Fleet Electrification Study
Charging Infrastructure Report

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Cover photo by Robert Smrekar on Flickr.

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ACRONYMS & DEFINITIONS

EVI	Electric vehicle infrastructure; referring to the charging station, required mounting, conduit, transformers and other balance of system equipment needed to supply electricity to electric vehicles.
kW	Kilowatt; a unit of power equal to 1,000 Watts; when used for solar PV system sizes, refers to the maximum instantaneous output of a solar panel (module) or system (for larger PV systems rating is generally in MW, Megawatt, or 1,000 kW).
kWh	Kilowatt-hour: a unit of energy equal to 3,600 kilojoules, or equivalent to the product of 1 kW of constant power used or produced, over 1 hour.
Levelized Cost of Charging (LCOC)	Levelized cost of charging is a metric used to compare the cost of serving EV load across multiple sites with different metering scenarios, load management strategies and DER mixes. It is calculated by dividing the total annual cost of serving load ($) by the total load served (kWh).
Managed Charging	The practice of adjusting an EV charging profile to optimize for cost and charge when electricity is cheaper or reduce coincident peak load.
Time-of-Use (TOU)	A utility billing structure for electricity where the retail price of electricity varies depending on the time of day, time of year and/or day of the week in which the electricity is being used.
Unmanaged Charging	The practice of allowing EV charging profiles to match natural driver/vehicle behavior, such that charging begins at the time of plug in and ends at the driver plug out time, or when the vehicle battery is fully charged (whichever occurs first).

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EXECUTIVE SUMMARY

This report accompanies the vehicle study for the City of San Luis Obispo's fleet electrification plan. The City's has set a goal to transition its municipal fleet by reaching 100% electrification of light-duty vehicles and 50% electrification of medium- and heavy-duty vehicles by 2030. As a result, there is a need for the City to install EV charging infrastructure at its primary domicile locations. Three sites were identified by the City as priority sites that will support a majority of the vehicle electrification over the next two decades. Those priority sites are the Corp Yard, 919 Palm Parking Garage, and Fire Station 1, which currently serve as domicile facilities for the majority of the fleet, and 1109 Walnut, as well as the future new Public Safety Center.

Analysis suggests that across all sites 31 Level 2 ports and 6 Level 3 ports would be required by 2025 and an incremental 37 Level 2 ports and 15 Level 3 ports by 2030. Installation of the 89 total ports is estimated to cost approximately $5,327,288 through 2030 and will support the charging of 211 fleet vehicles located at 10 sites. **The total EV charging infrastructure project cost will be approximately $2,883,769 after incentives.**

The cost estimates are subject to variability and uncertainty given the rapid expansion and evolving nature of the EV industry. Recent research has shown that charging infrastructure costs are subject to a similar experience curve as the solar industry, with material costs expected to decline over time, while soft costs such as site assessment, utility interconnection, and permitting remain high, unpredictable, and site-specific.[1] In order to minimize costs and ensure the successful implementation of EV charging infrastructure, it is recommended that the City engage in planning and coordination with stakeholders, including PG&E, during the implementation of the enclosed recommendations. It is also recommended that the City utilize incentives and grants from PG&E, the State, and Federal governments to offset the costs of EV charging infrastructure installation.

Overall, the installation of EV charging infrastructure for the City's municipal fleet is a critical step in reducing carbon emissions and leading by example to promote the use of clean energy transportation. By following the enclosed recommendations, the City can achieve its goal of 100% electric light-duty and 50% electric medium- and heavy-duty vehicles by 2030.

On the following page, Table 1 summarizes infrastructure needs across 11 domicile facilities based on 2025 and 2030 infrastructure buildout, which are detailed in this report. In the table, the infrastructure needs in 2030 are cumulative and include 2025 needs. It is assumed that the majority of make-ready infrastructure costs are incurred in the first phase of construction (2023-2025) and additional charging stations are added by 2030.

[1] Chris Nelder and Emily Rogers, Reducing EV Charging Infrastructure Costs, Rocky Mountain Institute, 2019, https://rmi.org/ev-charging-costs

PROJECTED INFRASTRUCTURE NEEDS BY SITE

This section summarizes infrastructure needs for 2025 and 2030 across all domicile facilities. In **Table 1**, the infrastructure needs in 2030 are cumulative and include 2025 needs.

