Assessment of Energy Intensity and Greenhouse Emission Mitigation of Proposed Poseidon Huntington Beach Desalination Plant

January 2022 Update

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January 19, 2022

Rev. 1

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1.0 Executive Summary

This updated report reviews the energy intensity and greenhouse gas (GHG) emissions associated with the grid power demand of the proposed Poseidon Huntington Beach desalination plant and examines an alternative GHG mitigation strategy that does not rely on carbon offset credits. The electric "grid reliability" impacts of the desalination plant are assessed in the context of the electricity supply limitations of the Los Angeles Basin. Recommendations are provided for an alternative GHG mitigation approach that would fully address the local grid reliability impacts of the desalination plant. Local solar power on commercial and industrial rooftops and parking lots, combined with local battery storage, should be used to mitigate all GHG emissions associated with the grid power needed to operate the desalination plant.

Water demand in Orange County Water District (OCWD) service territory has declined about 20 percent, from approximately 500,000 acre-feet per year (AFY) in 1998 when Poseidon first proposed a desalination plant in Huntington Beach, to 400,000 AFY in 2020. This 100,000 AFY decline is substantially greater than the 56,000 AFY potable water production capacity of the proposed Huntington Beach desalination plant.

Over this same time period the production capacity of OCWD purified recycled water used to recharge the groundwater basin, via the Groundwater Replenishment System (GWRS) indirect potable reuse project, has increased from zero in 1998 to 112,000 AFY, equivalent to 100 million gallons per day (MGD), in 2015. Production of GRWS purified recycled water will expand to 145,000 AFY (130 MGD) in 2023.

Los Angeles County and the Metropolitan Water District (MWD) are also in the initial development stages of a similar groundwater replenishment project, the "Regional Recycled Water Program," that will deliver approximately 65,000 AFY to OCWD to replenish groundwater by 2032.

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's GHG mitigation strategy for the proposed Huntington Beach desalination plant, as stated in its most recent 2017 GHG mitigation plan, is to make a one-time upfront payment to obtain GHG offset credits for the 50-year operating lifetime of the project. The desalination plant electricity demand will be indirectly responsible for 68,745 metric tons per year of carbon dioxide (CO_2) emissions. Poseidon proposes to mitigate these emissions with GHG offset credits.

According to Poseidon, these offset credits can be generated a variety of ways, by producing electricity with renewable sources such as solar or wind, or reforestation or preserving forests in other countries. One source of credits identified by Poseidon is the California Air Resources Board (CARB) cap-and-trade program. Use of carbon credits for compliance is controversial. They have been used in the past to give the impression holders of these credits are greener than they may in fact be. Meeting the Huntington Beach desalination plant electricity need with new local clean energy sources would remove doubt about the validity of the approach used by Poseidon to assert the desalination plant is carbon neutral.

Poseidon has set a de facto "economically feasible" cost ceiling for carbon credits of $10 per metric ton. Based on this carbon credit price ceiling, Poseidon would expect to pay a maximum of about $700,000 per year for the credits, or up to about $35 million up-front for fifty years of operation. In contrast, the cost of fifty years of CARB cap-and-trade allowances, at the 2022 cost ceiling price of $72.29 per metric ton, would be approximately $250 million.

The capital cost of the Huntington Beach desalination plant is currently estimated at about $1.4 billion.[1] In the Poseidon GHG offset scenario, with a $10 per metric ton cost cap, the company would pay less than 3 percent of the capital cost of the desalination plant for GHG offsets. However, in a "CARB offsets at the 2022 ceiling price" scenario, the company would pay about 18 percent of the capital cost of the desalination plant for offsets.

The negative marine impacts of the Huntington Beach desalination plant will be primarily local. The negative impacts of the desalination plant's demand on the Los Angeles Basin grid during tight supply conditions will also be local. Given this framework, the positive mitigation of the desalination plant's GHG emissions should also be local. Local mitigation is not a novel concept. Local GHG impact mitigation is proposed for another major Los Angeles area development project – Tejon Ranch – with projected GHG emissions on a comparable scale to those of the Huntington Beach desalination plant.

Solar and battery storage costs have declined steadily since Poseidon first developed its GHG mitigation plan. Sufficient local solar and battery storage – deployed in Huntington Beach and potentially in surrounding cities – to meet the annual energy and peak demand of the desalination plant can be constructed by Poseidon at reasonable cost relative to the capital cost of the desalination plant and the revenue it will generate when operational.

About 150 megawatts (MW_{AC}) of local solar on commercial and industrial rooftops and parking lots would meet the annual energy demand of the desalination plant. To put this amount of solar power in context, about 375 MW_{AC} of customer-owned solar is installed on rooftops and parking lots in Southern California Edison (SCE) territory every year. Separately, SCE has built a large-scale utility-owned urban solar project,[2] aggregating numerous warehouse rooftops in the Inland Empire,[3] that is approximately 100 MW_{AC} in total capacity.

For the specific purpose of offsetting the grid reliability impacts of the continuous 30 MW demand of the Huntington Beach desalination plant, four hours of battery storage (120 megawatt-hours) is also needed to assure the desalination plant imposes no burden on the local electric grid during times of peak demand. Four hours of storage at rated capacity is the standard

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[1] Los Angeles Times, *Controversial Poseidon desalination plant in Huntington Beach set for hearings this week*, July 28, 2020: https://www.latimes.com/socal/daily-pilot/news/story/2020-07-28/controversial-poseidon-desalinationination-plant-in-huntington-beach-set-for-hearings-this-week.

[2] See **Attachment A,** California Public Utilities Commission press release, *CPUC Approves Edison Solar Roof Program*, June 18, 2009, for overview of this SCE rooftop project.

[3] The Inland Empire is centered around the cities of Riverside and San Bernardino.

"peaker plant equivalent" battery storage duration for battery storage projects authorized by the California Public Utilities Commission (CPUC) in SCE service territory.

The capital cost of this local solar and battery storage mitigation strategy would be approximately $220 million in 2024 dollars, or about 15 percent of the project's estimated $1.4 billion capital cost. The annual cost of this solar and battery storage GHG mitigation scenario, $4.4 million per year over the 50-year project lifetime, would be in the range of 3 percent of the estimated $160 million per year in annual gross revenue of the Huntington Beach desalination plant. Under this local GHG mitigation scenario, Poseidon would pay for the construction of these solar and battery storage assets and then transfer ownership to Huntington Beach.

Mitigating the desalination plant electricity demand with local solar and battery storage resources is the most appropriate GHG mitigation strategy for the Huntington Beach desalination plant.

2.0 Introduction

Orange County Coastkeeper contracted Powers Engineering to provide a technical assessment of: 1) the energy intensity, in terms of kilowatt-hours per acre-foot of water (kWh/AF), and the associated GHG emissions of a range of actual and potential water supply options for Orange County, and 2) an alternative GHG mitigation strategy to achieve carbon neutrality with local clean energy resources.

The 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 OCWD service territory is supplied from groundwater sources, replenished through natural processes and with purified recycled water, with most of the remaining supply being imported water provided by the MWD. In contrast, the majority of potable water consumed in Southern California as a whole is imported water. For this reason, the energy intensity and CO_2 emissions associated with water imports are used as baseline values in this report.[4]

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

3.0 Description of Proposed Desalination Project

Poseidon proposes to build and operate a 50 MGD (56,000 AFY) desalination plant on the property of the Huntington Beach Generating Station (HBGS) in Huntington Beach, California. There is one operational steam boiler power unit on the property, HBGS Unit 2, with a capacity of 215 MW. Unit 2 uses seawater in a once-through cooling (OTC) configuration for power plant cooling. The proposed Huntington Beach desalination plant will utilize the existing OTC seawater intake and outfall pipelines currently serving Unit 2.

Unit 2 is operated infrequently. The CPUC has authorized the extension of the operational lifetime of this unit until December 2023.[5] A new power project has also been built at the site, the 644 MW Huntington Beach Energy Project combined-cycle power plant, that does not utilize an OTC cooling system.[6] This new 644 MW power plant became operational in 2021.[7]

Poseidon has pursued the development of the HBGS site as a seawater desalination facility since 1998. 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.

