The City of SAN DIEGO

City of San Diego
Municipal Energy Implementation Plan

Strategies to achieve zero emissions municipal buildings and operations by 2035.

SD sustainability

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Introduction

The City of San Diego is committed to leading by example in the fight against climate change, with a focus on decarbonizing our buildings and operations, and electrifying our fleet 100% by 2035. The City of San Diego's municipal buildings and fleet vehicles present significant opportunities to reduce carbon pollution and minimize the City's contribution to the climate crisis. In 2020, the City issued the Municipal Energy Strategy (MES), which demonstrates the commitment of the City of San Diego to lead locally, nationally and globally by advancing projects and policies for City buildings and operations that help mitigate the causes of climate change. The MES outlines a series of strategies and actions that will guide staff and stakeholders on the path to a zero emissions future for municipal facilities. As shown in Figure 1, municipal energy strategies include a focus on decreasing energy use while increasing resiliency in the face of energy disruptions, such as wildfires, floods and severe weather events that could threaten City infrastructure. The framework is also rooted in the goal of climate equity so that the benefits of these improvements increase access to opportunity for our communities most vulnerable to climate change.

Figure 1. Municipal Energy Strategies & Actions

Strategies	Actions
STRATEGY 1: Reduce Energy Consumption	**ACTION 1:** Identify and implement energy-efficiency projects
	ACTION 2: Measure and manage energy performance
STRATEGY 2: Increase Onsite Renewable Energy Generation	**ACTION 1:** Implement renewable energy projects
	ACTION 2: Assess the impacts of a changing market
STRATEGY 3: Strive for Zero Emissions Buildings	**ACTION 1:** Adopt and enforce zero emissions standards and policies
	ACTION 2: Reduce embodied carbon
STRATEGY 4: Support Resiliency and Grid Stability	**ACTION 1:** Deploy smart, connected distributed energy resources
	ACTION 2: Secure funding for grid-interactive efficient building pilot projects
STRATEGY 5: Engage and Educate	**ACTION 1:** Engage and educate building occupants and patrons
	ACTION 2: Train the local workforce

Building on the MES, this Municipal Energy Implementation Plan (Plan) provides more detail on current energy performance of City facilities, along with planned and proposed energy projects and their associated impacts on energy performance and the established zero emissions targets. The Plan identifies specific policies, priorities and programs to be pursued by City staff and stakeholders.

Implementation of these strategies will increase the City's resiliency in the face of climate-driven disruptions, advance climate equity through environmental stewardship and push the City's building portfolio toward the goal of zero emissions by 2035. The MES and this Plan will be updated periodically to reflect changing variables in the rapidly evolving clean-energy landscape.

Municipal Energy Targets

In 2022, the City of San Diego updated its Climate Action Plan (CAP), establishing a goal of net zero emissions communitywide by 2035. Strategy 1 of the City's CAP Our Climate, Our Future[1] calls for decarbonization of the built environment. In this strategy, decarbonization means to remove carbon from a system, with a focus on the source with the greatest potential for reduction: natural gas or methane. Measure 1.3 in the updated CAP addresses decarbonization of City facilities, with targets for removing natural gas from municipal buildings by 2030 (50%) and 2035 (100%) using a greenhouse gas (GHG) reduction metric (rather than facility count).

Similarly, Strategy 2 of the updated CAP addresses access to clean and renewable energy and calls for electrification of the municipal vehicle fleet. Measure 2.2 establishes fleet electrification targets, calling for a conversion of 100% of cars and light-duty vehicles (LDV) and 75% of medium- and heavy-duty vehicles (MDV and HDV) by 2035.

With the adoption of the CAP update in 2022, municipal energy targets were simplified from those established in the 2015 CAP and carried over to the MES. In addition to establishing a goal for zero emission municipal buildings by 2035, the MES also carried forward the approximate 30% municipal GHG emission reduction target established in the 2015 CAP,

Figure 2. CAP Measure 1.3: Decarbonize City Facilities – Targets

2030 TARGET	**2030 GHG REDUCTION**	**2035 TARGET**	**2035 GHG REDUCTION**
Phase out natural gas 50% in municipal facilities	(MT CO2e) 15,148	Phase out natural gas 100% in municipal facilities	(MT CO2e) 32,638

Figure 3. CAP Measure 2.2: Increase Municipal Zero Emissions Vehicles – Targets

2030 TARGET	**2030 GHG REDUCTION**	**2035 TARGET**	**2035 GHG REDUCTION**
Percent of all municipal fleet vehicles to be ZEVs: Cars: 75% LDV: 50% MDV: 50% HDV: 50%	(MT CO2e) 11,042	Percent of all municipal fleet vehicles to be ZEVs: Cars and LDV: 100% MDV: 75% HDV: 75%	(MT CO2e) 15,990

[1] Draft CAP located here

and translated it to a reduction in energy consumption via MMBTU (metric million British thermal units – a unit of energy associated with both electricity and natural gas). Moving forward the City will focus solely on the municipal zero emissions goal and will abandon the MMBTU reduction targets established in the MES. This new approach results in a more straightforward effort to prioritize projects and measure the impacts resulting from implementation of the strategies herein.

Municipal targets now align with the 2022 CAP:

1. Phase out natural gas in municipal facilities 50% by 2030, and 100% by 2035.

2. Convert 75% of cars and 50% of light-, medium- and heavy-duty fleet vehicles to zero emissions vehicles (ZEVs) by 2030, and convert 100% of cars and LDV and 75% of MDV and HDV to ZEVs by 2035.

To stay on track, the City has set tentative milestone targets to achieve at least a 50% reduction in direct GHG emissions from fossil-fuel combustion relative to 2019 levels by Jan. 1, 2030, and a 100% reduction by Jan. 1, 2035. Natural gas reductions will likely occur in multiple ways – i.e. whole-building electrification efforts combined with incremental "fuel switching" (switching from fossil fuels to electricity) of single-building systems and vehicles over time. Therefore progress toward these milestones will be measured based on overall reductions in GHG emissions from building and fleet-related fossil fuels relative to a 2019 baseline, rather than a discrete count of all-electric buildings and vehicles.

The shift to zero emissions buildings – buildings that are super energy efficient, all-electric and fueled solely by renewable energy – and fleets is becoming more commonplace and cost-effective as the market for electric technologies grows. Currently, electric water and space heating is feasible with the use of electric heat pump technologies. Similarly, backup diesel and natural gas generators can be replaced with battery energy storage and renewable microgrids where space and feasibility allow. Electric vehicle options are widely available for sedans and LDVs like pickup trucks. MDV and HDV electric options are still in development and solutions for many municipal services, like trash trucks and firetrucks, are not yet available in the market.

Zero vs. Net Zero

"Zero emissions" implies that no GHG emissions (from CO2, methane and nitrous oxide) are emitted.

"Net zero emissions" means sources can either eliminate emissions or continue to release GHGs as long as those emissions are reduced elsewhere.

The City is aiming for an ambitious **zero emissions** goal for its own municipal buildings and fleet in an effort to lead by example and prioritize a focus on a wide range of cost-effective solutions.

ZERO EMISSIONS BUILDINGS & OPERATIONS

ELECTRIFICATION

To reach the 2035 zero emissions buildings and operations goal, the City must begin to electrify its end uses, shifting away from fossil fuels including natural gas, gasoline, diesel fuel and other carbon-heavy fuels in municipal operations. In 2019, approximately 38% of the energy consumed in municipal buildings came from natural gas. Similarly, as of summer 2021, approximately 91% of the City's fleet was powered at least partially with a fossil fuel. The City maintains 176 natural gas and diesel backup generators, many supporting critical community services like water and wastewater treatment and pumping facilities. As the City transitions to 100% renewable electricity procured by San Diego Community Power (SDCP), maximizing the shift away from fossil-fuel use and toward electricity for all end uses is a critical step toward hitting the 2035 zero emissions goal. Thoughtful consideration will be necessary to ensure that critical services are not compromised by the shift away from traditional, trusted backup technologies like diesel generators, and that clean, alternative backup technologies are validated and reliable.

While municipal energy efforts are now focused solely on achieving zero emissions via fuel switching and using 100% renewable electricity to meet all energy needs, energy efficiency retains value and will remain a focus for staff. Energy-efficiency efforts have the primary benefit of reducing operating costs for the City. Energy prices from San Diego Gas & Electric (SDG&E), the long-standing local utility provider, increase by 4% annually on average. Price increases from SDCP, the City's new energy provider for most utility accounts as of 2021, are expected to increase at similar rates. Converting vehicles and building end uses to electric will naturally increase electricity consumption, but it will decrease the overall amount of energy consumed and the amount of GHGs emitted. That reduction will occur because electric heat pumps are much more efficient than natural gas heaters, and electric vehicles (EVs) are much more efficient than gasoline or diesel vehicles.

Electricity consumption will also increase due to development of Pure Water San Diego, a new water treatment facility that will provide clean drinking water beginning in 2025. A preliminary analysis indicates that the first phase of Pure Water will use approximately 132 GWh of electricity annually. The Pure Water program will be further expanded in 2035, with a second treatment facility anticipated to consume 218 GWh annually. Because Pure Water operations will be all electric and fueled with SDCP's Power100 energy mix, this significant increase in energy consumption will not drive an increase in GHG emissions.

VEHICLE ELECTRIFICATION

Providing EV charging stations at City buildings is the primary way the City can support the shift to zero emissions vehicles in the region. Currently numbering more than 4,000 fleet

vehicles, municipal fleet electrification will significantly impact the City's energy demand. Planning for, developing and managing the associated increase in electricity demand is underway and will depend on the advancement of the ZEV market in the region, particularly with regard to MDVs and HDVs.

In addition to City fleet vehicles, providing EV charging infrastructure for the City workforce and patrons who drive to City facilities will expand the feasibility of EVs for all San Diegans. However, even if an individual is paying to charge their personal vehicle on City property, the necessary electrical capacity and space for additional EV infrastructure must be accounted for when designing or upgrading municipal

LOOKING AHEAD

The City must implement three primary activities to achieve the zero emissions target:

Figure 4. Actions Needed to Achieve Zero Emissions

1. FUEL SWITCH away from natural gas in buildings and operations, and fossil fuels in the fleet, and transition to electric end uses, operations and vehicles

2. ENSURE ALL ENERGY CONSUMED IS RENEWABLE, supplied by onsite renewable energy, and/or 100% renewable grid electricity from local energy providers.

3. PURSUE EFFICIENCY IMPROVEMENTS to reduce energy consumption in buildings, and to realize associated energy cost savings.

ACTIONS COMPLETED AND UNDERWAY

In 2021 the City began the transition of all of its electricity accounts to SDCP and their 100% renewable electricity product. This transition will continue until all accounts are receiving 100% renewable electricity, per Mayoral direction. Availability of 100% renewable grid-supplied electricity is a critical element in achieving municipal energy goals and provides a strong foundation for all subsequent steps toward our targets.

Additionally, City staff have taken significant strides to increase building efficiency, install renewable energy solutions, and adopt EVs into the fleet. Currently, many facilities are equipped with efficient systems including LED lighting, direct digital controls, and high-efficiency HVAC (heating, ventilation and air-conditioning) units. Likewise, the City has installed more than 6 MW of solar PV on rooftops, parking lot canopies and at water and wastewater treatment facilities. City staff are actively retrofitting

compact fluorescent lighting with LEDs and pursuing renewable microgrid installations composed of solar PV and battery storage at municipal facilities like recreation centers and fire and police stations.

Last, this Plan documents important information that will inform the near-term actions below, including documentation of fleet vehicle charging locations and an estimate of the anticipated building electric load increase associated with transitioning all cars and LD fleet vehicles to electric and charging them from building electrical panels.

NEXT STEPS: NEAR-TERM

Through FY24, staff should focus on four main priorities:

1. Perform an inventory of fossil fuel building energy systems (i.e. gas-burning HVAC units, water heaters, pump stations, etc.) that will need to be replaced with electric systems. Assessments must quantify systems, document remaining useful system lifespans, and estimate electric demand increases and costs associated with fuel switching. Assessments should also determine building electric panel capacity and determine the scope of necessary panel upgrades to support electric building systems and fleet vehicles that will charge at specific locations.

2. Adopt a Zero Emissions Municipal Buildings & Operations Policy that will establish clear requirements for new construction and major retrofits of municipal facilities, including energy-efficiency targets, a requirement for all-electric systems, and requirements for fleet vehicle charging infrastructure (with consideration for public and workplace EV charging needs as well). Policy efforts are addressed more thoroughly in the following section of this Plan.

3. Prepare for deep decarbonization retrofits of existing facilities and electrification of the fleet. Work is underway to prepare to partner with Energy Services Companies (ESCOs) to pursue deep energy retrofits at existing municipal facilities. Building retrofits should include energy-efficiency improvements alongside installation of renewable energy, battery storage and microgrids where appropriate. Similarly, work is underway to secure an EV charging vendor partner to provide fleet and public/workplace charging at City facilities. All the while, Department of General Services Facilities Division staff should continue to replace gas-burning systems at end of life with electric alternatives.

4. Investigate and secure grant and federal stimulus funding to support municipal decarbonization efforts. As noted in the Programs section of this Plan, significant grant funding to support municipal building and fleet decarbonization efforts is currently available and more is anticipated as the federal and state governments continue to adopt ambitious climate goals and dedicate funds toward their achievement. It is likely that grant-funded energy projects would also require a community and/or resiliency element, which aligns with the priorities established the MES.

NEXT STEPS: MID-TERM

By fiscal year (FY) 2025, once initial fossil-fuel inventories and infrastructure upgrade assessments are complete, and once a zero emissions policy is adopted, staff should begin focusing in earnest on retrofits to existing facilities and installation of EV charging infrastructure.

NEXT STEPS: LONGER-TERM

Once existing building retrofits are underway via the ESCO model, and fleet EV infrastructure installations are underway, staff should shift focus to more comprehensive carbon reduction strategies including policies to address embodied carbon in building materials, carbon sequestration technologies that can be deployed at municipal facilities, and solutions that support community resiliency including community solar and microgrids.

CORE BENEFITS OF MUNICIPAL ENERGY ACTION

While reducing municipal GHG emissions is the main objective of this Plan, related challenges and benefits experienced by our residents each day should be considered for prioritization during implementation. Maximizing core benefits, especially those that address severe existing conditions like air quality, can be accomplished in tandem with implementation of the Plan. Core benefits may not have a direct or indirect impact on reducing the effects of climate change, but they warrant consideration in the interest of public health and safety, economic resiliency and overall quality of life.