TABLE 1: SUMMARY OF INFRASTRUCTURE NEEDS

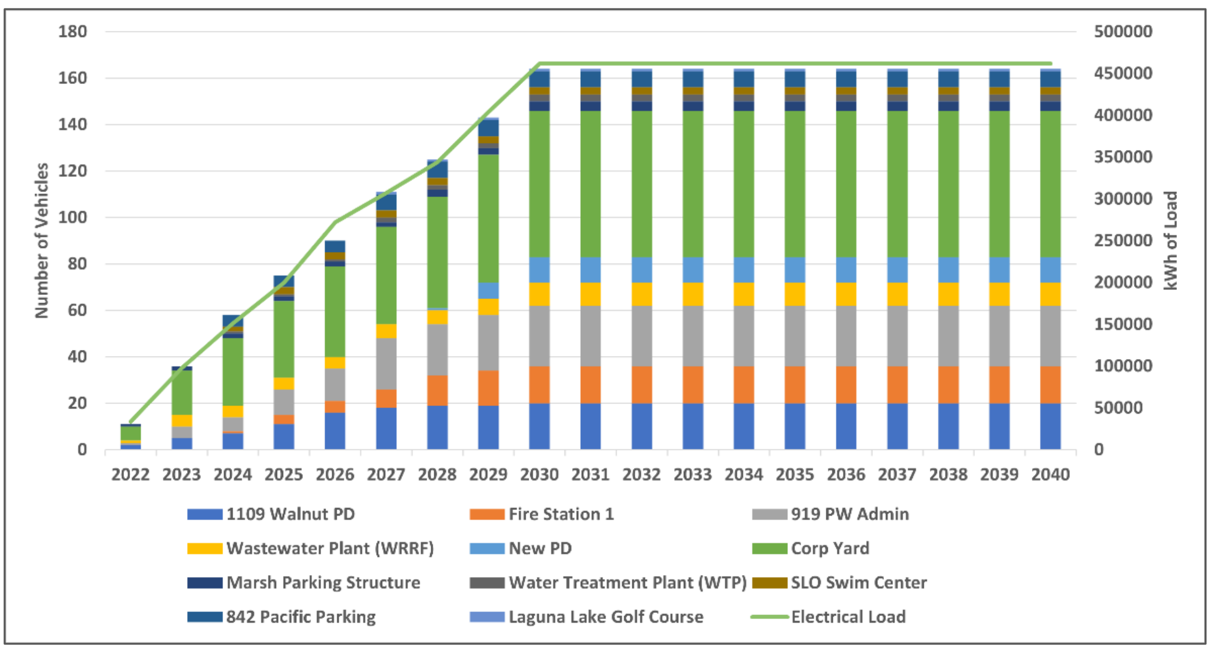
SITE	2025			2030		
	# OF EVs (% OF TOTAL)	# OF PORTS	VEHICLE TO PORT RATIO	# OF EVs (% OF TOTAL)	# OF PORTS	VEHICLE TO PORT RATIO
919 PW ADMIN	12 (80%)	3 x 6.6 kW 4 x 11.5 kW 1 x 25 kW	1.5	15 (100%)	7 x 6.6 kW 4 x 11.5 kW 2 x 25 kW	1.15
CORP YARD	33 (52%)	2 x 6.6 kW 12 x 11.5 kW 1 x 25 kW	2.2	63 (100%)	4 x 6.6 kW 22 x 11.5 kW 2 x 25 kW 1 x Freewire	2.2
LAGUNA LAKE GOLF COURSE	0 (0%)	2 x 11.5 kW	0	1 (100%)	2 x 11.5 kW	0.5
MARSH PARKING STRUCTURE	2 (50%)	1 x 6.6 kW	2.0	4 (100%)	1 x 6.6 kW 1 x 11.5 kW	2.0
NEW POLICE DEPARTMENT	0 (0%)	No ports in 2025	0	30 (100%)	8 x 6.6 kW 1 x 11.5 kW 8 x 25 kW	1.8
SLO SWIM CENTER	3 (100%)	1 x 6.6 kW 1 x 11.5 kW	1.5	3 (100%)	1 x 6.6 kW 1 x 11.5 kW	1.5
WASTEWATER PLANT (WRRF)	5 (50%)	1 x 6.6 kW 1 x 11.5 kW	2.5	10 (100%)	1 x 6.6 kW 1 x 11.5 kW	5.0
WATER TREATMENT PLANT (WTP)	1 (33%)	1 x 11.5 kW	1	3 (100%)	1 x 11.5 kW	3.0
FIRE STATION 1	4 (25%)	1 x 6.6 kW 2 x 11.5 kW	1.3	16 (100%)	7 x 6.6 kW 8 x 11.5 kW	1.1
842 PACIFIC PARKING	5 (71%)	No ports	No new ports recommended	0 (100%)	No ports	No new ports recommended
1109 WALNUT PD	11 (55%)	4 x 25 kW	2.75	20 (100%)	2 x 6.6 kW 8 x 25 kW	2.0

BACKGROUND

The report provides an analysis of the future electric vehicle infrastructure (EVI) needs across ten of the City of San Luis Obispo's fleet domicile facilities. Additional analysis is provided for priority sites expected to house most electric vehicles purchased by the City. The sites chosen for additional study are the Corp Yard, 919 Palm Parking, Fire Station 1, 1109 Walnut, and the Public Safety Center after it is constructed. The report builds directly on previous analysis by the Project Team that identified vehicle electrification opportunities and a vehicle electrification timeline for the City's fleet. **Figure 1** summarizes the vehicle electrification timeline and growth in annual electricity load for the City's domicile facilities. The infrastructure needs identified for each site are based on the timeline below and focused on 2025 and 2030.

