *Southern California Edison Company's (U 338-E) Application for Approval of the Results of Its 2013 Local Capacity Requirements Request For Offers for the Western Los Angeles Basin*, November 21, 2014. A 644 MW air-cooled combined cycle project is proposed for the Huntington Beach Generating Station site, with an online date of 2020. The project application was approved by the CPUC in November 2015. The approval is the subject of a legal appeal and the CPUC approval is not yet definitive as of September 26, 2016.

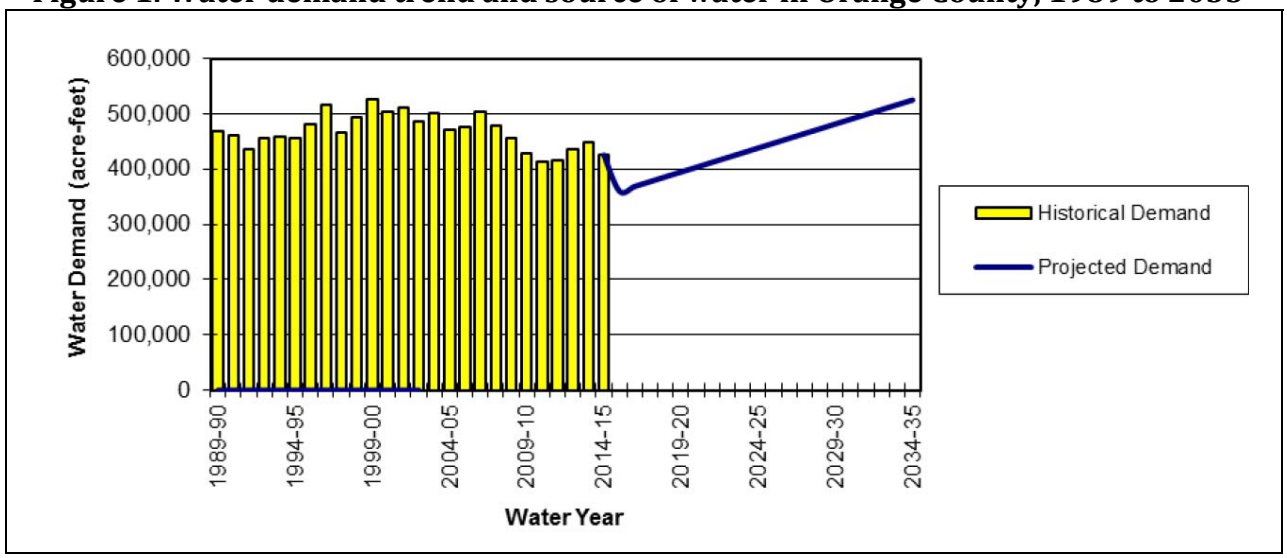
[4] The CEC Application for Certification (AFC) for the Huntington Beach Energy Project describes a 939 MW project, not the 644 MW project approved by the CPUC: http://www.energy.ca.gov/sitingcases/huntington_beach_energy/index.html.

Poseidon has pursued the development of the HBGS site as a seawater desalination facility since 1999. The City of Huntington Beach prepared and circulated the initial Final Environmental Impact Report (FEIR) for the project in 2002. The City Council certified the Recirculated EIR (2005 REIR) in September 2005. The City of Huntington Beach approved the project's conditional use permit and coastal development permit in February 2006. Changes in operational assumptions primarily related to seawater intake occurred after the certification of the REIR. As a result, in May 2010, a Subsequent EIR was prepared to address seawater intake effects based on a "standalone" condition, where the desalination facility would be responsible for direct intake of seawater.[5] Additional changes to the intake and discharge system are expected but have not yet been analyzed in an EIR or approved by the relevant regulatory agencies.

3.1 Orange County Water Demand Trends

Water demand in Orange County has declined about 150,000 acre-feet per year (AF-year), or about 30 percent, since Poseidon first proposed the project in 1999. See Figure 1. In addition, OCWD has added 103,000 AF-year of potable recycled water to its supply through the Groundwater Replenishment System (GWRS), which began operation in 2008 and was expanded in 2015.[6] The GWRS is expected to expand further to 128,000 AF-year of production by 2022,[7,] allowing even greater reliance on groundwater to meet demand.

Figure 1. Water demand trend and source of water in Orange County, 1989 to 2035[8]



[5] City of Huntington Beach, *Draft Subsequent Environmental Impact Report –Desalination Project at Huntington Beach*, May 2010, p. 1-2 and p. 1-3.
[6] See OCWD Groundwater Replenishment System, frequently asked questions webpage, September 28, 2016: http://www.ocwd.com/gwrs/frequently-asked-questions/.
[7] Orange County Water District, *Orange County Water District Groundwater Replenishment System Final Expansion Project, Addendum No. 6: Final Program Environmental Impact Report/Environmental Impact Statement & CEQA-PLUS Federal Consultation Review*, August 2016, p. E-1, p. 2-11.
[8] OCWD, *2014-2015 Engineer's Report on the Groundwater Conditions, Water Supply and Basin Utilization in the Orange County Water District*, February 2016, Figure 5, p. 24.

Further, Los Angeles County and Metropolitan Water District are proposing a similar groundwater replenishment project that would deliver approximately 65,000 AF-year to replenish OCWD's groundwater supply by 2027.[9,10] The additional supply could either: 1) offset the need for the Poseidon desalination project, or 2) allow OCWD member agencies to forego fully treated imported water.

