

PUBLIC WORKS RENEWABLE ENERGY MASTER PLAN

JANUARY 2020

Los Angeles County Public Works



Public Works
LOS ANGELES COUNTY

TABLE OF CONTENTS

EXECUTIVE SUMMARY	iii
1 INTRODUCTION	1
1.1 <i>Renewable Energy Initiatives in California</i>	1
1.2 <i>Renewable Energy Markets and Demand Drivers</i>	2
1.3 <i>Public Works Sustainability and Net Zero Energy Goals</i>	2
1.4 <i>REMP Objective</i>	3
1.5 <i>REMP Development Process</i>	3
2 OVERVIEW	5
2.1 <i>Public Works Current Energy Use</i>	5
2.2 <i>Pathway to Net Zero Energy Public Works</i>	11
3 RENEWABLE ENERGY TECHNOLOGIES	12
3.1 <i>Solar Installations</i>	12
3.2 <i>Wind Turbines</i>	13
3.3 <i>Energy Management Systems</i>	13
3.4 <i>Solar + Battery Storage</i>	14
3.5 <i>Solar + Battery Storage + EV</i>	14
3.6 <i>Kinetic Energy</i>	14
3.7 <i>Hydroelectric Energy</i>	15
3.8 <i>Thermal Energy</i>	15
3.9 <i>Fuel Cells</i>	16
3.10 <i>Microgrids</i>	16
3.11 <i>Microturbines</i>	17
3.12 <i>Thermal Conversion Technology</i>	17
4 PRIOR USE CASE EXAMPLES	19

5	PROJECT FUNDING AND FINANCING	22
5.1	<i>Power Purchase Agreement.....</i>	22
5.2	<i>Virtual Power Purchase Agreement.....</i>	23
5.3	<i>Lease.....</i>	24
5.4	<i>Purchase.....</i>	24
5.5	<i>Shared Savings</i>	25
5.6	<i>Performance-Based Contracting.....</i>	25
5.7	<i>Public-Private Partnership</i>	26
5.8	<i>Rate Tariffs</i>	26
6	SITE SELECTION.....	28
6.1	<i>Types of Public Works Facilities</i>	28
6.2	<i>Establishing Net Zero Goal.....</i>	28
6.3	<i>Site Selection Methodology</i>	30
6.4	<i>Assumptions</i>	31
7	RECOMMENDED RENEWABLE ENERGY SITES.....	34
7.1	<i>Solar PV Facilities.....</i>	35
7.2	<i>On-Site Thermal Conversion Technology.....</i>	67
7.3	<i>Hydro Turbine Replacement.....</i>	69
7.4	<i>Recommendations and Next Steps</i>	71
8	CONCLUSION	73
	ACKNOWLEDGEMENTS	75
	APPENDIX A REMP PROJECT SELECTION	A-1

EXECUTIVE SUMMARY

Los Angeles County Public Works (Public Works) aims to play a major role in renewable energy, energy efficiency, and enhanced energy reliability in the region with the goal of promoting local renewable energy generation that benefits the local economy. In 2016, Public Works set a Net Zero Energy Public Works goal to offset its energy usage by generating renewable energy at Public Works facilities. As a commitment to this goal, Public Works developed a Renewable Energy Master Plan (REMP) as a high-level roadmap to offset grid energy usage through renewable energy generation at Public Works facilities.

The REMP details emerging technologies and project financing options, with the primary consideration for those that are cost neutral for Public Works. It explores various technologies, case studies, and provides future project recommendations. The projects proposed in the REMP would offset energy usage both on-site at facilities and off-site with renewable energy technologies. The sites identified for potential renewable energy generation are:

1. LAND SITES

- a. **AVIATION:** General William J. Fox Airfield
- b. **WATER RESOURCES:** Eaton Wash Dam and Reservoir; Morris Dam and Reservoir; Puddingstone Diversion Dam and Reservoir; Hansen Spreading Grounds; Rio Hondo Spreading Grounds
- c. **TRANSPORTATION:** Road Division 555

2. BUILDING ROOFTOP SITES

Central/Lower Yard; Maintenance District No. 1 – Baldwin Park; Maintenance District No. 3 – Westchester; Maintenance District No. 4 – Hollydale; Hansen Yard – West Area; Imperial Yard – South Area; Longden Yard - East Area

3. SOLAR PANEL + BATTERY STORAGE

La Puente Building and Safety Building; Longden Yard Microgrid System

4. ON-SITE THERMAL CONVERSION TECHNOLOGY

Public Works Headquarters

5. HYDRO TURBINE REPLACEMENT

East Avenue M & 5th Street East; West Avenue L12 & 60th Street West

Combined, these sites have the potential to generate approximately 46 megawatts and are projected to offset 100 percent of the Public Works average annual energy demand through the annual production of over 70 million kilowatt-hour (assuming energy savings and renewable energy generated through Public Works' existing efforts offset the total energy demand). The project site investigations conducted during this study were completed through a high-level analysis, and a specific project level feasibility analysis will be required to confirm energy generation and to better understand the details for project implementation. In addition, the ability to offset 100 percent of the Public Works average annual energy usage will rely completely on its ability to work with the local utility companies to create a virtual net metering program. A virtual net metering program like Southern California Edison's Renewable Energy Self-Generation Bill Credit Transfer (RES-BCT) program, allows renewable energy that is generated at a single site to offset energy usage against multiple accounts at various locations. Finally, the recommended projects were selected based on their ability to obtain private sector financing to assist Public Works with its goal of no net cost for REMP projects.

The REMP is a path toward achieving Net Zero Energy Public Works, and it will demonstrate Public Works' leadership in sustainability and resiliency across its operations throughout Los Angeles County.

1 INTRODUCTION

The Los Angeles County Public Works (Public Works) is the largest Public Works agency in the United States that employs nearly 4,000 staff and is comprised of over 30 divisions, groups and offices that range in responsibility from workforce support, community relations to engineering and project management. With a budget of over \$3 billion, diligent use of funds is critical and must benefit the citizens of Los Angeles County.

Public Works aims to play a major role in renewable energy, energy efficiency, and enhanced energy reliability in the region with the goal of promoting local renewable energy generation that benefits the local economy. In 2016, Public Works set a Net Zero Energy Public Works Goal to offset its energy use by generating renewable energy at Public Works facilities.

To accomplish this goal, Public Works has developed a Renewable Energy Master Plan (REMP). The REMP consists of a high-level roadmap for generating renewable energy (RE) at Public Works facilities. It explores various technologies, case studies, and provides future project recommendations. These projects would offset energy usage both on-site at facilities and off-site with renewable energy technologies.

1.1 *Renewable Energy Initiatives in California*

California leads the nation in the development of clean energy by embracing its rich natural resources. The State's commitment is reflected in many policies and incentives in place to promote the adoption and acceleration of renewables. From a policy standpoint, California's Senate Bill 100¹ (SB 100) was signed into law in September 2018 and calls for 50 percent

¹ <https://focus.senate.ca.gov/sb100>

renewables by 2026, 60 percent renewables by 2030, and 100 percent carbon-free energy by 2045. Under the California Public Utilities Commission (CPUC)², the California Energy Efficiency Strategic Plan has been enacted so that all new commercial building construction will be zero net energy by 2030 and 50 percent of existing commercial buildings will be retrofit to zero net energy by 2030. While California already has the most progressive environmental and RE goals in the country, the State is now looking beyond 2030 to increase renewable energy even further and achieve even greater greenhouse gas (GHG) reduction.

1.2 Renewable Energy Markets and Demand Drivers

Driving factors for Public Works and stakeholders to shift to renewable energy include California State policy regulations for decarbonization, the Los Angeles County Strategic Plan, the Los Angeles County Board of Supervisors sustainability priorities, the Los Angeles County OurCounty Sustainability Plan, and Public Works' energy strategic plans and net zero energy goals.

Some of the benefits of net zero energy include energy savings (reduction of annual energy costs through on-site and off-site generation), GHG reduction, resiliency, redundancy and reduced dependence on the grid. The net zero energy goal attracts technology providers and private sector investors to finance clean energy projects and promotes health and wellness of building occupants.

1.3 Public Works Sustainability and Net Zero Energy Goals

Los Angeles County is committed to providing reliable and sustainable operations and has set three net zero goals (i.e. net zero water, net zero waste, and net zero energy). The Net Zero Energy goal is clearly demonstrated by Public Works taking a leadership role in generating local renewable energy in the region. The REMP will guide future renewable energy generation

² <https://www.cpuc.ca.gov/general.aspx?id=4125>

projects and initiatives by integrating RE projects throughout Public Works facilities and operations.

In addition to existing net zero goals at Public Works, the County of Los Angeles recently adopted the OurCounty Sustainability Plan which is a regional plan that includes renewable energy and energy efficiency goals. Public Works' REMP will support the goals of the OurCounty Sustainability Plan and facilitate implementation of all renewable energy related action items.

Los Angeles County is also a member of the board of directors for the Clean Power Alliance (CPA), which is the entity that oversees the Community Choice Aggregation (CCA) program for 31 jurisdictions in Los Angeles and Ventura counties. Los Angeles County Unincorporated Communities and County owned facilities in CPA territory participate in the CPA's "Clean Power" option, providing 50 percent renewable energy content. As the CPA continues to develop their renewable energy portfolio and more jurisdictions join the CPA, it is likely the demand for local renewable energy resources will increase. As one of the CPA's largest customers, the County and Public Works have an opportunity to become a provider of renewable energy to the CPA as they look to expand their energy procurement from local sources.

1.4 REMP Objective

The REMP's main objective is to outline a high-level roadmap to net zero energy by 2030 by identifying opportunities to expand renewable energy generation at Public Works facilities and developing 10-20 potential projects that Public Works can implement to achieve the goal.

1.5 REMP Development Process

The development of the REMP included the following tasks: Project Kick Off; Master Plan Framework and Goal Setting; Baseline Assessment of Public Works Operations; Technology

Evaluation; Renewable Energy Markets Overview 101; Identify Potential Opportunities and Case Studies; and Development of the Master Plan and Project Recommendations.

The REMP Team consisted of a selected group from 17 different Divisions representing all Public Works Core Service and Support Branch Areas. The REMP development process was specifically designed to incorporate ongoing feedback and input from experienced staff that have an intimate knowledge of Public Works facilities and operations.

REMP Team interviews were conducted to gather information on prior, current, and future RE initiatives. The discussion included Public Works' experience with RE technologies and the renewable energy generation projects that have already been implemented at Public Works. Detailed information about Public Works' operations, including maps of existing field facilities, project reports, feasibility studies, and utility usage data, were analyzed to identify opportunities to integrate renewable energy generation technology within Public Works' current operations and facilities. The information gathered and analyzed was incorporated into the recommendations of potential renewable energy sites at Public Works facilities.

The outcomes and findings represent an initial step toward achieving the vision of the REMP, which is **“To Become a Leader in Innovative and Sustainable Solutions for Renewable Energy Independence in Public Works Operations.”**

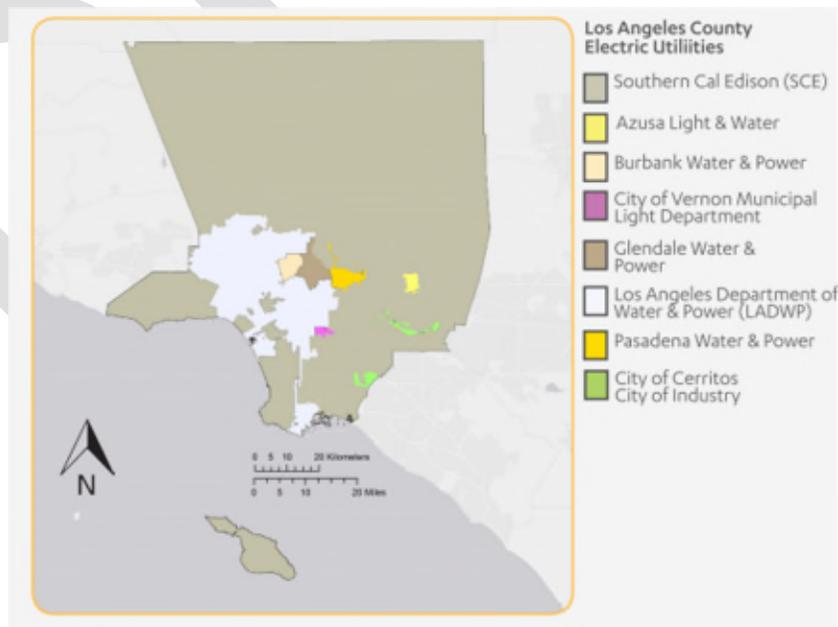
2 OVERVIEW

2.1 *Public Works Current Energy Use*

2.1.1 *Electricity*

Public Works has a wide range of assets including roads, streetlights, sewage, flood control facilities, airports, dams, and water service that provide services to residents in Los Angeles County. As its operations are spread out across the County, Public Works obtains electrical power from the CPA, Southern California Edison (SCE), Los Angeles Department of Water and Power (LADWP), Pasadena Water and Power, Azusa Light and Water, Glendale Water and Power, and Burbank Water and Power. See **Figure 2-1** for the various electric utilities throughout Los Angeles County). **Table 2-1** shows the total number of Public Works electricity accounts with the various utility providers.

Figure 2-1: Electric Utilities Within and Serving Los Angeles County



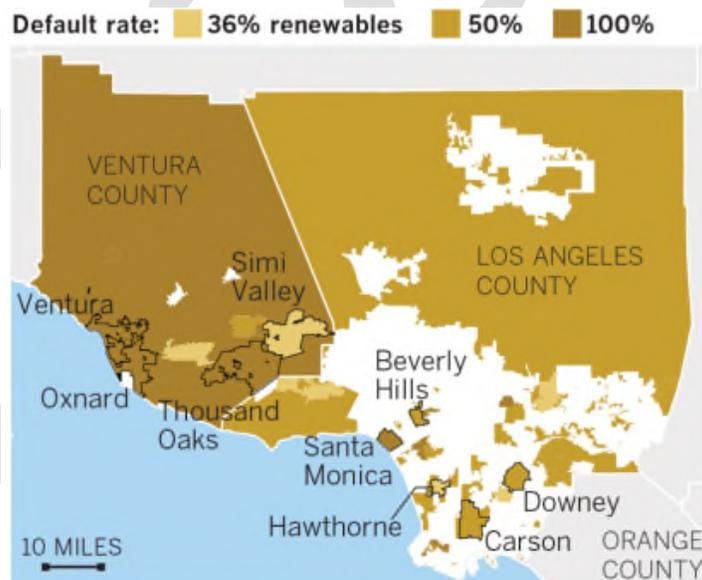
Map Source: 2017 Sustainable LA Environmental Report Card for Los Angeles County: Energy & Air Quality
<https://escholarship.org/uc/item/6xj45381>

Table 2-1: Public Works Electricity Accounts (2019)

Electricity	
Utility Provider	# of Accounts
Clean Power Alliance (CPA)	1,545
SoCal Edison (SCE)	669
City of Los Angeles (DWP)	50
City of Pasadena	8
City of Azusa	7
City of Glendale	6
City of Burbank	1

Most of Public Works electricity accounts obtain clean energy from the CPA, which currently provides 50 percent renewable energy to Public Works facilities. **Figure 2-2** shows the CPA's default renewable energy rates throughout Los Angeles and Ventura Counties. It should be noted that although the CPA purchases the clean energy, it is still delivered by SCE, which delivers over 95 percent of Public Works' electricity.