As presented in the report, vehicles are assigned to different domicile facilities by Optony. Though some of these vehicles may occasionally be parked in alternative locations, for clarity they are currently sorted according to their *initial domicile assignment in the year they are electrified, per Optony's recommendations based on the City's requests and needs*. For example, police vehicles may domicile at 1109 Walnut, 919 Palm Parking, and City Hall due to construction at the current Police Station location. Those police vehicles electrifying before the completion of the new Public Safety Center building are assigned in this report to those facilities, while police vehicles electrifying *after* the completion of the new Public Safety Center are assigned to that facility. Despite this, the full EV load that the new Public Safety Center will eventually need to shoulder is being accounted for in making charger recommendations for that facility.

FIGURE 1: CUMULATIVE VEHICLE ELECTRIFICATION BY FACILITY



APPROACH SUMMARY

Figure 2, below, outlines the general approach used in the detailed EVI analysis. Each step in this approach is further discussed in the following sections.

FIGURE 2: EVI ANALYSIS APPROACH

METHODOLOGY

When determining required charging infrastructure to support fleet electrification, there are two primary constraints that must be solved for:

- First, charging ports must have power high enough to charge vehicles during their dwell time. Appropriate port ratings (kW) may vary by vehicle type or use case.
- Second, there must be enough charging ports to provide sufficient energy to every vehicle parked at each domicile facility.

Solving for both constraints enables site-specific recommendations of charging infrastructure needs to be made for every domicile facility based on the energy needs and operating patterns of the vehicles at a given site, enabling a fleet to cost-effectively plan for implementation.

Since the purpose of long-term charging infrastructure planning is to enable San Luis Obispo to cost-effectively phase implementation of charging infrastructure with future needs in mind, this analysis relies on the “Current Technology Plus” scenario for vehicle electrification identified during the vehicle analysis. While it is likely that, due to expected expansion of medium- and heavy-duty electric vehicle options, San Luis Obispo will not purchase the exact electric models identified during the vehicle analysis, the required energy needs calculated will remain reflective of future needs. Thus, leveraging an aggressive vehicle electrification scenario ensures that charging infrastructure recommendations are sufficient to support all possible vehicle electrification and avoid the need for expensive retrofits.

DATA SOURCES

Two primary data sources were used to assess the dwell times, identify required port ratings and calculate charging probabilities for San Luis Obispo’s fleet.

- **Fueling Transactions:** A record of every fueling transaction completed by existing ICE vehicles in 2019 and 2021 was analyzed to inform required port ratings and provide insight into when vehicles currently fuel. Based on the best fit EV for each existing vehicle, existing fueling events were converted to charging events to assess minimum, maximum, and average charging times that could be expected if each existing vehicle were converted to electric and continued to fuel as it does today. Additionally, the time distribution and length of these synthetic charging events were used to create charging probabilities (discussed further below).
- **Staff Interviews:** Interviews with fleet staff were used to supplemental qualitative information on how vehicles operate. Interviews focused on areas that were not reflected in the quantitative data collected, namely emergency operations of Utility vehicles and shift patterns of Police patrol vehicles.

DUTY CYCLE ANALYSIS & PORT POWER RATINGS

Fueling transaction data and staff interviews were leveraged in different ways to analyze vehicle duty cycles in order to identify dwell times and combined with expected per vehicle energy needs to identify required port ratings for each facility. In some cases, multiple port ratings were identified for a single facility due to differences in the operations of subsets of vehicles located at a particular facility. For police patrol vehicles in the City’s fleet, average dwell times were approximately 12 hours between shifts. Dwell times were compared with vehicle energy needs to identify a common port power rating needed to provide the required daily energy during an average dwell time. For the Corp Yard, a facility with many medium- and heavy-duty vehicles, these initial recommendations were refined based on vehicle type. Fueling transactions converted to charging events were analyzed to filter out vehicles, usually those with large battery capacities, that may require charge times longer than the average dwell time in certain instances when the battery is depleted. The result was identification of two subsets of vehicles that required ports with higher power than the initial 6.6 kW recommendation.

POLICE VEHICLES

Due to their unique duty cycles and operational demands, vehicles in the police department were analyzed separately. These vehicles were split into two categories reflecting different duty cycles: admin and patrol. Admin units are assumed to follow similar duty cycles as a standard vehicle in the City's fleet, with daily driving and long overnight dwell time. Patrol vehicles were assumed to require charge times that could be achieved during an off shift. An analysis of the daily energy needs for special units indicated that 25 kW ports would be sufficient to provide every vehicle's average daily energy requirement in about 1.5 hours, and full charge (from 0% to 100%) in approximately 3 hours.