The Coastal Development Permit (CDP) issued for the project expired in 2010. Changes to the desalination plant operational assumptions, primarily related to the seawater intake, also occurred after the certification of the REIR. As a result, in May 2010, along with the approval of a second CDP, a Subsequent EIR was prepared to address seawater intake effects based on a standalone condition. "Standalone" means the desalination facility would be responsible for direct intake of seawater.[8] The most recent document, the Final Supplemental EIR, was issued in October 2017.[9] Poseidon issued its most recent GHG mitigation plan for the Huntington Beach desalination plant in February 2017.[10]

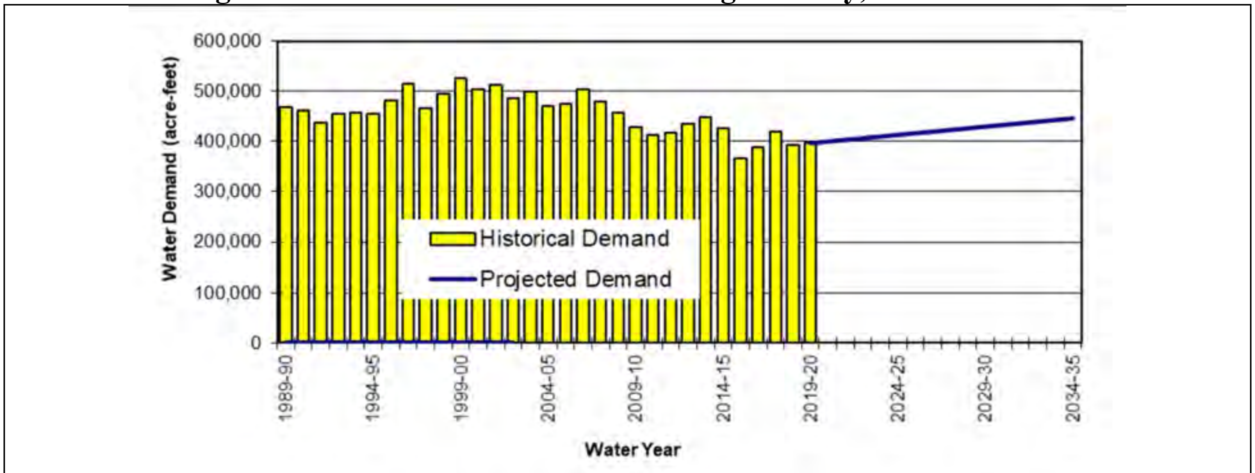
3.1 Orange County Water Demand Trends

Water demand in Orange County has declined about 100,000 AFY, or about 20 percent, since Poseidon first proposed the project in 1998, as shown in Figure 1. In addition, OCWD has added

[5] CPUC Decision D.21-12-015, December 2, 2021.
[6] 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.
[7] California Energy Commission, Huntington Beach Energy Project, webpage accessed January 5, 2022: https://www.energy.ca.gov/powerplant/combined-cycle/huntington-beach-energy-project.
[8] City of Huntington Beach, *Draft Subsequent Environmental Impact Report –Desalination Project at Huntington Beach*, May 2010, p. 1-2 and p. 1-3.
[9] State Lands Commission, *Final Supplemental Environmental Impact Report, Seawater Desalination Project At Huntington Beach: Outfall/Intake Modifications & General Lease – Industrial Use (PRC 1980.1) Amendment*, October 2017.
[10] Poseidon Resources, *Huntington Beach Desalination Plant - Energy Minimization and Greenhouse Gas Reduction Plan*, February 27, 2017.

112,000 AFY (100 MGD) of potable recycled water to its supply through the GWRS, which began operation in 2008 and was expanded in 2015.[11] The GWRS will be expanded further to 145,000 AFY (130 MGD) of production by 2023,[12] increasing reliance on groundwater to meet demand.

Figure 1. Water demand trend in Orange County, 1989 to 2035[13]



Los Angeles County and MWD are also proposing a groundwater replenishment project similar to GWRS, the "Regional Recycled Water Program," that would deliver approximately 65,000 AF-year to OCWD to replenish groundwater supply by 2032.[14,15] The additional supply could either: 1) offset any need for water from the Huntington Beach desalination plant, 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 MWD. The specific source and quantities of OCWD supply for the 2019-2020 fiscal year are shown in Table 1.

Table 1. Specific source and quantities of OCWD supply, 2019-2020[16]

2019-2020 supply source	Quantity (AFY)
Groundwater including potable reuse (GWRS supply)	286,498
Imported water - MWD	87,652
Santiago Creek native water	2,546

[11] See OCWD Groundwater Replenishment System, "Frequently Asked Questions" webpage, January 16, 2022: http://www.ocwd.com/gwrs/frequently-asked-questions/.
[12] Ibid.
[13] OCWD, *2019-2020 Engineer's Report on the Groundwater Conditions, Water Supply and Basin Utilization in the Orange County Water District*, February 2021, Figure 5, p. 21.
[14] 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.
[15] Metropolitan Water District, *Regional Recycled Water Program – Engineering and Technical Studies* (PowerPoint presentation), June 7, 2021, p. 10: https://www.mwdh2o.com/planning-for-tomorrow/building-local-supplies/regional-recycled-water-program/.
[16] OCWD, *2019-2020 Engineer's Report on the Groundwater Conditions, Water Supply and Basin Utilization in the Orange County Water District*, February 2021, Figure 5, p. 20.

Recycled water, non-potable	20,723
Total:	397,419

The most recent 2020 Urban Water Management Plan (UWMP) prepared by Municipal Water District of Orange County (MWDOC), which includes planning for delivery of imported water to OCWD, found that projected water supplies will be sufficient to meet forecast demand through 2045 without the addition of desalinated water from the Huntington Beach desalination plant.[17] Table 2 is OCWD's projected water supply mix for meeting a forecast 2045 demand of 445,777 AFY without the desalination plant.[18]

Table 2. Forecast OCWD 2045 water sources and quantities[19]

2045 supply source	Quantity (AFY)
OCWD Basin groundwater	236,274
Non-OCWD groundwater	24,890
Imported water - MWD	122,819
Surface water	4,700
Recycled water	57,094
Total:	445,777

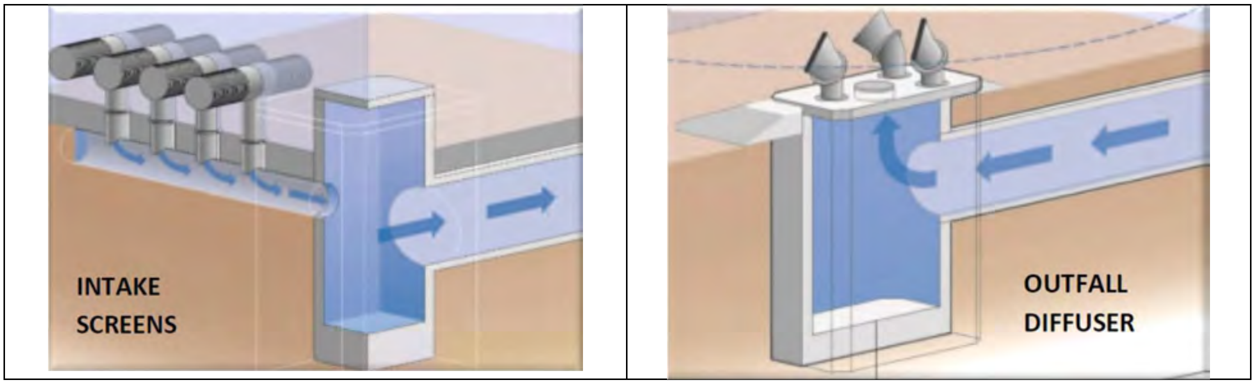
3.2 Proposed Desalination Plant

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.

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. Graphics of the intake screens and the discharge diffusers are shown in Figure 2.

[17] Municipal Water District of Orange County, *2020 Urban Water Management Plan*, June 2021, Table 4-1: MWDOC's Service Area Existing and Future Water Use by Source, p. 4-3.
[18] Ibid, p. 21.
[19] Municipal Water District of Orange County, *2020 Urban Water Management Plan*, June 2021, Table 4-1, p. 4-3.

Figure 2. Proposed Huntington Beach Desalination Plant intake screens and discharge diffusers[20]



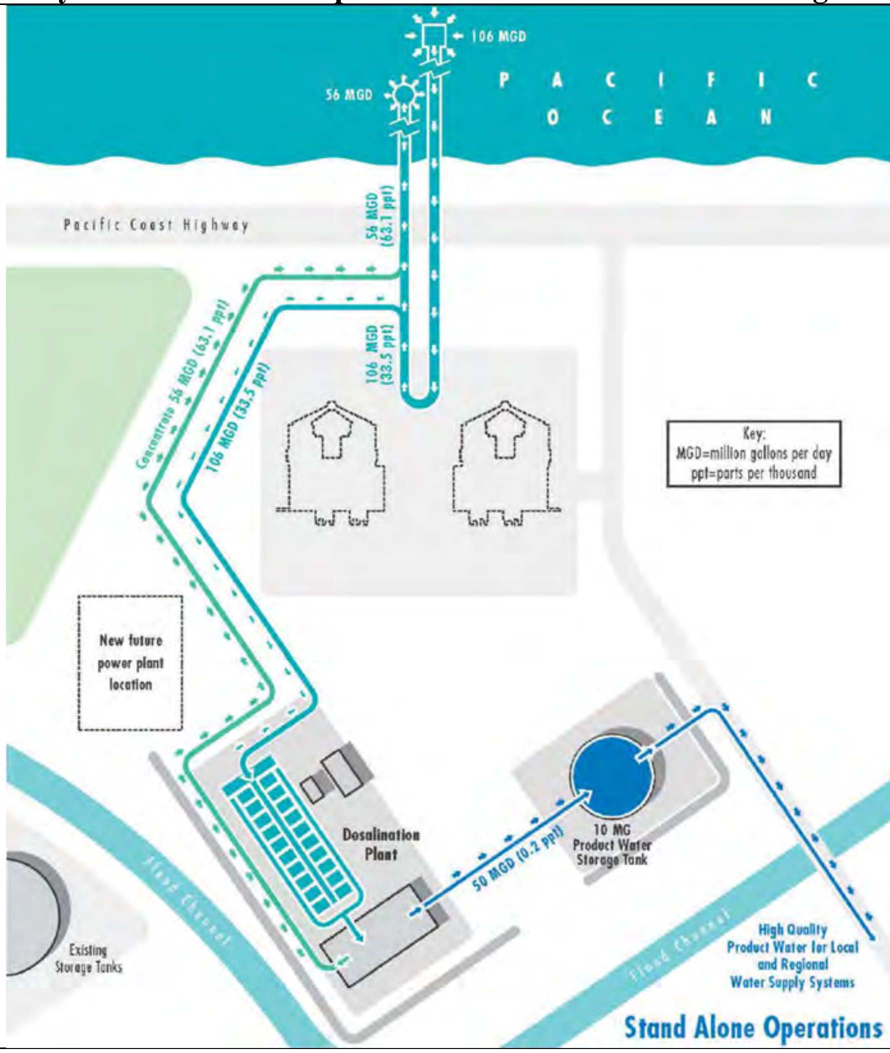
The proposed desalination project would consist of a seawater intake and discharge pipes, pretreatment facilities, a seawater desalination facility utilizing reverse osmosis (RO) technology, post-treatment facilities, product water storage, on- and off-site landscaping, chemical storage, on- and off-site booster pump stations, and 42- to 48-inch diameter product water transmission pipelines up to 10 miles in length.[21] The layout of the desalination plant, and the locations of the intake and discharge structures, are shown in Figure 3.