Figure 2-2: CPA Renewable Rates in Los Angeles and Ventura Counties



Note: Shown are boundaries of some of the largest cities served.

Source: Clean Power Alliance.

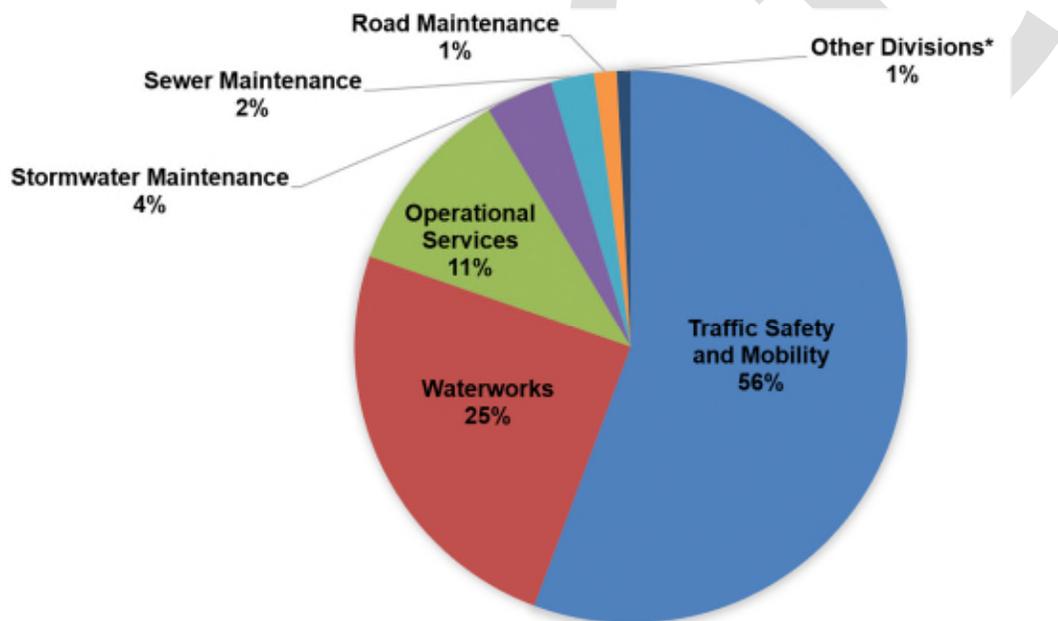
Graphics reporting by Thomas Suh Lauder

@latimesgraphics

Map Source: LA Times "What you need to know about Clean Power Alliance, SoCal's newest electric company" Feb 2019
<https://www.latimes.com/business/la-fi-clean-power-alliance-launch-20190201-story.html>

Public Works' total electricity use in 2017 was 121,626,054 kilowatt-hour (kWh). **Figure 2-3** shows the electricity used by Public Works Divisions, while **Figure 2-4** shows the electricity usage by operation. The highest energy use was Traffic Safety and Mobility Division's street lighting (56 percent).

Figure 2-3: 2017 Electricity Usage by Division

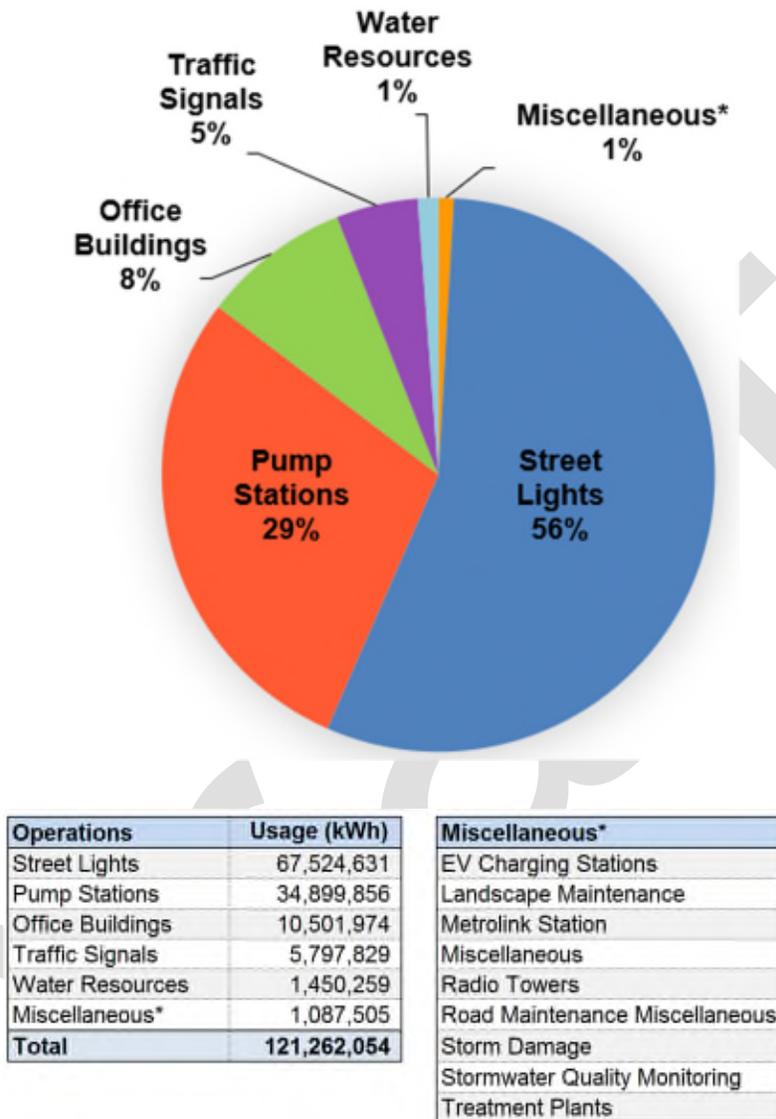


Division Name	Usage (kWh)
Traffic Safety and Mobility	67,524,631
Waterworks	29,862,519
Operational Services	13,439,634
Stormwater Maintenance	4,776,363
Sewer Maintenance	3,062,619
Road Maintenance	1,619,033

**Public Works Total Energy Usage:
121,262,054 kWh**

Other Divisions*	Usage (kWh)
Fleet Management	420,484
Stormwater Engineering	414,433
Building and Safety	85,436
Information Technology	14,154
Survey/Mapping and Property Mgmt	13,383
Construction	12,659
Land Development	11,011
Stormwater Quality	3,073
Transportation Planning and Programs	2,164
Geotechnical and Materials Engineering	457

Figure 2-4: 2017 Electricity Usage by Operation



2.1.2 Natural Gas and Fuel

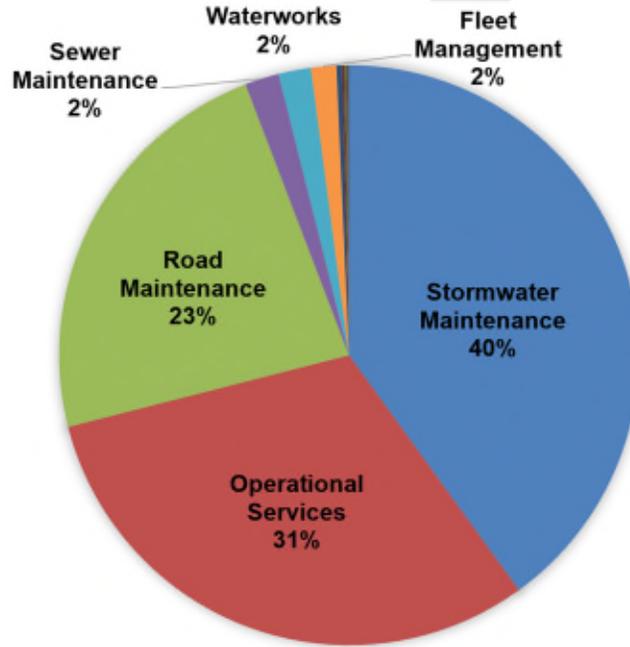
Although much smaller in proportion compared to electricity, natural gas, diesel, and gasoline are also important components of Public Works’ energy use.

Natural gas is provided by Southern California Gas Company and the City of Long Beach, with a total annual usage of 186,922 therms in 2017. See **Table 2-2** and **Figure 2-5** for additional information related to Public Works’ natural gas usage.

Table 2-2. Public Works Natural Gas Accounts (2019)

Natural Gas	
Utility Provider	# of Accounts
SoCal Gas	90
City of Long Beach	13

Figure 2-5: 2017 Natural Gas Usage by Division

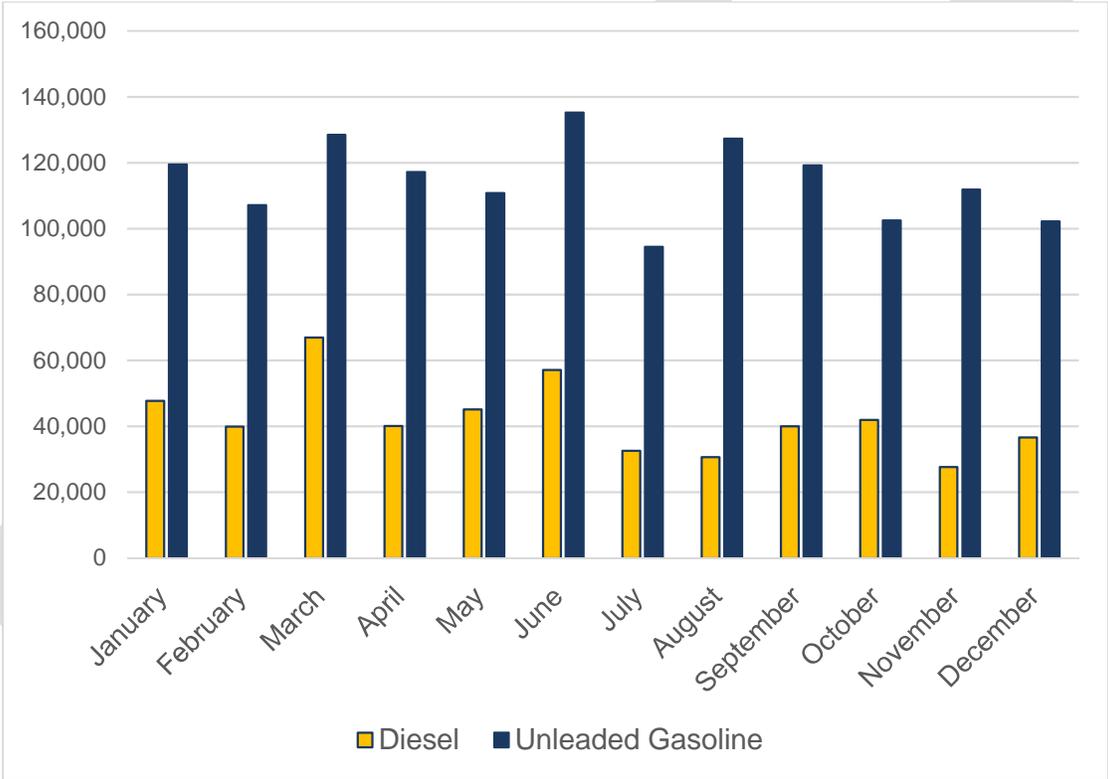


Name	Usage (therms)
Stormwater Maintenance	74,821
Operational Services	57,933
Road Maintenance	43,306
Sewer Maintenance	3,553
Waterworks	3,376
Fleet Management	2,649
Construction	603
Land Development	249
Survey/Mapping and Property Mgmt	249
Building and Safety	183
Total	186,922

Public Works total annual usage of diesel and unleaded gasoline in 2017 was 506,563 gallons and 1,375,727 gallons, respectively (see **Figure 2-6**). County vehicles such as trucks, mechanical equipment (i.e. trimmers, mowers), and heavy-duty vehicles (i.e. dozers, construction vehicles) are currently powered by diesel and unleaded gasoline.

Although the REMP mainly focuses on offsetting Public Works’ grid supported electricity uses with renewable energy technologies, Public Works continues to explore sustainable renewable alternatives to natural gas and fuel uses.

Figure 2-6: 2017 Fuel Usage (gallons)



Diesel	506,563 Gallons
Unleaded Gasoline	1,375,727 Gallons

2.2 Pathway to Net Zero Energy Public Works

Public Works set a goal of achieving Net Zero Energy Public Works by 2030. It is important to highlight the differences between renewable energy and net zero energy goals:

- **Renewable Energy** - locally-sourced renewable energy generation (e.g., solar, wind, small hydro, battery storage, fuel cell, biogas, flywheel etc.)
- **Net Zero Energy** - broad-based approach including energy efficiency, energy consumption modification, on-site renewable generation, renewable energy credits, and off-site renewable generation via Virtual Power Purchase Agreements (VPPA). Most commonly defined as offsetting 100 percent of energy usage (kWh/year) via renewable energy generation.

Both these approaches can be achieved through on-site generation (e.g., net metering) and off-site generation (e.g., virtual net metering or program similar to SCE's RES-BCT program). Under CPUC regulations, customer-generators cannot generate more than they use on an average annual basis³.

The REMP only focuses on renewable energy generation at Public Works facilities and does not include future adjustments to overall usage that may come from efficiency measures or additional load (e.g., electric vehicle charging stations). A separate effort by Public Works Facilities Management will identify potential efficiency measures that can be implemented across Public Works operations. The County Internal Services Department (ISD) is preparing an Electric Vehicle (EV) Master Plan that will look at future demand from EV charging. Future adjustments such as these can be added as inputs into the net zero target calculation (see Section 6.2 - Establishing Net Zero Goal).

³ <http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M158/K181/158181678.pdf>

3 RENEWABLE ENERGY TECHNOLOGIES

A variety of solutions and technologies were considered for the REMP. Renewable energy technologies were selected for further research based on Public Works operations, the potential for infrastructure integration, and available space at facility locations. These specific technologies may be considered for Public Works to achieve its net zero energy goals.

3.1 *Solar Installations*

Solar photovoltaic (PV) installations would provide the bulk of potential renewable energy generation for Public Works. There are several types of PV installations, such as ground - fixed tilt, ground - single-axis tracker, ground - dual axis tracker roof, carports, thin film, flexible PV, and floating PV. It is unlikely that Public Works would use concentrating solar power, via a parabolic trough or power tower. Floating solar could be an option for Public Works at reservoirs, irrigation reservoirs, or water-treatment sites. The recommended installation types in the REMP are as follows:

1. **Rooftop solar** – Installs solar panels, racking, and inverters on the roof. Involves penetrating roof membrane to serve as anchors in the event of high winds.
2. **Carport solar** – Uses steel beam structures (either single bay “L” structures or double bay “T” structures) in parking lots to create canopies covered with solar panels. Cars are able to park underneath the canopies. This is the most expensive option for solar installation.
3. **Ground mounted solar** – Racking is placed into the ground with aluminum piles. The cheapest and simplest version is fixed-tilt where the angle of the solar panels is fixed to a specific degree to maximize production (i.e., facing south). Single-axis tracker involves rotating the panels to track the sun from east to west throughout the day which can significantly increase energy production. These are typically used for larger (>5 MW) projects.