A summary of the vehicle dwell times identified by facility is provided in **Table 2.**

TABLE 2: VEHICLE DWELL TIME BY SITE

SITE	DWELL TIME
POLICE DEPARTMENT	11-13 hours between shifts, periodic emergency responses
CORP YARD	No dwell times calculated (no telematic data)
MARSH PARKING STRUCTURE	
919 PW ADMIN	
SLO SWIM CENTER	
WASTEWATER PLANT (WRRF)	
WATER TREATMENT PLANT (WTP)	
FIRE STATION 1	
SLO TRANSIT (NO VEHICLES)	

MANAGED CHARGING POTENTIAL

For many fleets, employing managed charging strategies that use the charging station software to limit the hours in the day when vehicles can charge are effective for reducing the cost of charging. In the case of San Luis Obispo, however, modeling for EV charging was based off an average cost of electricity at each domicile. As such, a managed charging scenario may result in additional savings beyond what is reported here.

LOAD MODELING & OVERALL INFRASTRUCTURE NEEDS

After determining port ratings, the number of ports required must be calculated. On facilities with a small number of vehicles this was determined by adding charging ports and manually calculating the minimum number of ports that could provide the required daily energy in the expected dwell time. For larger sites, a sophisticated probabilistic load modeling technique was used, as described below.

CHARGING PROBABILITIES

To enable accurate modeling of load growth over time and identification of total charging infrastructure needs in 2025 and 2030 at sites with many vehicles, a site-specific, annual, probabilistic method was used. Depending on the characteristics of the vehicles domiciled at each site, the distribution of fueling transactions and the distribution when vehicles are parked determined from the telematic data were converted to a probability distribution that indicated the chance that a vehicle was charging in each 15-min interval of a given week. For emergency vehicles, such as those in the Police Department, there is limited flexibility available in vehicle fueling patterns. Given operational requirements, vehicles, even after conversion to electric, must charge in the same way that they are fueling today. Emergency vehicles do not have 12 hours overnight to charge. As such, the distribution of current fueling transactions is the most appropriate data source to determine when those vehicles will be charging once they are converted to electric. In contrast, vehicles without daily emergency response requirements, such as those in the Public Works department, have significant flexibility to change fueling patterns once they are electrified. For these vehicles, the distribution of when vehicles are parked is the most appropriate data source to determine when those vehicles will be charging once they are converted to electric.

The weekly charging probability profile represents an average expectation for which time intervals are most and least likely to be used for charging by a vehicle during a work week. Since probability distributions differ depending on the number of EVs at a site, and that number is expected to increase each year, different distributions were created for each year at each site. Once probability profiles were established, projected EV load profiles were constructed by site and by year based on the total number of vehicles, required port ratings and annual energy requirements of those vehicles.

LOAD PROFILE BUILDER

In order to simulate the electric load profiles from charging of a future electric vehicle fleet, the Project Team utilized an internal modeling tool to build time dependent load profiles. The load profile builder leverages the weekly probability profiles discussed above to take an index of 672 numbers (the number of 15-minute intervals in a week), where each number represents the likelihood that a random charging interval will occur on that day and time. Once the charging probability indices are determined, the user provides additional inputs to the load profile builder. The load profile builder was given these fixed inputs for each department site in each year studied:

- Number of EVs at each facility[2]
- The total annual amount of electrical energy needed to fuel all EVs domiciled at each facility from 2023 to 2035
- Maximum number of ports available
- The power rating of each port, as determined for each site, with different port ratings for different sub-classes of fleet vehicles, as appropriate[3]
- The site’s rate structure, if applicable
- Whether the load profile should be built to allow unrestricted charging according to driver behavior and ignore TOU pricing impacts; or manage charging to avoid highest TOU cost impacts
- The time at which overnight and weekend charging treatment should be assumed for vehicles which are exclusively used during normal business hours, and parked during nights and weekends

These choices are given to the load profile builder as inputs in a control panel of a spreadsheet-based simulator. Over the

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[2] This determines the maximum number of vehicles charging at any given time, since the number of ports active is assumed to be less than or equal to the number of vehicles.

[3] Example: Police patrol vehicles have a different dwell times and behavior from Police administrative vehicles and required higher powered ports

course of a non-leap year, there are 35,040 charging intervals.[4] For each charging port (as based on inputs given above) the load profile builder creates a vector of 35,040 intervals and repeatedly generates a signal of whether that port should be active or inactive based on the probabilities given at the outset. The load profile builder then takes the sum of all charging in all intervals across all ports. The user is given this annual total along with an error signal which compares the total delivered energy to the required annual energy as determined in the fixed inputs. If the total amount of energy delivered is below the amount needed, an adjustment factor is increased to boost the utilization of each port in proportion to its probability profile. This boost forces more charging events into the most preferred charging intervals as determined by driver behavior from the data sources described above. However, if the total energy allotted by the load profile builder exceeds the amount of energy needed the user can decrease the number of ports or manage charging by restricting charging only to certain intervals (e.g., overnight and weekends).