The desalination process includes pre-treatment and RO. 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.[22]

[20] Poseidon Resources, *Huntington Beach Desalination Plant - Energy Minimization and Greenhouse Gas Reduction Plan*, February 27, 2017 (cover graphics).
[21] City of Huntington Beach, *Draft Recirculated Environmental Impact Report –Desalination Project at Huntington Beach*, April 5, 2005, p. 3-2.
[22] Additional energy savings would 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 at the end of 2023 to meet State requirements to minimize the intake and mortality of marine life.

Figure 3. Layout of desalination plant and ocean intake and discharge structures[23]



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 at the Huntington Beach desalination plant.[24] This represents an energy intensity of 4,748 kWh/AF.[25]

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[23] Alden Research Laboratory, Inc., *Huntington Beach Desalination Plant Intake/Discharge Feasibility Assessment*, March 14, 2016, Figure 2, p. 15.
[24] Poseidon, *Huntington Beach Desalination Plant – Energy Minimization and Greenhouse Gas Reduction Plan*, February 27, 2017, p. 7.
[25] Ibid, p. 7. (30,340 kW × 24 hr/day) ÷ [(50,000,000 gallon/day)(1 AF/326,000 gallon)] = 4,748 kWh/AF.

This is an electricity consumption rate equivalent to the GHG emissions associated with electricity demand of about 38,732 California homes, as shown in the following calculations:

> 2020 Energy Information Administration (EIA) data for California, annual average residential customer load = 6,862 kilowatt-hour per year (kWh-yr) per customer (572 kWh-month).[26]
>
> 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 ÷ 6,862 kWh-yr/home = 38,732 homes.

5.2 Energy Intensity of Potable Reuse

The energy intensity of recycling treated wastewater to potable quality, 1,055 kWh/AF, is based on operational data for the GWRS operated by the OCWD.[27]

Operational since January 2008, the GWRS originally produced 70 MGD of purified water. The project was expanded in 2015 to produce 100 MGD (112,000 AFY). Ultimate capacity for the GWRS is projected at 130 MGD (145,000 AFY) in 2023 after completion of an infrastructure build-out to increase wastewater flows from Orange County Sanitation District to the GWRS.[28]

The GWRS uses about half the energy per AF required to transport water, on average, from Northern California to Southern California.[29]

Purifying wastewater in the GWRS requires less than one-quarter the energy of ocean water desalination because there are far fewer dissolved solids (salts) to remove from wastewater (see Table 3). Conversely, the energy intensity of ocean water desalination is more than four times greater than that of purified recycled water. Wastewater contains about 1,000 ppm of salts compared to 35,000 ppm in ocean water. Removing the high concentration of salts in ocean water requires more energy, additional membranes, and shortens RO membrane life-span.

5.3 Comparison of Energy Intensities 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 OCWD GWRS, 3) Colorado River water transfers, and 4) State Water Project water transfers, and 5) Poseidon Huntington Beach desalination plant.

[26] U.S. EIA, *California Electricity Profile 2020*, November 4, 2021, Table 8. Sales to ultimate customers, revenue, and average price by sector, 1990 through 2020. 2020 residential demand = 94,934,563 megawatt-hours (MWh); residential customers = 13,834,719; average demand per customer = 94,934,563,000 kWh-yr ÷ 13,834,719 customers = 6,862 kWh-yr/customer.
[27] 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.
[28] 2021 GWRS technical brochure, p. 5: https://www.ocwd.com/media/10297/gwrs-technical-brochure-2021.pdf.
[29] Ibid, p. 21.

Table 3. Comparison of energy intensity of water supply alternatives

Alternative	Energy intensity (kWh/AF)
Conservation[30]	0
Potable reuse[31]	1,055
Colorado River water transfers[32]	2,223
State Water Project West water transfers[33]	2,817
Poseidon Huntington Beach desalination plant	4,748

[30] Conservation strategies include, for example: smart irrigation and landscaping, water efficient appliances. See OCWD webpage on water conservation strategies: https://www.ocwd.com/learning-center/water-use-efficiency/.

[31] 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.

[32] 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.

[33] Ibid.

6.0 GHG 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, equivalent to an annual electricity consumption of 265,888 MWh per year.[34] Poseidon estimates 68,745 metric tons per year (75,620 tons/yr) of GHG emissions associated with the annual power demand at the facility.[35]

6.2 Comparison of CO_2 Emission Rates of Potable Water Alternatives

Table 4 compares the energy intensity and annual CO_2 emission rates for five potable water supply alternatives: 1) conservation, 2) potable reuse based on the OCWD 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 assumes a production rate of 50 MGD. 50 MGD is equivalent to approximately 56,000 AFY of potable water.[36]

Table 4. Comparison of energy intensity and annual GHG emissions of water supply alternatives

Alternative	Energy intensity (kWh per AF)	GHG emissions for 56,000 AFY production [2020 SCE CO_2 emission factor = 464 lb/MWh][37] (tons CO_2 per year)
Conservation	0	0
Potable reuse[38]	1,055	13,707
Colorado River water transfers[39]	2,223	28,881
State Water Project West water transfers[40]	2,817	36,598
Poseidon Huntington Beach desalination plant	4,748	75,620 (Poseidon estimate)

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34 Ibid, p. 7.

35 Ibid, p. 8. (68,745 metric ton/yr) × (1.1 ton/1 metric ton) = 75,620 ton/yr.

36 (50,000,000 gallon/day)(1 AF/326,000 gallon)(365 day/yr) = 55,982 AFY.

37 EEI, *Electric Company ESG/Sustainability Quantitative Information – Southern California Edison*, p. 3, line 5.4 (2020 year), November 10, 2021: https://www.edison.com/content/dam/eix/documents/sustainability/eix-esg-pilot-quantitative-section-sce.pdf. CO_2 emission factor = 0.211 metric tons CO_2 per megawatt-hour (MWh). Therefore, SCE CO_2 emission rate = (0.211 metric tons CO_2 per MWh) × 1.1 ton/metric ton × 2,000 lb/ton = 464 lb CO_2/MWh.

38 1.055 MWh/AF × 56,000 AF/yr × 464 lb/MW-hr × (1 ton/2000 lb) = 12,992 ton/yr.

39 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.

40 Ibid.

7.0 Mitigation of Proposed Huntington Beach Desalination Plant Electric Load on Los Angeles Basin Grid Reliability

The continuous 30.34 MW Huntington Beach desalination plant load is equivalent to adding the electric load of 38,732 homes to the Los Angeles Basin grid.[41] The Los Angeles 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 the CPUC, available SCE electricity supply may not be sufficient to meet peak summer demand. In that context, SCE has received authorization from the CPUC to add supply resources in the Los Angeles Basin to address potential grid reliability issues in 2022 and 2023.[42]

The addition of a continuous 30.34 MW load in an area where state authorities have implemented fast-track mitigation measures to address the potential for grid reliability deficits underscores the need for the Poseidon GHG mitigation to be local clean energy projects. GHG offset credits associated with projects that are may be outside of the Los Angeles Basin and potentially outside of the country will not address this local grid reliability concern.