The first step to empowering communities to achieve greater access to opportunity is to understand the core benefits most important to them and use this information to directly influence the development and implementation of municipal energy improvements, particularly at community facilities like recreation centers and libraries. The following core benefits were identified from the extensive engagement process that took place during the development of the draft CAP.

Figure 5. Core Benefits of Municipal Energy Action

AIR QUALITY
- Indoor air quality
- Outdoor air quality

PUBLIC HEALTH
- Reduce pollution and litter
- Increase access to healthy and affordable food
- Increase walkability
- Increase access to parks, green space, and recreation
- Increase safety (e.g., pedestrian, bike)

JOBS & ECONOMY
- Local investment generated
- Potential for local jobs
- Increase affordability of transportation

RESILIENCY
- Reduce heat island effect
- Increase natural habitat
- Imporve biological resouces (i.e. trees, green spaces)
- Improve water quality
- Increased independence for local resources (i.e. energy, water)

Energy Policies

INTRODUCTION

Policies play an important role in ensuring sustainable growth of municipal infrastructure and influencing the behavior of occupants. For decades, the City has been a leader in promoting energy efficiency and conservation through energy policies. Updating existing policies and/or developing new policies to address municipal energy goals and priorities will ensure the City stays on track to achieve the GHG reductions identified in the CAP, and the goal of zero emissions municipal buildings by 2035.

EXISTING MUNICIPAL ENERGY POLICIES

Existing municipal policies that have a direct impact on the City's progress toward CAP goals include Council Policy 900-14 "Sustainable Building Policy," Council Policy 900-18 "Purchase of Energy-Efficient Products," and Council Policy 900-02 "Energy Conservation and Management." These policies were created before the adoption of the CAP in 2015.

SUSTAINABLE BUILDING POLICY 900-14

Policy Number: 900-14
Effective Date: May 18, 2010

The policy reasserts the City's commitment to green and sustainable building practices in new construction or major renovations of facilities that the City owns, occupies or leases. Along with other sustainable practices, it requires City-owned, occupied or leased new construction and major renovation projects to:

- Meet the requirements of the U.S. Green Building Council (USGBC) Leadership in Energy and Environmental Design Program® (LEED®) for Silver level certification.
- Use 15% less total building energy consumption than the minimally code-compliant building as modeled following current Title 24 requirements.
- Provide a minimum of 15% of total building energy from onsite self-generation using proven renewable energy technologies when site conditions and configuration allow for reasonable payback on the significant investment in renewable energy technologies.
- Additionally, the policy strongly encourages implementation of the following energy-related measures for City-owned, occupied or leased new construction and major renovation:
    - Enhanced commissioning and measurement and verification procedures for all facilities.
    - Designs to take maximum advantage of passive and natural sources of heat, cooling, ventilation and light.
    - Installation of high-efficiency lighting with occupancy sensors.
    - Use of energy management systems that can be automatically accessed for demand response calls with the local utility.

The policy also addresses non-energy sustainability practices including installation of efficient plumbing fixtures, non-potable water use for irrigation, occupant recycling, compliance with stormwater development and construction and demolition requirements, and adherence to indoor air quality standards.

The policy requires all City departments to understand the requirements and comply with the mandatory standards of the policy. It also requires the Engineering & Capital Projects Department, Development Services Department and Environmental Services Department (ESD) to ensure that the construction plans and implementation meet the mandatory standards.

The Sustainable Building Policy was initially adopted by Resolution R-289457 in 1997. The policy calls for an update at least every three years to align with applicable codes, standards and technologies. Updates occurred in 2001, 2003 and 2010.

ENERGY CONSERVATION AND MANAGEMENT POLICY

Policy Number: 900-02
Effective Date: June 19, 2001

The policy was developed with a purpose of applying energy conservation guidelines to various areas of municipal operations, City regulated activities, indirect influence and public education.

In the City operations category, the policy targets the following areas:

- Purchasing - Maximize energy conservation measures when purchasing.
- Construction - Utilize most current energy conservation techniques, materials and appliances in design and specifications for public facilities to result in facilities that are at least 25% more energy efficient than required by current Title 24.
- Building Maintenance and Operations - Maintain and operate buildings so that minimum amounts of energy are consumed.
- Vehicles - Operate and maintain vehicles in a manner that ensures maximum energy conserving performance.
- Energy Reliability and Independence - Reduce demand on the energy grid and enhance energy reliability and independence for City facilities.
- Innovative Projects - Pursue the innovative application of new, non-depleting energy sources in the provision of its regular municipal functions.
- Energy Budgeting - Establish Energy Budgets for all major City activities so that the levels of service prescribed by City Council are carried out with the highest level of energy efficiency.

- Off-Peak Use - Maximize its proportionate off-peak hour use of gas and electricity and to encourage and promote the adoption of off-peak rates by the utility company.

The policy also requires the City to actively promote the dissemination of energy conservation and management information to the citizens of the City, and to provide incentives to encourage implementation of energy saving programs.

The Energy Conservation and Management Policy was initially developed by Resolution R-215806 in 1976 and was updated in 2001.

PURCHASE OF ENERGY-EFFICIENT PRODUCTS POLICY

Policy Number: 900-18
Effective Date: June 19, 2001
The policy requires the City to purchase energy-efficient equipment that meets either ENERGY STAR specifications or U.S. Department of Energy (DOE) criteria that puts products in the upper 25% of energy efficiency. Specific product categories covered under this policy include, but are not limited to, the following:

- Office equipment
- Heating and cooling equipment
- Exit signs
- Lighting
- Appliances
- Other commercial products

The policy also calls for educating City employees about the economic savings and environmental benefits of ENERGY STAR compliant equipment and other practices that minimize energy use.

The Purchase of Energy-Efficient Projects Policy was initially established by Resolution R-295073 in 2001.

CURRENT PRACTICES

Municipal facilities built after the adoption of the Sustainable Building Policy 900-14 in 2003 are supposed to be built to achieve a minimum of LEED Silver. Sustainability elements in these new facilities include renewable energy technologies, cool roofs, and high-performance building envelope and lighting designs. While the policy calls for providing a minimum of 15% of total building energy from renewable sources, solar PV systems installed at several new facilities provide more than 30% of the total energy onsite. Although these projects achieved or exceeded LEED Silver requirements, many did not include enhanced commissioning, measurement and verification procedures, energy-efficient LEDs with occupancy sensors, and energy management systems that can be automatically accessed for demand response calls with the local utility. Review of the energy use profile of several City facilities built to LEED standard shows that they are consuming higher energy than projected.

> Title 24, Part 6 (the Energy Code) regulates building energy efficiency and renewable energy requirements for residential and nonresidential buildings in California. The California Energy Commission updates the Energy Code every three years. A code update released in 2022 will go into effect in 2023.

While existing policies provide guidelines for conserving energy in municipal construction and operations, they do not define roles and responsibilities to effectively implement or

enforce the policy requirements. Further, existing policies include conflicting guidance (e.g. 900-14 specifies that new municipal construction projects exceed Title 24, Part 6 by 15%, while 900-02 requires new buildings to exceed the state code by 25%).

DEVELOPMENT OF NEW AND REVISED POLICIES

A key component of implementing the MES is developing updated and/or new policies that better align with the CAP and MES. Staff will work with internal stakeholders to determine the best path forward, considering the benefits of updating existing policies versus development of new policies. Development of new and retirement of old policies may be the easiest way to establish standards for sustainable energy as the City focuses on achieving its new, more ambitious municipal energy goals. New and revised policies must include implementation details that clearly assign responsibilities to key departments, provide clear pathways for compliance, and establish enforcement and mitigation mechanisms.

NEW POLICIES ADDRESSING SUSTAINABLE NEW CONSTRUCTION & RETROFITS VS. BUILDING OPERATIONS

While the existing policies above address both new construction and ongoing municipal operations to some degree, separate policies for each phase of a building's life cycle may be easier to follow and enforce, and thus be more impactful to reaching clean-energy and sustainability goals. Given the current focus and momentum around sustainable energy, this Plan proposes development of two policies addressing 1) zero emissions building new construction and existing building retrofits, and 2) ongoing zero emissions building operations. Development of these policies would be facilitated by the Sustainability and Mobility Department. To address the sustainable use of other resources, an inter-departmental effort could focus on development of two additional policies addressing 3) non-energy sustainable building new construction and retrofits and 4) non-energy sustainable building operations. (Non-energy sustainable building topics typically include water, waste and indoor air quality, at a minimum). The latter two policies could refer to the first two policies so that all stakeholders have clear guidance addressing all aspects of sustainability in the municipal built environment.

Given the large number of buildings owned by the City and leased to other parties, a policy and toolkit addressing operations in leased City facilities would also be beneficial. Such a policy may require lessees to purchase 100% renewable energy from SDCP, and could address building performance, EV charging and more. The Sustainability and Mobility Department will work with the Department of Real Estate and Airport Management (DREAM) to explore development of policies that ensure lessees of City facilities do their part to reduce the impacts of climate change.

ZERO EMISSIONS MUNICIPAL BUILDINGS & OPERATIONS POLICY

Strategy 3, Action 1 of the City's MES is to adopt and enforce zero emissions building standards and policies for municipal facilities. Similarly, in Measure 1.3 of the 2022 CAP, the City is directed to develop and adopt a municipal zero emissions buildings and operations policy. Zero emissions (also referred to as zero carbon) buildings are designed and equipped so that all energy use in the building — for heating, cooling, lighting, appliances, fleet vehicle charging, etc. — is as efficient as possible and comes from renewable energy sources. Zero emissions buildings also do not use natural gas, which is a common building and water heating fuel with significant climate change impacts. As the City transitions to 100% renewable electricity procured by SDCP, establishing policies that require a shift away from natural gas use and toward electricity for all building end uses is one of the fastest and most effective ways to deliver on this strategy. The proposed policy would also address EV infrastructure, ensuring that as new projects are constructed or existing parking lots are retrofitted, EV charging for the public and City employees is installed to meet expected growth. ("Operations" in this sense refers to the EV charging elements.)

To meet San Diego's growing community needs, the City is building new neighborhood facilities including libraries, fire stations, recreation centers, etc. Simultaneously, existing City facilities are due for improvements, to address both deferred maintenance and to upgrade energy technologies like lighting and HVAC that are old, inefficient and due for replacement at end of life. Similarly, as the City's fleet transitions to EVs to meet state and self-imposed mandates, municipal building electrical infrastructure – specifically the electrical service panels – will provide the fuel for the growing electric fleet. A zero emissions policy will provide guidance and specifications for new and replacement technologies that enable fuel switching, demand response, building automation and fault detection, EV charging, and will increase the City's resiliency in the face of increasing energy disruptions.

Adoption of a zero emissions policy that applies to new municipal construction projects and major retrofits of existing municipal facilities will establish building standards and performance targets that address energy efficiency, solar PV, EV charging, and specifications for energy management and controls technologies to ensure all newly installed systems can be integrated into a Citywide building automation system (BAS) platform. A zero emissions policy can also direct further investigation into the costs associated with transitioning natural gas end uses to electric technologies for each asset managing department's (AMD's) portfolio of facilities. Policy development should include a special look at critical City operations, like water and wastewater treatment, and ensure that requirements do not negatively affect the City's ability to provide critical services.

After initial adoption of the zero emissions municipal buildings and operations policy, subsequent updates could increase the focus on building operations that generate

GHG emissions, including efficient use of appliances, temperature set points for HVAC and water heating systems, battery storage and microgrid operations, and potentially water and wastewater treatment facility operations. Through the continuous update of municipal construction guidance documents, the City can ensure it incorporates the latest technology and methods while reducing the embodied carbon and GHG emissions associated with extracting, manufacturing and transporting construction materials. Future updates to the policy could also address the embodied energy, or energy intensity of water, that result from treatment and delivery.

COST IMPACTS FOR ZERO EMISSIONS NEW CONSTRUCTION

Energy-efficient and all-electric design for buildings can substantially reduce the annual utility costs of operating the building. In addition to reducing utility costs, all-electric buildings also have a lower construction cost than mixed-fuel buildings, which use a mix of electricity and natural gas.

The costs and savings of different building design options were investigated in the 2019 Nonresidential New Construction Reach Code Cost Effectiveness Study (Reach Code Study),[2] which was commissioned by Southern California Edison under the auspices of the California Public Utilities Commission. The study evaluated the costs, energy savings and climate impact of different options such as all-electric design vs. mixed-fuel design, energy-efficient design vs. minimum-code design, and use of solar. The study considered different building types (medium office, hotel and medium retail) and looked at all of California's climate zones and major utility service areas, including the SDG&E area.

The Reach Code Study found that, in San Diego Climate Zones 7 and 10, energy-efficient design, all-electric design and rooftop solar all offer substantial cost savings for the building owner or tenant, and also reduce GHG emissions. For the case of a new medium-size office building (a three-story building with approximately 54,000 square feet of floor space) located in San Diego, the Reach Code Study found that using an all-electric design would reduce the total construction cost by about $70,000. Furthermore, the study found that using electricity rather than gas for all appliances would reduce utility bill costs by about $50,000 over 15 years.

The Reach Code Study also considered a suite of energy-efficiency measures, including items such as high-performance windows, use of economizers on all HVAC systems and advanced lighting controls. Compared to a building built to minimum code, the extra efficiency measures examined in the study increased construction cost by about $67,000, but yielded $210,000 of utility bill savings over 15 years.

Finally, the study examined the use of rooftop solar panels. It looked at both small solar systems and large solar systems. The study

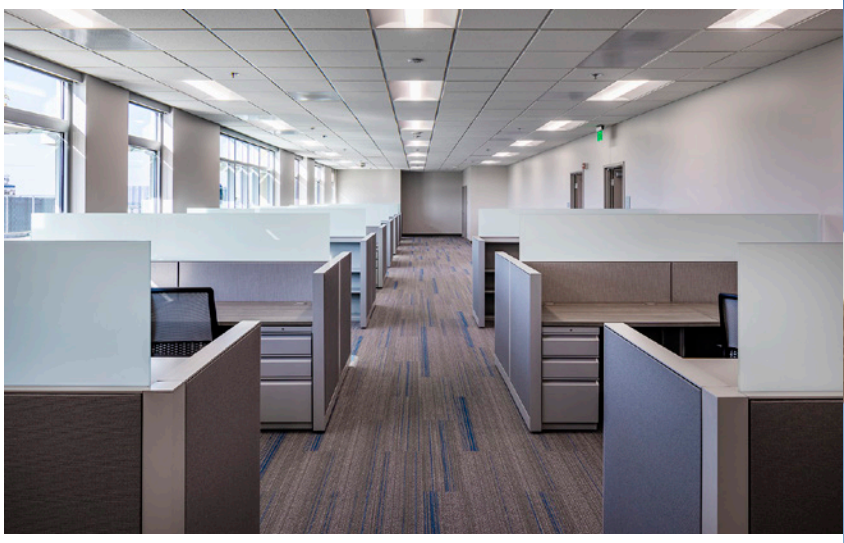
[2] 2019 Nonresidential New Construction Reach Code Cost Effectiveness Study

found that the most cost-effective option was a large solar system, sized either to cover the building's full annual electricity consumption or sized as large as the roof could accommodate. For the medium office building considered in the study, the solar system was limited by available roof area. The study found that including a 135 kW solar array as part of the initial construction would raise construction costs by $184,000 but provide $413,000 in utility bill savings over 15 years.