TOTAL PORT NEEDS

From the simulations of annual charging completed for each site, the total port needs for each power rating can be identified by analyzing the maximum number of coincident ports in use. To account for variations in vehicle charging needs, a safety factor of 20% is applied to the maximum coincident port number to determine the final recommended port counts.

[4] 365 days per year x 24 hours per day x 4 intervals per hour (with each interval at 15 minutes)

INFRASTRUCTURE COST ASSUMPTIONS

The cost assumptions for charging hardware and installation costs in this study are specifically for California and are primarily drawn from a 2019 study by the International Council on Clean Transportation.[5] This study aggregated data from past studies, as well as costs reported to public utility commissions via utility programs. Data on charger component costs aggregated through industry interviews by the Rocky Mountain Institute confirmed that the costs in the ICCT study were in an accurate range. Representative of the limited data available, both the ICCT and RMI studies built significantly on data from a 2013 Electric Power Research Institute study.[6] Given the age of the EPRI data, costs figures may have fallen in the intervening years. However, the cost range remains sufficiently broad to warrant a conservative approach.[7] **Table 3** includes a summary of the cost figures used to calculate total cost.

TABLE 3: SUMMARY OF EVI COST ASSUMPTIONS

CHARGER HARDWARE COSTS (PER PORT)		INSTALLATION COSTS				
CHARGER TYPE	COST ($)	# OF PORTS INSTALLED	L2 COST PER PORT (6.6 KW)	L2 COST PER PORT (11.5 KW)	DCFC COST PER PORT (25 KW)	FREEWIRE COST PER PORT
LEVEL 2 (6.6 KW)	$1,925	1	$39,600	$39,600	$52,600	$46,400
LEVEL 2 (11.5 KW)	$2,500	2	$19,800	$19,800	$49,600	$43,400
DC FAST (25 KW)	$15,746	3-5	$24,400	$24,400	$48,600	$42,400
FREEWIRE	$172,000	>6	$17,800	$17,800	$47,600	$41,400

The hardware costs used are per port and assume networked capability. Installation costs include labor, permits, taxes and the cost of make-ready electric infrastructure on the customer side of the meter. Make-ready electric infrastructure on the customer side of the meter generally includes wiring, conduits, trenching, service panels and switchgear upgrades (when needed) and can vary significantly from site to site.[8] The cost figures above include only wiring, conduit and service panel costs. Trenching costs for installation are *not* considered in the cost estimates calculated for this study because site layouts have not been determined.

Cost assumptions are used to provide a starting point in estimating infrastructure costs. City staff can adjust cost assumptions for key sites in the Fleet Electrification Pro-Forma accompanying this report.

ELECTRIC VEHICLE INFRASTRUCTURE INCENTIVES & FINANCING

There are regional and state-wide efforts in California to provide incentives to accelerate electric vehicle infrastructure deployment. One opportunity is the statewide Low Carbon Fuel Standard (LCFS) which provides a market-based mechanism for ongoing operational incentives to off-set energy costs. The City can earn credits based on the number of kilowatt hours dispensed by City-owned EVI and monetize those to reduce operational costs. Additionally, the City can receive incentives through its CCA, Central Coast Community Energy (CCCE) and the SLO County Air Pollution Control

[5] Michael Nicholas, Estimating electric vehicle charging infrastructure costs across major U.S. metropolitan areas, International Council on Clean Transportation, August 2019, https://theicct.org/sites/default/files/publications/ICCT_EV_Charging_Cost_20190813.pdf

[6] Electric Power Research Institute, Electric Vehicle Supply Equipment Installed Cost Analysis, 2013, https://www.epri.com/research/products/000000003002000577

[7] Initial data reported to the California Energy Commission via the CALeVIP project shows even higher installation costs than assumed in this report. However, these costs result from a small sample size that CEC indicates may have been skewed by a few high-cost sites. As a result, these costs have not been included in this study. The data is available here: https://www.energy.ca.gov/programs-and-topics/programs/clean-transportation-program/california-electric-vehicle/calevip-level.

[8] Reducing EV Charging Infrastructure Costs, Rocky Mountain Institute, 2019

District (APCD). SLO APCD incentives cover up to Level 3 chargers for public agencies, and cover 50% of installation, engineering, design, and equipment costs for non-low-income communities. Service upgrades may not be covered by APCD incentives and are not assumed to be covered in cost modelling. Incentives available to the City for fleet EVI are estimated at $2,443,519 or 45.9% of the total EVI project cost.

In addition to incentives, increasingly available 3rd-party financing options for fleets may be useful for San Luis Obispo to address capital costs required for charging infrastructure. Some charging infrastructure developers and vendors offer "charging as a service" options that enable a fleet to defer capital costs of infrastructure in favor of shifting those costs to the operating budget and paying them off on a per kWh basis over time. Charging as a service can be explored further as the City explores procurement options.