Three events in the last decade have put the focus on Orange County as a potential grid reliability weak point. These events are: 1) the unexpected permanent shutdown of the 2,250 MW San Onofre Nuclear Generating Station (SONGS) in 2012, 2) the well blowout at the SoCalGas Aliso Canyon gas storage facility in 2015 that led to the state's plan to permanently close Aliso Canyon by 2027, and 3) rolling statewide blackouts in August 2020 caused by tight electricity supplies under peak demand conditions.[43]

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 natural gas storage field in the SoCalGas system. As a result of the emergency closure of Aliso Canyon, the grid operator may now impose limits on natural gas consumption used in Los Angeles Basin electric generators under certain peak demand conditions.[44] A map of the affected electric generators in the Aliso Canyon delivery area is shown in Figure 4.[45] HBGS is in the Aliso Canyon delivery area.

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[41] 265,778,400 kWh-yr ÷ 6,862 kWh-yr/home = 38,732 homes.

[42] CPUC, Decision 21-12-015, *Phase 2 Decision Directing Pacific Gas and Electric Company, Southern California Edison Company, and San Diego Gas & Electric Company to Take Actions to Prepare for Potential Extreme Weather in the Summers of 2022 and 2023*, December 2, 2021.

[43] CAISO/CPUC/CEC, *Final Root Cause Analysis – Mid-August 2020 Extreme Heat Wave*, January 13, 2021.

[44] CAISO/CPUC/CEC/LADWP, *Aliso Canyon Winter Action Plan*, August 22, 2016.

[45] CAISO/CPUC/CEC/LADWP, *Aliso Canyon Action Plan to Preserve Gas and Electric Reliability for the Los Angeles Basin*, April 5, 2016, Figure 2, p. 11: https://www.cpuc.ca.gov/-/media/cpuc-website/files/uploadedfiles/cpuc_public_website/content/news_room/news_and_updates/aliso-canyon-action-plan-04-4-16-final-clean.pdf.

Figure 4. Los Angeles Basin electric generators served by Aliso Canyon storage field

At a minimum 30 MW of battery storage, with sufficient capacity to produce 30 MW for four hours, is needed to fully address the Huntington Beach desalination plant load during peak demand events.[46] This battery capacity can be placed locally in and around Huntington Beach to mitigate the additional load the Huntington Beach desalination plant will impose on the Los Angeles Basin grid.

Battery storage is now a primary grid reliability resource in California, with 1,000s of MW of battery storage capacity online or planned. As a result of CPUC's original battery storage decision in October 2013, SCE was required to have 580 MW energy storage capacity under contract by 2020.[47] Subsequent CPUC decisions have increased the amount of projected battery storage capacity in SCE territory to 2,810 MW by 2023.[48]

Battery storage is in use at the Irvine Ranch Water District, a member agency of OCWD. The 6.3 MW and 35.7 megawatt-hour (MWh) storage system utilizes Tesla batteries to store power at eleven of the Irving Ranch Water District's most energy-intensive points,

[46] Measured in 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.

[47] See D.13-10-040, October 17, 2013, Table 2, p. 15: http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M079/K533/79533378.PDF.

[48] SCE press release, *SCE to Add 535 Megawatts of Energy Storage to Improve Grid Reliability -Resources Are Expected for Summer 2022*, October 21, 2021: https://newsroom.edison.com/releases/sce-to-add-535-megawatts-of-energy-storage-to-improve-grid-reliability-resources-are-expected-for-summer-2022.

including three water treatment plants, six pumping stations, a deep-water aquifer treatment plant and a groundwater de-salter facility.[49]

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

Poseidon plans to use GHG credits of one form or another to offset the overwhelming majority of GHG emissions associated with the proposed Huntington Beach desalination plant.[50] However, Poseidon states in its GHG reduction plan that $10 per metric ton of CO_2 emissions is its cost ceiling for GHG offsets. Poseidon will pay the City of Huntington Beach $10 per metric ton of CO_2 to fulfill its carbon neutrality commitment if carbon offsets cannot be found at that price or less.[51]

The basis for the $10 per metric ton of CO_2 value appears to be the California Air Resources Board (CARB) cap-and-trade auction floor value for the initial 2012 and 2013 cap-and-trade auctions.[52]

The CARB cap-and-trade allowance program is limited to specific source types and does not include desalination plants.[53] However, source types other than those currently included in the program may participate.[54] Poseidon states in its GHG reduction plan that it will purchase carbon offsets, potentially from CARB, to achieve carbon neutrality.[55]

The actual CARB cap-and-trade auction clearing price may be much higher than the $10 per metric ton ceiling defined by Poseidon. The allowance settlement price in the most recent cap-and-trade quarterly auction, in November 2021, was $28.26 per metric ton.[56] The cap-and-trade program also maintains a two-tier Allowance Price Containment

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[49] Irvine Ranch Water District press release, *IRWD and Macquarie Capital Announce Completion of the Largest Behind-the-Meter Energy Storage Project in the U.S.*, June 25, 2018:

[50] Poseidon Resources, *Huntington Beach Desalination Plant - Energy Minimization and Greenhouse Gas Reduction Plan*, February 27, 2017, pp. 14-21. Poseidon indicates that it is also "exploring the installation" of rooftop solar (606 kilowatts) on its desalination plant buildings (p. 11).

[51] Ibid, p. 18.

[52] CARB, *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.

[53] CARB, *Regulation for the California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms*, April 2019: http://www.c2es.org/us-states-regions/action/california/cap-trade-regulation#sub3.

[54] Ibid.

[55] Poseidon Resources, *Huntington Beach Desalination Plant - Energy Minimization and Greenhouse Gas Reduction Plan*, February 27, 2017, pp. 15-16. "Poseidon will purchase carbon offset projects, except for RECs, through/from TCR, CAR, CARB, or California APCDs/AQMDs." and "the Plan is designed to assure that selected offset projects will mitigate GHG emissions as effectively as on-site or direct GHG reductions."

[56] CARB, *Summary of Auction Settlement Prices and Results*, November 2021 (accessed January 16, 2022): https://ww2.arb.ca.gov/sites/default/files/2020-08/results_summary.pdf.

Reserve where allowances can be directly purchased at a set price, in 2022, of $46.05 and $59.17 per metric ton.[57] Both tier prices increase by 5 percent plus inflation each year.[58]

In the event that no allowances remain in the Reserve and an entity like Poseidon Huntington Beach does not have sufficient allowances in its compliance accounts, CARB has the authority to offer an annual price ceiling sale to cover the gap. CARB has set the price of the 2022 price ceiling sale at $72.29 per metric ton. The price ceiling also increases by 5 percent plus inflation each year.[59]

In its February 27, 2017 GHG compliance submittal, Poseidon has proposed a default GHG offset protocol that assures that Poseidon will pay no more than $10 per metric ton of CO_2 emissions.[60] As noted, Poseidon projects that it will emit 68,745 metric tons per year of CO_2, and intends to purchase 50 years of allowances/offset credits via a one-time upfront payment. At $10 per metric ton, Poseidon would pay $687,450 per year to assert the desalination plant is carbon neutral.

The GHG offset compliance cost would be much higher for the Huntington Beach desalination plant using CARB cap-and-trade allowances. Table 5 is a comparison of the lifetime, 50-year upfront payment for: 1) carbon offsets at $10 metric ton, 2) the November 2021 CARB cap-and-trade allowance settlement price, 3) the lower-tier 2022 reserve price, 4) the upper-tier 2022 reserve price, and 5) the 2022 ceiling price.

Table 5. Comparison of proposed Poseidon carbon offset ceiling price to CARB cap-and-trade (C&T) allowance prices

Carbon offset price type	Value ($/metric ton)	Quantity (metric ton/yr)	Annual cost ($/yr)	50-year carbon offset cost ($)
Poseidon self-selected carbon offset price cap	10	68,745	687,745	34,387,250
C&T Nov 2021 settlement price	28.26	68,745	1,942,734	97,136,700
C&T 2022 reserve price (lower tier)	46.05	68,745	3,165,707	158,285,350
C&T 2022 reserve price (upper tier)	59.17	68,745	4,067,642	203,382,100
C&T 2022 ceiling price	72.29	68,745	4,969,576	248,478,802

[57] CARB, *Cap-and-Trade Program, Cost Containment Information*, webpage accessed January 16, 2022: https://ww2.arb.ca.gov/our-work/programs/cap-and-trade-program/cost-containment-information. "From 2021 - 2030, allowances in the Reserve will be offered at two tier prices. Those levels were set at USD 41.40 and USD 53.20 in 2021. Both tier prices increase by 5% plus inflation each year. The tier prices in 2022 are USD 46.05 and USD 59.17. Price Ceiling Sale: CARB may offer an annual price ceiling sale to covered and opt-in entities to purchase what they need to meet their compliance obligation due that November. . . The price of the 2022 price ceiling sale is USD 72.29."

[58] Ibid.

[59] Ibid.

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

A realistic upper-bound ceiling for the one-time upfront 50-year lifetime cost of GHG mitigation for the Huntington Beach desalination plant, based on the 2022 CARB cap-and-trade allowance price ceiling, would be approximately $250 million. This is a much greater cost than the $34.4 million projected by Poseidon at a self-determined GHG mitigation cost ceiling of $10 metric ton of CO_2.