In summary, out of the options considered, the Reach Code Study found that the best value for money could be obtained by using all three: an energy-efficient, all-electric building with onsite solar. This was also the option with the most reduction in GHG emissions. Furthermore, the Reach Code Study also considered other types of commercial buildings (medium retail and hotel), other utility service areas and other climate zones. Across the board, the study found that an energy-efficient, all-electric building with solar strongly outperforms its mixed-fuel, minimum-code equivalent both on the basis of cost over 15 years and on the basis of GHG emissions.

COST IMPACTS FOR EXISTING BUILDING DECARBONIZATION

Assessing the costs of decarbonizing the City's existing building stock is significantly more



complicated than for new construction. The City's existing building stock is composed of hundreds of facilities of various sizes and built across more than nine decades. Existing infrastructure – everything from electric service panels to roof materials to control systems – varies significantly. As such, cost estimates to convert existing fossil-fuel burning systems to electric are currently unknown. Staff are exploring options to perform fossil-fuel inventories of existing facilities, along with assessments of electric infrastructure, to gain a better understanding of the estimated costs and savings associated with electrification efforts. Similarly, staff are gathering information about the options for fleet electrification and assessing the cost implications of installing EV charging stations to support an all-electric fleet.

SUMMARY

The City's existing policies are outdated and due for updates addressing energy conservation strategies that have been identified and grown in popularity since the latest drafts were adopted in 2001. New and revised policies can also address lessons learned during the COVID-19 pandemic related to building ventilation, remote work and the ability to reduce energy consumption and GHGs through telecommuting, hot-desking and other alternatives to the 40-hour onsite work week experienced by many City employees. Comprehensive and well-structured policies will play a critical role in both providing clear guidance and establishing compliance and enforcement mechanisms that will increase the likelihood that the City achieves its zero emissions goals.

Energy Programs

INTRODUCTION

The MES establishes high-level priorities and areas of focus that staff should consider as they work to reduce GHG emissions across the municipal building portfolio and achieve the goal of zero emissions municipal operations over the next 14 years. The descriptions below address these priorities and provide guidance for staff implementing clean-energy projects.

ENERGY PROJECT FINANCING & FUNDING

The energy performance opportunities outlined in this report are substantial and equate to significant costs for AMDs. The MES goal to reach zero emissions at municipal facilities conflicts with limited available budgets to fund capital improvements and deferred maintenance. While further study is required to assess the specific cost impacts of electrification and GHG reductions among existing facilities, staff can act now to identify internal and external funding sources that will enable energy retrofits to existing buildings. Because energy-efficient design, all-electric design and rooftop solar all offer substantial cost savings in new construction projects, this section focuses on funding for zero emissions efforts for the City's existing buildings and vehicle charging infrastructure.

CITY FACILITIES IMPROVEMENTS / ABT00001

The Department of General Services' City Facilities Improvement ABT00001 is the primary source of funds available to support decarbonization of the City's existing facilities. According to the Fiscal Year (FY) 2022 Budget, this annual allocation provides for capital improvements at City facilities, including improvements to roofs, heating, ventilation, air conditioning, elevator replacements, adjacent parking lots and facility expansions.[3] ABT0001 is intended to cover the costs of priority repairs and improvements, with a focus on keeping City facilities safe and operable. This annual allocation was anticipated to receive $13.5 million in Commercial Paper Funding in FY2022. In FY2022, Facilities Services' budget included unidentified funding needs in the amount of $433,059,708, reflecting the estimated amount needed to address the deferred capital needs of the City's General Fund-supported buildings based on condition assessments. This estimate does not include the costs of fuel switching, installation of EV charging, nor the costs of upgrading electric service panels to support an increased electric demand associated with decarbonization of our buildings and fleet. While not all of these unfunded improvements are energy related, it is clear that General Fund monies are not adequate to cover the cost of facility improvements necessary to achieve the municipal energy goals. Fortunately, there are well-established models of financing that the City can utilize to support retrofits to meet municipal energy goals and, in some cases, related deferred maintenance needs.

[3] Adopted Budget Fiscal Year 2022

ENERGY-AS-A-SERVICE

Energy-as-a-Service (EaaS) is an innovative business model whereby a service provider offers various energy-related services. Providers typically bundle energy advice, asset installation, financing and energy management solutions to offer a suite of services to customers.[4] EaaS solutions provide an antidote to the increasing complexity and volume of clean-energy solutions that stray from local government core competencies and put strain on limited capital budgets. EaaS can shift risks away from the City to third-party partners that provide guarantees specific to energy savings, GHG reductions and avoided operating costs. The City is already leveraging EaaS through execution of power purchase agreements (PPAs) for solar PV and an Energy Management Services Agreement (EMSA) for renewable microgrids. Additional EaaS options should be considered as the City pursues electrification of its facilities and fleet.

PARTNERSHIPS WITH ENERGY SERVICE COMPANIES

The City is currently pursuing EaaS partnerships with Energy Service Companies (ESCOs), which are full-service energy engineering and construction firms that develop and implement energy savings plans for a building or portfolio of buildings, install energy-efficiency and clean-energy upgrades, and provide system maintenance and monitoring through the life of service agreements. ESCOs also facilitate financing for the project, eliminating upfront capital costs. While ESCOs are well known for offering Energy Savings Performance Contracts (ESPCs) to enable energy-efficiency projects, they also provide a range of energy project financing options to support installation of renewable energy, microgrids and more. These agreements are collectively referred to as Energy Conservation Contracts. Many ESCOs also perform a wide range of infrastructure improvements and provide EV charging services.

ESCOs invest their funds to cover the upfront costs of energy projects performed at City facilities. The resulting energy cost savings are then used to pay for the upgrades over time. The ESCO guarantees the projected energy savings and provides ongoing reports verifying the actual savings. If guaranteed savings are not met, the ESCO provides reimbursement and/or fixes the problem at no additional cost.

In 2020, staff secured an amendment to the municipal code to update the process by which the City procures such contracts. The amendment allows staff to execute energy conservation contracts with the ESCO that performed investment grade audits without a separate bid process. This change significantly reduces the risk of not achieving the desired savings and gives the ESCO the confidence it needs to guarantee the energy savings.

The new municipal code language leverages CA Government Code Sections 4217.10-4217.18, which were adopted in 1984 as a result of an energy crisis to assist public agencies in expediting and financing energy conservation measures. It provides public agencies a streamlined alternative process for procuring public works energy services contracts related to renewable energy and energy conservation in public facilities and on land owned by public agencies. To enter into Energy Conservation Contracts the City must: (1) determine the terms of the contract are in the best interest of the City at a regularly scheduled public hearing, where two weeks' public notice of the hearing was provided; and (2) find that funds for the repayment of the financing or the cost of design, construction, and operation of the facility, or both, are projected to be available from a reduction in the cost of energy that would have been consumed in the absence of the services, or from revenues resulting from sales of electricity from the facility.

[4] Energy as a service: Innovation Landscape Brief; IRENA, 2020

ENVISIONED PROCESS

Sustainability and Mobility Department staff are working with key internal stakeholders to establish a procurement for ESCOs and implementation process for energy conservation contracts as follows:

1. City performs a competitive Request for Statements of Qualifications (RFSQ) to establish a pre-approved list of ESCOs that meet the City's desired criteria.

2. City assigns specific buildings from the larger Clean-Energy Retrofit portfolio to the pre-approved ESCOs; City & ESCO enter into Project Development Agreement (PDA) defining the scope and cost of Investment Grade Audits (IGA).

3. ESCOs perform IGAs to determine project scope, costs and guaranteed savings.

4. Staff explores addition of deferred maintenance and/or CIPs into the scope of work as allowable given cash-flow projections. Staff also explores opportunities to infuse budget with City funds, state or utility incentives, and/or grant funds to reduce financing term.

5. City and ESCO enter into contract (ESPC, PPA, EMSA or other) when the City finds the contract to be in the best interest of the City and that anticipated cost to the City for services provided by the ESCO will be less than the anticipated marginal cost to the City of the energy that would have been consumed by the City without the project.

    - If IGA does not reveal a viable project, or if parties cannot agree on project scope and/or financing terms, City pays for IGA but does not execute contract.

6. ESCO completes project and performs commissioning.

7. ESCO performs ongoing measurement and verification to validate performance

and reviews performance results on an annual basis (at minimum) with appropriate City staff.

8. ESCO provides reimbursement if guaranteed savings are not met and/or fixes the problem at no additional cost.

Sustainability and Mobility staff are currently working with AMDs to pursue comprehensive energy retrofits on approximately 50 municipal facilities in partnership with ESCOs, as referenced in the Projects section below. The participating facilities were selected based on the energy performance opportunities provided by SC Engineers (consultant to the Sustainability and Mobility Department), input from asset managers, and consideration of the equity, resiliency and core benefits impacts anticipated from each project. Additional projects will be identified in the coming years; staff anticipates leveraging the ESCO model repeatedly over the next 12 years to reach the 2035 zero emissions goal.

While ESCO funds can likely be used to cover the costs of some deferred maintenance, any project costs that do not drive direct energy savings will lengthen the contract financing terms. Asset managers should be prepared to dedicate capital to support building improvements that may not be directly tied to energy savings but may be required in order to achieve energy reductions. Examples of ancillary building improvement costs include asbestos remediation to enable wiring for new electrical appliances and end uses, electric service panel upgrades, ADA improvements triggered by deep retrofits, and network cabling to enable installation of building automation technologies, among others.

Staff will leverage the ESCO RFSQ process to identify partner ESCOs that provide services in alignment with the strategies and priorities established in the MES and the Plan, including firms that are experienced in deploying distributed energy resources that increase the City's resiliency in the face of climate change-driven disasters (e.g., renewable microgrids and grid interactive efficient building technologies) and move City facilities and operations toward not just CAP targets but also the goals in the Climate Resilient SD plan. Similarly, staff will seek ESCOs that partner with local clean-energy workforce training providers and will leverage City retrofit projects to provide on-the-job training for local workers. ESCO partnership agreements will address prevailing wage, specialized skillsets and union certifications, and help establish high-road jobs that provide a just transition to an all-electric future.

GRANTS, REBATES AND INCENTIVES

Significant grant funding to support municipal building and fleet decarbonization efforts is currently available and more is anticipated. While there is significant funding in federal legislation currently moving forward, City staff should not lose sight of the funding that already exists to accelerate the transition to a clean-energy economy. Grant opportunities are commonly offered by the Environmental Protection Agency (EPA), DOE, and Department of Transportation, as well as state agencies including the California Energy Commission and California Air Resources Board. Similarly, incentives and rebates are commonly made available by the California Public Utilities Commission via Investor Owned Utilities. In addition, because decarbonization efforts have co-benefits that improve community resiliency, equity and health outcomes, agencies focused on health, emergency response and planning, workforce development, and economic development are also potential sources for funding to support the City's municipal energy goals. This includes the Federal Emergency Management Agency's Building Resilient Infrastructure and Communities (BRIC)

program and the Economic Development Administration's American Rescue Plan Programs.

To identify funding opportunities, Sustainability and Mobility staff will work with the City's Grants Office to track funding announcements from these agencies and others and will leverage resources such as the Federal Funding Opportunities for Local Decarbonization (FFOLD) tool developed by the World Resources Institute and RMI.[5] Staff will work with internal and external partners to prepare grant applications that highlight the City of San Diego's ambitious climate and equity goals and secure funds for a variety of activities that support municipal decarbonization efforts. Staff will also take advantage of rebates and incentives to help offset project costs.

In the past 10 years the City has been awarded grants from the California Energy Commission, National Renewable Energy Labs (NREL), and the American's Cities Climate Challenge. These grants and related programs have helped the City convert existing libraries to near zero net energy facilities, helped the City set up a Smart City Open Urban Platform to better monitor buildings energy consumption, and helped analyze the City of San Diego's solar potential for midsized facilities as well as on our own City facilities. The City is in the design phase for a California Energy Commission grant where eight critical facilities are being equipped with renewable microgrids, solar and battery storage to help reduce the City's operating cost and grid dependance while increasing the City's resiliency. Smart City Open Urban Platform

[5] https://cityrenewables.org/resources/federal-funding-opportunities-for-local-decarbonization-ffold/

Smart City Open Urban Platform (SCOUP)

In 2017 the City of San Diego received a grant from the California Energy Commission and the Local Government Commission to launch the Smart City Open Urban Platform (SCOUP) to enable remote, automated control and tracking of energy systems at City facilities. Under the pilot, energy use data and EPA's Energy Star Portfolio Manager benchmarking data for all 3,500 municipal energy meters were integrated into SCOUP databases and displayed through public-facing energy dashboards. Additionally, three municipal libraries were integrated into a central Building Automation System (BAS) equipped with fault detection and diagnostics. With this system in place, the City expects to more efficiently operate the libraries and experience both energy and GHG reductions. The project wrapped up in March 2022.

Notably, implementation of the project resulted in a significant outcome that would not have otherwise been realized – collaboration and recognition among key internal stakeholder departments regarding the significant value and work associated with establishing a citywide, enterprise BAS.

SCOUP will help our City be better prepared to weather climate-change-driven disruptions. The SCOUP dashboards will provide better transparency into demand shifting opportunities. This will not only decrease costs, but also allow the City to play its part in times of grid stress, thereby reducing risks of outages and wildfires, and increasing safety and resiliency across our communities. Remote accessibility to energy-system controls increases response times of facilities' staff and ensures building energy systems can be managed more easily in times of disruption.

Zero Net Energy Library Project

The City of San Diego, in partnership with the Center for Sustainable Energy, California Energy Commission, Mazzetti Inc., M+NLB Construction Services, San Diego Green Building Council and San Diego Gas & Electric completed a multiyear project to test, verify and publicize the integration of energy efficiency, onsite renewable power and other demand-side resources to convert three public libraries to near zero-net energy buildings.