INFRASTRUCTURE NEEDS & CAPITAL COST ESTIMATES

Unlike vehicle electrification, which has the potential for total cost of ownership savings, the infrastructure required to charge electric vehicles is a cost that the City of San Luis Obispo is required to bear in support of their fleet electrification goals. A primary challenge when identifying charging infrastructure needs is identifying the minimum number of charging ports at each location required to satisfy the fleet's daily energy needs while balancing operational considerations such as dwell time. One way to minimize the total cost of EVI is to minimize installation costs through futureproofing. Instead of installing a handful of charging stations to meet immediate need and then having to remove those, expand power capacity and re-install more chargers as fleet electrification continues, total costs can be minimized by installing make-ready electrical infrastructure to support future charging needs at the time of initial installation. Long-term planning of charging infrastructure allows fleets to futureproof effectively.

OPERATIONAL CONSIDERATIONS OF VEHICLE TO PORT RATIOS

For every domicile facility considered, the recommendations indicate a vehicle to port ratio greater than 1:1. Implementing vehicle to charger ratios higher than 1:1 minimizes EVI hardware and installation costs but has operational considerations, as not every vehicle can be plugged in at the same time. This challenge can be managed in a variety of ways ranging from staff training to software solutions. A first solution is to recognize that during standard operations, the City's vehicles do not need to be charged every night. San Luis Obispo is about 13 square miles in area and it is important to recognize that, especially as electric vehicle ranges increase, the common perception that EVs need to charge daily is a misconception. Across the sites analyzed in this report, the average daily energy needs per vehicle ranges from 3.3-15.28 kWh per day, with a maximum of 15.28 kWh per day at the Police Department. In contrast, the vehicle types modeled have between 12-138 kWh battery capacities. This is a clear indication that the majority of vehicles in the City's fleet will not be required to charge on a daily basis.

A second option that may be appropriate for large sites, such as the Corp Yard or new Public Safety Center, that require more complex management is to have additional staff on hand that rotate the vehicles overnight.

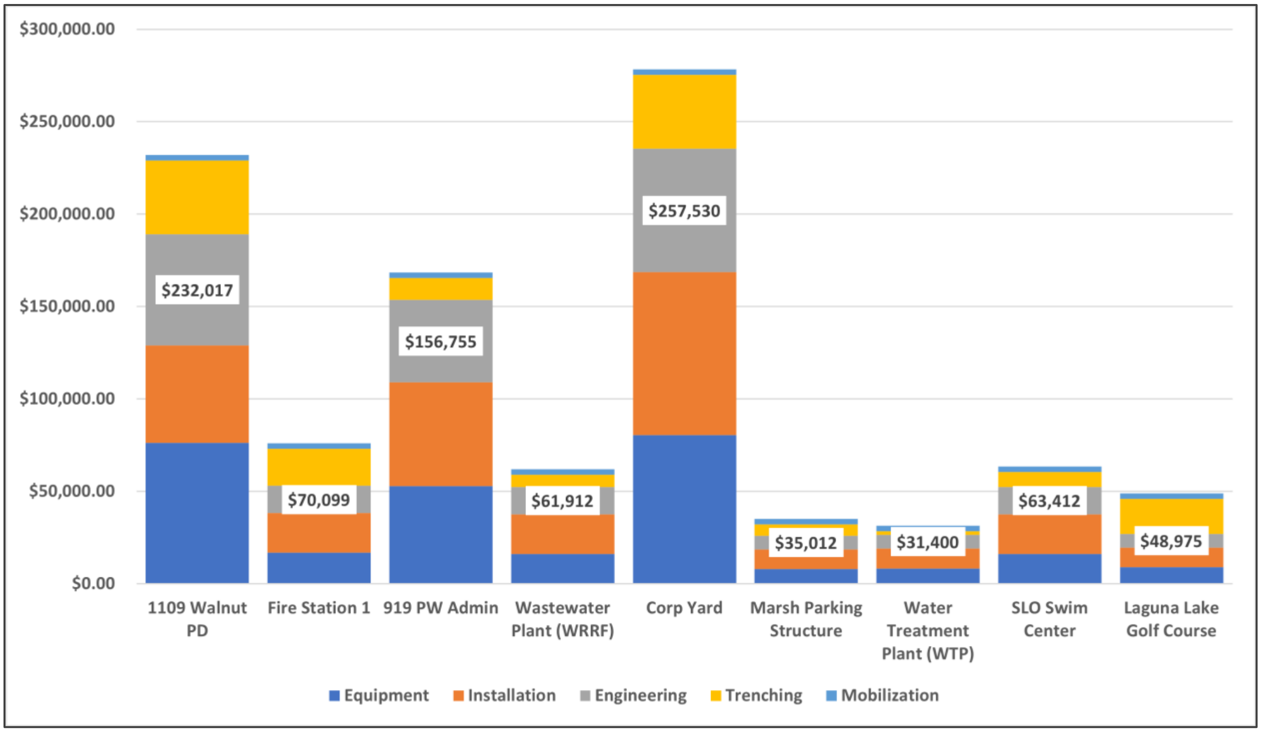
Finally, the recommendations provided below are for "fully powered" ports, meaning charging ports that have sufficient circuit capacity to provide a power output at their nameplate capacity. In some cases, it may be advantageous for the City to add additional charging ports, without taking the capital-intensive step of expanding the recommended power capacity, to enable more vehicle to be plugged in at once and leverage software to balance charging across ports.