Legitimacy of carbon offsets: The legitimacy of carbon offsets has been questioned due to the difficulty in corroborating the validity of claims that the offsets represent bona fide permanent GHG reductions. This problem was addressed in a December 2021 Los Angeles Times article on the development of Tejon Ranch north of Los Angeles, where a recent court settlement would allow development of nearly 20,000 new homes:[61]

> Researchers have documented many flaws in these (carbon offset) programs, including wildfires burning down forests that are supposed to be protected, overestimates of how much carbon is stored in certain landscapes, and the inclusion of trees that were already protected and were never going to be chopped down.
>
> Responding to that criticism, Climate Resolve's Lindblad said the settlement will push Tejon Ranch to invest specifically in "new projects that reduce emissions." It also requires Tejon Ranch to use offsets only as a "last resort" when it's unable to reduce emissions onsite - and only then with the approval of a monitoring group formed by Climate Resolve and the developer.

The skepticism of carbon offsets is widespread in the electricity supply arena. California is rapidly transitioning from a historic investor-owned utility (IOU) model of "bundled" supply and delivery service, to supply by public Community Choice Energy (CCE) providers and delivery over the transmission and distribution system owned by the incumbent IOU. In the case of Huntington Beach, the CCE provider is Orange County Power Authority (OCPA),[62] and the IOU is SCE.

A number of CCEs are not using carbon credits to claim GHG reductions for their electricity supply portfolio, primarily due to customer concerns about the validity of the

[61] Los Angeles Times, *Can a far-flung suburb be net zero?*, December 27, 2021:

[62] See: https://www.ocpower.org/. OCPA will begin serving commercial customers in April 2022 and residential customers in October 2022.

claimed reductions. CCEs such as Peninsula Clean Energy and Marin Clean Energy have rejected the use of carbon offsets to reach GHG reduction targets.[63,64]

9.0 Local GHG Reductions Are Necessary to Address the Local Impacts of the Desalination Plant

The most effective mechanism available to Poseidon to assure the GHG emissions generated by the operation of the Huntington Beach desalination plant are directly offset in the Los Angeles Basin is to completely offset the GHG emissions from the operation of the desalination plant with local solar and battery power. This would require approximately 150 MW_{AC} of installed solar capacity,[65] along with 120 MW-hr of battery storage in the Huntington Beach area, to fully offset the GHG emissions and grid reliability impacts of the desalination plant.

Rooftop solar is being installed in the Los Angeles Basin and nearby areas at a large scale. The installation rate of net-metered rooftop solar[66] on homes and businesses in SCE territory is approximately 375 MW_{AC} per year.[67] To put this solar installation rate in context, at the current rooftop solar installation rate of about 30 MW_{AC} per month,[68] it would take five months to install the 150 MW_{AC} of solar capacity necessary to fully address the electricity demand of the proposed Huntington Beach desalination plant.

Poseidon can effectively offset its entire GHG emissions burden by building 150 MW_{AC} of local solar on commercial and industrial rooftops and parking lots. The model for this project is the SCE warehouse rooftop solar project, involving the aggregation of many warehouse rooftops in the framework of a single large project, in the Inland Empire.[69]

The cost of commercial rooftop solar is reasonable. Figure 5 shows the estimated installed unit benchmark cost of residential and commercial rooftop solar, and utility-

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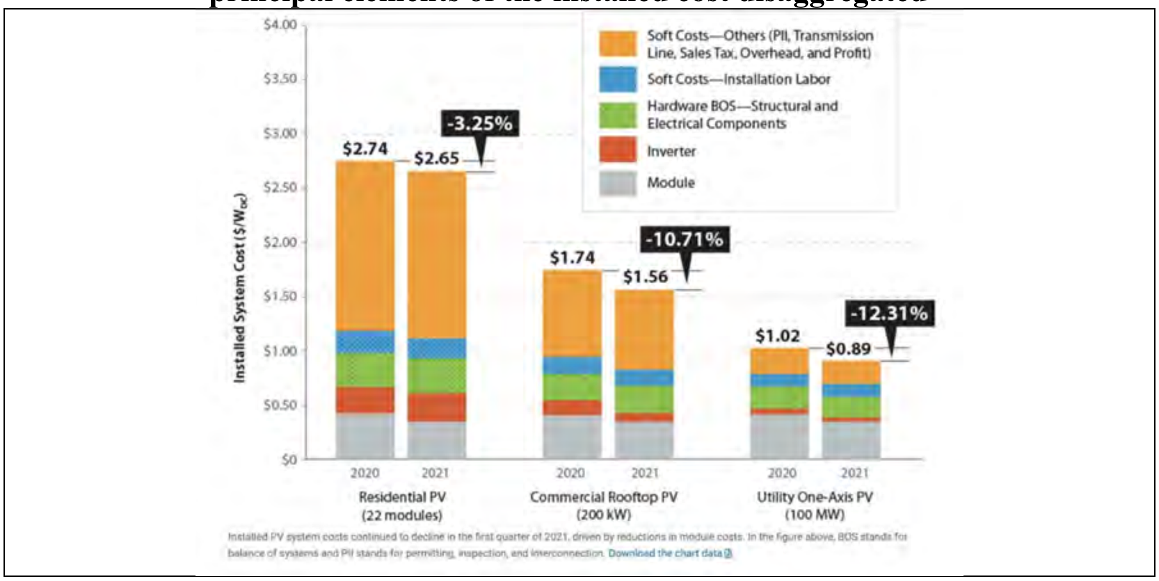
[63] December 2017, *Peninsula Clean Energy 2018 Integrated Resource Plan*, p. 11. "PCE has made a commitment not to procure unbundled RECs to meet either its RPS requirements or its additional requirements to provide customers with 50% or 100% renewable energy. Members of PCE's Board, Executive Committee, and Citizens Advisory Committee expressed concerns about how unbundled RECs have been used and misused to give the impression that polluters are more "green" and "clean" than they actually are. Although each unbundled REC is created because 1 MWh of renewable energy has been generated to create that REC, the use of unbundled RECs has created confusion in the market."
[64] Marin Clean Energy webpage, accessed January 5, 2022: https://www.mcecleanenergy.org/energy-suppliers/. "Starting in 2019, MCE's energy portfolio includes zero unbundled renewable energy certificates (RECs)."
[65] The capacity factor of rooftop solar in Orange County would on average be in the range of about 0.20. Poseidon would have a continuous electricity demand of about 30 MW on a continuous basis. For the Poseidon annual electricity demand to be completely met by local solar power would require: 30 MW ÷ 0.20 = 150 MW of solar capacity.
[66] Net-metered rooftop solar is solar capacity installed on the customer side of the electric meter.
[67] California Distributed Generation Statistics, "Statistics and Charts" and "SCE", accessed January 5, 2022: https://www.californiadgstats.ca.gov/charts/. The five-year 2016-2020 installation average rate for SCE territory is approximately 375 MW per year.
[68] 375 MW_{AC}/year ÷12 months/year = 31.25 MW_{AC}/month.
[69] See **Attachment A**.

scale remote solar capacity, in the first quarter of 2021. The benchmark installed cost of commercial rooftop solar in the first quarter of 2021 was $\$1.56/W_{DC}$.[70,71] The cost decline rate for commercial rooftop solar installed cost between 2020 and 2021 was approximately 10 percent. [72]

<u>Recommended approach</u>: Poseidon would finance the installation of 150 MW_{AC} of solar on commercial and industrial rooftops and parking lots in Huntington Beach and (potentially) surrounding cities. Assuming a contract year of 2024 and a 10 percent per year decline rate in the installed cost of commercial rooftop solar, the installed cost of this solar capacity would be about $\$1.26/W_{AC}$.[73] Under this scenario, the cost to Poseidon of this solar capacity would be: $\$1.26/W_{AC} \times 10^6\ W_{AC}/MW_{AC} \times 150\ MW_{AC} = \$189$ million (2021 dollars).

Figure 5. 2021 installed cost of rooftop and utility-scale solar, \$ per watt, with principal elements of the installed cost disaggregated[74]



Battery storage, with four hours of duration at the rated 30 MW demand of Poseidon Huntington Beach, would be included at the commercial solar installations to assure the desalination plant imposes no net additional load on the grid during peak demand conditions. The total battery storage capacity would be 30 MW × 4 MWh/MW = 120 MWh.

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[70] NREL, *U.S. Solar Photovoltaic System and Energy Storage Cost Benchmark: Q1 2021,* November 2021: https://www.nrel.gov/news/program/2021/new-reports-from-nrel-document-continuing-pv-and-pv-plus-storage-cost-declines.html.

[71] The assumed direct current-to-alternating current ("dc-to-ac") conversion factor for commercial rooftop solar is 0.90. Therefore, the installed "ac" capacity installed capital cost of commercial rooftop solar is: $\$1.56/W_{DC} \div 0.90 = \$1.73/W_{AC}$. .