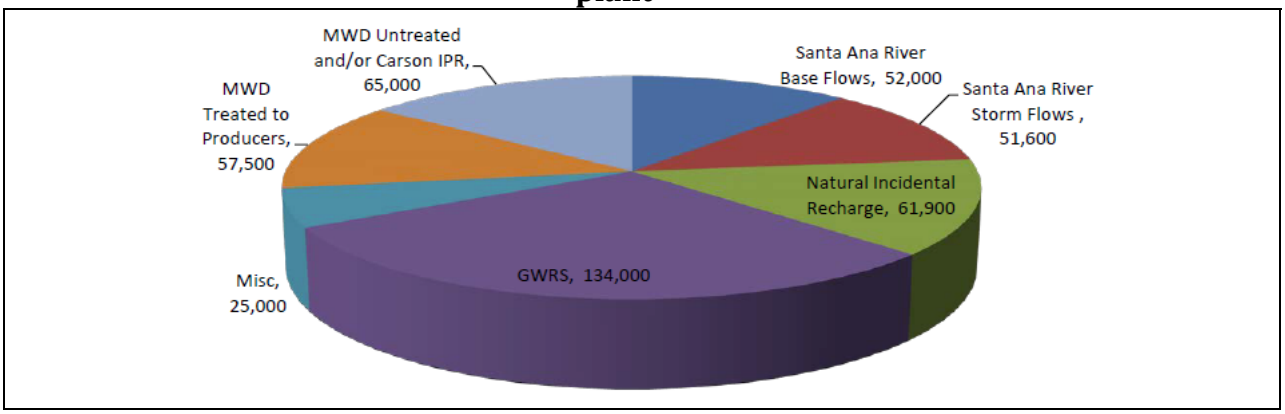
The source of the OCWD water supply is primarily groundwater supplemented with supply from Metropolitan Water District (MWD). The specific source and quantities of OCWD supply for the 2015-2016 fiscal year are shown in Table 1.

Table 1. Specific source and quantities of OCWD supply, 2015-2016[11]

2015-2016 supply source	Quantity (AF)
Groundwater, including potable reuse (GWRS supply)	281,750
Imported water - MWD	44,750
Santiago Creek native water	2,500
Recycled water, non-potable	21,000
Total:	350,000

OCWD is prepared to meet future water needs without the Huntington Beach desalination plant. Figure 2 is OCWD's water supply mix for meeting a projected 2040 demand of 447,000 AF-year without the desalination plant.

Figure 2. OCWD 2040 water supply mix without Huntington Beach desalination plant[12,13]



[9] OCWD Board of Directors Meeting, *Agenda Item - Metropolitan Water District Los Angeles County City of Carson Indirect Potable Reuse Project*, September 7, 2016, p. 1.
[10] OCWD Board of Directors Meeting, *Potential Regional Recycled Water Program* (PowerPoint presentation), September 7, 2016.
[11] Ibid, Table 5, p. 24.
[12] OCWD Board of Directors Meeting, *Agenda Item - Metropolitan Water District Los Angeles County City of Carson Indirect Potable Reuse Project*, September 7, 2016, p. 2. [graphic of water supply mix without Poseidon]
[13] Municipal Water District of Orange County, *Final Draft 2015 Urban Water Management Plan*, May 2016, p. 2-5. Planning horizon identified as 2040.

3.2 Proposed Desalination Plant

The proposed 50 Mgd seawater desalination project at HBGS would convert seawater drawn into the existing HBGS intake structure (with some modifications) into drinking water using a reverse osmosis (RO) desalination process. The desalination plant would draw approximately 100 Mgd from the intake structure and produce 50 Mgd of potable drinking water. The remaining 50 Mgd would be seawater with an elevated salt concentration, as the salts in the 50 Mgd of potable water would be concentrated in this 50 Mgd discharge stream. The 50 Mgd of concentrated discharge from the RO process would be discharged through the existing HBGS OTC discharge pipe.

The proposed desalination project would consist of a seawater intake system, pretreatment facilities, a seawater desalination facility utilizing reverse osmosis technology, post-treatment facilities, product water storage, on- and off-site landscaping, chemical storage, on- and off-site booster pump stations, and 42- to 48-inch diameter product water transmission pipelines up to 10 miles in length.[14] Figure 3 shows the location of the structures and parcels proposed for the 50 Mgd desalination plant at HBGS.

Recent proposed modifications to the HBGS cooling system to adapt it for use in the desalination process would include fine-mesh screens on the intake pipe and pressurized diffusers on the existing discharge pipe. These modifications have not been analyzed by Powers Engineering to determine the additional energy demand they represent.