Energy conservation measures implemented included light-emitting diode (LED) lighting, lighting controls, plug load management devices, heating, ventilation, and air conditioning controls and whole-building automation platforms that measure demand trends to optimize equipment operations. The project also engaged and educated library staff, volunteers, and community members through interactive, in-library kiosks on zero-net energy and integrated demand side management strategies, sustainable energy and associated environmental benefits, extending energy savings beyond the three project sites.

To measure success, the project team conducted pre- and postconstruction surveys of library staff and volunteers. The team also conducted nine months of post-retrofit measurement and verification with a three-month projection to estimate annual post-retrofit energy consumption due to COVID-19 shut down of the libraries. The project results indicated that the energy-efficiency measures reduced electric consumption at the libraries between 13 and 30 percent. Photovoltaics were installed at each of the libraries independent of the grant.

As a result, two of the libraries were able to achieve near zero-net energy due to combining the photovoltaics and energy-efficiency measures. The project demonstrated a blueprint to achieve near zero-net energy for other City of San Diego municipal buildings along with the benefits and challenges of retrofitting existing buildings.

Future grant funds will help the City pursue innovative decarbonization projects addressing challenges such as sustainable aviation fuel, carbon capture and storage, long duration battery storage, community resiliency hubs and more.

ELECTRIC VEHICLE CHARGING

The City is electrifying fleet vehicles for a multitude of reasons, including regulatory compliance, economic benefit, and GHG reductions. The primary action to meet this gasoline reduction goal is the conversion fleet vehicles to electric vehicles (EVs). Several state-

level regulations and directives are catalyzing fleet conversions. Governor Newsom's September 2020 Executive Order N-79-20 requires that, by 2035, all new car and light-truck vehicle purchases in the state be zero emissions vehicles. In addition, Executive Order N-79-20 requires the California Air Resources Board (CARB) to develop regulations that mandate all operations of medium- and heavy-duty vehicles shall be zero emissions by 2045.[6] Lastly, CARB is currently developing an Advanced Clean Fleet (ACF) regulation for final approval at the end of 2021 that will mandate the gradual ZEV adoption for all large fleets in the state, with targets starting as early as 2024.

Beyond mandates and regulations, fleet electrification has tremendous economic benefits including lower lifecycle costs and reduced risk of fuel price volatility when compared to gas-powered vehicles. Public agencies that have converted to zero emissions vehicle fleets have reported the cost per mile drops up to 65%.

ELECTRIC VEHICLE CITY FLEET

The City's fleet has approximately 4,000 on-road vehicles - a mix of sedans, LD, MD and HD vehicles. The Department of General Services Fleet Operations team manages the procurement of City vehicles and procures an average of 500 fleet vehicles per year, with most vehicles remaining in service at the City for approximately seven years with some exceptions (primarily public safety vehicles). As of the end of 2020, 20 of the City's on-road fleet vehicles are all-electric. The City has quite a way to go to achieve the 2030 and 2035 ZEV targets established in the 2022 CAP.

Figure 6. CAP Measure 2.2: Increase Municipal Zero Emissions Vehicles – Targets

2030 TARGET	**2030 GHG REDUCTION**	**2035 TARGET**	**2035 GHG REDUCTION**
Percent of all municipal fleet vehicles to be ZEVs: Cars: 75% LDV: 50% MDV: 50% HDV: 50%	(MT CO2e) 11,042	Percent of all municipal fleet vehicles to be ZEVs: Cars and LDV: 100% MDV: 75% HDV: 75%	(MT CO2e) 15,990

To date, upfront vehicle cost and lack of variety in vehicle models have limited electric fleet adoption. Significant advancements in battery technology as well as production commitments from the automobile manufacturers have brought down the costs of EVs generally. At present, there are a variety of affordable, fleet-focused EVs on the market. While there remains a moderate price premium for EVs, significant savings in operating, maintenance and fuel costs can offset upfront investments after only a few years of operation, reducing overall fleet operating costs. This is especially the case in the sedan market, which has seen popular uptake for public fleets to electrify.

In addition to LD vehicles, several medium and heavy-duty vehicles are also launching to market, including electrified refuse trucks, dump trucks and step vans. As this market

[6] https://www.gov.ca.gov/wp-content/uploads/2020/09/9.23.20-EO-N-79-20-Climate.pdf

segment continues to gain vehicle availability, in part due to ever decreasing cost of batteries and improving battery density/vehicle range, more vehicles are expected to be available for fleet purchase in years to come.

Several key advancements in the vehicle market are expected to quickly impact the options available for the City to convert fleet vehicles. First, a number of key manufacturers are focused on developing partial-to-fully electrified pick-up truck options, including Chevrolet, Ford, Lordstown Motors, Rivian and Tesla. These pick-up truck options are expected to market as soon as 2021. While higher in MSRP than sedan EVs, the operational savings are expected to be proportionally higher, due to the relatively poor fuel economy and idle time of standard internal combustion pick-up trucks.

Another market segment of vehicles of particular importance to the City fleet conversion is growth in medium-and-heavy-duty options, ranging from Class 3 to Class 8. A few step van, refuse and dump truck options are currently available for sale, with more expected to market in the next three to five years. Finally, electrification of transit and school bus options should be emphasized as a market already available and expected to grow further. This can create unique fleet charging strategy for the City of San Diego, in collaboration with SDMTS and school districts, where chargers could be shared across fleets depending on when charging is needed throughout the course of a workday.

EMPLOYEE CHARGING

Several employers have begun to offer access to electric vehicle charging stations (EVCS) so employees can charge personal EVs during the workday. Benefits of daytime charging include using excess renewables generated by onsite and grid-tied solar PV, which helps increase grid stability. The City is exploring partnerships with EV charging providers to determine the appropriate structures and rates for workplace charging for City employees.

PUBLIC CHARGING

The City can also provide access to EVCS at libraries, parks, recreation centers and other facilities frequented by the public. Several approaches to the installation and management of pubic EVCS on City property are available including partnerships with EVCS companies that would provide charging stations at no cost to the City. Policy decisions about where to prioritize charging stations, preferences for fees or revenue sharing from commercial activity on public land, and other topics need to be determined prior to deploying public access EVCS at City facilities. Charging stations at City-owned parking garages are another option to investigate, which must take account of the large electricity load increase from EVCS at the garages with relatively light electrical infrastructure/capacity.

CHARGING INFRASTRUCTURE BARRIERS TO ADOPTION

The largest barrier to EV fleet conversion has been the cost and complexity of installing charging stations for all-electric vehicles. As such, the specific timeline of fleet vehicle electrification will be dependent on installing charging stations to support new electric vehicles. As of summer 2021, significant work has been done to evaluate the cost and

feasibility of installing charging stations at a sampling of City facilities, and the City continues to work toward a comprehensive plan for fleet electrification charging station deployment.

BUILDING AUTOMATION

A Building Automation System (BAS) is a way to centralize controls of a building's heating, ventilation, air conditioning, lighting and other building systems. BAS have been proven to improve occupant comfort, reduce energy consumption and GHGs, provide remote access to equipment, reduce operations and maintenance costs and lengthen equipment life. An enterprise BAS could also serve as a platform for the "internet of things" (IoT) and allow for integration of non-energy technologies such as occupancy sensors, air quality sensors, etc.

The Plan includes establishment of a citywide, enterprise BAS platform. An enterprise BAS will allow the Department of General Services Facilities Division to receive alerts, adjust thermostats, and troubleshoot energy performance issues remotely via a single login to one system. The Facilities Services Division currently has remote access to approximately 50 of the City's 200+ occupied municipal buildings via Energy Management Systems (EMS), each with individual accounts and logins and with few alerts or alarms. This means building occupants must call and submit complaints before Facilities staff log in to view their EMS to adjust set points. At buildings without EMS, Facilities staff must adjust systems onsite. With an enterprise BAS, the Facilities Division has the potential to shift from being a reactionary department that spends the majority of time responding to complaints, to a proactive department that can begin to perform more deferred maintenance in their spare time.

In 2015 the City received grant funding from the CA Energy Commission (CEC) for Zero Net Energy retrofits at three libraries. The retrofits included installation of Tridium Niagara BAS. These systems are serving as single-building BAS without an enterprise system in place. Similarly, in 2017 the City received a grant from the CEC to install a Smart City Open Urban Platform (SCOUP). One of the SCOUP grant's primary deliverables is to pilot BAS at five facilities that will collect and analyze energy performance data from participating buildings, provide alarms when buildings are not performing as desired, and allow Facilities staff to make adjustments remotely from a central command point. This system would, ideally, be managed by dedicated staff referred to as "BAS Operators." These staff could be in-house DGS Facilities team members, or the role could be contracted out. This role does not currently exist at the City.

In partnership with the Department of Information Technology (DoIT), Sustainability and Mobility staff released a Request for Information (RFI) to gather information about BAS from the industry; responses are pending as of this writing. RFI responses will inform development of specifications and requirements for an enterprise BAS that could be installed at a future date, pending available

funding. Discussions with DoIT also address long-term maintenance contracts once systems are connected to the City network, funding for said contracts, and working with Purchasing and Contracting to identify the best procurement pathway to support the determined path forward.

Because of the necessary sophisticated network architecture, access controls and cybersecurity requirements, BAS is one major component of this Plan that will likely incur upfront capital and ongoing maintenance cost to the City. It was determined early in the process, and in ongoing coordination with DoIT, that the BAS should not be financed or parceled out to one of more of the anticipated ESCO partners, but instead be coordinated under a centralized effort spearheaded by appropriate City departments (namely DoIT, DGS Facilities and Sustainability and Mobility). However future retrofits performed by ESCOs will include installation of monitoring and controls equipment that should integrate with the City's centralized, enterprise BAS. While there are opportunities for grant revenue to offset these costs, like the two projects mentioned above, the BAS will need direct funding from the City budget.

A FOCUS ON EQUITY

In 2019, the City of San Diego developed the first-of-its-kind Climate Equity Index (CEI), in partnership with several community-based organizations representing Communities of Concern or advocating for environmental justice policy development. The goal of the CEI is to measure the level of access to opportunity residents have within a census tract and assess the degree of potential impact from climate change to these areas. The CEI is the first tool in the country that considers the effects of climate change, environmental pollution and vulnerable populations.

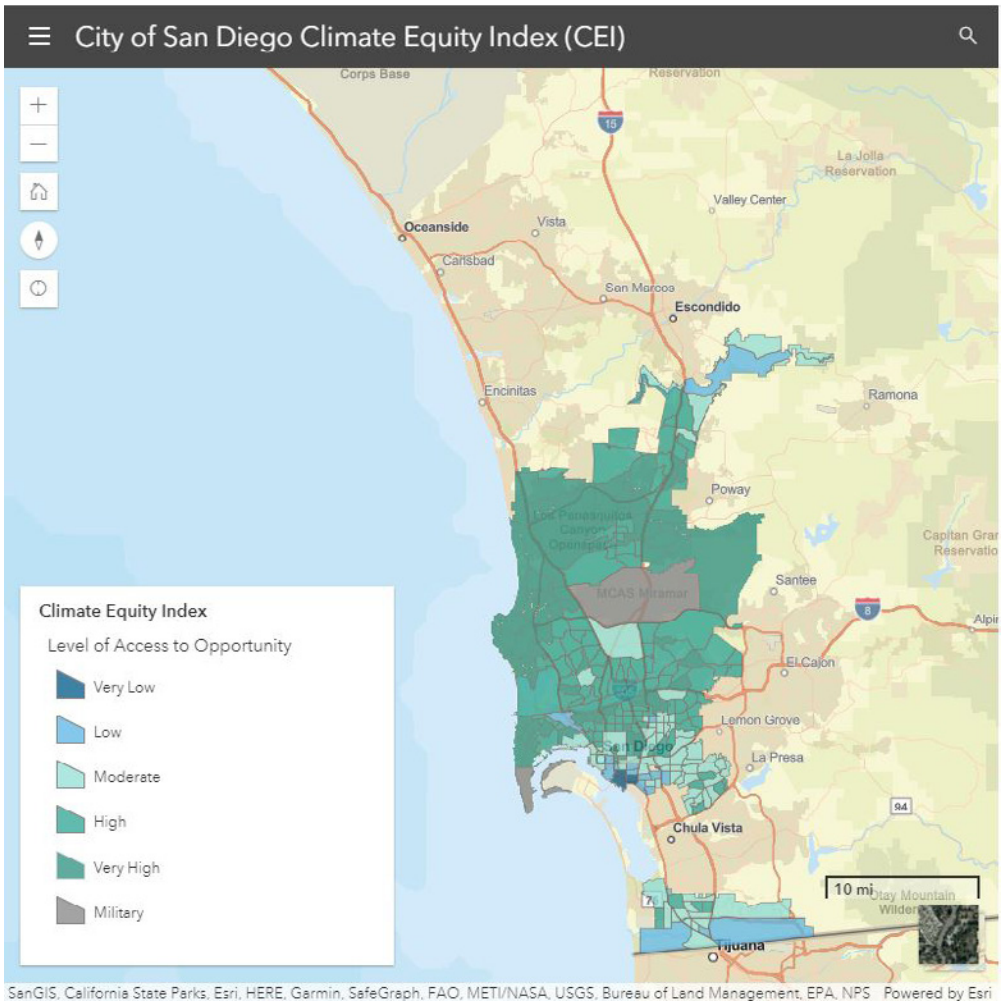
Leveraging the CEI, staff will assess the opportunity for municipal facility energy retrofits to increase access to resources for Communities of Concern. Where retrofits will increase access, they will be prioritized. Examples of municipal energy projects that might increase access to resources include:

- Installation of a renewable microgrid with battery energy storage at a library that enables the facility to remain operable during a power outage, allowing the library to continue to serve as a Cool Zone for the surrounding Community of Concern even during energy disruptions.
- Installation of new air conditioning systems (coupled with solar PV to offset increased electricity consumption) at recreation centers. Many recreation centers in southern areas of the City are not equipped with air conditioning, limiting their use, and reducing the comfort of patrons on hot days.
- Electrification of the City's fleet and installation of EV charging stations at municipal parking locations, which are commonly located in or adjacent to census tracts with low CEI scores. Fleet electrification significantly reduces air pollution, improving air quality in Communities of Concern.

Climate equity:

Addressing historical inequities suffered by people of color, allowing everyone to fairly share the same benefits and burdens from climate solutions and attain full and equal access to opportunities regardless of one's background and identity.[7]

[7] Definition developed by participating stakeholder consensus.