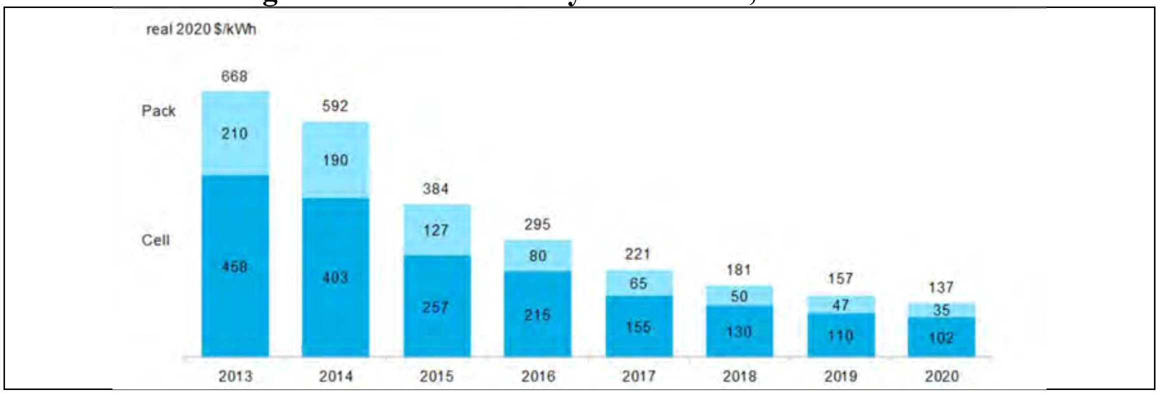
[72] NREL, 2021, p. vi. Figure ES-1. Comparison of Q1 2020 and Q1 2021 PV cost benchmarks.

[73] $\$1.73/W_{AC} \times (1 - 0.10)^3 = \$1.26/W_{AC}$.

[74] Ibid.

A survey of leading battery manufacturers indicates that battery equipment costs are steadily declining, as shown in Figure 6, with a benchmark equipment cost of $137/kWh in 2020.[75] Additionally, the National Renewable Energy Laboratory (NREL) forecasts that the installed cost of battery storage, which includes installation labor and all additional hardware - and soft costs like permitting - to make the battery storage fully operational, will be approximately $250/kWh in 2024-2025 timeframe.[76] Using the NREL estimate, Poseidon's cost to purchase and install this amount of battery storage capacity would be: 120 MWh × 10^3 kWh/MWh × $250/kWh = $30 million.

Figure 6. Lithium battery cost decline, 2013-2020[77]



Note: A battery pack and battery cells are the two elements of a functional lithium battery.

The total cost to Poseidon to fully address it energy needs with local solar power and assure grid reliability under peak demand conditions with sufficient battery storage would be: $189 million (solar) + $30 million (battery storage) = $219 million.

This $219 million solar + battery capital expenditure, averaged over the 50-year operating lifetime of the Huntington Beach desalination plant, would amount to $4.4 million per year. The San Diego County Water Authority calculated a $2,866/AF cost for desalination water from Poseidon's Carlsbad desalination plant for 2019-2020.[78] The annual gross revenue from the sale of 56,000 AF from the Huntington Beach desalination plant, at $2,866/AF, would be $160 million per year.

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[75] BloombergNEF, *Battery Pack Prices Cited Below $100/kWh for the First Time in 2020, While Market Average Sits at $137/kWh*, December 16, 2020: https://about.bnef.com/blog/battery-pack-prices-cited-below-100-kwh-for-the-first-time-in-2020-while-market-average-sits-at-137-kwh/. "BNEF's 2020 Battery Price Survey, which considers passenger EVs, e-buses, commercial EVs and stationary storage, predicts that by 2023 average pack prices will be $101/kWh."

[76] NREL, *Cost Projections for Utility-Scale Battery Storage: 2021 Update*, June 2021, Figure ES-2. Battery cost projections for 4-hour lithium ion systems, p. iv: https://www.nrel.gov/docs/fy21osti/79236.pdf.

[77] Ibid.

[78] San Diego County Water Authority, *Rates & Charges and Budget Update - Administrative and Finance Committee*, PowerPoint presentation, October 22, 2020, pdf p. 78: https://www.sdcwa.org/sites/default/files/2016-12/Board/2020_Presentations/2020_10_22BoardPresentations.pdf.

Therefore, the cost of GHG mitigation, at $4.4 million per year over 50 years, would represent less than 3 percent of the annual gross revenue of $160 million per year.[79]

Substantial work has already been done by the California Energy Commission (CEC) on the capacity of Huntington Beach to host rooftop commercial and industrial solar rooftop and parking lot installations.[80] The 2019 CEC study evaluated one neighborhood in Huntington Beach, the Oak View neighborhood. However, the study also characterized the solar hosting capacity of six Huntington Beach substations in the vicinity of Oak View, concluding these substations could collective absorb over 350 MW of additional distributed solar generation.[81]

The 2019 CEC study also reviewed a "utility scenario," where solar would be located only on commercial and industrial rooftops and parking lots, with the solar output on the utility side of the meter and delivered directly to the grid.[82]

The Oak View analysis is scalable to other areas of Huntington Beach, as noted in the CEC study. This tool should be utilized by Poseidon and the City of Huntington Beach to identify 150 MW_{AC} of solar capacity on commercial and industrial rooftops and parking lots in Huntington Beach. The battery storage capacity can be co-located at the sites with rooftop solar or located at the nearest utility substation(s). The CEC's scalable "utility scenario" is the right template to identify the local solar sites that will serve as GHG mitigation for the proposed Huntington Beach desalination plant.

10.0 Conclusions

Water demand in OCWD service territory has declined substantially since the Huntington Beach desalination project was first proposed in 1998. Demand has declined from approximately 500,000 AFY to 400,000 AFY, a 20 percent reduction. On the supply side, the GWRS began producing purified recycled water in 2008 and currently produces 112,000 AFY (100 MGD). GWRS production is expected to increase to 145,000 AFY (130 MGD) in 2023. OCWD forecasts it will meet water demand through 2045 without supply from the Huntington Beach desalination plant.

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 GHG offsets to achieve carbon neutrality for the desalination plant. This approach to carbon neutrality will not address the local grid reliability impacts of adding a continuous 30 MW load in the Los Angeles Basin.

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[79] $4.4 million per year ÷ $160 million per year = 0.0275 (2.75 percent)

[80] California Energy Commission, *Huntington Beach Advanced Energy Community Blueprint - A Scalable, Replicable, and Cost-Effective Model for the Future*, April 2019.

[81] **Attachment B** (excerpts of Huntington Beach report), Table 14: 66/12 kV Substations – Existing Generation, Projected Load, and Maximum Remaining Hosting Capacity (p. 81).

[82] Ibid, p. C-1, p. C-4, p. C-5.

150 MW_{AC} of local solar power, and 30 MW of local battery storage, should be developed by Poseidon in Huntington Beach to fully mitigate the carbon footprint of desalination plant operations and to assure the plant does not compromise local grid reliability. The annual cost of the solar and battery storage GHG mitigation scenario would be in the range of 3 percent of the annual gross revenue of the Huntington Beach desalination plant.

ATTACHMENT A

California Public Utilities Commission
505 Van Ness Ave., San Francisco

FOR IMMEDIATE RELEASE **PRESS RELEASE**

Media Contact: Terrie Prosper, 415.703.1366, news@cpuc.ca.gov Docket #: A.08-03-015

CPUC APPROVES EDISON SOLAR ROOF PROGRAM

SAN FRANCISCO, June 18, 2009 - The California Public Utilities Commission (CPUC), in its ongoing commitment to innovative programs and policies to advance the delivery of renewable energy, today approved a solar photovoltaic program for Southern California Edison.

The program will result in the deployment of 500 megawatts (MW) of solar photovoltaic (PV) on existing commercial rooftops in Edison's service territory. Edison will own, install, operate, and maintain 250 MW of solar PV projects, which will primarily consist of one to two MW rooftop systems. The remaining 250 MW will be installed, owned, and operated by independent, non-utility solar providers selected through a competitive process.

Prior to today's decision, utility solar programs in the one to two MW range had limited participation in the California Solar Initiative or Renewables Portfolio Standard (RPS) program. Edison's program creates a new avenue for developing such smaller sized solar projects.

"This program represents a valuable complement to the existing renewable procurement efforts we have underway, given the significant permitting challenges large scale renewables face, both in terms of transmission and the generating facilities themselves," said CPUC President Michael R. Peevey. "It represents an important hedging strategy by allowing for the deployment of distributed resources that, while somewhat more expensive than the large scale renewable projects that are the primary focus of the RPS program, offer a much higher level of certainty in terms of when they will come online."

Added Commissioner John A. Bohn, author of the decision, "This decision is a major step forward in diversifying the mix of renewable resources in California and spurring the development of a new market niche for large scale rooftop solar applications. Unlike other generation resources, these projects can get built quickly and without the need for expensive new transmission lines. And since they are built on existing structures, these projects are extremely benign from an environmental standpoint, with neither land use, water, or air emission impacts. By authorizing both utility-owned and private development of these projects we hope to get the best from both types of ownership structures, promoting competition as well as fostering the rapid development of this nascent market."

"This decision is good for California because it makes good use of all that sun and warehouse roofs in Southern California to produce clean energy right where we need it, both by Edison and independent generators," commented Commissioner Rachelle Chong. "I commend Edison for its foresight in bringing a focus on commercial solar PV projects that are 1-2 megawatts in size."