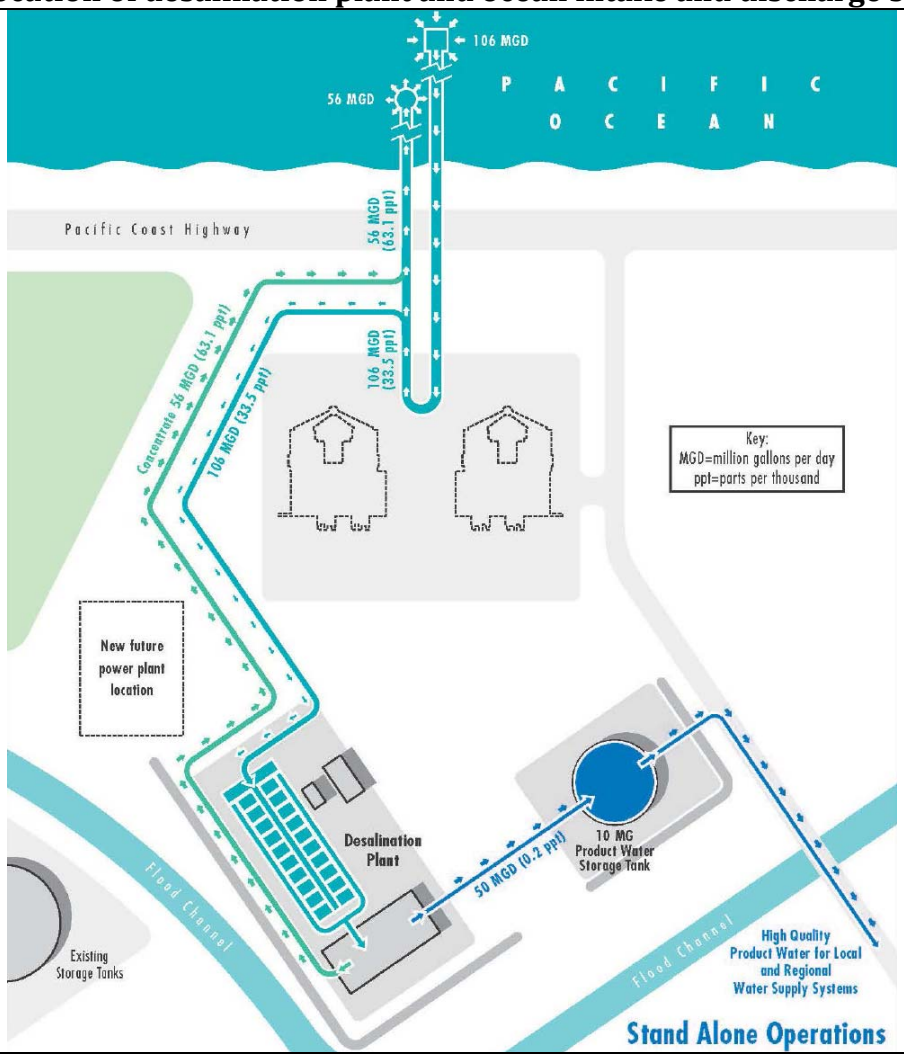
The pre-treatment process requires energy to remove larger particles from the feedwater prior to the RO filtration system. Studies show that withdrawing seawater from sub-surface intakes can reduce or eliminate the need for pre-filtration, and consequently the energy demand and cost of constructing and maintaining the pre-filtration system. However, the current proposal does not call for the use of sub-surface intakes and this report does not analyze those energy savings.

The RO process would be a single-pass design using high rejection seawater membranes. The system would be made up of 13 process trains (12 operational and one standby). Each RO train would have a capacity of approximately 4 Mgd. High pressure electric feed pumps would convey water from the intake filters to the RO membranes. The pumps will provide feed pressures of 800 to 1,000 pounds per square inch. The actual feed water pressure depends on several factors including the temperature of the intake water, salinity of the intake water, and the age of the membranes.[15]

[14] City of Huntington Beach, *Draft Recirculated Environmental Impact Report –Desalination Project at Huntington Beach*, April 5, 2005, p. 3-2.

[15] Additional energy savings may result from the use of warmer water supplied from the HBGS OTC discharge. The desalination process was originally designed, in 2005, to operate at both ambient and elevated seawater temperature. Warmer water increases the efficiency of the RO membranes (Draft REIR, p. 3-25). However, the cooling water system, including use of the intake structure and the warm water discharge, will discontinue operation to meet new State requirements to minimize the intake and mortality of marine life.

Figure 3. Location of desalination plant and ocean intake and discharge structures[16]

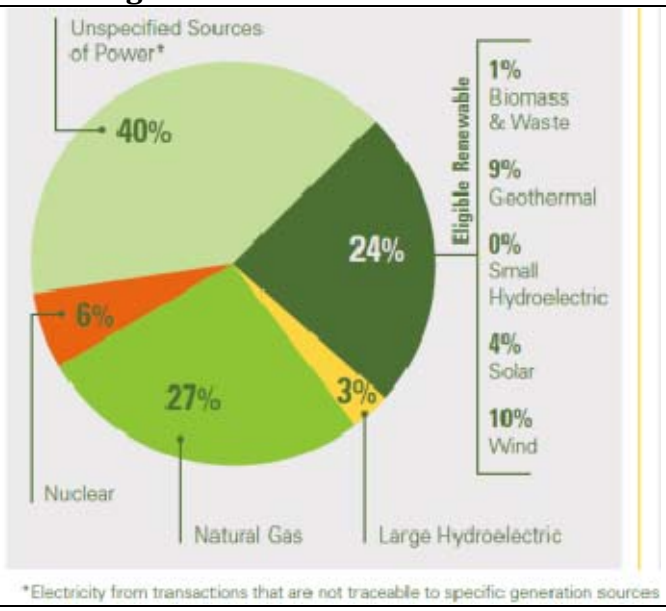


4.0 Greenhouse Gas Emission Rate of Purchased Utility Power

The Huntington Beach desalination project would purchase all of its electricity for the local investor-owned utility, Southern California Edison (SCE). The 2014 power mix of SCE, meaning the mix of power generation sources and the quantity of power generated by those sources is shown in Figure 4. An accurate accounting of the power mix allows precise calculation of the composite CO_2 emission rate of SCE grid power.