4. **Floating solar** – For project sites with large bodies of water (e.g., reservoirs, irrigation ponds), floating solar can provide a unique solution. Like fixed tilt ground mounted solar, it uses a racking system to create rows of panels at a fixed angle to the sun. However, instead of piles driven into the ground, the racking is attached to flotation devices to allow it to float on water. Because it is more expensive than ground mounted solar, project size and scale must be large (at least 2-3 MW) to justify the additional expense.

3.2 Wind Turbines

Wind power is one of the most abundant ways to generate clean electricity and is becoming more cost competitive. Wind turbines capture kinetic energy from the wind and convert it into mechanical energy in the turbine to create electricity. Turbine sizes have consistently grown, and modern wind turbines stand in excess of 500 feet tall from base to tip of the blades. It should be noted that wind technology was analyzed but not recommended, as wind projects are not allowed in Los Angeles County per the Renewable Energy Ordinance⁴.

3.3 Energy Management Systems

An energy management system (EMS) is an important tool for owners/operators of facilities, especially those that have renewable energy generation. An EMS incorporates software tools to manage generation and load. This can be as simple as a building EMS that manages lighting and heating, ventilation, and air conditioning (HVAC) but becomes increasingly complex as the owner/operator increases in size and diversity of its portfolio of facilities (e.g., number of buildings, renewable energy generators, microgrids). Ideally, all facilities (including renewable energy generators) would be managed by a centralized EMS.

⁴ <http://file.lacounty.gov/SDSInter/bos/supdocs/109934.pdf>

3.4 Solar + Battery Storage

Battery energy storage combined with solar generation (known as solar + storage) for Public Works facilities is another important technology to be considered, as storage serves multiple purposes including peak shaving/demand charge reduction, renewable generation integration, emergency backup, microgrid, and grid services (capacity, frequency regulation).

Public Works could benefit from storage via reduced demand charges, stabilize intermittent RE generation production, and (via their utility) lower dependence on natural gas peaker plants. However, some of the challenges include the cost, availability of lithium, and limited charge/discharge cycles. The current marketplace of battery storage technologies includes lithium ion, including solutions from providers like Tesla and Stem, zinc air batteries from NantEnergy, zinc bromide flow batteries from Primus Power, redox flow solutions from Sumitomo Electric. Public Works should work closely with developers to better understand where each technology could be deployed, based on building and site-specific usage.

3.5 Solar + Battery Storage + EV

Public Works may also want to consider solar + storage + EV charging as a consideration for future projects and possibly integration into certain sites, especially as electrification of transportation gains further momentum and funding becomes available for EV projects. Public Works projects its light-duty fleet will increase to over 1,000 light-duty vehicles by 2029 and will also increase the energy use.

3.6 Kinetic Energy

One emerging energy technology is electricity stored as kinetic energy in a fast-rotating flywheel. This technology presents two major advantages: unlimited high-power charge and discharge cycles (more than 200,000) without degradation over the full system lifetime of

20 years⁵. In addition, being based on mechanical versus chemical energy, the flywheel provides a more sustainable solution with less potential environmental impact than chemical batteries. This technology could be applicable at Public Works sites, but additional assessment and feasibility will be required. This is an emerging technology and Public Works may need to secure a grant for a pilot project.

3.7 Hydroelectric Energy

Pumped hydroelectric energy storage, a well-established technology that uses two different reservoirs and gravity to generate electricity during periods of high demand and pumps water from the lower reservoir to the upper reservoir during periods of low demand. Pumped hydroelectric energy can provide carbon-free power during peak periods, flood control, and water supply. However, environmental impacts, permitting issues, and frequent droughts have been drawbacks to adding additional pumped hydroelectric storage in California.

3.8 Thermal Energy

Thermal energy storage is a proven and increasingly deployed technology that utilizes water-based solutions to create ice during periods of low energy cost, and then uses the ice to cool water and/or air during the day to lower peak energy demand. Further, it can also be used to “pre-cool” HVAC systems to lower their energy demand. Public Works Headquarters (HQ) could be an ideal building for this solution, pending additional assessment and feasibility. Benefits include lower electrical demand, passive, self-contained system, and established performance history. Issues to consider for this technology include siting, as the footprint can be large or may be too heavy for some rooftops while some HVAC or water systems may not be compatible.

⁵ <https://www.chakratec.com/technology/>

Another solution may be evaporation cooling technology, which lowers the entering air temperature by 20 degrees or greater, thereby increasing chiller capacity up to 15 percent and offering water saving benefits.⁶

3.9 Fuel Cells

Hydrogen fuel cell technology has been refined over the last few decades and is now one of the most efficient sources to produce electricity. Similar to a battery, fuel cells convert potential chemical energy into electrical energy and generate heat as a by-product; the chemical energy can be stored inside a battery connected to the fuel cell, which will continuously generate electricity as long as they are supplied with hydrogen and oxygen. Hydrogen fuel cells including long duration backup solutions could potentially offer a solution to critical Public Works sites, with the ability to provide backup energy which can last several hours to several days (depending on the amount of hydrogen tank storage available)⁷.

3.10 Microgrids

A microgrid is a localized group of electricity sources and loads that operates within a larger synchronous grid. A key element of the microgrid is its ability to disconnect to an “island” mode and instantaneously function autonomously as conditions dictate. Microgrids are often designed in conjunction with public safety strategy plans in the event of major natural disasters.

Public Works may be able to incorporate microgrids at a number of its facilities around the County and may consider further assessment of microgrid projects located in heavy urban areas, critical infrastructure facilities, or remote sites to provide a more redundant electricity supply. Microgrids add resiliency and reliability to the local grid and community. Microgrids incorporate various renewable energy generation sources (e.g., solar) and distributed energy resources (e.g., battery storage). An EMS control is required to monitor and optimize energy

⁶ <http://www.evaporcool.com/about-us/>

⁷ <https://www.gencellenergy.com/gencell-technology/>

demands, the use of the renewable energy generated, and distributed resources. The EMS must also communicate with the grid in order to disconnect from the grid to enter "island" mode.

3.11 Microturbines

Microturbines are used to generate electricity in gravity fed municipal water pipelines typically around 20–300 kW per turbine installation depending on design. Benefits of installing microturbines in water pipelines include less environmental impacts than large-scale hydro, utilizing water that is already flowing in pipes to generate electricity, relieve problematic fluctuations in pressure, and can be installed during routine maintenance.⁸

Microturbines may be a potential source of renewable hydropower at Public Works locations. Hydroelectric turbines have been designed for high performance at low heads between 10 feet and 60 feet (3–20 meters). Single unit microturbine capacities can range from 25 kW to 1,000 kW⁹. Due to site-specific challenges, including flow variations (diurnal, weekly, seasonal), power quality and energy storage issues, downstream impacts on flow patterns, and grid connection issues, it is recommended that detailed analysis of potential sites be conducted.

3.12 Thermal Conversion Technology

Several conversion technology solutions, specifically anaerobic digesters, generate electricity from biogas and have a potential for cogeneration when heat and electricity are produced. Another set of technologies is thermal waste conversion technology (CT), and includes gasification and pyrolysis technology; essentially heating the feedstock in an enclosed vessel, containing little to no oxygen, to temperatures high enough to break the molecular bonds and creating a synthetic gas, or syngas. Syngas can be used to produce low-carbon electricity or other beneficial products such as ethanol-based fuels, heat, or hydrogen for fuel cells¹⁰. Public

⁸ <http://lucidenergy.com/how-it-works>

⁹ https://www.natelenergy.com/wp-content/uploads/2017/06/Natel_hydroEngine_June2017_web.pdf

¹⁰ <https://www.climatecolab.org/contests/2016/waste-management/c/proposal/1329507>

Works conducted a Waste Characterization Study¹¹, which estimates that Public Works HQ may generate as much as three (3) tons per day of waste that can be used for thermal CT; however, it was recommended that only one (1) ton per day of waste be considered since Public Works does not fill up all of their waste collection containers every week. Technology designed to capture the energy in municipal solid waste (MSW) and dry organic waste streams, like InEnTec's Plasma Enhanced Melter (PEM), could be applicable at Public Works HQ but additional assessment would be required for a pilot project.

Draft

¹¹ https://pw.lacounty.gov/epd/tf/Attachments/Minutes_Attachments/2016_Attachments/SCS_WasteCharacterizationStudy_05182016.pdf

4 PRIOR USE CASE EXAMPLES

Case studies, projects, and RE technologies that were identified and analyzed for Public Works' potential utilization at sites are discussed in **Table 4-1**. All of these examples have been successfully deployed and, in some cases, have a lengthy track record of successful operation.

Table 4-1: Prior Use Case Studies

Technology	Project Name	Location	Size (kW)/ Description	Developer	Additional Details
Microgrid	Santa Rita Union School District Solar + Storage Microgrid	Salinas, CA	1 MWPV + 1.1 MWh storage	EcoMotion, SolEd Benefit Corp, Sharp, Black & Veatch, MBL-Energy	\$0 up front cost to school, funded via PPA with Generate Capital as financing entity ¹²
Floating Solar	Kunde Family Winery	Sonoma County	10 kW floating solar PV system	Ciel & Terre International	First in Sonoma Valley to install a Hydrelío floating solar array on one of its eight irrigation ponds. ¹³
LED Streetlight Conversion	LADWP LED Conversion	Los Angeles, CA	200,000 streetlights	Bank of America	\$105.5 M performance contracting ¹⁴
Battery Storage	Soka University	Aliso Viejo, CA	400 kW	Stem	Zero up front cost; Annual net savings \$55,000-\$100,000. 10-Year Estimated Savings \$740,000 ¹⁵

¹² <https://www.solarpowerworldonline.com/2018/05/solarstorage-installed-in-santa-rita-union-school-district-in-california/>

¹³ <https://www.sonomacountygazette.com/cms/pages/sonoma-county-news-article-5902.html>

¹⁴ <https://about.bankofamerica.com/en-us/partnering-locally/los-angeles-LED.html>

¹⁵ <https://bit.ly/2Y7HsAH>

Battery Storage	San Diego Zoo	San Diego, CA	1 MW/4 MWh	EDF Renewables	Shared Savings model; details not disclosed to public ¹⁶
Kinetic Energy	EV Charging Stations	Italy, Austria & Czech Republic	Multiple charging stations	Chakratec	Rollout in Israel and EU currently, entering US market currently ¹⁷
Hydroelectric Energy	San Gabriel Dam Hydroelectric Project	LA County	5 MW	Los Angeles County Flood Control District	PPA with SCE currently in place and part of RES-BCT program
Thermal Energy	Ice Bear installs in SCE	100 sites across So. Cal	21.6 MW (aggregate)	Ice Energy	No cost to customers as part of program with SCE ¹⁸
Thermal Energy	Beale Air Force Base	Marysville, CA	Pre-coolers were installed in a 50-ton air-cooled chiller at the 15,000 sq ft Contrails Dining Facility.	Evaporcool	Savings 20% Energy Reduction 280 kWh/yr.-ton cooling energy and CO2 savings 22% water usage 0.9 gal/day-ton ¹⁹
Fuel Cells	SDG&E	San Diego, CA	Solution for substation replacing diesel backup generators	GenCell Energy	Pilot; automatically charges back-up batteries at substations and keeps them at full power for up to 10 times as long as normal battery rooms, product emits no carbon dioxide. ²⁰

¹⁶ <https://cleantechnica.com/2018/10/29/san-diego-zoo-selects-edf-renewables-for-1-mw-4mwh-battery-installation/>

¹⁷ <https://www.jpost.com/Jpost-Tech/Business-and-Innovation/Chakratec-uses-kinetic-energy-to-charge-electric-cars-in-minutes-588075>

¹⁸ <https://www.utilityproducts.com/line-construction-maintenance/article/16023560/ice-energy-completes-first-phase-of-largest-distributed-thermal-storage-system-installation-in-us>

¹⁹ <http://www.evaporcool.com/case-studies/government-building-application/>

²⁰ <https://www.elp.com/articles/2017/01/sdg-e-partners-with-gencell-on-fuel-cell-technology.html>

Microgrid	Fremont Fire Station	Fremont, CA	40 kW Solar + 100 kWh battery	Gridscape	\$2.4M with \$1.8M CEC Grant will save — at minimum — \$250,000 in power costs over about a 10-year period. ²¹
Microturbine	Riverside Public Utilities Installation	Riverside, CA	A single, 42", 20 kW LucidPipe turbines inside 60-inch diameter water pipeline.	Lucid Energy	Can produce 50-60 MWH of electricity per year to the grid, considered renewable source ²²
Hydroelectric Energy	Apple hydroEngine Project	Madras, Oregon	Unknown	Natel Energy	Apple Inc. is purchasing electricity produced from this pilot project to lower its carbon footprint and help power one of its data centers. ²³
Micro Digester	Flexibuster	Several across the UK and Europe	Varies	SeAB	In partnership with UC Davis, a pilot producing 480 MWH/year for a Naval Base via a grant from the California Energy Commission ²⁴

²¹ <https://www.greentechmedia.com/articles/read/startup-microgrids-fire-stations>

²² <http://lucidenergy.com/wp-content/uploads/2016/10/LucidEnergy-RiversideCaseStudy-2016-10-lr.pdf>

²³ <https://www.energy.gov/eere/articles/innovative-hydropower-technology-now-powering-apple-data-center>

²⁴ <https://waste-management-world.com/a/seab-food-waste-anaerobic-digestion-project-at-uc-davis>

5 **PROJECT FUNDING AND FINANCING**

After years of steady cost decline, RE technologies are becoming an increasingly competitive way to meet new energy generation needs locally. Technology improvements, increased availability, and options in project finance and procurement, as well as greater numbers of large-scale project developers are driving the cost down for RE generation.

There are numerous funding and financing options available to Public Works for the implementation of renewable energy projects identified in the REMP. Specifically, for solar PV and battery energy storage systems, the following options are most viable:

5.1 ***Power Purchase Agreement***

The Power Purchase Agreement (PPA) is the most commonly used zero up-front capital financing mechanism for renewable energy projects, specifically for solar PV. A PPA is an agreement that allows the developer/seller to finance, construct, and maintain the RE project, while Public Works agrees to provide the property for development and purchase the on-site generated electricity for a specified term (i.e. 15–20 years) at a fixed price, thus creating a revenue stream for the developer. PPAs are particularly useful for building public sector projects, as private entities (developers) can take advantage of tax credits that public entities cannot use. Public Works should be aware of end of term obligations including, but not limited to, buyer's right to purchase the system and the developer's duty to restore/remediate the site at the end of the contract term.