Commissioner Timothy Alan Simon said, "I support this decision because it strikes a balance between promoting utility-owned generation and competitive procurement for independent energy producers, as well as distributed generation and central station solar systems. Finally, it will bring much needed economic stimulus to the Inland Empire."

Because this is the first significant foray by a utility into ownership of renewable generation, the CPUC will carefully monitor the program's progress, examine ways in which the program can be improved, and fine tune the program when and where appropriate.

The energy generated from the project will be used to serve Edison's retail customers and the output from these facilities will be counted towards Edison's RPS goals. The output and capacity of the projects will not count towards the California Solar Initiative program goals.

The RPS program is one of the most ambitious renewable energy standards in the country. It requires investor-owned utilities to procure 20 percent of their electricity sales from renewable sources by 2010. Governor Schwarzenegger subsequently established an RPS target of 33 percent by 2020 for all retail sellers of electricity. The California Solar Initiative has a goal to install 3,000 MW of new customer solar projects by 2016, moving the state toward a cleaner energy future and helping lower the cost of solar systems for consumers.

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ATTACHMENT B

Energy Research and Development Division

FINAL PROJECT REPORT

Huntington Beach Advanced Energy Community Blueprint

A Scalable, Replicable, and Cost-Effective Model for the future

California Energy Commission

Gavin Newsom, Governor

April 2019 | CEC-500-2019-047

EXECUTIVE SUMMARY

Introduction

California's Renewables Portfolio Standard requires that 33 percent of the state's electricity be powered using renewable resources by 2020, 50 percent by 2026, and 60 percent by 2030. In 2016, the Energy Commission released a solicitation titled, The EPIC Challenge, a two-phase competition to assist California's local governments in meeting these targets. The competition focuses on overcoming financial and regulatory challenges to more widely deploy advanced energy communities. This concept was created to represent the combination of technology types that can (1) reduce energy demand through energy conservation measures, (2) generate energy using renewable sources, and (3) manage community energy flows to optimize service and connection with the surrounding communities. The first phase of the competition is focused on the planning and design of a replicable advanced energy community, inclusive of a master community design, case study, and resources. Phase II will award funding to build-out the design developed under Phase I, and was released in the fall of 2018.

As a Phase I recipient, a team consisting of the Advanced Power and Energy Program at University of California, Irvine, the City of Huntington Beach, Altura Associates, the National Renewable Energy laboratory, Southern California Edison, and Southern California Gas was partnered together to develop tools to optimally design an advanced energy community for the disadvantaged Oak View community. The Huntington Beach Advanced Energy Community project's goal was to install various interworking clean energy technologies in way that could be successfully replicated in other communities.

Project Process

Tool development included the creation of the community-scale energy modeling platform URBANopt. This tool is able to capture the complex relationships between building and community energy use when considering different types of energy conservation measures. Since it is based on the EnergyPlus building energy simulation engine, URBANopt can be expanded to include numerous other energy conservation and renewable generation measures. The current version examines interior and exterior lighting efficiency, plug load efficiency, and structural improvements that can be used to reduce interior heating and cooling loads. Development also included a smart community energy management model that included the DERopt community solar energy and battery energy storage optimization model. Using this model, it is possible to optimally determine the best types and locations of renewable generation within the community, and ensure feasible operation. This model also can be used to evaluate the renewable fuel potential for a community.

During development of the tools, the team also participated in extensive community outreach, which is discussed in more detail, under the Knowledge Transfer section.

Table 12: Southern California Edison Time-of-Use Rates for Domestic Customers

Charge Type	TOU-D-A	Notes
Summer On-Peak ($/kWh)	0.48	Summer weekdays from 2pm -8pm
Summer Mid-Peak ($/kWh)	0.28	Summer weekdays from 8am - 2pm or 8pm - 10pm, or Summer Weekends from 8am - 10pm
Summer Off-Peak ($/kWh)	0.12	All other summer times
Winter On-Peak ($/kWh)	0.36	Winter weekdays from 2pm -8pm
Winter Mid-Peak ($/kWh)	0.27	Winter weekdays from 8am - 2pm or 8pm - 10pm, or Winter Weekends from 8am - 10pm
Winter Off-Peak ($/kWh)	0.13	All other winter times

Source: University of California, Irvine

Table 13: Southern California Edison Tiered Rates for Domestic Customers

Rate	SCE - D	SCE - D - Care	Notes
Summer T1	0.1746	0.11784	Summer usage up to 100% baseline
Summer T2	0.2462	0.16558	Summer usage between 101% and 400% baseline
Summer T3	0.3466	0.23308	Summer usage above 400%
Winter T1	0.1746	0.11784	Winter usage up to 100% baseline
Winter T2	0.2462	0.16558	Winter usage between 101% and 400% baseline
Winter T3	0.3466	0.23308	Winter usage above 400%

Source: University of California, Irvine

Existing Oak View Energy Infrastructure

As a first step towards modeling the existing electric distribution system, the team performed an initial characterization of the local distribution circuits and substations using SCE's DERiM (Distributed Energy Resources Interconnection Map) [16]. The DERiM ArcGIS© database provided not only the precise geographical location of substations, sub-transmission, and distribution circuits, but also information on the current and projected future load and generation and, most importantly, maximum distributed generation hosting capacity.

Ocean View 66/12 kV Substation

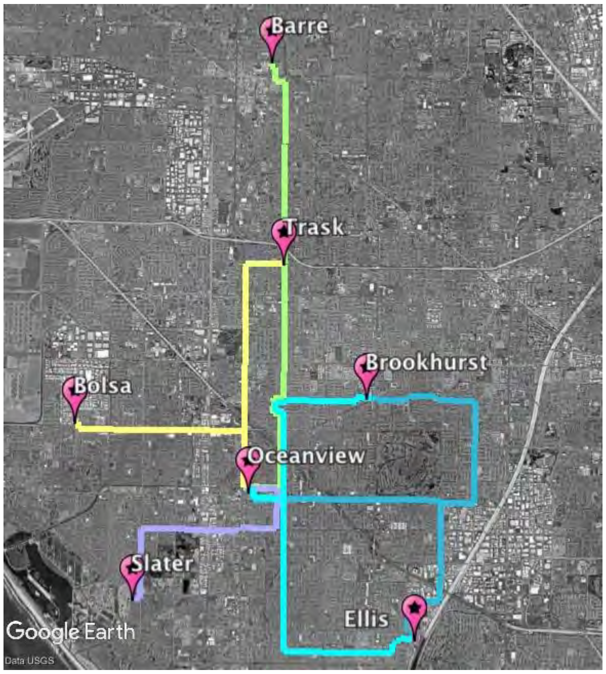
The Ocean View 66/12 kV substation is the B-substation that feeds the Oak View AEC. A B-substation steps-down voltage from the sub-transmission voltage level (typically 66 kV and 115 kV) to the distribution voltage level (typically 4 kV, 12 kV, and 16 kV), The Ocean View Substation is part of the Ellis-A System [16]. Ocean View's projected load for 2017 is 49.20 MW.

Ellis-66/12 kV currently hosts 3.95 MW of DG and still offers capacity for hosting an additional 40.85MW [16]. Figure 30 shows an aerial view of the Ocean View substation as found using *Google Earth Pro©* [41]. There are five 66 kV sub-transmission circuits (Figure 31) that create a network between six neighboring B-substations: Ellis, Bolsa, Barre, Trask, Brookhurst, and Slater.

Figure 30: View of Ocean View Substation

Source: Google Earth

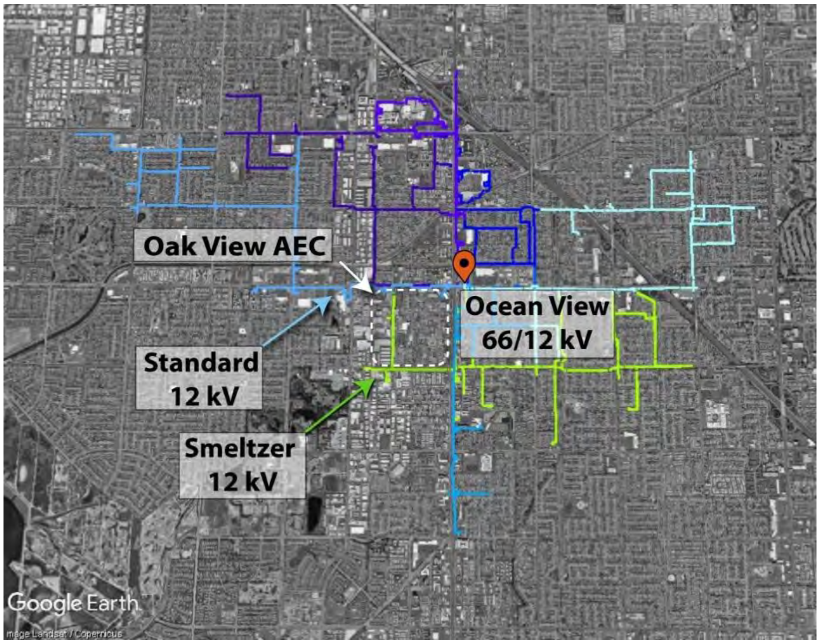
Figure 31: 66 kV Circuits from Ocean View substation.