PROJECTED INFRASTRUCTURE NEEDS: COSTS

The section presents projected electric vehicle infrastructure costs for each site based on build out to meet 2030 needs. The costs listed are total costs for a given site and are not reflective of project-specific costs if the San Luis Obispo pursues phased implementation of the required charging infrastructure. All charts are after incentives.

Figure 3 summarizes the estimated costs by component across all sites for base infrastructure needs in 2025. Costs include all charging station hardware and installation costs, as well as costs for procurement management (as applicable) and estimated overhead for Public Works staff.

FIGURE 3: ESTIMATED EV CHARGING INFRASTRUCTURE COSTS (2025 – BASE NEEDS)



Beyond costs for charging hardware, conduit, wiring and trenching, additional electrical infrastructure upgrades to building equipment can add cost if charging infrastructure is connected to the building meter, or a new service is needed.

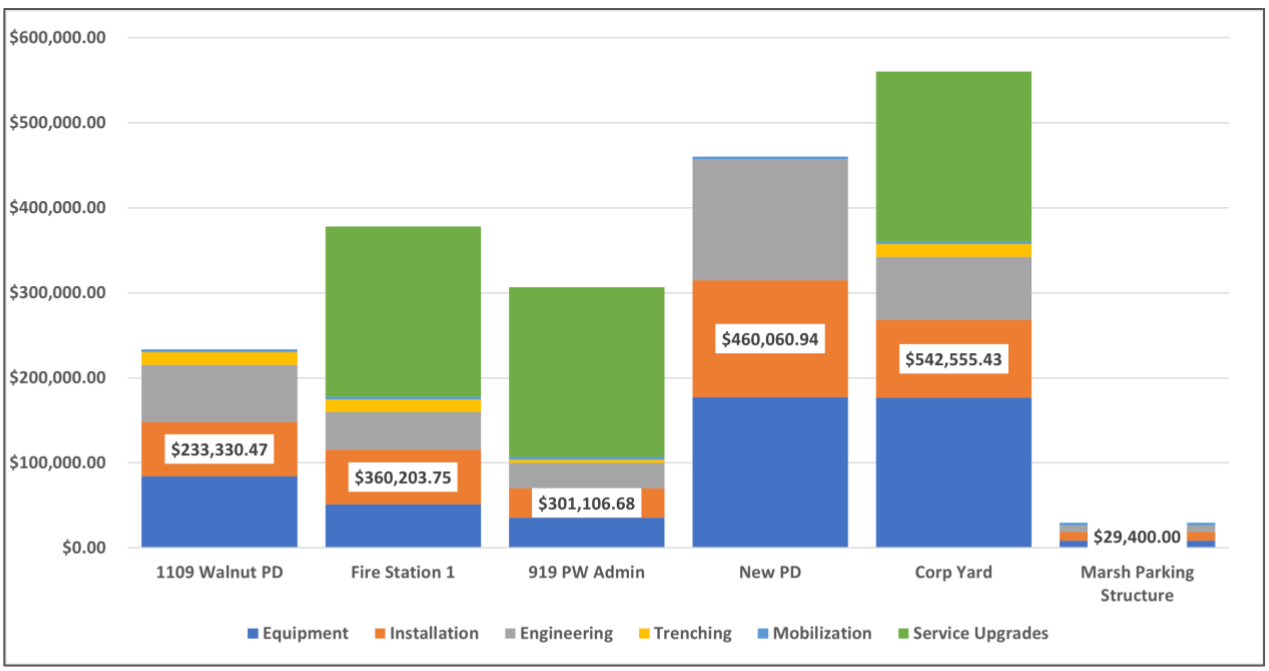
Table 4 summarizes the remaining power capacity on each facility's main switchgear compared to the additional power needed in the recommended charging scenario. The charging needs of the Police Department are listed under the 919 Palm Parking, 1109 Walnut and Corp Yard. This review of the City of San Luis Obispo's domicile facilities indicated that current power capacity at Fire Station 1, Corp Yard, and 919 Palm Parking is **not** sufficient to support all future charging. This means that switchgear upgrades or a software solution such as adaptive load management will be required, depending on the needs of the site. Adaptive load management is a solution that leverages software to balance the power a set of charging stations is drawing to ensure that the total draw never exceeds the building capacity. While costs for load management software vary based on power and quantity of chargers, it is safe to say that the solution can be a less capital-intensive than a service upgrade, but requires the ability to curtail charging ports, which is not recommended for police vehicles.