As the REMP focused on projects that would result in zero up-front costs to Public Works, the RE projects recommended in the REMP would most likely be financed through a PPA. A few key advantages of PPAs are:

- Limited or zero up-front capital expenditure.

- Long-term contract (15–20 years) allowing Public Works to purchase power at a fixed cost, which is generally lower than the market energy rate.
- Interconnecting and supplying the grid with surplus energy (if combined with battery storage).

A few key disadvantages include:

- Risk of lower purchase price in the event the market price of power drops below the contracted PPA price.
- More advanced technology could become available during the 15–20 year contract term.
- PPAs may become less attractive to developers due to the scaling back of the Federal Investment Tax Credit (ITC), which is an incentive only available to for-profit project financiers or underwriters and cannot be utilized by municipal, state, and government agencies or nonprofit organizations. The ITC for commercial projects will go from 30 percent in 2019, to 26 percent in 2020, to 22 percent in 2021, and remain at 10 percent from 2022 and beyond (excluding residential projects, which will go down to 0 percent).

5.2 Virtual Power Purchase Agreement

Public Works may seek to enter into a Virtual Power Purchase Agreement (VPPA), which is distinct from a PPA in several ways. Under a VPPA contract there is no physical transfer of power, and Public Works can claim credit for offsetting energy use without physically developing an on-site project. A VPPA allows Public Works to enter into a long-term (15–25 year) contract to purchase electricity at a fixed price and receive Environmental Attributes/Renewable Energy Credits (RECs) from a developer, thus virtually offsetting Public Works' energy use. RECs are also commonly referred to as “offsets” and have no physical connection to the facilities or load. RECs allow for commodification of a unit of power produced from renewable sources (e.g., 1 MWh of renewable energy generation is equal to 1 REC).

Public Works should consider legal restrictions when contemplating a VPPA (i.e., debt, contracting, budgeting, authority, politics).

Since VPPAs allow entities to obtain financing for the development, construction, and operation of their RE project, Public Works could also utilize a VPPA to offset energy costs or subsidize the Public Works' RE project by selling excess energy and corresponding RECs in the market.

5.3 Lease

A lease is most commonly used to fund battery storage projects, and sometimes solar PV projects. It is a long-term contract (usually a minimum of 10 years) where Public Works can benefit from zero to low up-front costs and only pay a monthly fixed cost to fund the project. Typically, there are buyout terms with the option for ownership at the end of the term. Financial institutions prefer the lease payment structure for storage projects because of the certainty of the revenue stream. Public Works may want to consider options for leases in territories that otherwise prohibit PPAs (i.e., sites in LADWP service territory).

5.4 Purchase

Public Works can always purchase the renewable energy outright and utilize funding mechanisms such as bonds, grants, or low interest financing programs. A summary of these mechanisms is described below:

- **Bonds**

Municipal bonds are commonly used to finance infrastructure projects. Bonds can be underwritten specifically for energy projects or can be part of broader infrastructure financing efforts. If ownership of the RE projects is a high priority to Public Works, it should develop a bond financing strategy. Some examples of bonds are the Clean Renewable Energy Bonds or Qualified Energy Conservation Bonds from the 2009 American Recovery and Reinvestment Act funds or Sustainable Energy Bonds from the California Statewide Communities Development Authority.

- **Grants**

The State of California provides grant funds to municipalities to encourage the development and implementation of renewable energy projects. Very few of these programs provide 100 percent funding of project costs, so matching funds must be identified. Some examples of grants are the California Energy Commission grant, programs like the Alternative and Renewable Fuel Vehicle Technology Program/ Assembly Bill No. 118 (AB 118), and Energy Efficiency and Conservation Block Grant program.

- **Low Interest Loans**

Low-interest loan programs are also available for renewable energy projects. For example, the Energy Conservation Assistance Act loans provide a 1 percent interest rate for cities/counties.

5.5 Shared Savings

Used almost exclusively for battery projects, shared savings is a financing agreement where the developer funds the up-front costs of the project and takes a percentage of the cost savings. While this is attractive to customers, benefits such as zero or low up-front costs, and incentives for the developer to maximize savings, it is more difficult to finance because financial institutions do not like the uncertainty.

5.6 Performance-Based Contracting

Performance-based contracting is typically utilized by creditworthy customers for HVAC, upgrade lighting to LEDs, and other efficiency measures. The contract is based on energy savings (should be a minimum guaranteed savings) where Public Works makes annual payments to the 3rd party financier equivalent to the costs savings until the project is paid off. At the end of the term, the full savings revert to the customer.

5.7 Public-Private Partnership

A public-private partnership (e.g., performance-based contracting) is another way for public agencies to implement projects without spending capital from the general fund. A public-private partnership is a collaboration between a public agency and a private third party to finance, construct, and operate a project. Typically, there is an assumed amount of savings, which Public Works would pay the private third party until the project has been paid off.

5.8 Rate Tariffs

Rate tariffs can be used as a revenue source to offset energy costs. These apply to RE projects that are considered “behind the meter,” where the energy generated is used to power the facility and excess energy is sent back to the grid, which the utility company can purchase. A rate tariff is the dollar value the utility company will purchase the excess energy, which would provide revenue for Public Works. Rate tariff prices vary depending on account type based upon their industry, sector, location, size of operation, and other factors. As of March 2019, the net metering credit value for the CPA was \$0.042/kWh, SCE was \$0.038/kWh, and LADWP was \$0.035-\$0.063/kWh (depending on specific rate tariff).

Table 5-1 summarizes select project financing options for Public Works to consider.

Table 5-1: Financing Options for Renewable Energy Technology

	PPA	Virtual PPA	Commercial-Scale PPA	Lease	Purchase	Shared Savings	Performance-Based Contracting
Solar	X	X	X	X	X		
Wind	X	X		X			
Battery Storage	X		X	X	X	X	
Thermal Energy					X		X
Lighting Retrofits					X		X
Small Hydro	X			X	X		
Thermal Conversion Technology				X	X		

6 **SITE SELECTION**

6.1 *Types of Public Works Facilities*

Public Works has a broad range of facilities, from pump stations and dams to maintenance yards and office buildings. With a diverse portfolio of sites, an initial screening was conducted to identify sites for a full feasibility analysis. According to the Master Facilities List, Public Works has a total of 312 facilities. The categories are as follows: Airports, Field Yards, Offices, Fleet Management (Shops), Pump Stations, Debris Basins, Dams, Spreading Grounds, Maintenance Districts (MD), and Sewer Districts.

6.2 *Establishing Net Zero Goal*

Before identifying sites, the overall target for net zero was calculated. This involved using the current total electricity use at Public Works (demand is approximately 121.3 million kWh) as the overall target for achieving net zero. As mentioned above, under CPUC regulations, no customer-generator can produce more than it uses on an annual average basis; therefore, the Public Works initial target was 121.3 million kWh. Several key factors were considered when calculating the actual net zero energy targets, including RES-BCT offset by the San Gabriel Dam Hydroelectric Plant, HQ Solar Carport Project, and energy use reduction through conversion of streetlights to LED. Solar PV is the recommended technology because it has the highest likelihood of meeting the requirements of the REMP's goal of net zero energy at no cost to Public Works. Below are the reasons why solar PV is strongly recommended:

- Most flexible, scalable technology (from small rooftop to large utility-scale).

- Well-established path to financing at no upfront cost to Public Works through third parties, such as through PPAs.
- Largest pool of potential vendors/partners/developers for Public Works to choose from to implement the REMP.

The following methodology was used as the basis for the calculation to derive Public Works' future net zero offset:

1. Public Works' total energy demand is 121.3 million kWh (see **Figures 2-3 and 2-4**).
2. The existing net metering RE projects (Waterworks microturbine, Los Angeles County Waterworks Solar Farm, Los Angeles County Waterworks Lancaster Solar Canopy) generate approximately 2.3 million kWh that is directly offset behind the meter, resulting in a remaining 119 million kWh of usage from the grid.
3. The San Gabriel Dam Hydroelectric Plant produces 27.5 million kWh, which offsets energy usage via the RES-BCT program.
4. The street lighting total energy usage is estimated to be about 67.5 million kWh. The Street Light Conversion Project, expected to be completed in 2022, will purchase approximately 40,000 high pressure sodium streetlights from SCE and convert them to high efficiency Light Emitting Diode (LED) streetlights, which is expected to reduce the total streetlight energy usage by 40 percent, or 27 million kWh.
5. The projected energy generation by the HQ Solar Carport Project is estimated at 1.4 million kWh and will be considered as net metering. The energy reduction will be reflected as a reduced energy usage during billing.
6. **The overall Net Zero Energy target is 63.1 million kWh.** The original energy demand of 121.3 million kWh was reduced by 2.3 million kWh from existing RE projects, 27.5 million kWh from the San Gabriel Dam Hydroelectric Plant, 1.4 million kWh HQ Solar Carport Project, and 27 million kWh from the streetlight conversion.

6.3 Site Selection Methodology

Sites selection was based on the capacity of projects to help achieve the net zero energy goal through a characteristics-based approach. In this approach, desktop aerial imagery was used for site assessment to determine compatibility with solar PV. Based on existing systems in operation for the three primary types of solar PV systems, the assumptions for space requirements were as follows:

- 100 square feet of rooftop per 1 kW of rooftop solar
- 260 square feet of flat ground per 1 kW of ground-mount solar
- 300 square feet of parking lot per 1 kW of solar parking canopy

In addition, to estimate system production, the assumed annual solar energy yield was 1,550 hours (h), which means 1,550 kWh is produced per 1 kW of solar PV per year. Floating solar PV is highly dependent on the shape of the reservoir on which it is installed, the space requirement is equivalent to ground-mount solar PV. Buffers were added to the estimates of available space to account for the variable physical characteristics of reservoirs.

Using the assumed annual solar yield of 1,550 kWh and the annual usage offset target, the target aggregate system size for achieving net zero can be calculated. Per the above offset target calculations, the annual net zero energy offset target is 63.1 million kWh. To determine the target system size, the total offset target (63.1 million kWh) is divided by the assumed yield (1,550 h), which is 41,000 kW. Therefore, the target aggregate system size for net zero would be 41,000 kW or 41 MW.

6.4 Assumptions

In the initial approach to the REMP, the following assumptions were made:

- Net zero energy is the main objective for Public Works.
- Project site selection did not account for added electricity uses from future EV charging stations or increase in Public Works fleet. However, it is important to recognize that a more sustainable future at Public Works would also include electrification of light-, medium-, and eventually heavy-duty vehicles.
- Identifying the largest energy users within Public Works facilities would provide the quickest path to achieving net zero.
- Focusing on the largest potential project sites would get Public Works closest to net zero at the lowest cost.
- Floating PV would be a viable option for some of the reservoirs identified.
- For sites outside of SCE territory, an equivalent program to SCE's RES-BCT should be created.
- No energy usage reductions from the ongoing energy efficiency study were incorporated into the usage projections.
- Recommendations for offsetting Public Works use of natural gas or transportation fuel are not included in this report; however, the purchase of Renewable Natural Gas would also greatly reduce carbon emissions while providing flexibility in energy resources.

6.5 Analysis

The site selection methodology focused on a facilities-based project selection process. Sites were broken down into two categories: large land area sites (**Table 6-1**) and large building area (i.e., rooftop) sites (**Table 6-2**). Several sites (i.e. Road Division 555, Public Works HQ, etc.) fell under both categories.

Table 6-1: Large Land Area Sites
(from largest to smallest, minimum of 8 acres)

1	General William J. Fox Airfield	13	Morris Dam and Reservoir
2	San Dimas Dam and Reservoir	14	Puddingstone Diversion Dam and Reservoir
3	Puddingstone Dam and Reservoir	15	Road Division 524
4	Brackett Field Airport	16	Road Division 555
5	Whiteman Airport	17	Lake Hughes Treatment Plant
6	Big Dalton Dam and Reservoir	18	Public Works Headquarters
7	Eaton Wash Dam and Reservoir	19	MD 4 – Hollydale
8	Hansen Spreading Grounds	20	Lower/Upper Yard - Alcazar
9	Rio Hondo Spreading Grounds	21	South Maintenance Area - Malibu
10	Compton/Woodley Airport	22	Live Oak Dam and Reservoir
11	San Gabriel Valley Airport	23	Southwest District
12	Sawpit Dam and Reservoir	24	Central Yard - Alcazar

Table 6-2: Large Building Area Sites

(from largest to smallest, minimum of 3,5000 square feet estimated rooftop area)

1	Public Works Headquarters Facilities	10	Longden Yard – East Area
2	Central/Lower Yard – Alcazar	11	Imperial Yard – South Area
3	MD 4 – Hollydale	12	Hansen Yard – West Area
4	Central/Upper Yard - Alcazar	13	Altadena Fleet Yard
5	MD 5 – Palmdale	14	South Maintenance Area – Malibu
6	MD 3 – Westchester	15	South Yard
7	MD 1 – Baldwin Park	16	Central Yard
8	Upper Yard – Alcazar	17	Road Division 519/119
9	North Maintenance Area	18	Road Division 555

Using the site size (acres of land or square footage of rooftop) information, a desktop analysis was conducted to estimate actual usable space. For rooftops, this included removing HVAC and other rooftop obstacles from the available square footage figure. For overall land area, this involved removing developed areas, dense vegetation zones, steep slopes, and utility line crossings from the overall available area. With the methodology outlined above for calculating system sizes for ground, rooftop, and canopy installations using available area, analysis was conducted to determine an estimated system size, with the overall goal of 41 MW to achieve net zero.

More information is provided in **Appendix A – REMP Project Selection**.

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7 RECOMMENDED RENEWABLE ENERGY SITES

All sites were analyzed through the lens of the Net Zero Energy Public Works goal. As discussed earlier, this methodology focused on offsetting the largest users of electricity within Public Works (e.g., street lighting, pump stations, etc.) through the most cost-efficient procurement by maximizing system size of projects.

Several of the sites recommended for feasibility analysis would need to participate in either the RES-BCT program with SCE or an equivalent program with the local utility company. Further, it is crucial that Public Works begin discussions immediately to identify optimal programs to maximize implementation of renewable projects for reaching Public Works' net zero energy goal.

The site recommendations were based on the economies of scale for solar project development, with larger ground-mounted systems providing the highest efficiency of implementation and, therefore, the lowest pricing for Public Works. The goal for the REMP, in addition to net zero energy, was to provide projects at no additional cost to Public Works.

Prior to assessing the recommended project sites, the technology types were narrowed down to those that have been implemented on a broad scale and have demonstrated track records for financing. The primary technology type recommended was solar PV. Project sites were vetted based on compatibility with this technology. Prior use cases for solar PV are discussed in detail in the renewable energy technologies section. See the list below for the recommended sites.