[16] Alden Research Laboratory, Inc., *Huntington Beach Desalination Plant Intake/Discharge Feasibility Assessment*, March 14, 2016, Figure 2, p. 15.

Figure 4. SCE 2014 Power Mix[17]



There are two sources of CO_2 emissions in the 2014 SCE power mix: 1) natural gas, 2) unspecified sources of power. Unspecified sources of power means wholesale power generated in the western U.S. The most recently available CEC analysis (2008) of unspecified sources of power indicates this power is 41.9 percent natural gas and 33.7 percent coal.[18] This analysis of the composition of unspecified sources of power remains reasonably accurate, as coal-fired power generation in the western U.S. declined less than 5 percent over the 2007-2015 time period.[19] All other sources of unspecified sources of power besides natural gas and coal are carbon-free, and include large hydro, renewables, and nuclear.

To corroborate the carbon footprint of 2014 SCE power mix, it is necessary to have accurate information on: 1) CO_2 emission factor for natural gas combustion, 2) CO_2 emission factor for coal combustion, and 3) the percentages of natural and coal-fired power in the "unspecified sources of power" that comprised 40 percent of SCE's power sales in 2014.

4.1 CO_2 Emission Factors for Natural Gas, Coal, and Unspecified Sources of Power

4.1.1 Natural Gas

Composite California 2013 natural gas-fired combustion heat rate = 8,537 Btu/kWh.[20]

[17] SCE, *2014 Corporate Responsibility Report*, October 19, 2015, p. 29.
[18] CEC, *2008 Net System Power Report*, July 2009, Table 1, p. 3. The CEC discontinued analysis of the composition of undisclosed sources of power, also known as net system power, with this July 2009 report.
[19] EIA, *Power sector coal demand has fallen in nearly every state since 2007*, April 28, 2016.
[20] CEC, *Thermal Efficiency of Gas-Fired Generation in California: 2014 Update*, September 2014,Table 1, p. 1.

Natural gas CO_2 emission factor = 117 lb/MMBtu.

Therefore, 8,537 Btu/kWh × 1000 kW/MW × 117 lb $CO_2/10^6$ Btu = 999 lb/MWh.

The composite California 2013 natural gas-fired combustion CO_2 emission factor = 999 lb/MWh.

4.1.2 Coal

Sub-bituminous coal CO_2 emission factor = 2,160 lb/MWh.[21]

4.1.3 Unspecified sources of power

The CO_2 emission factor for unspecified sources of power is sum of the natural gas (41.9 percent) and coal (33.7 percent) combustion components of the unspecified power mix:

(0.419 × 999 lb/MWh) + (0.337 × 2,160 lb/MWh) = 1,147 lb/MWh.

4.2 SCE CO_2 Power Generation Emission Factor

The SCE CO_2 power generation emission factor is the weighted average of the CO_2 emission factors for natural gas, unspecified sources of power, and clean energy resources that produce no CO_2 emissions. The SCE CO2 emission factor is calculated below for 2014 and for 2030, assuming SCE reaches a 50 percent renewable portfolio standard (RPS) by 2030.

4.2.1 2014

As shown in Figure 1, the two sources of CO_2 emissions in the SCE generation mix are natural gas (27 percent) and unspecified sources of power (40 percent). Therefore, the CO_2 emission rate for the 2014 SCE power mix is:

2030 SCE CO_2 EF = (0.27 × 999 lb/MWh) + (0.40 × 1,147 lb/MWh) = 729 lb/MWh

The CO_2 emission factor identified by SCE in its 2014 Corporate Responsibility Report of 0.26 metric ton/MWh is low when accurate assumptions are used to characterize the carbon footprint of the "unspecified sources of power."[22] 0.26 metric ton/MWh equals approximately 570 lb/MWh.[23] This is the CO_2 emission rate identified by Poseidon for SCE

[21] EIA, *Frequently Asked Questions - How much carbon dioxide is produced per kilowatthour when generating electricity with fossil fuels?*, February 29, 2016. Powers Engineering assumes the predominant form of coal burned in Western coal plants is sub-bituminous coal mined in Wyoming and Montana.
[22] SCE, *2014 SCE Corporate Responsibility Report*, p. 28.
[23] 0.26 metric ton/MWh × (1.1 ton/metric ton) × 2,000 lb/ton = 572 lb/MWh.

grid power in the company's GHG reduction plan.[24] The actual 2014 SCE CO_2 emission factor is approximately 28 percent higher, at 729 lb/MWh, than the reported 570 lb/MWh.