TABLE 4: REMAINING POWER CAPACITY VS. POWER NEEDED

SITE NAME	ESTIMATED CAPACITY AVAILABLE (KW)	2040 CHARGING NEEDS (kW)	SUFFICIENT CAPACITY?
GOLF COURSE	Unknown	23	TBD
WATER TREATMENT PLANT	Unknown	11.5	TBD
SLO SWIM CENTER	36.23	18.1	Yes
MARSH PARKING LOT	80.83	18.1	Yes
WASTEWATER PLANT	Unknown	18.1	TBD
FIRE STATION 1	19.03	138.2	No
CORP YARD	129.63	337.1	No
919 PW ADMIN	13.17	142.2	No
1109 WALNUT	Unknown	213.2	TBD

Figure 4 summarizes the estimated costs by component across all sites for base infrastructure needs in 2030, with the addition of estimated building electrical capacity upgrades.

FIGURE 4: ESTIMATED EV CHARGING INFRASTRUCTURE COSTS (2030 - BASE NEEDS WITH BUILDING UPGRADES)



UTILITY UPGRADE COSTS

If the required charging infrastructure exceeds the capacity of the nearest transformer on the distribution system, make-ready costs on the utility side of the meter have the potential to exceed costs on the customer side of the meter. All site needs should be reviewed by the City to determine if additional upgrades may be needed to support charging.

IMPLEMENTATION OF EV CHARGING INFRASTRUCTURE

It is crucial that the City act on immediate term recommendations for EV charging infrastructure to ensure there is sufficient charging capacity for the fleet as it transitions to EVs. Because the City already has some EVI installed, the recommendations within this report consider 2025 to be the construction year for immediate needs, although infrastructure can be installed sooner if preferred.

The Pro Forma, found in Appendix A of this report, details the cost estimates for each phase of construction (2025 and 2030), along with recommended equipment for each site. Details from the Pro Forma can be used by the City to determine project budget and informing the procurement process, such as publishing a request for proposals for design or design and build.

RECOMMENDED 2025 EV CHARGING INFRASTRUCTURE

SITE	# OF PORTS FOR 2025	# OF PORTS FOR MAKE READY (2025 CONSTRUCTION)
919 PW ADMIN	3 x 6.6 kW 4 x 11.5 kW 1 x 25 kW	7 x 6.6 kW 4 x 11.5 kW 2 x 25 kW
CORP YARD	2 x 6.6 kW 12 x 11.5 kW 1 x 25 kW	4 x 6.6 kW 22 x 11.5 kW 2 x 25 kW 1 x Freewire
LAGUNA LAKE GOLF COURSE	2 x 11.5 kW	2 x 11.5 kW
MARSH PARKING STRUCTURE	1 x 6.6 kW	1 x 6.6 kW 1 x 11.5 kW
NEW POLICE DEPARTMENT	None	4 x 6.6 kW 1 x 11.5 kW 8 x 25 kW
SLO SWIM CENTER	1 x 6.6 kW 1 x 11.5 kW	1 x 6.6 kW 1 x 11.5 kW
WASTEWATER PLANT (WRRF)	1 x 6.6 kW 1 x 11.5 kW	1 x 6.6 kW 1 x 11.5 kW
WATER TREATMENT PLANT (WTP)	1 x 11.5 kW	1 x 11.5 kW
FIRE STATION 1	1 x 6.6 kW 2 x 11.5 kW	7 x 6.6 kW 8 x 11.5 kW
842 PACIFIC PARKING	None	None
1109 WALNUT	4 x 25 kW	2 x 6.6 kW 8 x 25 kW

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APPENDIX A: FLEET ELECTRIFICATION PRO FORMA

APPENDIX A: FLEET ELECTRIFICATION PRO FORMA (EXCEL ATTACHMENT)

The City of San Luis Obispo fleet electrification pro forma has been provided to the City as a separate Excel attachment.

APPENDIX B: INCREMENTAL COST OF CARBON REDUCTION

APPENDIX B: INCREMENTAL COST OF CARBON REDUCTION FROM FLEET ELECTRIFICATION

TIME PERIOD	CARBON EMISSIONS REDUCED ($MTCO_2$)	MARGINAL CAPITAL COST ($)	MARGINAL TCO ($)	CHARGING INFRASTRUCTURE COSTS ($)	ESTIMATED COST OF CARBON REDUCTION ($/$MTCO_2$)
2023-2025	264.97	$954,249	$(377,749)	$1,952,774	$5,944
2026-2030	380.2	$2,106,633	$(422,028)	$3,294,640	$7,555