7.1 Solar PV Facilities

7.1.1 Land Sites with Open Space

A. AVIATION FACILITIES



a. General William J. Fox Airfield
4555 West Avenue G, Lancaster 93536

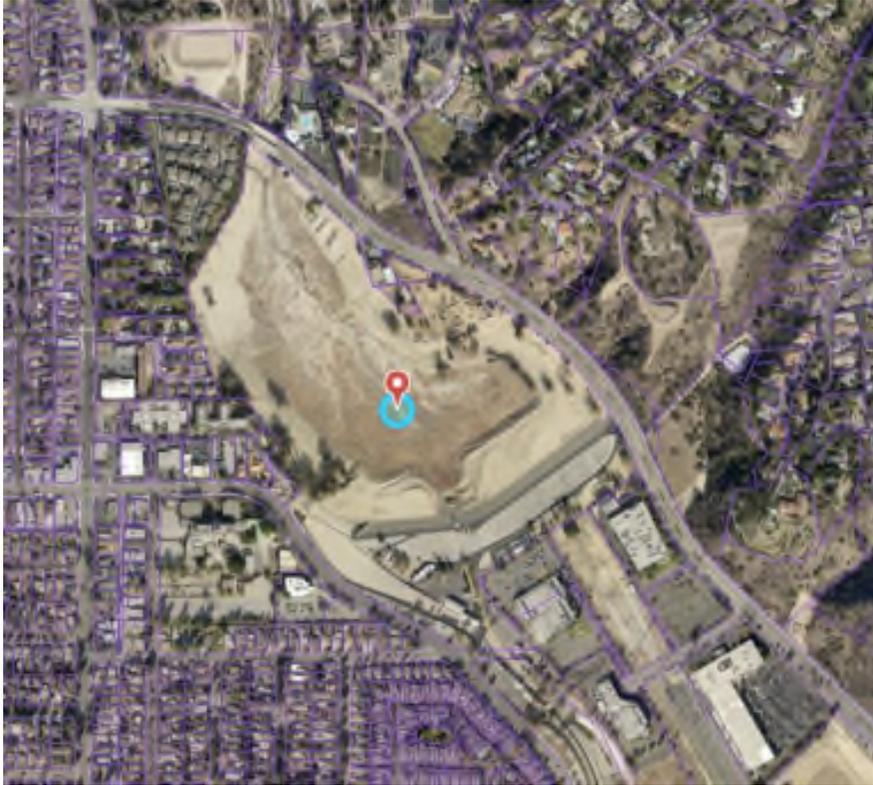
- i. **Utility:** Southern California Edison
- ii. **Current Energy Usage:** N/A Tenants are responsible for utility billing; RES-BCT (RES-BCT and net metering cannot be used at the same meter. On-site usage only pertains to net metering, not RES-BCT).
- iii. **Project Type:** Ground PV, Canopy
- iv. **Estimated Footage:** 120+ acres
- v. **Estimated System Size:** 20+ MW
- vi. **Estimated System Production:** >30 million kWh/year

- vii. **Recommendation:** It will be crucial for Public Works to discuss potential options with the SCE to maximize the capacity of the site's generation and inclusion into SCE's RES-BCT program. For canopy sites, it is recommended that Public Works conduct economic benefit analysis to determine whether the cost and proposed use of the solar canopy fits within the objectives for the site.
- viii. **Prior use case:** Los Angeles County Waterworks Solar Farm²⁵; Denver International Airport has four solar farms (totaling over 10 MW), including a 4.4-MW project commissioned in 2011 and owned by Constellation. The airport has a total of 42,358 solar panels spread across 55 acres of solar fields.²⁶
- ix. **Benefit:** Potential for commercial scale energy generation
- x. **Funding options:** PPA, RES-BCT
- xi. **Potential Challenges:** The Airport's future development and growth plans must be factored into any solar project that is installed at the site, as well as potential interconnection limitations for SCE transmission lines and substations (for example, developing a larger solar PV generation project may exceed substation capacity and additional feasibility studies must be conducted); security and monitoring of the project should also be considered. As is the case with any large PV system, environmental permitting will be required and could pose significant cost and delay.

²⁵ <https://pw.lacounty.gov/wwd/web/Documents/Solar%20Power%20System%20for%20Water%20Facility%20in%20Lancaster.pdf>

²⁶ <https://www.solarpowerworldonline.com/2016/03/7-cool-solar-installations-at-u-s-airports/>

B. WATER RESOURCE FACILITIES



a. **Eaton Wash Dam and Reservoir** **2986 New York Drive, Pasadena 91107**

- i. **Utility:** Pasadena Water and Power
- ii. **Current Energy Usage:** N/A
- iii. **Project Type:** Ground PV
- iv. **Estimated Footage:** 30+ acres
- v. **Estimated System Size:** 5+ MW
- vi. **Estimated System Production:** >7.5 million kWh/year

- vii. **Recommendation:** Because of the site-specific challenges, including flow variations (diurnal, weekly, seasonal), flood control issues, potential impacts on the environment and wildlife, downstream impacts on flow patterns, and grid connection issues, it is recommended that detailed analysis, due diligence, and feasibility be conducted. The security and monitoring of the project site should be considered both during construction and after completion. It will be crucial for Public Works to discuss potential options with the Pasadena Water and Power to identify programs to maximize implementation of renewable projects for reaching Public Works' net zero energy goal.
- viii. **Prior Use Case:** Los Angeles County Waterworks Solar Farm
- ix. **Benefit:** Potential for commercial scale energy generation
- x. **Funding Options:** PPA or Virtual Net Meter Program
- xi. **Potential Challenges:** This site is adjacent to residential communities and there may be a need for stakeholder engagement and outreach to the community; as with most large renewable generation projects, an interconnection study will be required; this is also located in the Pasadena Water and Power (PWP) territory and specific communications and negotiations with PWP will be required. As is the case with any large PV system, environmental permitting will be required and could pose significant delay and cost.



b. Morris Dam and Reservoir

9500 North San Gabriel Canyon Road, Azusa 91702

- i. **Utility:** Azusa Light and Water
- ii. **Current Energy Usage:** N/A
- iii. **Project Type:** Floating PV
- iv. **Estimated footage:** 12–18 acres
- v. **Estimated System Size:** 2–3 MW
- vi. **Estimated System Production:** 3–4.5 million kWh/year
- vii. **Recommendation:** Because of the site-specific challenges, including flow variations (diurnal, weekly, seasonal), flood control issues, potential impacts on the environment and wildlife, downstream impacts on flow patterns, and grid connection issues. It is recommended that detailed analysis, due diligence, and feasibility be conducted. The security and monitoring of the project site should be considered both during

construction and after completion. It is crucial for Public Works to discuss potential options with the Azusa Light and Power to identify programs to maximize implementation of renewable projects for reaching Public Works' net zero energy goal.

- viii. **Prior Use Case:** Kunde Family Winery²⁷
- ix. **Benefit:** Potential for commercial scale energy generation
- x. **Funding Options:** PPA or Virtual Net Meter Program
- xi. **Potential Challenges:** It is recommended that detailed analysis be conducted, with a special focus on the water depth of the basin; post-construction operations and maintenance will also need to be addressed; the site also falls within Azusa Light and Water's (ALW) service territory, so special communications and negotiations with ALW will be required. As is the case with any large PV system, environmental permitting will be required and could pose significant cost and delay.

²⁷ <https://www.sonomacountygazette.com/cms/pages/sonoma-county-news-article-5902.html>

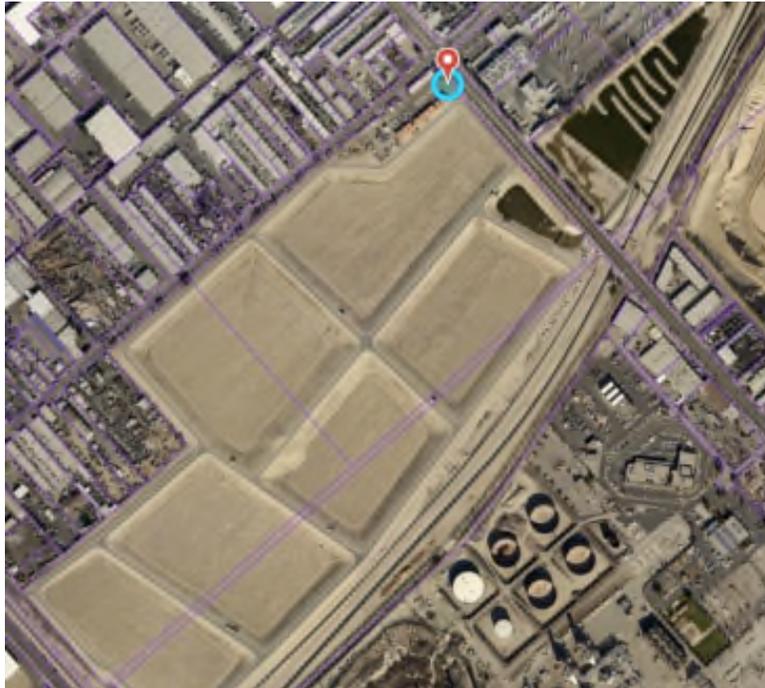


**c. Puddingstone Diversion Dam and Reservoir
5580 San Dimas Canyon Road, La Verne 91750**

- i. **Utility:** Southern California Edison
- ii. **Current Energy Usage:** N/A; RES-BCT (RES-BCT and net metering cannot be used at the same meter. On-site usage only pertains to net metering, not RES-BCT).
- iii. **Project Type:** Ground PV or Floating PV
- iv. **Estimated footage:** 12–18 acres
- v. **Estimated System Size:** 2–3 MW
- vi. **Estimated System Production:** 3–4.5 million kWh/year
- vii. **Recommendation:** Because of the site-specific challenges, including flow variations (diurnal, weekly, seasonal), flood control issues, potential impacts on the environment and wildlife, downstream impacts on flow patterns, and grid connection issues, it is recommended that detailed analysis and feasibility be conducted. The security and monitoring of the

project site should be considered both during construction and after completion.

- viii. **Prior Use Case:** Kunde Family Winery
- ix. **Benefit:** Large RES-BCT site
- x. **Funding Options:** RES-BCT/ PPA
- xi. **Potential Challenges:** It is recommended that detailed analysis, due diligence, and feasibility be conducted, with a special focus on the basin depth; post-construction operations and maintenance will also need to be addressed; potential community outreach and stakeholder engagement may be necessary as the site is adjacent to residential areas; available developable area may be altered by the transmission line easement crossing the site. As is the case with any large PV system, environmental permitting will be required and could pose significant cost and delay.



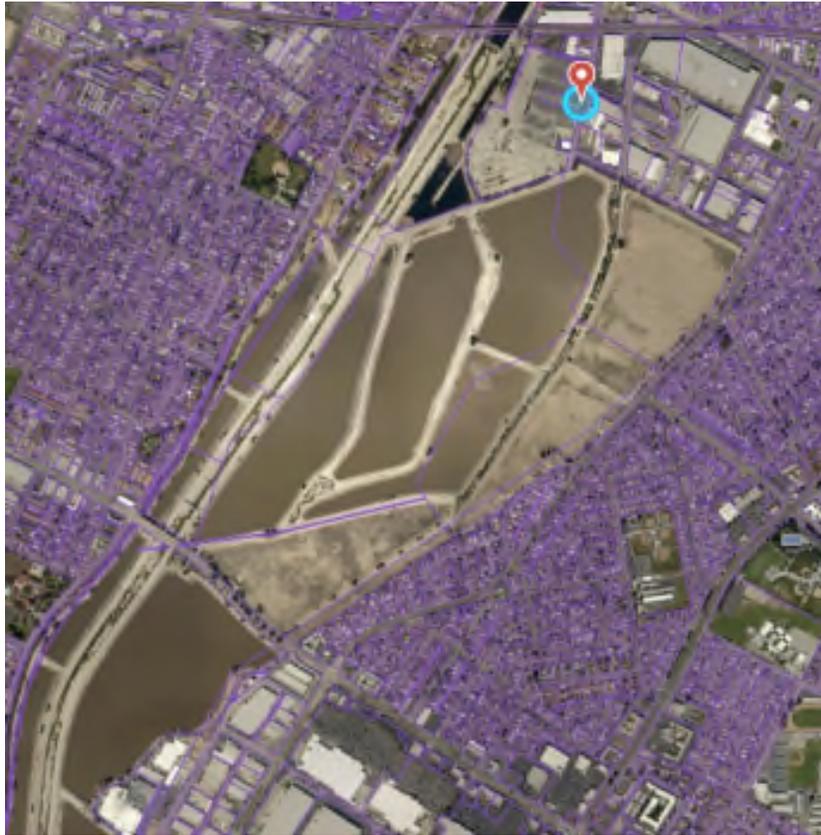
d. Hansen Spreading Grounds

10179 Glenoaks Boulevard, Sun Valley 91352

- i. **Utility:** Los Angeles Department of Water and Power
- ii. **Current Energy Usage:** N/A; Site is recommended for virtual net meter type of program with LADWP (cannot use RES-BCT and net metering on the same meter)
- iii. **Project Type:** Ground PV
- iv. **Estimated footage:** 30+ acres
- v. **Estimated System Size:** 5+ MW
- vi. **Estimated System Production:** >7.5 million kWh/year
- vii. **Recommendation:** Because of the site-specific challenges, including potential impacts on the environment and wildlife, potential height restrictions, typical vehicle patterns in, around and out of the yard, and grid

connection issues, it is recommended that detailed analysis, due diligence, and feasibility be conducted. The security and monitoring of the project site should be considered both during construction and after completion. Since the project is estimated to generate an excess of energy, it is recommended to participate in programs that provides rebates and incentives for green energy sent back to the grid.

- viii. **Prior Use Case:** Los Angeles County Waterworks Solar Farm
- ix. **Benefit:** Potential for commercial scale energy generation
- x. **Funding Options:** PPA or Virtual Net Meter Program
- xi. **Potential Challenges:** This site may have potential conflicts with spreading ground site operations and more analysis into the vehicle traffic in, around, and out of the site is recommended; as with most large renewable generation projects, an interconnection study will be required; this is also in LADWP Territory and will require specific communications and negotiations with LADWP. As is the case with any large PV system, environmental permitting will be required and could pose significant cost and delay.



e. Rio Hondo Spreading Grounds
353 South Van Norman Road, Montebello 90640

- i. **Utility:** Southern California Edison
- ii. **Current Energy Usage:** N/A; RES-BCT (RES-BCT and net metering cannot be used at the same meter. On-site usage only pertains to net metering, not RES-BCT).
- iii. **Project Type:** Ground PV
- iv. **Estimated Footage:** 30+ acres
- v. **Estimated System Size:** 5+ MW
- vi. **Estimated System Production:** >7.5 million kWh/year

- vii. **Recommendation:** Because of the site-specific challenges, including flow variations (diurnal, weekly, seasonal), flood control issues, potential impacts on the environment and wildlife, downstream impacts on flow patterns, and grid connection issues, it is recommended that detailed analysis, due diligence, and feasibility be conducted. It will be crucial for Public Works to discuss potential options with the SCE to maximize the capacity of the site's generation and inclusion in the RES-BCT program.
- viii. **Prior Use Case:** Los Angeles County Waterworks Solar Farm, Piru Spreading Grounds Solar Project – not developed yet²⁸
- ix. **Benefit:** Large RES-BCT site
- x. **Funding Options:** PPA/RES-BCT
- xi. **Potential Challenges:** This site may have potential conflicts with spreading ground site operations and more analysis into the vehicle traffic in, around, and out of the site is recommended; as with most large renewable generation projects, an interconnection study will be required as well as review of security and monitoring of the project site both during construction and after completion. As is the case with any large PV system, environmental permitting will be required and could pose significant cost and delay.