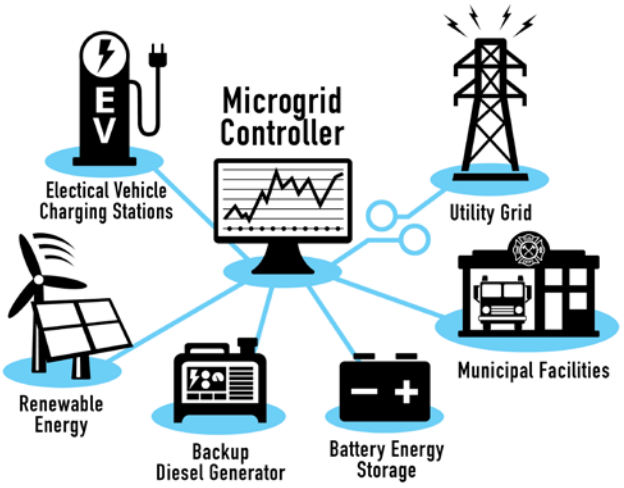


A FOCUS ON RESILIENCY

Resiliency is the ability to remain functional during, or to bounce back quickly in response to disruptions. Both the MES and Plan describe efforts to increase the City's resiliency in the face of climate-driven energy disruptions from wildfires, floods and other severe weather events. San Diego is already experiencing more frequent and intense heatwaves, increased wildfire risk, and more unpredictable and intense rain events. Climate Resilient SD will be the City's comprehensive climate adaptation and resiliency plan, which will increase our ability to adapt, recover and thrive in a changing climate. Climate Resilient SD will include energy-related actions that both reduce municipal GHG emissions and increase resiliency.

A prime example of an energy project that increases the City's resiliency is installation of renewable microgrids that allow municipal facilities to remain operable during power outages. Renewable microgrids equipped with solar PV and battery storage can enable limited facility operations when the electricity grid is down without the use of backup diesel generators, which generate significant GHGs. Vehicle-to-grid (V2G) systems that allow EV batteries to discharge to the larger electric grid or a site-specific microgrid during times of need are another example of clean-energy solutions that provide resiliency benefits.

Figure 7. Typical Microgrid Structure and End Uses



During the majority of time when the larger electricity grid is operational, microgrids enable electricity demand management strategies that reduce energy costs and grid stress. Facilities equipped with renewable microgrids can serve as emergency distribution centers and shelters during disasters, and Cool Zones during power outages driven by high temperatures.

Another energy initiative that will increase the City's climate resiliency is the prioritization of technologies that result in grid-interactive efficient buildings (GEBs). The DOE defines GEBs as energy-efficient buildings with connected, smart, distributed energy resources (DERs) that are integrated and continuously optimized for the benefit of building owners, occupants and the electric grid.[8] Establishing GEBs across the City's municipal building portfolio will ensure the City does its part to maintain a balanced grid, which will help reduce power outages related to grid stress. Because GEBs are typically accessible via remote access, these buildings will be able to come back online more quickly and continue providing services after disruptions.

Figure 8. Features of Grid-interactive Efficient Buildings

EFFICIENT

Persistent low energy use minimizes demand on grid resources and infrastructure

CONNECTED

Two-way communication with flexible technologies. the grid and occupants

SMART

Analytics supported by sensors and controls co-optimize efficiency, flexibility and occupant preferences

FLEXIBLE

Flexible loads and distributed generation/storage can be used to reduce, shift or modulate energy use

Sustainability staff will continue to work with asset managers to identify municipal facilities and communities that would benefit from installation of renewable microgrids and other energy technologies that increase resiliency.

Staff will continue to coordinate with the Planning Department and leverage Climate Resilient SD to ensure that energy projects with resiliency benefits are strategically implemented to bring the best value to the City.

[8] https://www.energy.gov/eere/buildings/grid-interactive-efficient-buildings

WORKFORCE TRAINING & DEVELOPMENT

Municipal electrification efforts have the potential to help transform the market for building decarbonization. Energy projects that transition gas-burning equipment to electric alternatives and renewable and advanced energy projects present opportunities for on-the-job training for both City staff and local trainees. A San Diego Jobs Impact Analysis performed by The Building Electrification Institute and Inclusive Economics in December 2021 showed a net job gain for building retrofit workers, particularly for HVAC technicians, electrical workers, and general construction laborers and carpenters as a result of municipal decarbonization efforts by the City of San Diego. Additionally, no expected near-term impacts on gas utility or gas infrastructure workers were identified in the analysis.

To enable this type of workforce development, the City can partner with local workforce education and training partners, including labor unions and community organizations, to engage and train local industry participants. Retrofit project contracts should incorporate skilled and trained labor standards, which can help ensure that the jobs created are good quality jobs and that these upgrades deliver the projected energy benefits. The City can also work directly with manufacturers and distributors to bring training to the local workforce to help build a local supply chain for alternative electric space and water heating technologies as the market advances.

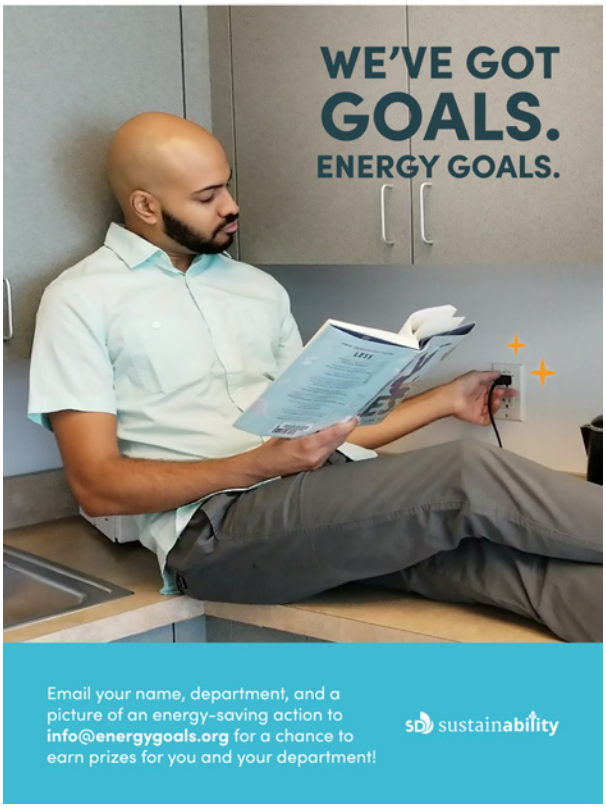
STAFF EDUCATION & ENGAGEMENT

City staff and patrons of the City's public buildings have a role to play in achieving municipal energy and GHG reduction goals. Throughout the ongoing process of identifying, prioritizing and implementing clean-energy projects on municipal facilities, project staff will engage with facility staff and community members to increase awareness, gather feedback and share lessons learned.

An example of staff engagement is the Energy Goals campaign that Sustainability staff delivered in fall 2020. The challenge was led by the City's Sustainability and Mobility Department, who called on employees to learn about energy and to take actions that reduce San Diego's carbon footprint and help reach goals outlined in the City's MES and CAP. The Sustainability and Mobility Department and their consultant TEC developed robust virtual resources to engage the City's workforce as it navigated the changing landscape related to the COVID-19 pandemic. Through participation in the Energy Goals challenge, the City illustrated its commitment to energy efficiency and conservation and its investment in employee development.

Delivered through a "Pledge. Learn. Act." framework, Energy Goals combined outreach methods to maximize the challenge's impact across departments. Through TEC's online engagement platform, https://energygoals.org/, City employees accessed educational videos and materials, shared energy-saving actions through photo uploads, and competed between departments to save energy. TEC created an Energy Goals kick-off video featuring City employees, signage, email blasts and newsletters to encourage participation, then delivered the challenge with a "train-the-trainer" style implementation.

Using a combination of built-in analytics



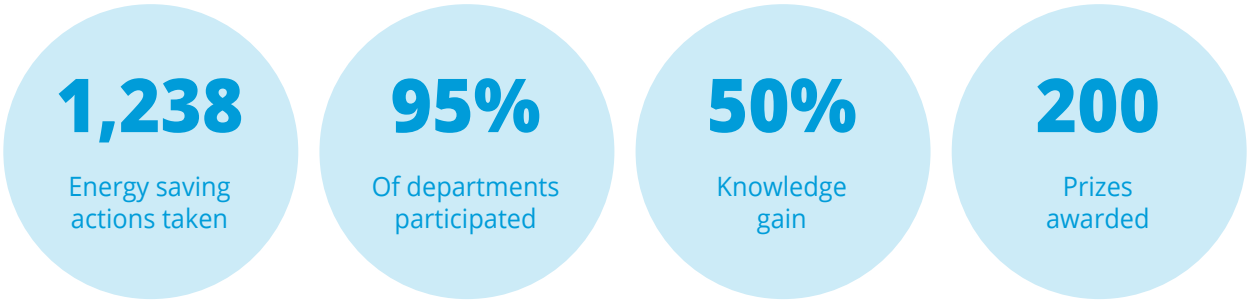
> "I had fun participating in the Energy Goals challenge and definitely learned some new info/practices. Thank you for being part of the awesome team who put this all together!"
> *-Energy Goals Participant*

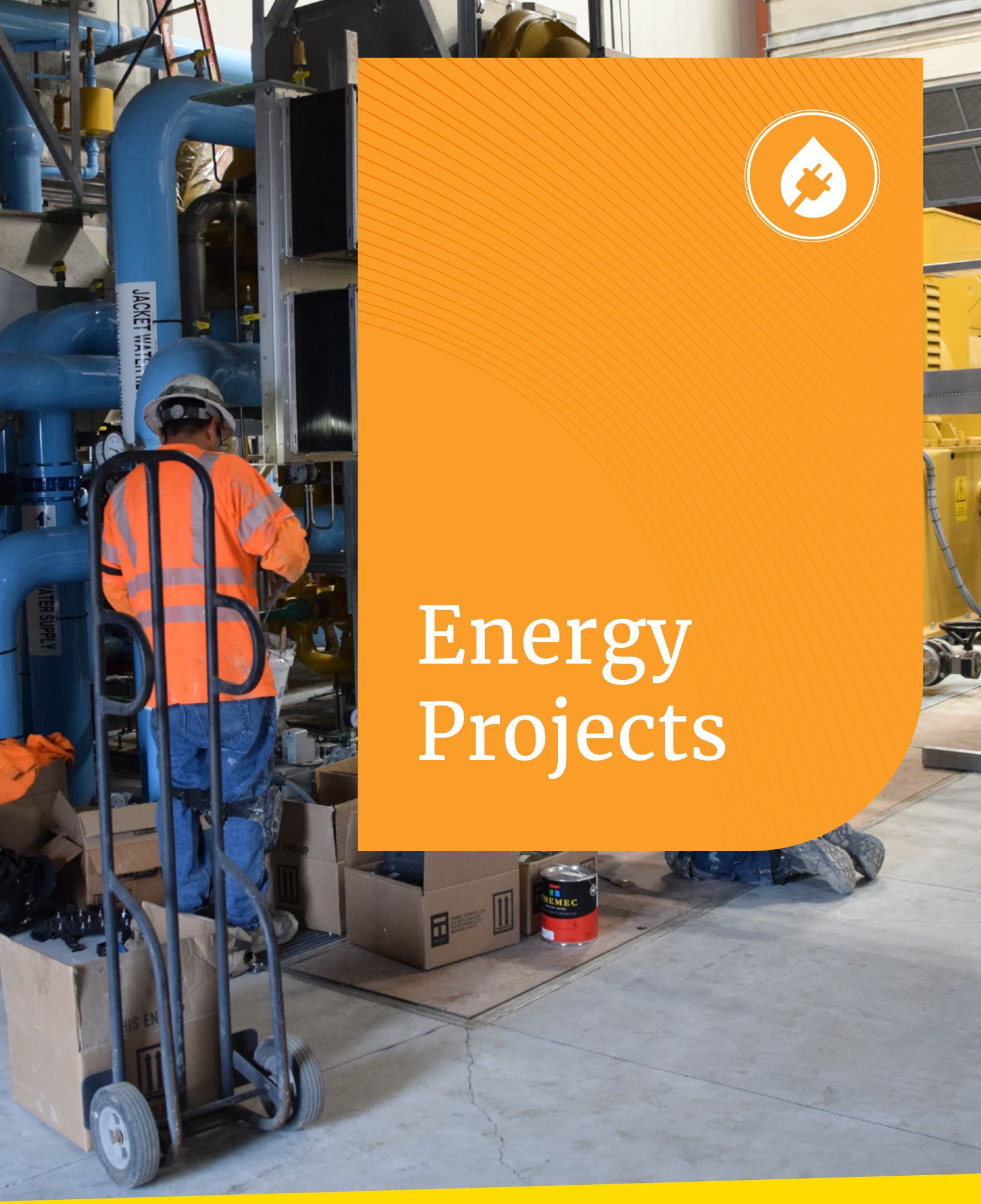
through the Energy Goals platform, pre- and post-surveys, and testimonials from Energy Champions, this initiative demonstrated how knowledge, behaviors and attitudes were transformed into tangible, energy saving actions.

Engagement of patrons that frequent public facilities like Libraries and Recreation Centers is another opportunity to increase awareness of GHG reduction strategies and achieve

the municipal energy targets. Through informational signage and informational dashboards in the lobbies, staff can leverage patrons to reduce energy consumption while on site and enable them to deploy similar strategies in their own homes and lives.

Figure 9. Energy Goals Outcomes





Energy Projects

INTRODUCTION

The City manages more than 7.6 million square feet of infrastructure composed of more than 1,800 functional facilities including libraries, police stations, park facilities, water and wastewater treatment plants and pump stations, and more. Additionally, the City operates more than 60,000 streetlights and traffic lights. Investing in the City's existing infrastructure is a vital part of energy planning for the future, as most of the infrastructure that will shape the City's future is already built. Understanding the energy consumption of the City's assets and infrastructure is essential to ensure appropriate planning.