4.2.2 2030

SCE is under a legal mandate to achieve a 50 percent RPS by 2030.[25] In 2014, 24 percent of SCE's power came from renewable energy sources.[26] Assuming the additional renewable energy displaces in equal parts the natural gas and unspecified components of SCE's 2014 electricity supply, in 2030 natural gas will supply 14 percent and unspecified power 27 percent of the SCE power mix. The 2030 SCE CO_2 emission factor will be:

2030 SCE CO_2 EF = (0.14 × 999 lb/MWh) + (0.27 × 1,147 lb/MWh) = 450 lb/MWh

5.0 Energy Intensity of Water Supply Alternatives

5.1. Energy Intensity of Poseidon Huntington Beach Desalination Plant

Poseidon estimates a continuous electricity demand of 30.34 MW to produce 50 mgd of potable water.[27] This represents an energy intensity of 4,748 kWh/AF.[28]

This is an electricity consumption rate equivalent to the GHG emissions associated with electricity demand of about 39,410 California homes, as shown in the following calculations:

2014 Energy Information Administration (EIA) data for California, annual average residential customer load = 6,744 kWh-yr (562 kWh-month).[29]

Poseidon annual electricity demand = 30,340 kW × 8,760 hr/yr = 265,778,400 kWh-yr.

Poseidon electric demand, converted to number of homes = 265,778,400 kWh-yr ÷ 6,744 kWh-yr/home = 39,410 homes.

[24] Poseidon, *Huntington Beach Desalination Plant - Energy Minimization and Greenhouse Gas Reduction Plan*, November 6, 2015, p. 7.
[25] Los Angeles Times, *Gov. Brown signs climate change bill to spur renewable energy, efficiency standards*, October 7, 2015: http://www.latimes.com/politics/la-pol-sac-jerry-brown-climate-change-renewable-energy-20151007-story.html.
[26] See Figure 1.
[27] Poseidon, *Huntington Beach Desalination Plant – Energy Minimization and Greenhouse Gas Reduction Plan*, November 6, 2015, p. 7.
[28] (30,340 kW × 24 hr/day) ÷ [(50,000,000 gallon/day)(1 AF/326,000 gallon)] = 4,748 kWh/AF.
[29] U.S. EIA, 2014 Average Monthly Bill – Residential (Data from forms EIA-861- schedules 4A-D, EIA-861S and EIA-861U), Table 5A.

5.2 Energy Intensity of Potable Reuse

The energy intensity of recycling treated wastewater to potable quality, 1,055 kWh/AF, is based on 2015 data for the Groundwater Replenishment System (GWRS) operated by the Orange County Water District.[30]

Operational since January 2008, the GWRS originally produced 70 mgd of purified water. The project was expanded in 2015 to produce 100 mgd (103,000 AF-year). Ultimate capacity for the GWRS is projected at 130 mgd (128,000 AF-year) after infrastructure is built to increase wastewater flows from Orange County Sanitation District to the GWRS.[31]

The GWRS uses less than half the energy required to transport water, on average, from Northern California to Southern California.[32]

Purifying wastewater in the GWRS is about one-third the cost of ocean desalination because there are far fewer dissolved solids (salts) to remove from wastewater, about 1,000 ppm as compared to 35,000 ppm in ocean water. Removing that high concentration of salts in ocean water requires three times more energy, additional membranes, and shortens reverse osmosis membrane life-span.[33]

5.3 Comparison of Energy Intensities of Potable Water Alternatives

Table 2 compares the energy intensity and annual CO_2 emission rates for five potable water supply alternatives: 1) conservation, 2) potable reuse based on the Orange County Water District Groundwater Replenishment System (GWRS), 3) Colorado River water transfers, and 4) State Water Project water transfers, and 5) Poseidon Huntington Beach desalination plant.

Table 2. Comparison of energy intensity of water supply alternatives

Alternative	Energy intensity (kWh per AF)
Conservation[34]	0
Potable reuse[35]	1,055
Colorado River water transfers[36]	2,223
State Water Project West water transfers[37]	2,817
Poseidon Huntington Beach desalination plant	4,748

[30] J. Kennedy – Executive Director of Engineering and Water Resources, Orange County Water District, e-mail to J. Geever detailing calculation of GWRS energy intensity in kWh/AF for calendar year 2015, September 19, 2016.
[31] 2016 GWRS technical brochure, p. 4: http://www.ocwd.com/media/4267/gwrs-technical-brochure-r.pdf.
[32] Ibid.
[33] Ibid.
[34] Conservation strategies include, for example: smart irrigation and landscaping, water efficient appliances. See OCWD webpage on water conservation strategies: http://www.ocwd.com/learning-center/water-use-efficiency/conservation-strategies/.
[35] J. Kennedy – Executive Director of Engineering and Water Resources, Orange County Water District, e-mail to J. Geever detailing calculation of GWRS energy intensity in kWh/AF for calendar year 2015, September 19, 2016.
[36] H. Blanco – USC Center for Sustainable Cities, *Water Supply Scarcity in Southern California: Assessing Water District Level Strategies, Chapter 9*, November 2012, Appendix 3, p. 251.
[37] Ibid.