²⁸ https://www.unitedwater.org/images/stories/News-Outreach/Public-Notices/IS-MND%20UWCD%20Piru%20Solar_Public%20Review%20Draft_042216.pdf

C. TRANSPORTATION FACILITIES



a. Road Division 555

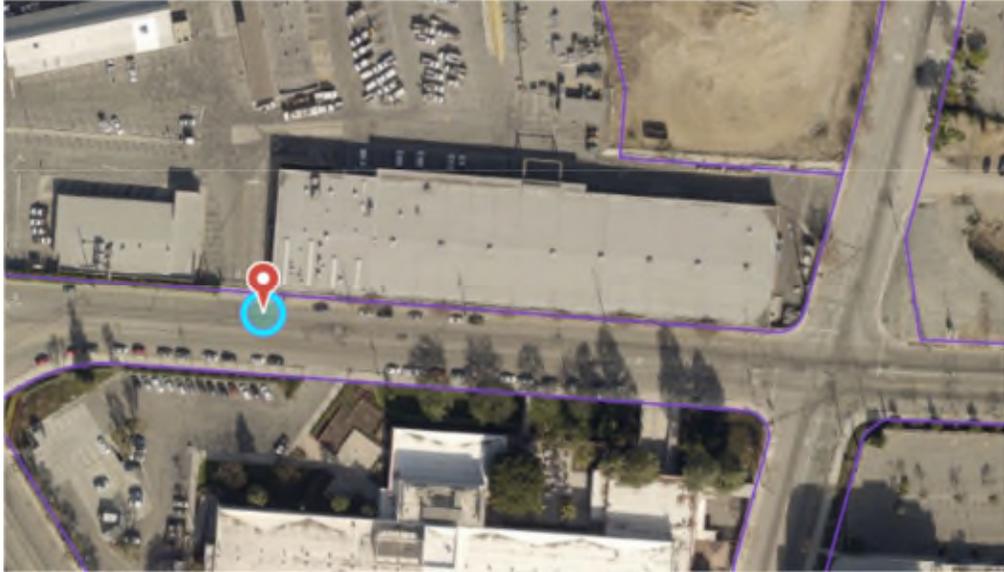
17341 East Avenue J, Lancaster 93535

- i. **Utility:** Southern California Edison
- ii. **Current Energy Usage:** N/A; RES-BCT (RES-BCT and net metering cannot be used at the same meter. On-site usage only pertains to net metering, not RES-BCT).
- iii. **Project Type:** Ground PV
- iv. **Estimated footage:** 12–18 acres
- v. **Estimated System Size:** 2–3 MW
- vi. **Estimated System Production:** 3–4.5 million kWh/year
- vii. **Recommendation:** Because of the site-specific challenges, including potential impacts on the environment and wildlife, potential height

restrictions, typical vehicle patterns in, around and out of the yard, and grid connection issues, it is recommended that detailed analysis, due diligence, and feasibility be conducted. The security and monitoring of the project site should be considered both during construction and after completion. It will be crucial for Public Works to discuss potential options with the SCE to maximize the capacity of the site's generation and inclusion in the RES-BCT program.

- viii. **Prior Use Case:** Los Angeles County Waterworks Solar Farm
- ix. **Benefit:** Large RES-BCT site
- x. **Funding Options:** PPA/RES-BCT
- xi. **Potential Challenges:** This site may have potential conflicts with operations and more analysis into the vehicle traffic in, around, and out of the site is recommended; as with most large renewable generation projects, an interconnection study will be required. As is the case with any large PV system, environmental permitting will be required and could pose significant cost and delay.

7.1.2 Building Rooftop Sites



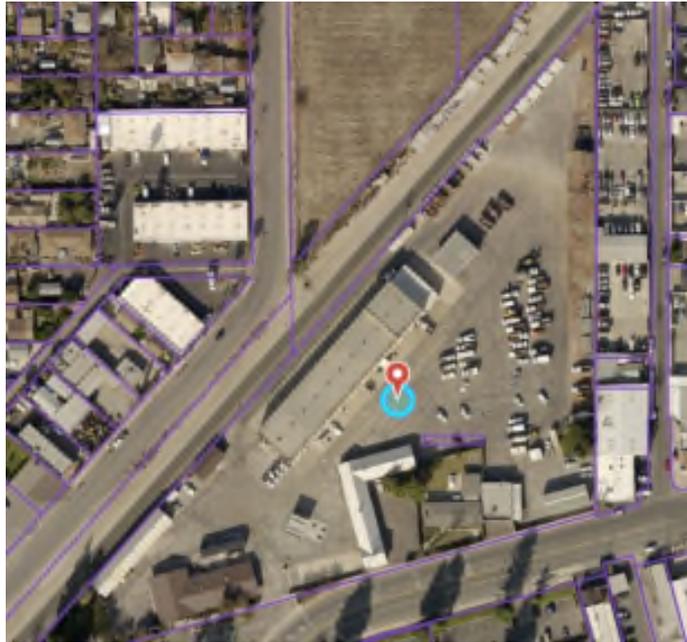
a. Central/Lower Yard – Alcazar Yard 1537 Alcazar Street, Los Angeles 90033

- i. **Utility:** LADWP
- ii. **Current Energy Usage:** 885,600 kWh/year
- iii. **Project Type:** Rooftop and Canopy PV
- iv. **Estimated Footage:** 57,340 sq ft
- v. **Estimated System Size:** 573 kW
- vi. **Estimated System Production:** 888,764 kWh/year
- vii. **Recommendation:** Conduct feasibility analysis, including but not limited to rooftop assessment to determine viability of roofs, switchgear analysis, ability to gather multiple rooftop arrays into one point of interconnection, and an interconnection study with the utility. Focus on commercially viable projects greater than 50 kW. Since the project is estimated to generate

an excess of energy, it is recommended to participate in programs that provides rebates and incentives for green energy sent back to the grid.

- viii. **Prior Use Case:** Port of Los Angeles
- ix. **Benefit:** Offset on-site usage
- x. **Funding Options:** PPA or grant
- xi. **Potential Challenges:** There are several challenges associated with combining multiple rooftop solar arrays into one point of interconnection. These include but are not limited to cost, trenching, wiring, and capacity/condition of switchgear.

Draft



b. Maintenance District No. 1 – Baldwin Park
14747 East Ramona Boulevard, Baldwin Park 91706

- i. **Utility:** Southern California Edison
- ii. **Current Energy Usage:** 236,913 kWh/year
- iii. **Project Type:** Rooftop PV
- iv. **Estimated Footage:** 18,098 sq ft
- v. **Estimated System Size:** 181 kW
- vi. **Estimated System Production:** 280,513 kWh/year
- vii. **Recommendation:** Conduct feasibility analysis, including but not limited to rooftop assessment to determine viability of roofs, switchgear analysis, ability to gather multiple rooftop arrays in to one point of interconnection, and interconnection study with the utility. Focus on commercially viable projects greater than 50 kW. It will be crucial for Public Works to discuss potential options with the SCE to maximize the

capacity of the site's generation and inclusion in the RES-BCT program.

- viii. **Prior Use Case:** Port of Los Angeles
- ix. **Benefit:** Offset on-site usage
- x. **Funding Options:** PPA or grant
- xi. **Potential Challenges:** There are several challenges associated with combining multiple rooftop solar arrays into one point of interconnection. These include but are not limited to cost, trenching, wiring, and capacity/condition of switchgear.

Draft

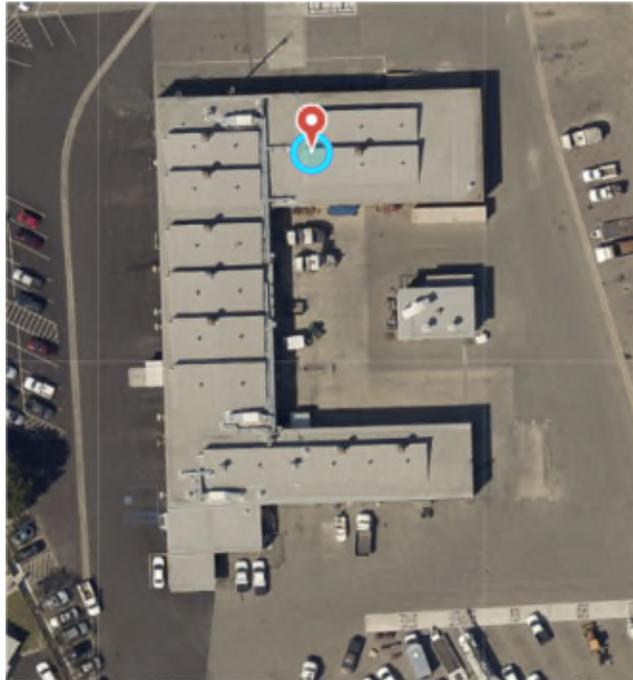


c. Maintenance District No. 3 – Westchester
5530 West 83rd Street, Los Angeles 90045

- i. **Utility:** Los Angeles Department of Water and Power
- ii. **Current Energy Usage:** 265,363 kWh/year
- iii. **Project Type:** Rooftop PV
- iv. **Estimated Footage:** 22,856 sq ft
- v. **Estimated System Size:** 229 kW
- vi. **Estimated System Production:** 354,268 kWh/year
- vii. **Recommendation:** Conduct feasibility analysis, including but not limited to rooftop assessment to determine viability of roofs, switchgear analysis, ability to gather multiple rooftop arrays in to one point of interconnection, and interconnection study with the utility. Focus on commercially viable projects greater than 50 kW. Since the project is estimated to generate an excess of energy, it is recommended to participate in programs that provides rebates and incentives for green energy sent back to the grid.

- viii. **Prior Use Case:** Port of Los Angeles
- ix. **Benefit:** Offset on-site usage
- x. **Funding Options:** PPA or grant
- xi. **Potential Challenges:** There are several challenges associated with combining multiple rooftop solar arrays into one point of interconnection. These include but are not limited to cost, trenching, wiring, and capacity/condition of switchgear.

Draft



**d. Maintenance District No. 4 – Hollydale
11282 Garfield Avenue, Downey 90242**

- i. **Utility:** Southern California Edison or Clean Power Alliance
- ii. **Current Energy Usage:** 373,385 kWh/year
- iii. **Project Type:** Rooftop and Canopy PV
- iv. **Estimated Footage:** 45,259 sq ft
- v. **Estimated System Size:** 453 kW
- vi. **Estimated System Production:** 701,518 kWh/year
- vii. **Recommendation:** Conduct feasibility analysis, including but not limited to rooftop assessment to determine viability of roofs, switchgear analysis, ability to gather multiple arrays into one point of interconnection, geotechnical analysis for canopies, and interconnection study with the utility. Focus on commercially viable

projects greater than 50 kW. It will be crucial for Public Works to discuss potential options with the SCE to maximize the capacity of the site's generation and inclusion in the RES-BCT program.

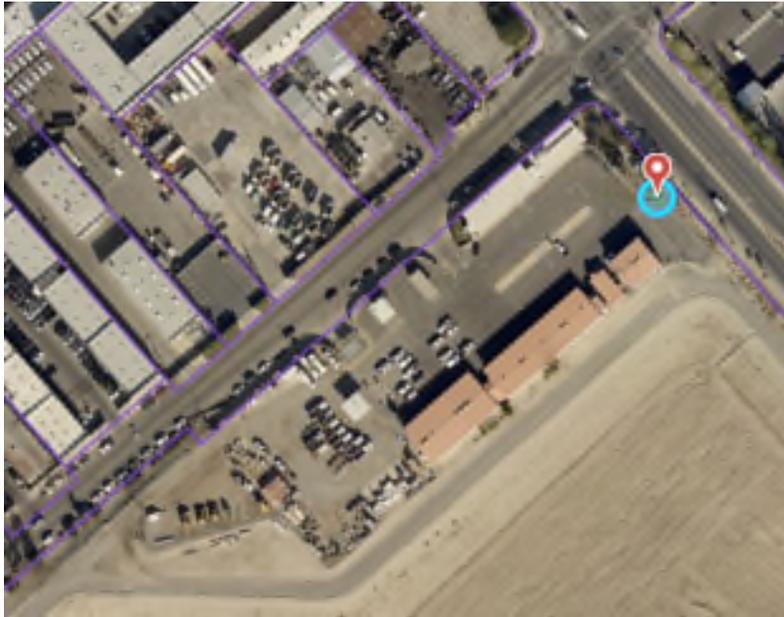
viii. **Prior Use Case:** Port of Los Angeles

ix. **Benefit:** Offset on-site usage

x. **Funding Options:** PPA or grant

xi. **Potential Challenges:** There are several challenges associated with combining multiple rooftop solar arrays into one point of interconnection. These include but are not limited to cost, trenching, wiring, and capacity/condition of switchgear.

DRAFT



e. Hansen Yard – West Area

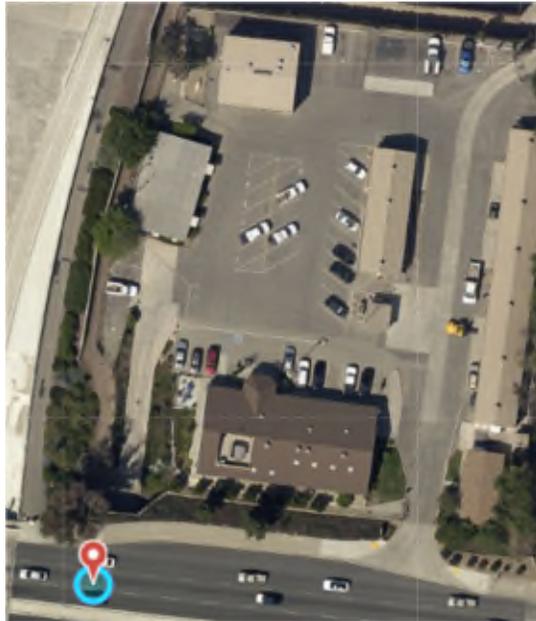
10179 Glenoaks Boulevard, Sun Valley 91352

- i. **Utility:** Los Angeles Department of Water and Power
- ii. **Current Energy Usage:** 119,360 kWh/year
- iii. **Project Type:** Rooftop PV
- iv. **Estimated Footage:** 12,812 sq ft
- v. **Estimated System Size:** 128 kW
- vi. **Estimated System Production:** 198,587 kWh/year
- vii. **Recommendation:** Conduct feasibility analysis, including but not limited to rooftop assessment to determine viability of roofs, switchgear analysis, ability to gather multiple rooftop arrays in to one point of interconnection, and interconnection study with the utility. Focus on commercially viable projects greater than 50 kW. Since the project is estimated to generate an excess of energy, it is recommended to

participate in programs that provides rebates and incentives for green energy sent back to the grid.