Figure 10. Energy Used by Department (2019)

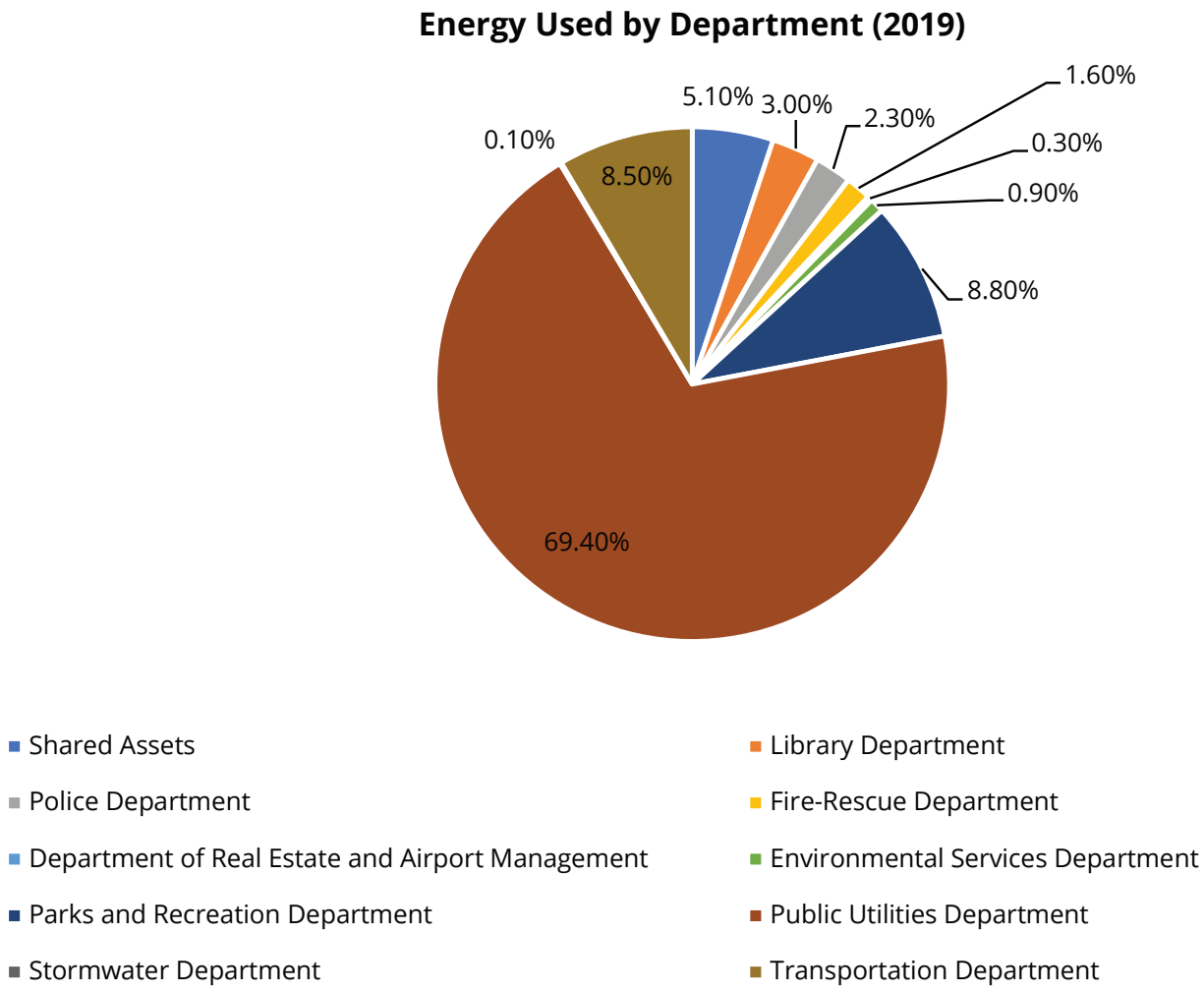


Figure 11. Renewable Electricity Generation Capacity (2019)

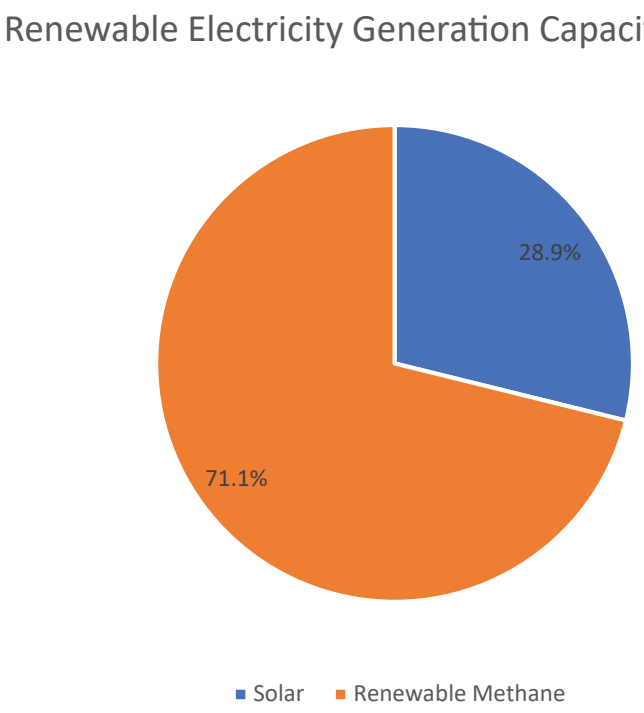


Figure 12. Solar Energy Generation by Department (2019)

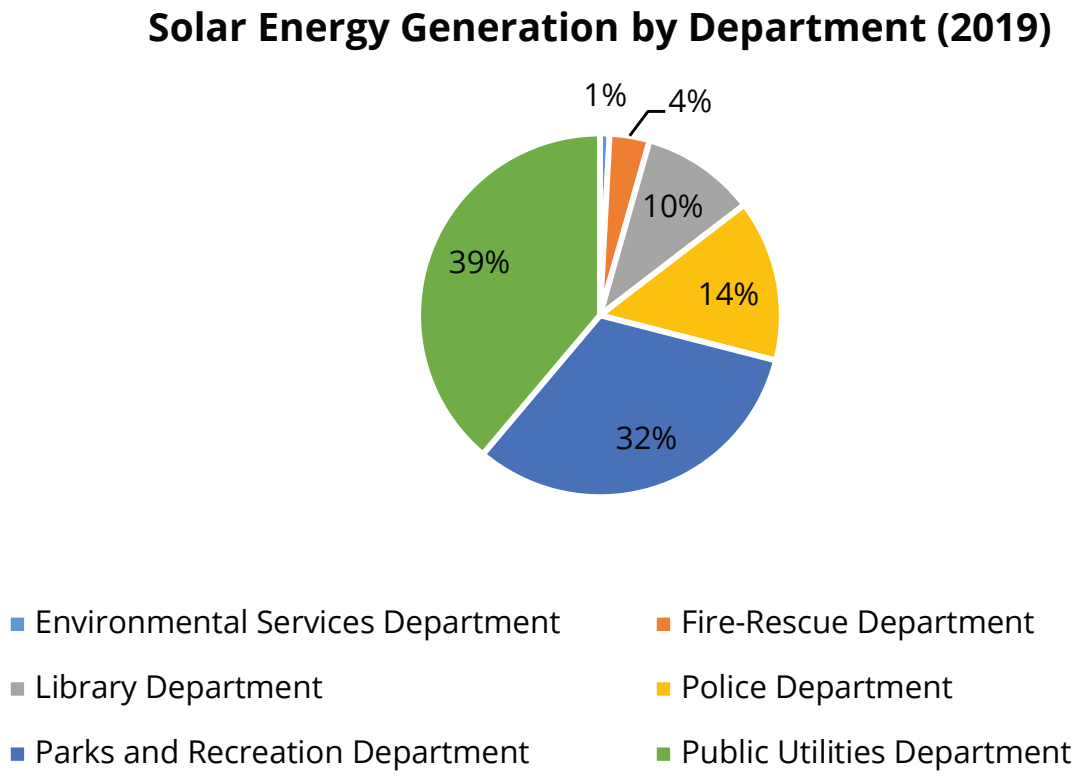
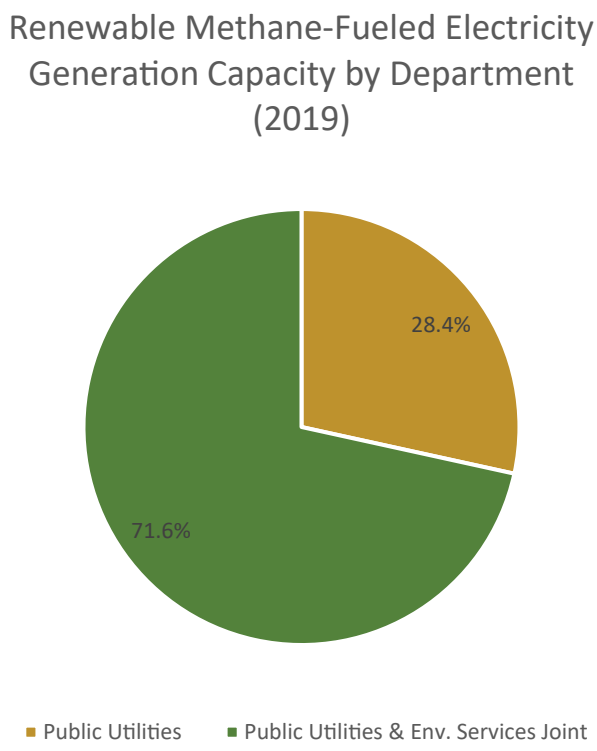


Figure 13. Renewable Methane-Fueled Electricity Generation Capacity by Department (2019)



The figures above show a breakdown of the energy consumed and generated by the departments that manage specific types of assets, referred to as Asset Managing Departments (AMDs).[9] In 2019 PUD comprised approximately 70% of total municipal energy consumption and comprised 39% of the total municipal solar capacity.[10] Water and wastewater treatment plants and pump stations account for the highest percentage of the annual municipal energy use of the City. For non-PUD facilities, heating, cooling, and lighting comprise approximately 60% of total energy used.

City facilities built after 2001 were constructed to LEED standards. Their design included sustainability elements such as onsite solar PV systems, energy-efficient lighting and cool roofs.

Between 2016 and 2020, the City focused many resources toward construction of more than 45 new facilities including libraries, fire stations, recreation centers and more. Conversely, approximately 80% of municipal facilities were built before 2000. These facilities are aging and are ripe with energy-saving opportunities.

[9] Note, energy consumption data does not include energy generated and used onsite due to lack of adequate metering. Installation of solar metering equipment is being explored to allow for more accurate data tracking and analysis.

[10] Over the last 5 years PUD's energy consumption typically accounted for 60% of the total municipal energy consumption.

The City has made significant strides to reduce energy consumption at municipal facilities. Reducing municipal energy use while accommodating an increase in operating hours of libraries and recreation centers, adding new fire stations and libraries to the City's building stock, and installing new streetlights is a notable achievement. Between 2010 and 2020, the City targeted low-risk, high-yield energy-saving and renewable energy projects such as streetlight retrofits, retrocommissioning (RCx) of aging facilities, and installation of solar PV via power purchase agreements (PPAs). The City also pursued more advanced energy projects including converting three libraries to near-zero net energy (ZNE) buildings. These successes have laid a strong foundation for long-term increases in energy performance and energy cost savings.

ENERGY PERFORMANCE OPPORTUNITIES

From 2018-2020, the City of San Diego worked with local energy engineering firms – Shadpour Consulting Engineers, Inc. (SC Engineers) and Alternative Energy Systems Consulting, Inc. (AESC) – to assess energy opportunities across the City's municipal building portfolio. SC Engineers performed energy audits on more than 40 City facilities including libraries, fire stations, recreation centers and offices, while AECS performed process and energy audits at 17 Public Utilities Department (PUD) facilities including water and wastewater treatment plants and pump stations. The audits were preformed to help the City better understand the energy savings potential at a few key City Facilities. The audit investigations revealed a significant set of untapped energy reduction and zero emissions retrofit opportunities that can be implemented to help achieve municipal energy targets.

The following energy-efficiency measures and distributed energy resources have been identified for implementation at City facilities. Recommended installation considerations are provided for each technology category. While the list below is not specific to any one facility, subsequent sections of this report provide more detail regarding opportunities at specific municipal assets.

INDOOR LIGHTING

The City's facilities contain varied interior use areas, including entrance lobbies, community rooms, staff working areas, computer rooms, multi-use rooms, and restrooms. Most of these areas are lit by linear T8 fluorescent lamp

fixtures. Other areas, such as restrooms and community rooms, frequently contain compact fluorescent lamps (CFLs). Indoor decorative fixtures contained in the lobbies of many City facilities utilize a combination of incandescent lamps, CFLs and metal halide lamps. Most interior lights are controlled by manual wall switches.

The following features should be considered when improving indoor lighting:

- LED troffer retrofit kits that reuse the existing fixture housing will be allowed. Retrofit tubes will not be considered.
- LED light fixtures should be on the Design Lights Consortium (DLC) qualified products list of fixtures.
- LED light fixtures should meet Title 24 energy code requirements including Chapter 4 requirements for multilevel lighting controls, occupant sensing controls, automatic daylighting controls and demand responsive controls.
- The complete replacement of existing lighting fixtures with new LED fixtures should be pursued where bulb upgrades or retrofit kits are not feasible.

OUTDOOR LIGHTING

Exterior lighting is a major opportunity for improvement. The City facilities contain varied exterior lights, including parking lights, decorative ground and tree lights, wall-mounted building perimeter lights and sign lights. The perimeter light fixtures utilize a combination of metal halide and CFL, and parking pole lights use high-pressure sodium fixtures. Other decorative and tree lights frequently contain halogen and incandescent lights. Exterior lighting is controlled by a combination of manual switches and timers.

The following features should be considered when improving outdoor lighting:

- LED lights should be the standard. LED retrofit kits which replace all reflectors and optical systems of existing luminaires for outdoor pole/arm mounted and wall-mounted luminaires. Screw-in retrofit lamps will not be considered.
- LED light fixtures should be on the Design Lights Consortium (DLC) qualified products list of fixtures.
- LED light fixtures should meet Title 24 energy code requirements including Chapter 4 requirements for daylight availability, automatic scheduling controls and motion sensing controls.
- The complete replacement of existing lighting fixtures with high efficiency LED lighting and Title 24 compliant lighting control features.

HVAC SYSTEMS

HVAC systems serving municipal facilities include a combination of traditional packaged and split heat pump air conditioning units. The majority of the City's units have already passed their effective useful lives. HVAC units

are typically controlled locally by thermostats. HVAC systems usually account for the highest percentage of energy consumption of City buildings. Having reliable and energy-efficient HVAC systems installed at community buildings is a climate equity priority as many City facilities are designated as "Cool Zones" to shelter San Diego residents without air conditioning during extreme heat events. The City will explore replacement of aging HVAC units with energy-efficient units that reduce energy use and improve occupant comfort.

The following features should be considered when improving the existing HVAC systems:

- Replacement of HVAC units that transition natural gas heating to all electric heat pump units is highly desirable to meet the City's municipal electrification goal.
- HVAC units should be premium efficiency and minimum 14 SEER rated.
- The advanced rooftop unit controller (ARC) kits should include a fan variable frequency drive, economizer, and demand control ventilation.
- Variable Refrigerant Flow systems with heat recovery will be considered highly desirable.
- HVAC units with factory installed economizers should be considered highly desirable.
- Replacement of constant air volume (CAV) units with variable air volume (VAV) units should be connected to the network with a central building controller.