Source: University of California, Irvine; DERiM circuits exported to Google Earth

Additionally, there are seven 12 kV circuits (Figure 32) that originate from Ocean View and deliver electricity to the Oak View AEC and surrounding area: Smeltzer, Bushard, Beach, Bishop, Heil, Standard, and Wintersburg. The Oak View AEC residential customers are mainly served by Smeltzer 12 kV, whereas the north-west commercial customers are mainly served by Standard 12 kV.

Figure 32: 12 kV Circuits from Ocean View Substation



Source: University of California, Irvine; DERiM circuits exported to Google Earth

Neighboring 66/12 kV Substations

Data gathered from DERiM [16] for existing generation, projected 2018 system load, and remaining generation hosting capacity on the primary 66 kV substations are summarized in Table 14. The Integration Capacity Analysis (ICA) method used to calculate the maximum capacity values (see [42]) defines the amount of distributed generation and aggregated loads the system that may be capable of supporting in its current configuration, that is, without any upgrades needed. The ICA takes into account four criteria with the ultimate goal to maintain system safety and reliability after DER placement:

1. Thermal rating: prevents thermal overloads of conductors, transformers, circuit breakers, and line devices.
2. Power quality/vVoltage: prevents operation outside of the allowable power quality or voltage limits defined by the California Rule 21 and Engineering Standards, which are drawn from American National Standard (ANSI) C84.1 - 2011 Range A. Steady-state voltage is limited to remain in the range between 0.95 p.u. and 1.05 p.u. or 114 to 126 on a 120 V base. Voltage fluctuation limits of 3 percent are used.
3. Protection: ensures existing protection schemes will still promptly detect and respond to abnormal system conditions

4. System flexibility: ensures line transfers and emergency restorations are still performed reliably.

Table 14: 66/12 kV Substations – Existing Generation, Projected Load, and Maximum Remaining Hosting Capacity

Substation	Total Existing Generation (MW)	Projected Load (MW)	Maximum Remaining Generation Integration Capacity (ICA) (MW)
Barre (66/12 kV)	3.35	75.50	108.65
Brookhurst	3.30	44.80	41.50
Bolsa	2.90	40.00	37.10
Ellis (66/12 kV)	3.95	42.50	40.85
Slater	4.42	50.50	51.57
Trask	5.58	86.10	95.22

Source: University of California, Irvine, [16]

The maximum remaining generation ICA values are defined as technology-agnostic, that is, they do not refer to a specific type of distributed generation resource. To calculate the ICA for a specific generation technology (like solar PV), the technology specific hourly per-unit production (the hourly output per MW installed) must be taken into account. Equation (1) is used to calculate the remaining solar PV hosting capacity for the AEC.

$$TS_{ICA}(t) = \frac{TA_{ICA}}{TS_{pu}(t)} \tag{1}$$

Where:

$TS_{ICA}(t)$ = Technology Specific ICA on time t

TA_{ICA} = Technology Agnostic ICA

$TS_{pu}(t)$ = Technology Specific per-unit output on time t.

66 kV Sub-Transmission Feeders

The lengths of the 66 kV sub-transmission feeders connecting the substations were measured using Google Earth's geospatial measuring tool and are shown in Figure 33.

12 kV Distribution Feeders

The current generation/load and the remaining generation/loading hosting capacity of the two primary 12 kV distribution feeders, Smeltzer and Standard, were also gathered from DERiM. According to SCE's methodology [42], the ICA values for 12 kV feeders were broken down into specific circuit segments (shown in Table 15 and Table 16). As a starting point for this study, the total ICA assumed is the sum of the ICA values of the individual segments that directly feed the AEC community. For the AEC, these segments 2 and 3 for the Smeltzer circuit (Figure 34), and segment 1 for the Standard circuit. The values assumed for feeder length account for the total circuit length, which was measured using the geospatial measuring tool in Google Earth.

capacity for the Oak View community. Under this method, the team considered realistic rooftop constraints, such as the existence of existing roof mounted equipment or exhaust flue ducting, building code at setback requirements, and other structural limitations observed during site visits and energy audits. The total area that can be covered is shown in the aerial image of the Oak View community in Figure 44.

Figure 44: Aerial Image of Maximum Solar Photovoltaic Capacity across Entire Oak View Community

Source: University of California, Irvine

The maximum solar PV capacity assuming a panel efficiency of 18 percent is shown in Table 28. If the maximum capacity were installed, the projected energy production would be approximately 16 GWh, less than the projected 17 GWh used annually after LED and plug load ECM implementation. This shortfall, however, is due to the mismatch between the solar PV capacity in the waste transfer sector and the electrical loads at that location. The maximum solar PV capacity at the waste transfer station is projected to produce 1.6 GWh, much less than

APPENDIX C: Solar Photovoltaic Scenarios

In addition to the maximum solar PV capacity scenario developed in the section on distributed energy resource potential in Chapter 8, three additional solar PV scenarios were developed using the heuristic solar PV design tool. These scenarios include the "grid constraint scenario" where solar PV is sized such that the solar PV system is capable of operating without storage, curtailment, or overloading the local utility grid, the "carport scenario", where only carport solar PV is adopted, and the "utility scenario", where only large solar PV systems are adopted to be placed on the utility side of the meter.

Under the grid constraint scenario, as shown in Figure C-1, each PV Zone in the community is given a limitation of the amount of PV can be deployed in that specific Zone. The determination is made based on the transformer rating such as power and voltage as well as the corresponding power flow. Those factors become the constraint for how much PV each zone could potentially have without causing the problem to the local power distribution system. Therefore, the PV installation potential has been dramatically reduced in the community. From maximum to grid constraint scenario, certain specific design criteria need to be considered to optimizing the system efficiency and maximizing energy output. After applying the methodology described in Chapter 1, the community's total PV potential is reduced by almost 57 percent.

Figure C-1: Oak View Community Solar Photovoltaic System Overview under the Grid Constraint Scenario

Source: University of California, Irvine

Table C-1: Constraint Scenario, Solar Photovoltaic Potential and Energy Production Broken Down into All Community Sectors

Oak View Community (Grid Constraint Scenario)	C&I Sector	School Sector	Residential Sector	Community Total
PV Capacity (MW)	3.62	0.66	1.74	6.02
Annual Production (GWh)	5.50	0.97	2.65	9.12
kWh/kW	1,521	1,463	1,525	1,515
System Performance (%)	79.5%	79.3%	78.4%	79.2%

Under this scenario, as shown in Figure C-2, remove all the rooftop PV arrays, and only count for carport PV which is designed based on the empty parking lot in the community. This scenario is supposed to estimate how much public carport PV structure cloud potentially exist without considering any carport PV design regulations and requirements (such as carport PV structure needs to be 20 feet away from permanent buildings). Those will be considered and included in the utility scenario. In the carport PV scenario, most carport PV array will be concentrated in the C&I and the School sector. There are several available carport PV potential locations in the Residential sector which could provide shade for public vehicles. The carport PV array in the residential sectors is usually small systems and likely to be scatted around, which could be a challenge for power local distribution compared with those large, concentrated, and continuous arrays in commercial sectors.

Figure C-2: Oak View Community Solar Photovoltaic System Overview under the Carport Photovoltaic Scenario

Source: University of California, Irvine

Table C-2: Carport Photovoltaic Scenario, Solar Photovoltaic Potential and Energy Production Broken Down into All Community Sectors

Oak View Community (Carport PV Scenario)	C&I Sector	School Sector	Residential Sector	Community Total
PV Capacity (MW)	2.64	0.48	0.99	4.11
Annual Production (GWh)	3.98	0.72	1.55	6.25
kWh/kW	1,509	1,504	1,567	1,521
System Performance (%)	81.8%	82.2%	82.2%	81.9%

In utility scenario, as shown in Figure C-3, most of the solar PV will be placed in C&I sector, with rest of the sectors with only carport PV system. Comparing with the carport PV scenario, all the carport PV in the community are designed based on regulations and rules. The PV capacity in each zone and sector are sized under the constraint from the grid. Comparing with the carport PV scenario, most of the small carport PV structure between car garages in South Residential and North Residential Sector cannot be built based on the design requirement that the canopy PV structure needs to be 20 feet from permanent buildings, which caused a dramatical reduction in solar PV capacity in the residential sector.

Figure C-3: Oak View Community Solar Photovoltaic System Overview under the Utility Scenario

Source: University of California, Irvine

Table C-3: Utility Scenario, Solar Photovoltaic Potential and Energy Production Broken Down into All Community Sectors

Oak View Community (Utility Scenario)	C&I Sector	School Sector	Residential Sector	Community Total
PV Capacity (MW)	4.27	0.40	0.33	5.00
Annual Production (GWh)	6.54	0.60	0.51	7.65
kWh/kW	1,533	1,512	1,552	1,530
System Performance (%)	81.4%	82.5%	82.6%	81.6%