- viii. **Prior Use Case:** Port of Los Angeles
- ix. **Benefit:** Offset on-site usage
- x. **Funding Options:** PPA or grant
- xi. **Potential Challenges:** There are several challenges associated with combining multiple rooftop solar arrays into one point of interconnection. These include but are not limited to cost, trenching, wiring, and capacity/condition of switchgear.

Draft



f. Imperial Yard – South Area

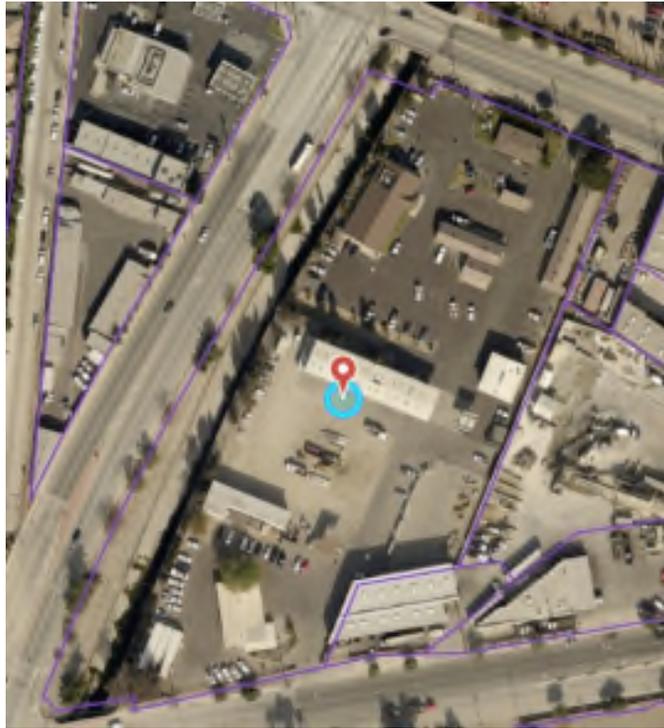
5525 Imperial Highway, South Gate 90280

- i. **Utility:** Southern California Edison
- ii. **Current Energy Usage:** 118,899 kWh/year
- iii. **Project Type:** Rooftop PV
- iv. **Estimated Footage:** 14,378 sq ft
- v. **Estimated System Size:** 111 kW
- vi. **Estimated System Production:** 222,853 kWh/year
- vii. **Recommendation:** Conduct feasibility analysis, including but not limited to rooftop assessment to determine viability of roofs, switchgear analysis, ability to gather multiple rooftop arrays into one point of interconnection, and interconnection study with the utility. Focus on commercially viable projects greater than 50 kW. It will be crucial for Public Works to discuss potential options with the SCE to maximize

the capacity of the site's generation and inclusion in the RES-BCT program.

- viii. **Prior Use Case:** Port of Los Angeles
- ix. **Benefit:** Offset on-site usage
- x. **Funding Options:** PPA or grant
- xi. **Potential Challenges:** There are several challenges associated with combining multiple rooftop solar arrays into one point of interconnection. These include but are not limited to cost, trenching, wiring, and capacity/condition of switchgear.

Draft



g. Longden Yard – East Area

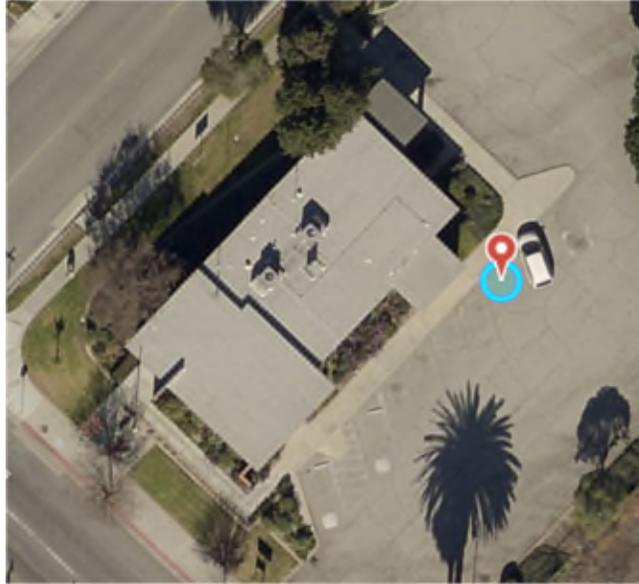
160 East Longden Avenue, Irwindale 91706

- i. **Utility:** Southern California Edison
- ii. **Current Energy Usage:** 130,379 kWh/year
- iii. **Project Type:** Rooftop PV
- iv. **Estimated footage:** 17,569 sq ft
- v. **Estimated System Size:** 176 kW
- vi. **Estimated System Production:** 272,316 kWh/year
- vii. **Recommendation:** Conduct feasibility analysis, including but not limited to rooftop assessment to determine viability of roofs, switchgear analysis, ability to gather multiple rooftop arrays in to one point of interconnection, and interconnection study with the utility. Focus on

commercially viable projects greater than 50 kW. It will be crucial for Public Works to discuss potential options with the SCE to maximize the capacity of the site's generation and inclusion in the RES-BCT program.

- viii. **Prior Use Case:** Port of Los Angeles
- ix. **Benefit:** Offset on-site usage
- x. **Funding Options:** PPA or grant
- xi. **Potential Challenges:** There are several challenges associated with combining multiple rooftop solar arrays into one point of interconnection. These include but are not limited to cost, trenching, wiring, and capacity/condition of switchgear.

7.1.3 Solar Panel + Battery Storage

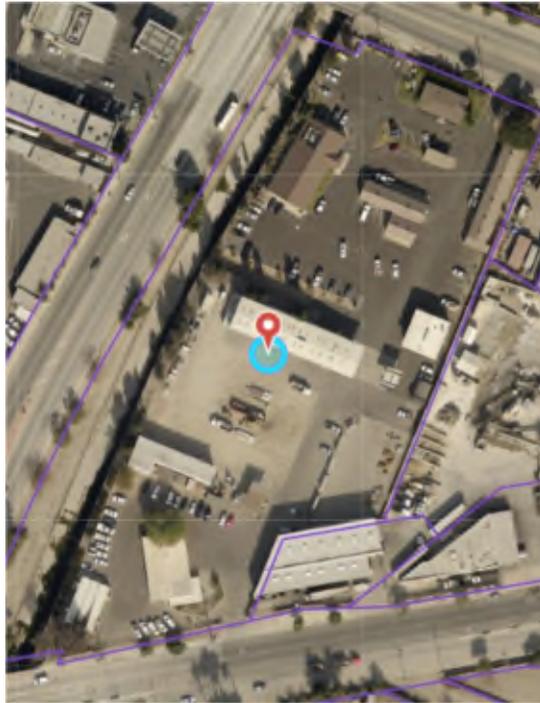


a. La Puente Building and Safety Building 16005 Central Avenue, La Puente 91744

- i. **Utility:** Southern California Edison
- ii. **Current Energy Usage:** The office building is currently under construction and energy demands are still to be determined. Load estimates include (2) desktop printers, (2) copiers, (15) computers and monitors and a network closet;
- iii. **Project Type:** Rooftop Solar PV and 8-hour Backup Battery
- iv. **Estimated Footage:** 1,900 sq ft of area suitable for solar
- v. **Estimated System Size:** 32 kW DC
- vi. **Estimated System Production:** 47,600 kWh/year
- vii. **Recommendation:** The initial goal of net-zero or as close as possible. Solar PV system will help offset electrical demand including power for

EV parking stalls and install 8-hour battery backup for emergency power and lighting. Battery storage should also consider opportunities to offset peak demand.

- viii. **Prior Use Case:** Santa Rita Union School District Solar + Storage Microgrid and Fremont Fire Station
- ix. **Benefit:** Net metering
- x. **Funding Options:** PPA/ Up front purchase/ Lease
- xi. **Potential Challenges:** Cost benefit analysis and funding mechanisms should be considered when installing rooftop Solar PV and battery storage. Future energy demands of the building are unknown and should be calculated for offset goals.



b. Longden Yard Microgrid Project
160 Longden Avenue, Irwindale 91706

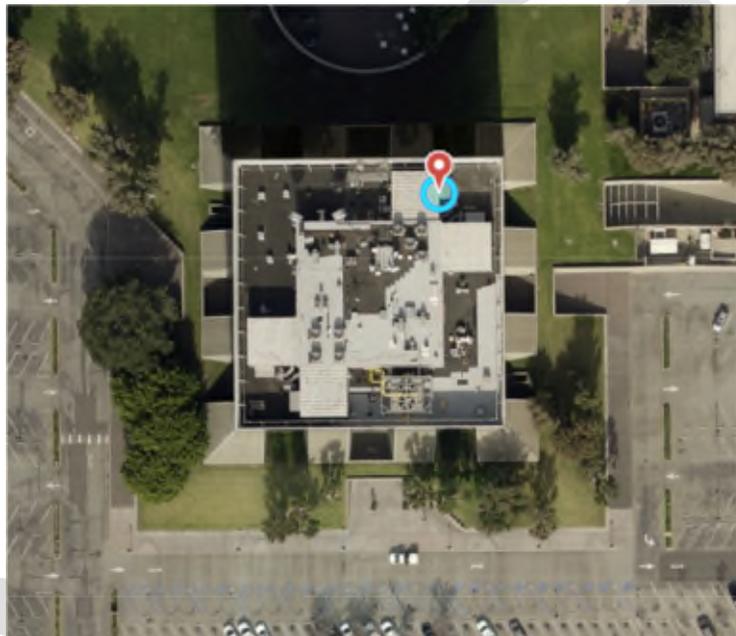
- i. **Utility:** Southern California Edison
- ii. **Current Energy Usage:** 133,470 kWh/year
- iii. **Project Type:** Rooftop/Canopy/Ground Mount PV and Battery Storage
- iv. **Estimated Footage:** TBD
- v. **Estimated System Size:** TBD
- vi. **Estimated System Production:** TBD
- vii. **Recommendation:** The project will be net-zero or as close as possible. Solar PV system will help offset electrical demand including power for future EV parking stalls and install up to 72-hour battery backup for emergency power and lighting. Battery storage should also consider opportunities to offset peak demand.

- viii. **Prior Use Case:** Santa Rita Union School District Solar + Storage Microgrid and Fremont Fire Station
- ix. **Benefit:** Microgrid
- x. **Funding Options:** PPA/ Up front purchase/ Lease
- xi. **Potential Challenges:** The future electrical demands of additional EV chargers for light duty vehicles and up to heavy duty vehicles are unknown and will impact the energy demands that will need to be offset to reach net zero energy. The solar panel area is still to be determined based on the demand and the type of solar will need further investigations for available space and structural design.

Draft

7.2 On-Site Thermal Conversion Technology

Public Works has done an in-depth study on waste generation and potential for thermal conversion or micro digesters. As part of the REMP, all reports on CTs were analyzed and it is recommended that a CT be considered for a pilot demonstration project. Further assessment of energy generation values and costs should be undertaken to evaluate the most suitable option for a demonstration CT project at Public Works HQ.



a. Public Works Headquarters

900 South Fremont Avenue, Alhambra 91803

- i. **Utility:** Southern California Edison
- ii. **Current Energy Usage:** 4,661,799 kWh/year
- iii. **Project Type:** Conversion Technology
- iv. **Estimated System Capacity:** 1 ton per day (tpd) of post-recycled municipal solid waste (MSW)

- v. **Estimated Output:** >40,000 kWh per year (assuming 200 kWh per ton of MSW and operating 4 days per week)
- vi. **Recommendation:** Conduct feasibility analysis
- vii. **Prior Use Case:** More than a dozen units installed worldwide since 1995. Biomass to ethanol project under development with Aemetis in Stanislaus County, California.
- viii. **Benefit:** MSW and organic waste reduction and energy production
- ix. **Funding Options:** Grant
- x. **Potential Challenges:** Permitting and high costs to convert syngas into usable products such as energy or fuels.
- xi. **Recommendations:** It is recommended that Environmental Programs Division engage their specialty consultant to identify ways a small CT project at Public Works HQ can be funded through grants, incentives, and tax credits that can offset some of the costs, increase the financial viability of a CT system and contribute to net zero goal Public Works operations by 2030.

7.3 Hydro Turbine Replacement



a. East Avenue M & 5th Street East, Lancaster 93550

- i. **Utility:** Southern California Edison
- ii. **Current Energy Usage:** 1.3 million kWh per year
- iii. **Project Type:** Pressure Reducing Hydro Turbine
- iv. **Estimated footage:** Not applicable
- v. **Estimated System Size:** 2 Turbines, 140 kW
- vi. **Estimated System Production:** 1.7 million kWh/year
- vii. **Recommendation:** Replace pressure reducing valve(s) with pressure-reducing turbine(s) to generate electricity.
- viii. **Prior Use Case:** M7W Hydro turbine
- ix. **Benefit:** Offset on-site usage
- x. **Funding Options:** PPA or grant
- i. **Potential Challenges:** Interconnection Facilities Financing and Ownership Agreement (IFFOA) and Generating Facility Interconnection Agreement (GFIA) can be time consuming.



b. West Avenue L12 & 60th Street West, Lancaster 93536

- ii. **Utility:** Southern California Edison
- iii. **Current Energy Usage:** 500,000 kWh/yr
- iv. **Project Type:** Pressure Reducing Hydro Turbine
- v. **Estimated footage:** Not applicable
- vi. **Estimated System Size:** 1 Turbine, 60 kW - in study phase
- vii. **Estimated System Production:** 500,000 kWh- in study phase
- viii. **Recommendation:** Replace pressure reducing valve(s) with pressure reducing turbine(s) to generate electricity.
- ix. **Prior Use Case:** M7W Hydro turbine
- x. **Benefit:** Offset on-site usage
- xi. **Funding Options:** PPA or grant
- xii. **Potential Challenges:** Interconnection Facilities Financing and Ownership Agreement (IFFOA) and Generating Facility Interconnection Agreement (GFIA) can be time consuming. Limited space.

7.4 Recommendations and Next Steps

It is recommended to conduct a detailed feasibility analysis on each of the recommended sites. For the solar PV sites, the assessment should address the following items:

Rooftop

- Roof construction type and condition
- Load-bearing capacity
- Roof warranty terms and conditions
- Switchgear condition and capacity
- Distance between buildings (if combining multiple rooftops to offset one meter)

Canopy

- Shading from adjacent buildings or trees (especially on south side of parking lot)
- Condition of parking lot surface
- ADA compliance
- Distance to switchgear
- Condition and capacity of switchgear
- Soil conditions beneath parking lot
- Orientation of parking spaces (ideal for parking rows to be facing south)

Ground

- Soil conditions
- Flood zone
- Topography
- Environmental concerns (California Environmental Quality Act [CEQA], hazmat, etc.)
- Tree/brush removal
- Distance to point of interconnection
- Available capacity on transmission/distribution lines
- Existing easements (gas lines, overhead transmission, etc.)
- Surrounding land use and proximity to residential areas
- Shape of reservoir and variability of water depth (if floating PV)
- For spreading grounds, volume/frequency of flooding and space for maintenance vehicles.