6.0 Greenhouse Gas Emissions of Water Supply Alternatives

6.1 Annual CO_2 emissions from Huntington Beach desalination plant

Poseidon estimates a continuous power demand of 30.34 MW for the desalination plant, an annual electricity consumption of 265,888 MWh per year.[38] The expected annual CO_2 emission associated with this level of power consumption would be:

The Poseidon Huntington Beach indirect CO_2 emissions from electricity generation, based on the actual 2014 SCE CO_2 emission rate, would be:

729 lb/MWh × 265,888 MWh/yr × 1 ton/2,000 lb = 96,916 ton/yr

An annual CO_2 emissions rate of 96,916 tons/yr is more than 20,000 tons/yr higher than the 75,620 tons/yr estimated by Poseidon that are associated with the generation of power to be used by the facility.[39]

By 2030, the annual CO_2 emission rate of the Huntington Beach desalination plant would decline to 59,825 ton/yr if SCE reaches the 50 percent RPS target.[40]

6.2 Comparison of CO_2 Emission Rates of Potable Water Alternatives

Table 3 compares the energy intensity and annual CO_2 emission rates for five potable water supply alternatives: 1) conservation, 2) potable reuse based on the Orange County Water District Groundwater Replenishment System (GWRS), 3) Colorado River water transfers, and 4) State Water Project water transfers, and 5) Poseidon Huntington Beach desalination plant. The annual CO_2 emission rate calculation is assumes a production rate of 50 million gallons per day (mgd). 50 mgd is equivalent to 56,000 AF-yr of potable water.[41]

[38] Ibid, p. 7.
[39] Ibid, p. 8. (68,745 metric ton/yr) × (1.1 ton/1 metric ton) = 75,620 ton/yr.
[40] 450 lb/MWh × 265,888 MWh/yr × 1 ton/2000 lb = 59,825 ton/yr.
[41] (50,000,000 gallon/day)(1 AF/326,000 gallon)(365 day/yr) = 55,982 AF-yr.

Table 3. Comparison of energy intensity and annual GHG emissions of water supply alternatives

Alternative	Energy intensity (kWh per AF)	GHG emissions for 56,000 AF-yr production, using 2014 SCE CO_2 emission factor (tons CO_2 per year)
Conservation	0	0
Potable reuse[42]	1,055	21,535
Colorado River water transfers[43]	2,223	45,376
State Water Project West water transfers[44]	2,817	57,501
Poseidon Huntington Beach desalination plant	4,748	96,619

7.0 Impact of Proposed Huntington Beach Desalination Plant Electric Load on LA Basin Grid Reliability

The 30.34 MW Huntington Beach desalination plant load is equivalent to adding the electric load of 39,410 homes to the LA Basin grid.[45] The LA Basin is classified as a local reliability area that must maintain a minimum amount of local generation to assure supply reliability in the event that major transmission lines are unavailable at times of peak demand. According to SCE, available generation may not be sufficient to meet peak summer demand within a few years. In that context, SCE recently received authorization from the California Public Utilities Commission (CPUC) to add supply resources in the LA Basin to address forecast grid reliability issues in 2022.[46]

7.1 Impact of Loss of Aliso Canyon Natural Gas Storage Field on LA Basin Grid Reliability

The SoCalGas Aliso Canyon natural gas storage facility suffered a catastrophic well blowout in October 2015 that resulted in the emergency closure of the storage field. This is the largest storage field in the SoCalGas system. As a result of the emergency

[42] 1.055 MWh/AF × 56,000 AF/yr × 729 lb/MWh × (1 ton/2000 lb) = 21,535 ton/yr.
[43] H. Blanco – USC Center for Sustainable Cities, *Water Supply Scarcity in Southern California: Assessing Water District Level Strategies, Chapter 9*, November 2012, Appendix 3, p. 251.
[44] Ibid.
[45] 265,778,400 kWh-yr ÷ 6,744 kWh-yr/home = 39,410 homes
[46] CPUC, Decision 15-11-041, *Decision Approving, in Part, Results of Southern California Edison Company Local Capacity Requirements Request for Offers for the Western LA Basin Pursuant to Decisions, 13-02-015 and 14-03-004*, November 19, 2015.

closure of Aliso Canyon, the grid operator may now impose limits on natural gas usage in electric generators under certain peak demand conditions.[47] A map of the affected electric generators in the Aliso Canyon delivery area is shown in Figure 5.[48] HBGS is in the delivery area.

Figure 5. LA Basin electric generators served by the Aliso Canyon storage field

7.2 Grid Reliability Alternatives for Poseidon Huntington Beach Electric Load

The possible addition of a continuous 30.34 MW load in an area where state authorities have implemented fast-track mitigation measures to address a potential grid reliability deficit points to the need for the Poseidon GHG offsets to be generated by real projects in the LA Basin grid reliability area, and not by offset credits associated with projects that are likely to be outside of the LA Basin.

One element employed to address grid reliability and effective storage of renewable energy is battery storage. As a result of California Public Utilities Commission decisions D.13-10-040, SCE is required to have 580 MW energy storage capacity

[47] Aliso Canyon Winter Action Plan, August 22, 2016: http://www.energy.ca.gov/2016_energypolicy/documents/index.html#08262016.
[48] Aliso Canyon Summer Action Plan, April 5, 2016, Figure 2, p. 11: http://www.energy.ca.gov/2016_energypolicy/documents/#04082016.

under contract by 2020.[49] To date SCE has approval for installation of 264 MW of energy storage resources in its service territory.[50] This means SCE has an obligation to have over 300 MW of additional energy storage resources under contract by 2020. At a minimum 30 MW of battery storage, with sufficient capacity[51] to produce 30 MW for several hours to address peak demand events, can and should be located at the HBGS site to offset the additional load the Poseidon desalination plant will impose on the LA Basin grid.