SOLAR WATER HEATING AND POOL COVERS

Most City facilities use natural gas based domestic water heaters. A typical domestic hot water heater has 80% efficiency and uses approximately 3,000 Therms natural gas annually – emitting approximately 15.9 metric tons of CO_2e. The size of the storage tank of the water heater varies between 40 gallons and 80 gallons. Available energy audits indicate that the existing domestic water heaters serving facilities have already passed their effective, useful life. Audits also indicate a need for the replacement of domestic water piping insulation.

The natural gas consumption of municipal pools makes up approximately 40% of all Parks and Recreation facilities' annual natural gas consumption and approximately 4% of the total municipal energy use. The City's pools use natural gas-based boilers to heat the pool water. The boilers typically operate 24 hours a day, seven days a week. The high natural gas consumption of the City's pools is responsible for high Rec Center Energy Use Intensities (EUI). EUI is the ratio of energy consumption of a City building to the gross floor area (GFA) of a building. EUI can be useful to compare buildings of different sizes to understand if they are running efficiently compared to one another.

The City will pursue replacement of the existing domestic water heaters with electric heat pump water heaters and/or solar water heaters to eliminate natural gas use and support the City's

building zero emissions goal. In addition, the City will pursue installation of an automated, roll-out pool cover system to thermally insulate the pool and reduce water heating needs.

The following features should be considered when replacing the existing water heating and installing solar water heating and pool covers:

- Replacement of water heaters that transition natural gas heating to all electric heat pump units is highly desirable to meet the City's municipal zero emissions goal.
- The solar water heater should have supplemental electric heating.
- Solar water heater system size should match the existing domestic hot water heater size.
- The measure should provide an optional cost of replacement of the existing domestic water heater with a heat pump water heater.
- A solar water heater system which eliminates natural gas use of the existing domestic water heater without increasing electricity use should be considered highly desirable.
- Installation of a supplemental pool solar water heating system should be considered highly desirable.
- Solar water heating system should have more than a 10-year warranty.
- The installation of pool solar water heating and pool cover through a utility or state offered rebate and incentive program should be considered highly desirable.

ROOFS AND WINDOWS

The roof and windows of several City facilities are in poor condition. Poorly insulated roof and windows often increase heat gain through the roof surface and via air infiltration, which eventually leads to an increase in the cooling demand of the facility. The replacement of roofs and windows in poor condition is recommended to help improve City facilities as well as improve tenant comfort.

The following features should be considered when improving the existing roof and window replacement:

- The windows should be dual-pane and have low emissivity.
- The replacement of the roof covering before applying a cool roof coating should be considered.
- A complete window replacement should be considered.

AIR COMPRESSORS

The City has a wide range of facilities including maintenance garages and operations yards. Representative audits of these facilities indicate that compressed air systems in maintenance garages account for approximately 4% of the facility's energy use. Some air compressors were installed in 1985 and are well beyond their effective useful life. The City will explore an air leak assessment and repair of air leaks in the compressed air system serving the Fleet Maintenance garages, as well as the replacement of the existing compressor with a new, energy-efficient compressor equipped with a variable frequency drive (VFD).

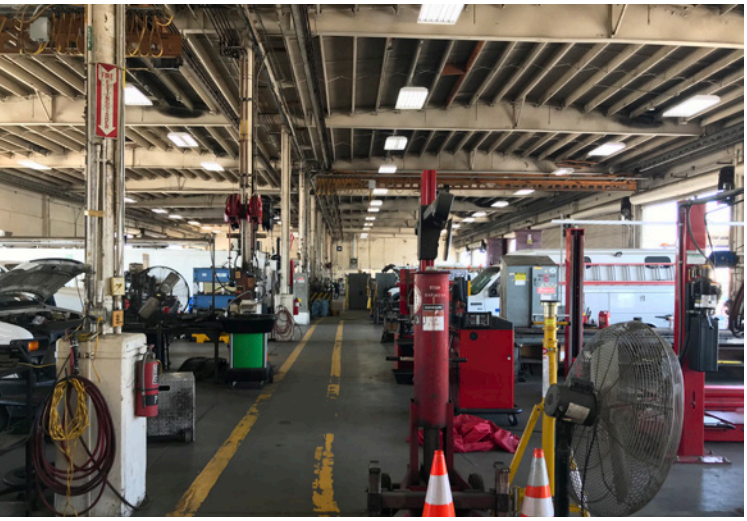
The following features should be considered when addressing air compressors:

- The measure should include an air-leak assessment of the compressed air system and replacement of push-to-connect fittings with an alternative two-piece ferrule sealing wedge fitting.

- The installation of ultrasonic leak detectors should be considered highly desirable.

- Air compressors should be equipped with a VFD.

- Replacement of existing compressors with a VFD equipped air compressor through a utility or state-offered rebate or incentive program should be considered highly desirable.



PUMPS

An available audit of the Vista Terrace Pool indicates that the pool pumps operate 24 hours a day, seven days a week to maintain the necessary turnover rate required by the Health Department. The pump installed at the Vista Terrace Pool operates at a constant speed and the current turnover rate of the pool is estimated to be five hours, which is less than the minimum turnover rate required by the Health Department. The City will pursue installation of variable frequency drives (VFDs) on circulation pumps at municipal pools to allow the pumps to operate at a lower speed while maintaining the turnover rate required by the Health Department. This change will allow the city to use less electricity while providing a better level of service to our citizens.

The following features should be considered when retrofitting pumps with VFDs:

- Pump VFDs should meet the City's Building Automation Standard requirements.

- Pump VFDs should be accessible remotely.

- Replacement of existing pumps with a new energy-efficient pump and a VFD should be considered highly desirable.

ENTERPRISE BUILDING AUTOMATION SYSTEM

A central Building Automation System (BAS) will enable the City to evaluate, manage and repair its existing facility equipment in a more strategic fashion. The BAS will allow the Facilities Division to easily troubleshoot problems with HVAC units and resolve tenant comfort issues. The City will pursue development of an enterprise BAS solution equipped with automated Fault Detection and Diagnostics (FD&D) software. The City will pursue integration of existing building management systems into the central BAS platform.

The following features will be considered in the development of the enterprise BAS:

- Work closely with DoIT to ensure that smart, connected technologies adhere to cybersecurity protocols. Ensure smart sensors and technologies that collect data adhere to City ordinances addressing privacy and surveillance.
- All new and existing facilities having energy systems upgraded should be connected into the central BAS platform.
- The FD&D system should monitor HVAC systems, indoor lighting, outdoor lighting and facility energy use data.
- The FD&D system should meet the City's BAS standard and should include all fault rules described in the standard for each system type contained in the facility.
- FD&D providers capable of providing additional FD&D rules outside of those outlined in the City's BAS Standard will receive additional consideration.

FACILITY RETROCOMMISSIONING

A recently completed RCx investigation of a City facility identified that optimizing the operation of an existing building system can reduce the building's total annual energy consumption by more than 20%.

The following features should be considered when performing facility RCx:

- Chilled and heating hot water supply temp setpoint reset.
- Pump VFD installation.
- Supply air temperature setpoint reset.
- Boiler lockout.
- Duct static pressure setpoint reset.
- Conversion of Constant Air Volume (CAV) unit to Variable Air Volume (VAV) unit.
- Economizer repair.
- Implementation of optimum economizer sequencing.
- Scheduling of HVAC and lighting system.
- Elimination of simultaneous heating and cooling.
- Parking exhaust fan ventilation control.
- Proposals which receive utility incentives for RCx measures will be considered highly desirable.
- The RCx measures should have a combined payback of less than seven years.
- Thermostats should be BACnet compatible and meet the City's Building Automation Standard and Title 24.
- Work closely with DoIT to ensure that smart, connected technologies adhere to cybersecurity protocols. Ensure smart sensors and technologies that collect data adhere to City ordinances addressing privacy and surveillance.

SOLAR PHOTOVOLTAICS (PV)

The City currently operates 41 solar PV systems with a cumulative generating capacity of 6.46 MW. The largest solar project is a 1.1 MW system installed by PUD at the Alvarado Water Treatment Plant in 2006.

City facilities still offer ample renewable energy generation opportunities. As the City works toward the zero emissions goal for 2035, installation of solar PV will be imperative. The City will pursue installation of enough solar PV capacity at each facility to help meet the zero emissions goal.

The following features should be considered when installing solar PV:

- Solar PV panels should have a minimum 20-year warranty.
- Photovoltaic system controllers should be integrated into the City's building automation platform.
- Integrated solar + storage battery systems with demand management software should be considered highly desirable.
- Cool roof coatings with solar reflectance more than 70 and thermal emittance more than 0.8 is highly desirable for replacement roofs.
- PV system monitoring equipment (commonly referred to as Data Acquisition Systems or DAS) with web-based data access (i.e. online dashboard) is required on any new installed solar PV systems on City facilities.
- Work closely with DoIT to ensure that smart, connected technologies adhere to cybersecurity protocols. Ensure smart sensors and technologies that collect data adhere to City ordinances addressing privacy and surveillance.

BATTERY ENERGY STORAGE SYSTEMS

Battery energy storage systems (BESS) are rechargeable battery systems that store energy from solar arrays or the electric grid and provide that energy to a building at a different time. BESS have a wide range of applications. Commercial applications include peak shaving, load shifting, emergency backup and various grid services.

The following features should be considered when installing BESS:

- Employ battery storage strategies such as demand peak shaving, time-of-use shifting or cost arbitrage. The BESS should have a method for determining peak load times and automatically discharging.
- The BESS system may be charged through a solar system or utility power. A solar and BESS system should work in concert to maximize the use of renewable power and minimize reliance on the grid.
- The minimum battery storage size acceptable is 15 kW battery power capable of operating for five hours at nameplate rating. These are based on NREL (National Renewable Energy Laboratory) recommendations for optimizing the economics of demand savings.
- Loss of existing parking stalls to make space for BESS equipment should be avoided whenever possible.
- A BMS (Battery Management System) should be provided to control the charging

and discharging of the equipment. The BMS should include an HMI (Human Machine Interface) and be field programmable. Programming instructions and setpoints should be shared with the City.

- Work closely with DoIT to ensure smart, connected technologies adhere to cybersecurity protocols. Ensure smart sensors and technologies that collect data adhere to City ordinances addressing privacy and surveillance.

MICROGRIDS

Microgrids are standalone energy grids that can island from the larger electricity grid and remain operational using energy stored onsite. Renewable microgrids rely on renewable energy generated and stored onsite to power building end uses. Buildings with microgrids are examples of grid-interactive efficient buildings (GEBs), which the DOE describes as energy-efficient buildings with connected, smart, distributed energy resources (DERs) that are integrated and continuously optimized for the benefit of building owners, occupants and the electric grid. Microgrids are a key strategy in increasing the City's resiliency, or the ability to remain functional during, or to bounce back quickly in response to, energy disruptions, including climate-driven wildfires, floods and severe weather events.

Renewable microgrids serve similar functions as backup diesel generators, but without the associated GHG emissions. The City will deploy renewable microgrids at facilities with backup diesel generators to test and validate the use of microgrids as permanent replacements. The City will also explore installation of microgrids at additional facilities that present resiliency and grid benefits.

The following features should be considered when installing microgrids:

- Deploy technologies and actions that adjust electricity demand according to the real-time needs of the grid and consumers to increase the economic value of site upgrades and decrease payback periods.

- Work closely with DoIT to ensure that smart, connected technologies adhere to cybersecurity protocols. Ensure smart sensors and technologies that collect data adhere to City ordinances addressing privacy and surveillance.

- Prioritize the installation of renewable microgrids that incorporate onsite solar and BESS.

ELECTRIC VEHICLE CHARGING

The City currently has 46 Level 2 charging stations dedicated to fleet charging on City property, and another 18 Level 2 charging stations for employee charging stations. The charging stations were installed at no cost as part of the SDG&E Power Your Drive program. The City pays the utility bill for the fleet vehicle stations; the charging stations dedicated to employee charging bill energy usage directly to the employee's residential SDG&E account.

Figure 14. Existing EV Charging Stations

SDG&E Power Your Drive City of San Diego Location	Site Address	Fleet/Employee	Employee Parking Spaces	Fleet Parking Spaces
Police Station East (Aero Drive)	9225 Aero Drive	Fleet	0	10
Police Station West (Gaines Street)	5215 Gaines Street	Fleet	0	14
Rose Canyon Operations Yard	3775 Morena Boulevard	Both	8	12
Development Services Department	1222 First Avenue	Fleet	0	10
Environmental Services Department	9601 Ridgehaven Court	Employee	10	0
		TOTAL L2 PORTS BY USE	**18**	**46**
		TOTAL L2 PORTS	**64**	

Several options are available to the City of San Diego when considering fleet vehicle charging. Determining the number and type of EVCS required to support fleet EVs will depend on a variety of factors, most importantly the types or level of chargers to install and the vehicle to charging port ratio. EV chargers are classified into three categories: Level 1, Level 2 and direct current (DC) fast charging.

- Level 1 (L1) charging uses a common wall outlet. Most EVs include a L1 charging cord so this level of charging does not necessarily require installation of charging equipment if a standard 110-120V outlet is available. L1 chargers typically deliver between 3.5 and 6.5 miles of range per hour of charging.

- Level 2 (L2) equipment offers charging through a 240V, AC plug and requires electric vehicle service equipment (EVSE) with a dedicated 40-amp circuit. Level 2 EVSEs come in many configurations (wall mounted, free standing, curbside and ceiling-mounted) and can be networked to accept payment and communicate charging status. Most L2 equipment offers additional functionality such as remote access/control

via Wi-Fi or cellular connection, access control/ability to accept multiple forms of payment and load balancing across multiple chargers. L2 chargers typically deliver between 14 and 35 miles of electric range per hour of charging.

- Direct Current Fast Charging (DCFC) is the highest-powered and thus fastest way to charge an EV. Most DCFC on the market require inputs of 480+ volts and 100+ amps (50-60 kW) and can deliver approximately 175 miles of electric range per hour of charging, with some newer DCFC models delivering almost double that. Most DCFCs are networked to charge customers for use and help with power management to avoid peaks in demand.

CHARGING INFRASTRUCTURE AND RATIOS

At the early stages of fleet electrification, most public fleets assign one vehicle to one Level 2 charging port. The benefit of each vehicle having their own charger means there is no need for a charging plan that requires drivers to share the charging stations on a scheduled rotation. This simplifies the transition to the EVs and decreases the chance that a fleet vehicle will be left without sufficient battery and associated range to complete its daily work.