In addition, the following are recommended as next steps:

- Initiate discussions with CPA and local utility companies regarding programs that will benefit Public Works in its REMP and net zero energy goals. This should include a program similar to SCE's RES-BCT program with two critical changes: 1) Include street lighting accounts to be offset by renewable energy generating projects and 2) Increase system size limit for generating sites (currently 5 MW in SCE RES-BCT).
- If Public Works chooses to generate renewable energy on sites that do not have significant on-site load/usage, it is recommended to work with local utility companies to create a feed-in tariff program similar to the LADWP program. Under a feed-in-tariff program, Public Works would sign a contract with the utility company to sell all the energy generated back to the utility company for a fixed price. This would allow Public Works to generate revenue. Note that the local utility would receive credit for the renewable energy generated; however, it could still be applied toward Public Works' net zero energy goal.
- Assess the compatibility of larger-scale solar PV project development within its broader operational plans.
- Conduct a needs analysis for battery storage systems to identify primary purpose and use for these systems at Public Works sites (e.g., demand charge reduction vs. on-site resiliency vs. broader community benefits through a microgrid).

8 CONCLUSION

Public Works has the potential to produce enough renewable energy to achieve its Net Zero Energy Public Works goal. A maximum of 46 MW is conceivable for RE generation on Public Works sites to achieve net zero energy with zero upfront cost.

Participation in the SCE RES-BCT program or similar program with the local utility company is crucial for Public Works to meet its net zero energy goal. Public Works will need to work with the local utility companies to ensure that the program(s) will be in place to allow for the largest off-site generation projects. The critical elements that must be included in such a program are: 1) allowing for lighting accounts to be included as accounts/meters to be offset by renewable energy projects in the RES-BCT program; and 2) increasing the maximum system size from 5 MW (the current maximum system size under RES-BCT) to at least 10 MW or greater.

Finally, the following items are also recommended:

- Energy efficiency is very important to achieve the Net Zero Energy Public Works goal. In addition to a facility energy audit, it is recommended that Public Works explore a partnership with the National Renewable Energy Laboratory (NREL), U.S. Department of Energy to leverage their technical expertise and assistance in RE data, financial tools and emerging technologies. For example, LADWP is working with NREL on the LA100 Study (100 percent Renewable Energy Study) to determine what investments should be made to achieve a 100 percent RE supply.
- Further analysis and coordination of the Public Works EV fleet electrification and EV charging infrastructure will significantly increase the electricity load (energy use).

- Future research into an integrated Energy Management System (EMS) to help Public Works track and manage their distributed energy resources, electric vehicle fleet and charging infrastructure, as well as HVAC and other building technologies is recommended to control, monitor, and optimize all the resources producing and utilizing energy.
- It is recommended that Public Works create a means (e.g., group email, software solutions or even a regular REMP team meeting) for continuing education and empowerment of Public Works Divisions and Branches on RE emerging technologies, applications, and financing. It will also be the best way for Public Works staff to share best practices and lessons learned (e.g., when negotiating with a third party on RE project financing and other contracts).
- Explore the option of combining multiple RE projects within Public Works or with other County Departments that utilize the same or similar RE technology. Grouping projects together may form a project scope that can increase bid competitiveness, allow for projects that range in size to gain priority, and achieve greater economy of scale to lower the project construction costs. ISD has been directed by the Board to investigate partnering Countywide RE projects.
- Private sector or third-party developers could finance these projects as long as it makes business case and there is a pathway for return on investment. It is recommended that Public Works create an avenue for developers to express interest or provide a proposal for Public Works consideration.
- Provide leadership and advocate for better State and County incentives for renewables, which is important when it comes to innovative RE technologies and creative project financing and funding options. It is recommended that Public Works staff continue their active participation in regulatory and policy conversations for incentives that benefit the local economy, underserved communities, and the environment.

ACKNOWLEDGEMENTS

The REMP was developed through a collaborative effort with support, advice, and enthusiasm from Public Works staff from various Divisions, representing all Core Service and Support Branch Areas, along with HDR, and Value Sustainability.

PUBLIC WORKS STRATEGIC PLANNING AND SUSTAINABILITY OFFICE

- Youn Sim, PhD, PE - Head of Strategic Planning and Sustainability
- Christopher Sheppard, PE - Senior Civil Engineer
- Crystal Franco, PE – Senior Civil Engineer
- Tera Haramoto, PE - Civil Engineer

PUBLIC WORKS STAFF, BY DIVISION

- Budget/Fund Management: Jennifer Phan
- Building and Safety: Mario Torres, Mostafa Kashe
- Community and Government Relations: Teresa Villegas
- Construction: Luis Cervantes
- Design: Hakop Meymarian, Ivan Fong, Javier Almaraz, Opart Pongpun
- Environmental Programs: Kawsar Vazifdar
- Fiscal: Celine Tran
- Fleet Management: Michael Semon, Sean Skidmore
- Human Resources: Barbara Baiz
- Operational Services: Bill Mining
- Project Management II: Regina Quan
- Road Maintenance: Ryan Butler
- Stormwater Engineering: Adam Walden, Sarkis Zargaryan
- Stormwater Quality: TJ Moon
- Traffic Safety and Mobility: Inez Yeung
- Waterworks: Ramy Mattar

SPECIAL GUEST PRESENTER

- Matt Langer, COO, Clean Power Alliance of Southern California (CPA)

VALUE SUSTAINABILITY

- Salem Afeworki, LEED GA, ENV SP - Principal
- Yair Crane - Project Manager/ Emerging Technology Lead
- Robin Park - Senior RE Specialist and Developer
- Kelly Sanders, PhD - Senior Water-Energy Nexus Expert
- Noah Perch-Ahern - Regulatory/ Legal Advisor

HDR

- Scott Bacsikin, PE, Vice President
- Fernando Garcia, PE, Grid Modernization Lead
- Gretchen Dolson, PE, LEED AP, Renewable Energy Practice Lead
- Lauren Hillman, Project Control

APPENDIX A

REMP PROJECT SELECTION

Solar PV is the recommended technology for the majority of recommended projects because it has the highest likelihood of meeting the requirements of the REMP's goal of net zero energy at no cost to Public Works. Solar projects were selected based on available open space for potential ground mount, canopy, and floating solar projects and available roof space for potential solar rooftop projects.

Ground-Mount, Canopy, and Floating Solar Projects

Ground mount, canopy, and floating solar project were evaluated based on parcel size (sq ft), which was obtained through an internal Public Works program called View LA. Only sites with a parcel size greater than 8 acres were evaluated, which resulted in a list of 24 locations, including airports, reservoirs, spreading grounds, and offices/field yards (see **Table A-1** for more information).

Table A-1: Potential Land Sites for Ground-Mount, Canopy, and Floating Solar Projects

Facility Name	Public Works Division	Project Type	City	Parcel Size (ac)	Project Size (ac)	Est. System Size (MW)	Est. Production (Million kWh/yr)	Selection Notes
General William J. Fox Airfield	Aviation	Airport	Lancaster	385.5	120	20	31	Large open site for ground and canopy PV; should be part of discussions with local utility to maximize capacity of site
San Dimas Dam and Reservoir	Stormwater Maintenance	Reservoir	La Verne	385.2	site eliminated - potential system production not evaluated			Very narrow reservoir and surrounded by hills/mountains; does not appear to be buildable
Puddingstone Dam and Reservoir	Stormwater Maintenance	Reservoir	San Dimas	309.3	site eliminated - potential system production not evaluated			Reservoir is used for recreational purposes by County Parks and Recreation (Bonelli Regional Park)
Brackett Field Airport	Aviation	Airport	La Verne	167.7	site eliminated - potential system production not evaluated			No ground-mount opportunity, only canopy and limited rooftop
Whiteman Airport	Aviation	Airport	Pacoima	153.3	site eliminated - potential system production not evaluated			No ground-mount opportunity, only canopy and limited rooftop
Big Dalton Dam and Reservoir	Stormwater Maintenance	Reservoir	Glendora	120.4	site eliminated - potential system production not evaluated			Very narrow, small reservoir; does not appear to be buildable
Eaton Wash Dam and Reservoir	Stormwater Maintenance	Reservoir	Pasadena	69.3	30	5	8	Large open site for ground PV; requires feasibility analysis; adjacent residential areas
Hansen Spreading Grounds	Stormwater Maintenance	Spreading Grounds	Sun Valley	58.7	30	5	8	Large open site for ground PV; requires feasibility analysis; adjacent residential areas
Rio Hondo Spreading Grounds	Stormwater Maintenance	Spreading Grounds	Montebello	55.4	30	5	8	Large open site for ground PV; requires feasibility analysis; adjacent residential areas
Compton/Woodley Airport	Aviation	Airport	Compton	47.9	site eliminated - potential system production not evaluated			No ground-mount opportunity, only canopy and limited rooftop
San Gabriel Valley Airport	Aviation	Airport	El Monte	46.9	site eliminated - potential system production not evaluated			No ground-mount opportunity, only canopy and limited rooftop
Sawpit Dam and Reservoir	Stormwater Maintenance	Reservoir	Monrovia	46.6	site eliminated - potential system production not evaluated			Very narrow reservoir and surrounded by hills/mountains; does not appear to be buildable
Facility Name	Public Works Division	Project Type	City	Parcel Size (ac)	Project Size (ac)	Est. System	Est. Production	Selection Notes

						Size (MW)	(Million kWh/yr)	
Morris Dam and Reservoir	Stormwater Maintenance	Reservoir	Azusa	29.9	12-18	2-3	3-4.5	Large reservoir for floating PV; requires feasibility analysis
Puddingstone Diversion Dam and Reservoir	Stormwater Maintenance	Reservoir	San Dimas	23.2	12-18	2-3	3-4.5	Large open space/reservoir for ground or floating PV; requires feasibility analysis; adjacent to residential areas
Road Division 524	Road Maintenance	Yard	La Crescenta	22.7	site eliminated - potential system production not evaluated			Too many trees
Road Division 555	Road Maintenance	Yard	Lancaster	17.4	12-18	2-3	3-4.5	Good location for ground PV
Lake Hughes Treatment Plant	Sewer Maintenance	Plant	Lake Hughes	17.0	site eliminated - potential system production not evaluated			Eliminated due to lower RE generation potential when compared to selected projects
Public Works Headquarters	Operational Services	Office	Alhambra	16.2	site eliminated - potential system production not evaluated			Eliminated due to lower RE generation potential when compared to selected projects
Maintenance District No. 4 - Hollydale	Road Maintenance	Yard	Downey	13.1	site eliminated - potential system production not evaluated			Eliminated due to lower RE generation potential when compared to selected projects
Lower/Upper Yard - Alcazar Yard - Traffic Ops/Electrical	Operational Services	Yard	Los Angeles	11.0	site eliminated - potential system production not evaluated			Eliminated due to lower RE generation potential when compared to selected projects
South Maintenance Area - Malibu	Waterworks	Office	Malibu	9.4	site eliminated - potential system production not evaluated			Land is owned by LA County, not Public Works
Live Oak Dam and Reservoir	Stormwater Maintenance	Reservoir	Claremont	9.2	site eliminated - potential system production not evaluated			Surrounding area is mountainous and does not appear buildable
Southwest District	Building & Safety	Office	Los Angeles	8.6	site eliminated - potential system production not evaluated			Eliminated due to lower RE generation potential when compared to selected projects
Central Yard - Alcazar Yard - Facilities Management Sec.	Operational Services	Yard	Los Angeles	8.1	site eliminated - potential system production not evaluated			Eliminated due to lower RE generation potential when compared to selected projects

Building Rooftop Projects

Building rooftop projects were evaluated based on building rooftop area. Building data was obtained from a previous facility audit. The rooftop area was estimated to be 0.8 times the total building square footage divided by the total number of stories of the building. Only locations where the building rooftop size or cumulative of all rooftops at the site were greater than 3,500 sq ft were evaluated, which resulted in a list of 18 locations, with a total of 98 buildings (see **Table A-2** for more information).

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Table A-2: Potential Building Rooftop Solar Projects

Facility Name	Division	Building Area (ft ²)	Est. Roof Area (ft ²)	Est. System Size (kW)	System Production (kWh/yr)	Selection Notes
Central/Lower Yard - Alcazar	Operational Services	105,210	57,340	573	888,764	Large size - combined across multiple rooftops; good RE energy generation potential
Maintenance District No. 4 - Hollydale	Road Maintenance	56,574	45,259	453	701,518	Large size - combined across multiple rooftops; good RE energy generation potential
Public Works Headquarters - Parking Structure	Operational Services	102,600	41,040	137	212,040	Parking structures require canopy/carport structures, not roof-mount. Estimated calculation is 300SF/1kW; energy currently offset by San Gabriel Dam Hydroelectric
Central/Upper Yard	Operational Services	48,547	38,838	388	601,983	Potential for location to be sold.
Public Works Headquarters - Main and Annex Buildings	Operational Services	470,187	30,904	309	479,017	Energy currently offset by San Gabriel Dam Hydroelectric
Maintenance District No. 5 - Palmdale	Road Maintenance	44,295	23,723	237	367,710	
Maintenance District No. 3 - Westchester	Road Maintenance	28,570	22,856	229	354,268	Large size - combined across multiple rooftops; good RE energy generation potential
Maintenance District No. 1 - Baldwin Park	Road Maintenance	30,512	18,098	181	280,513	Large size - combined across multiple rooftops; good RE energy generation potential
North Maintenance Area	Waterworks	22,218	17,774	178	275,503	Due to previous study, the roof cannot structurally support the solar panels; project is not economically feasible considering necessary building retrofit to accommodate additional load
Longden Yard - East Area	Stormwater Maintenance	24,723	17,569	176	272,316	Large size - combined across multiple rooftops; good RE energy generation potential
Imperial Yard - South Area	Stormwater Maintenance	20,164	14,378	144	222,853	Large size - combined across multiple rooftops; good RE energy generation potential
Facility Name	Division	Building Area (ft ²)	Est. Roof Area (ft ²)	Est. System Size (kW)	System Production (kWh/yr)	Selection Notes

Hansen Yard - West Area	Stormwater Maintenance	17,103	12,812	128	198,586	Large size - combined across multiple rooftops; good RE energy generation potential
Altadena Fleet Yard	Fleet Management	14,058	11,246	112	174,319	Eliminated due to lower RE generation potential when compared to selected projects
South Maintenance Area - Malibu	Waterworks	13,855	11,084	111	171,802	Land is owned by LA County, not Public Works
South Yard	Sewer Maintenance	10,803	8,642	86	133,957	Eliminated due to lower RE generation potential when compared to selected projects
Central Yard	Sewer Maintenance	12,280	8,642	86	133,945	Eliminated due to lower RE generation potential when compared to selected projects
Road Division 519/119	Road Maintenance	7,128	5,702	57	88,387	Eliminated due to lower RE generation potential when compared to selected projects
Road Division 555	Road Maintenance	5,160	4,128	41	63,984	Eliminated due to lower RE generation potential when compared to selected projects