Energy storage projects are being fast-tracked to address, in part, the unavailability of Aliso Canyon to supply natural gas to electric generation plants during periods of peak demand. Tesla announced on September 15, 2016 that it would complete a 20 MW battery storage project at SCE's Mira Loma substation by the end of 2016.[52] This project is part of a suite of battery storage projects initiated to address the loss of the Aliso Canyon Aliso Canyon. A 100 MW battery installation was also approved by the CPUC for the AES Alamitos Generating Station in Long Beach in November 2015.[53] AES has a proposal to expand the Alamitos battery project to 300 MW in the future.[54]

Further, a project composed of battery storage to help resolve water reliability and the "water-energy nexus" is proposed for the Irvine Ranch Water District, a member agency of OCWD. The project will be the largest of its kind at a public water agency in the U.S. The 7 MW and 34 megawatt-hour (MWh) storage system will utilize Tesla batteries to store power at eleven of Irving Ranch Water District's most energy-intensive points in its operations, including three water treatment plants, six pumping stations, a deep water aquifer treatment plant and a groundwater de-salter facility.[55]

Local solar can also be deployed to offset the 30.34 MW electric load the Huntington Beach desalination plant would impose on the LA Basin. The maximum output of solar panels occurs in the middle of the day, while summer peak demand generally occurs around 4 pm to 5 pm. As a result, substantially more solar capacity than 30.34 MW is needed to assure 30.34 MW is actually being delivered to the grid at the peak hour.

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[49] See D.13-10-040, October 17, 2013, Table 2, p. 15: http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M079/K533/79533378.PDF.
[50] See CPUC Decision D.15-11-041, November 19, 2015, p. 5.
[51] Measured in megawatt-hours, or MWh. Sufficient capacity was defined as the ability to operate for 4 hours at rated MW capacity on three consecutive days in SCE's November 21, 2014 Application A.14-11-012 to the CPUC in which SCE proposed battery projects capable of providing 4 hours of output at rated MW capacity on three consecutive days.
[52] Los Angeles Times, September 15, 2016: http://www.latimes.com/business/la-fi-tesla-edison-20160915-snap-story.html.
[53] See CPUC Decision D.15-11-041, November 19, 2015, p. 5.
[54] Utility Dive, *AES to partially replace California gas plant with 300 MW of battery storage*, July 25, 2016: http://www.utilitydive.com/news/aes-to-partially-replace-california-gas-plant-with-300-mw-of-battery-storag/423171/.
[55] See: http://www.irwd.com/liquid-news/ams-and-irwd-partner-on-energy-storage-project.

Solar power purchase agreement contracts for solar projects of 26 MW are now being signed for well under $40 per megawatt-hour (MWh) in California.[56] The benchmark 2015 wholesale power price in Southern California in 2015 is $55 per MWh.[57] Poseidon should work with SCE to encounter a contractual framework to offset its annual power consumption with solar power, preferentially local solar power in the LA Basin. This alternative to GHG offsets would turn an expense to Poseidon into a net economic benefit by lowering the energy cost to Poseidon to operate the desalination plant while completely offsetting GHG emissions.

8.0 Poseidon Carbon Neutral Proposal Will Not Assure Offsetting of GHG Emissions

Poseidon indicates that it will develop an amount of rooftop solar equivalent to the roof area of its desalination plant buildings, and use GHG credits of one form or another to offset all GHG emissions from the proposed Huntington Beach desalination plant.[58] However, ultimately Poseidon makes clear in its carbon neutral plan that $10 per metric ton of CO_2 emissions is a reasonable cost ceiling for offsets and that it will pay the City of Huntington Beach $10 per metric ton of CO_2 if offsets cannot be found at that price. .[59]

The basis for the $10 per metric ton of CO_2 value appears to be the California cap-and-trade auction floor value for the initial 2012 and 2013 cap-and-trade auctions.[60] The exemption level for the California cap-and-trade auction program is 25,000 metric tons per year. The program is limited to specific source types and does not specifically include desalination plants.[61] However, source types other than those currently included in the program may participate.[62] Poseidon states in its Greenhouse Gas Reduction Plan that it will purchase carbon offsets to achieve carbon neutrality.[63]

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[56] Utility Dive, *Cheapest power in the US? Palo Alto muni eyes solar at under $37/MWh*, February 23, 2016: http://www.utilitydive.com/news/cheapest-power-in-the-us-palo-alto-muni-eyes-solar-at-under-37mwh/414372/.
[57] SDG&E Application A.15-04-014, *Approval of 2016 Electric Procurement Revenue Requirement Forecasts, Prepared Direct Testimony of Yvonne M. Le Mieux*, April 15, 2015, p. 9.
[58] Poseidon Resources, *Huntington Beach Desalination Plant - Energy Minimization and Greenhouse Gas Reduction Plan*, November 6, 2015, p. 11 and pp. 15-18.
[59] Ibid, p. 18.
[60] California Air Resources Board, *Cap-and-Trade Regulation Instructional Guidance, Chapter 5: How Do I Buy, Sell, and Trade Compliance Instruments?*, December 2012, p. 9: https://www.arb.ca.gov/cc/capandtrade/guidance/chapter5.pdf#page=2.
[61] Summary of California GHG cap-and-trade program, Subarticle 3 - Applicability: http://www.c2es.org/us-states-regions/action/california/cap-trade-regulation#sub3.
[62] Ibid.
[63] Poseidon Resources, *Huntington Beach Desalination Plant - Energy Minimization and Greenhouse Gas Reduction Plan*, November 6, 2015, pp. 15-16. "Poseidon will purchase carbon offset

The actual cap-and-trade auction clearing price may be much higher than the $10 per metric ton floor value. The cap-and-trade program also has offset credits, known as allowances from the Allowance Price Containment Reserve that can be directly purchased at a cost of $40 to $50 per metric ton. These costs rise at 5 percent per year after 2013.[64] By 2020, as a rate of increase of 5 percent per year, the cost to directly purchase offset credits will rise to $56 to $70 per metric ton.[65] The cap-and-trade auction cost may be lower than the direct purchase cost of emission credits. However, these costs are uncertain. The certain cost for the direct purchase of cap-and-trade emission credits in 2020 will be $56 to $70 per metric ton, assuming no inflation.

The cap-and-trade auction floor price and the Allowance Price Containment Reserve allowances increase by regulation at a rate of 5 percent per year, without even considering the impact on the availability of cap-and-trade allowances under of the 50 percent RPS requirement.[66] This means that a first tier Allowance Price Containment Reserve allowance that cost $50 per metric ton in 2013 would cost $115 per metric ton in 2030 before accounting for inflation.[67] In its November 6, 2015 GHG compliance submittal, Poseidon has proposed an unsupportable default GHG offset protocol that assures that Poseidon will pay no more than $10 per metric ton of CO_2 emissions.[68]

Poseidon estimates its first-year CO_2 emissions at 65,278 metric tons per year. Therefore, at $10 per metric ton, Poseidon would pay $652,780 to assert the desalination plant is carbon neutral, with the expectation that this cost would be recovered to a limited degree over time as the SCE CO_2 emission factor declines as it adds more renewable energy resources. In fact, the cost of cap-and-trade allowances will be as high as $70 per metric ton in 2020 and $115 per metric ton in 2030, unadjusted for inflation. At a firm cap-and-trade allowance cost of $70 per metric ton in 2020, Poseidon could be paying closer to $7 million for GHG offsets compared to less than $700,000 that it would pay assuming a cost of $10 per metric ton for offsets.

The most effective mechanism available to Poseidon to assure the GHG emissions generated by the operation of the desalination plant are directly offset in the LA Basin is to expand the scope of its small solar proposal to completely offset the GHG

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projects, except for RECs, through/from TCR, CAR, CARB, or California APCDs/AQMDs." and "Adherence will ensure that the offset projects acquired by Poseidon are real, permanent, quantifiable, verifiable, enforceable, and additional consistent with the principles of AB 32."

[64] California Air Resources Board, *Cap-and-Trade Regulation Instructional Guidance, Chapter 5: How Do I Buy, Sell, and Trade Compliance Instruments?*, December 2012, Table 5.2, p. 23.

[65] $40/metric ton × $(1.05)^7$ = $56/metric ton; $50/metric ton × $(1.05)^7$ = $70/metric ton.

[66] Any inflation must be added to the stipulated 5 percent per year rate increase.

[67] $50/metric ton × $(1.05)^{17}$ = $115/metric ton.

[68] Poseidon Resources, *Huntington Beach Desalination Plant - Energy Minimization and Greenhouse Gas Reduction Plan*, November 6, 2015, p. 18.

emissions from the operation of the desalination plant. This would require approximately 150 MW of installed solar capacity, battery storage and/or some combination of energy efficiency investments in Huntington Beach area combined with solar power to fully offset the GHG emissions from the plant. By way of comparison, the installation rate of net-metered solar power on homes and businesses in SCE territory is approximately 40 MW per month.[69] At a rooftop solar installation rate of 40 MW per month, it would take less than four months to install 150 MW of capacity.

Solar can be developed for less than the wholesale cost of power in SCE territory. Poseidon can effectively offset its entire GHG emissions burden, and potentially generate additional income, by building 150 MW of local solar in the LA Basin on rooftops and parking lots.

9.0 Conclusions

Water demand in OCWD service territory has declined substantially since the Huntington Beach desalination project was first proposed in 1999. Demand has declined from approximately 500,000 AF-year to 350,000 AF-year, a 30 percent reduction. On the supply side, the GWRS began producing purified recycled water in 2008 and currently produces 103,000 AF-year. GWRS production is expected to increase to 128,000 AF-year in 2022.

The energy intensity of ocean water desalination is more than four times greater than that of purified recycled water. As a result, the carbon footprint of ocean water desalination is more than four times greater than that of purified recycled water.

Poseidon proposes to purchase carbon emission offsets to achieve carbon neutrality for the desalination plant. This approach to carbon neutrality will not address the grid reliability impacts of adding a continuous load of 30.34 MW in the LA Basin. SCE is under regulatory mandate to have at least another 300 MW of energy storage under contract by 2020. At least 30 MW of battery storage at the HBGS site is necessary to offset the grid reliability impacts of the desalination plant.

Poseidon can also facilitate the installation of sufficient local solar power to achieve carbon neutrality for the desalination plant due to the favorable economics of solar power to wholesale energy cost of grid power. The contract price of power purchase agreements for solar projects in California has dropped well below the utility wholesale power cost. Given the favorable economics of solar power relative to the utility's wholesale cost of energy, local solar should be developed by Poseidon in sufficient quantity to fully offset the carbon footprint of desalination plant operations and support local grid reliability.

[69] SCE monthly net-metered solar installation rate data, August 2016: https://www.sce.com/wps/wcm/connect/21db29a7-7291-408a-a86e-fdf658067696/Aug+NEM+Monthly+Growth_3.pdf?MOD=AJPERES.