Level 1 charging could be a viable solution for many fleet vehicles, specifically for those that are parked for at least 12 hours and drive less than 45 miles per day on average. The average daily miles traveled by a LD fleet vehicle is 35 miles. Retrofitting city facilities to install electrical infrastructure to support L1 charging would be significantly less expensive and complex than retrofitting facilities to support and install L2 charging. That said, when new charging installations are planned in new construction, a higher output 240-V circuit is often more cost-effective as it offers greater charging capacity for an equivalent installed price. Additionally, an L1 charging solution could require drivers to plug in the vehicle on a daily basis and would likely necessitate one L1 outlet per vehicle. Further exploration into the fleet makeup and demands is required to determine how, if at all, L1 charging is appropriate to include in a fleet charging infrastructure strategy.

DC Fast Chargers are also expected to be a required mix of the charging strategy to support the fleet electrification. The speed of charging of DCFC best mirrors the existing "gas station model" that drivers are used to. Additionally, for buildings with two or fewer vehicles, installing dedicated charging may be cost prohibitive. These vehicles may need to rely on a central

charging depot of DCFCs and incorporate traveling to the depot to refill the battery. Based on average daily driving, this depot charging could occur as infrequently as once every other week, depending on the battery capacity of the fleet vehicle. Lastly, for vehicles that are used infrequently, such as construction equipment, it may be more cost effective to have these vehicles use a charging depot rather than install dedicated charging at their facilities.

The mix of charging station types will inform vehicle to charging port ratios. The vehicle to charging port ratios will inform how many and where charging stations are installed to support the conversion of our City's fleet to EVs. The charging station types and ratios will likely vary based on vehicle type and use and are likely to change over time as technology, policy and driver acceptance evolve. Vehicle -to-grid (V2G) systems may also be appropriate for in some instances, providing a grid resiliency benefit. Accordingly, an in-depth study to develop a charging strategy for the City's fleet vehicles is required to properly determine how to manage the impacts of fleet electrification in the Plan.

The following features should be considered when installing fleet EV charging stations:

- Data sharing functionality either continuously or at regular intervals (at least monthly), including usage statistics
- Level 2 or DC Fast Charging types of stations
  - Equipment must be listed by an approved product listing agency, rated for outdoor use, and installed in accordance with the manufacturer's specifications
  - All DC Fast Charging EVSE must provide at least one SAE J1772 DC Combined Charging System Type 1 compliant connection per site and/or at least one CHAdeMO compliant connection per site
  - All Level 2 EVSE must provide at least one SAE J1772 connection
- Conformance to Open Charge Point Protocol (OCPP) v1.6 or later
- Cable retraction system
- 5-year hardware warranty minimum
- Demand response functionality
- Cloud connected, smart charging capability

ADVANCED ENERGY TECHNOLOGIES

As the clean-energy landscape advances over the next 15 years, the City will continue its relationship with clean-energy leaders including Cleantech San Diego, Rocky Mountain Institute, National Renewable Energy Labs, the California Energy Commission and the DOE, among others. These relationships will help the City maintain its leadership role and pursue pilot projects that validate new technologies.

ENERGY PERFORMANCE OPPORTUNITY REPORTS

HOW TO READ THIS SECTION

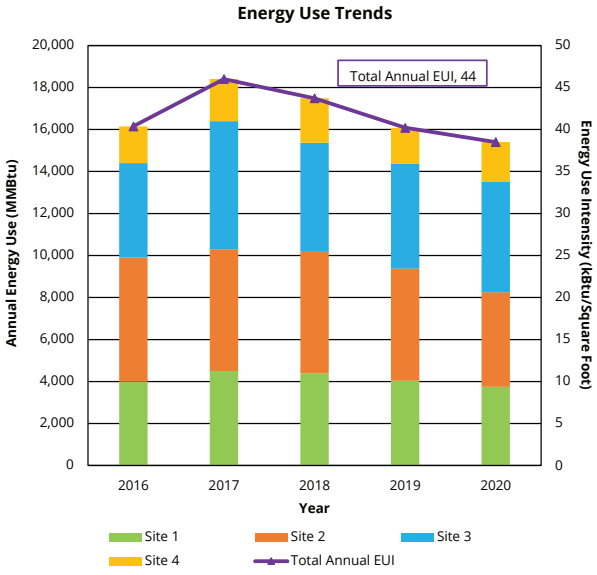
This section provides a summary of the energy savings and electrification opportunities for each AMD and its portfolio of facilities and fleet vehicles. Summaries are provided in "Energy Performance Opportunities" (EPO) reports for each AMD. EPO reports consists of the following:

- **Overview:** Provides an overview of the portfolio of facilities managed by each AMD and a map indicating relative energy consumption.
- **Energy Use Analysis:** Provides historical energy trends for each AMD facility and comparison to national averages where possible.
- **Efforts to Date:** Provides a list of known energy projects completed by the AMD since 2016[11] that have contributed to the municipal energy goals.
- **Energy Performance Improvement Opportunities:** Provides feasible energy reduction and zero emissions project opportunities for each facility managed by the AMD.
- **Electrification:** Provides the AMD's annual natural gas use and addresses fuel switching and renewable energy necessary to achieve zero emissions.
- **EV Charging:** Provides estimates for near-term EV charging needs for each facility managed by the AMD.

The EPO reports utilize the following charts to analyze the performance of municipal assets and summarize the findings:

ENERGY USE TRENDS CHART

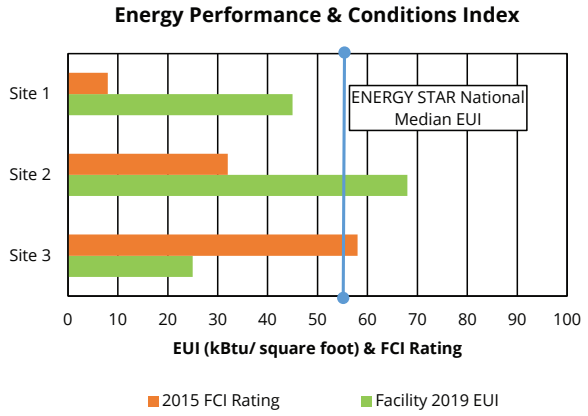
To assess energy performance and identify opportunities, it is helpful to evaluate the historic energy use trends of municipal facilities. The horizontal axis shows the year. The primary vertical axes (left) indicates energy use and secondary vertical axes (right) indicates the total annual EUI of the group of sites. Energy use of each site within the group is shown with a bar stacked on top of one another. The height of the stacked bar indicates the total energy use of a group of sites. This chart reveals changes in the energy use and a total annual EUI of a group of sites between 2010 and 2016. Change in the total annual EUI helps in evaluating the performance of the group and impacts of changes among the group. The variation in the height of the stacked bar helps in identifying key events such as adding or removing a site from the group or change in occupancy patterns.



[11] Providing data back through 2016 reveals trends that enable a clear understanding of existing performance and recent improvements that impact that performance.

ENERGY USE INTENSITY AND CONDITIONS INDEX CHART

Energy Use Intensity (EUI) expresses a building's energy use as a function of its size or other characteristics.[12] The U.S. EPA maintains a database of EUI scores for 25% of commercial buildings in the U.S., generating a national median EUI score by building type. Categorizing EUI by asset type is important because some sites are more energy intensive than others. For example, a library uses considerably less energy than a recreation center with a pool. Comparing the EUI rating of a facility against the national median EUI rating helps in evaluating the energy performance of a site. An EUI rating higher than the national median EUI rating indicates room for energy performance improvement. Note, EUI values reflect energy purchased from SDG&E. Solar energy produced and consumed onsite is excluded due to incomplete data.

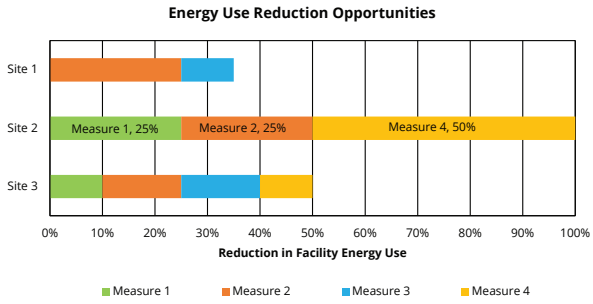


Similarly, Facility Condition Index (FCI) expresses the relative condition of a group of facilities and is primarily used to support asset management initiatives among government entities. FCI is the ratio of the cost of maintenance, repair, and replacement deficiencies of a facility to the replacement value of the facility. A high rating often suggests that the site's subsystems, such as heating, air conditioning, lighting, roofs and windows are deteriorating and are responsible for high energy consumption. Comparing an EUI rating with an FCI rating of a site helps in understanding conditions of a building's subsystems and identifying energy reduction opportunities.

FCI values shown on in this study have been gathered from the City of San Diego: Facilities Condition Assessment: Comprehensive Report for City-Occupied General Fund Facilities FY2014 to FY2016. Facilities constructed after 2015 have not been assigned FCIs by the City of San Diego at this time.

ENERGY PERFORMANCE OPPORTUNITIES CHART

The Chart depicts feasible energy performance improvement measures and associated savings. The stacked multi-colored bar indicates various measures proposed for each site. The width of the stacked bar shows the impact of proposed measures on the site's energy use which can be read from the horizontal axis.

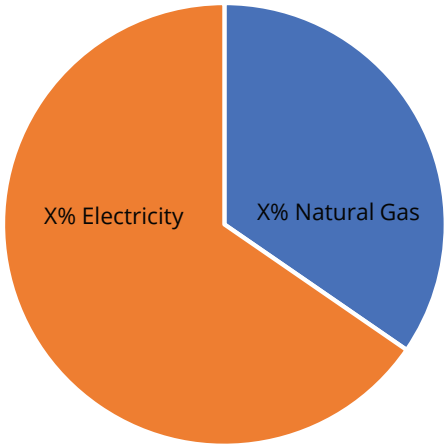


[12] https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager/understand-metrics/what-energy

ELECTRIFICATION

This chart shows the amount of fossil-fuel energy consumed as a percentage of total AMD energy consumed in 2019. As the City works toward decarbonizing its facilities, this data can help AMDs anticipate the amount of fuel switching necessary by 2035.

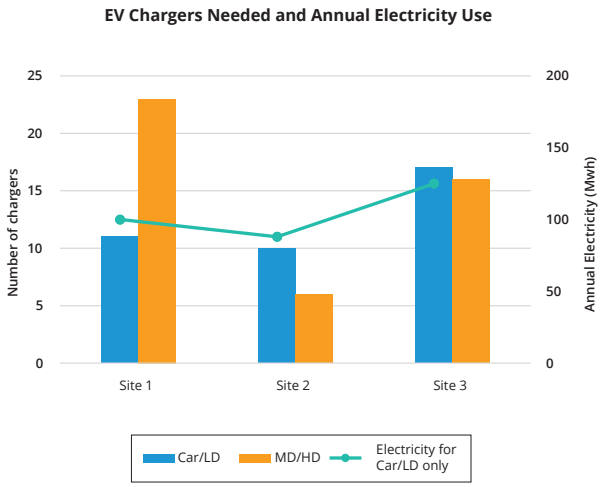
2019 Energy Consumption Mix



EV CHARGING OPPORTUNITIES & IMPACTS CHART

This chart shows, for each AMD, the number of EV charging stations needed to support current fleet charging infrastructure needs assuming all existing combustion engine fleet vehicles will transition to EVs, but retain their current parking location or "base" in most cases. Charts are broken down to show charging needs associated with cars and light-duty (LD) EVs separate from medium-duty (MD) and heavy-duty (HD) EVs, with the assumption that EVs and LD EVs are readily available and supporting infrastructure could be installed in the near future.

Conversely, while the market for electric MD and HD vehicles is advancing rapidly, purchases of electric MD and HD fleet vehicles are further off. The chart also shows the anticipated increase in electricity consumption associated with increased EV charging (cars and LDVs only) for each AMD (turquoise line). Because vehicle efficiency information (needed to calculate electricity usage) is not yet available for MD and HD vehicle classes, electricity consumption associated with those vehicles is not included on the charts. The charts do not address the resulting decrease in petroleum fuel consumption.



Sites on the X-axis are facilities managed by the AMD. The blue column represents the total number of chargers needed at each facility to power the cars and LD vehicles that currently park there; the orange column represents the total number of chargers needed to power MD and HD vehicles.

LIBRARY DEPARTMENT

The City of San Diego public library assets consist of 35 branch libraries, the Central library, and an adult literacy program office. While the average library is less than 30,000 square feet, this department spans more than 1.1 million square feet in total floor area.

Asset Managing Department: San Diego Public Library Department

Mission: To inspire lifelong learning through connections to knowledge and each other.

Share of 2019 Municipal Energy Use: 3.0%

Summary of Library Facility Energy Opportunities: Based on the information provided in the figures below, the Library Department has significant opportunities to reduce energy consumption and begin electrifying end uses to achieve the municipal zero emissions goal by 2035. Over the last several years, the Library Department's energy consumption and Energy Use Intensities (EUIs) have been trending upwards, indicating that older facilities would benefit from RCx and equipment upgrades to ensure the buildings are performing optimally. The Central Library, which accounts for more than 40% of the annual Library energy use, should be prioritized for energy-efficiency improvements in the near term.

The following 10 facilities have been identified by the Sustainability and Mobility and Library Departments for near-term comprehensive energy retrofits in partnership with Energy Service Companies (ESCOs):

- Beckworth
- Carmel Mountain
- Central
- City Heights
- Linda Vista
- Logan Heights
- Oak Park
- Otay Mesa
- Scripps Ranch
- Skyline Hills

The sites above were selected based on initial research done by SC Engineers. Retrofits at the sites listed above are expected to have a payback under seven years and achieve at least a 30% energy reduction.

The Library Department has nine branches that would be strong candidates for Zero Net Energy, or near Zero Net Energy facilities. The nine branches listed below have the potential to create enough onsite solar to offset the total building's energy consumption annually. These sites include:

- Beckworth
- Carmel Mountain
- Linda Vista
- Pacifica Beach
- Otay Mesa
- Oak Park
- Logan Heights
- College Rolando
- La Jolla
- Rancho Bernardo

To achieve the zero emissions goal, all Library facilities will need to electrify end uses (i.e. eliminate natural gas equipment), maximize cost-effective onsite solar, and install energy management systems to maintain operational efficiency throughout the day, week and season. Costs associated with transitioning natural gas end uses to electric technologies have not been quantified; further study is required to assess the cost impacts of electrification at existing facilities.

Figure 15. 2019 Energy Use Map – Library Department

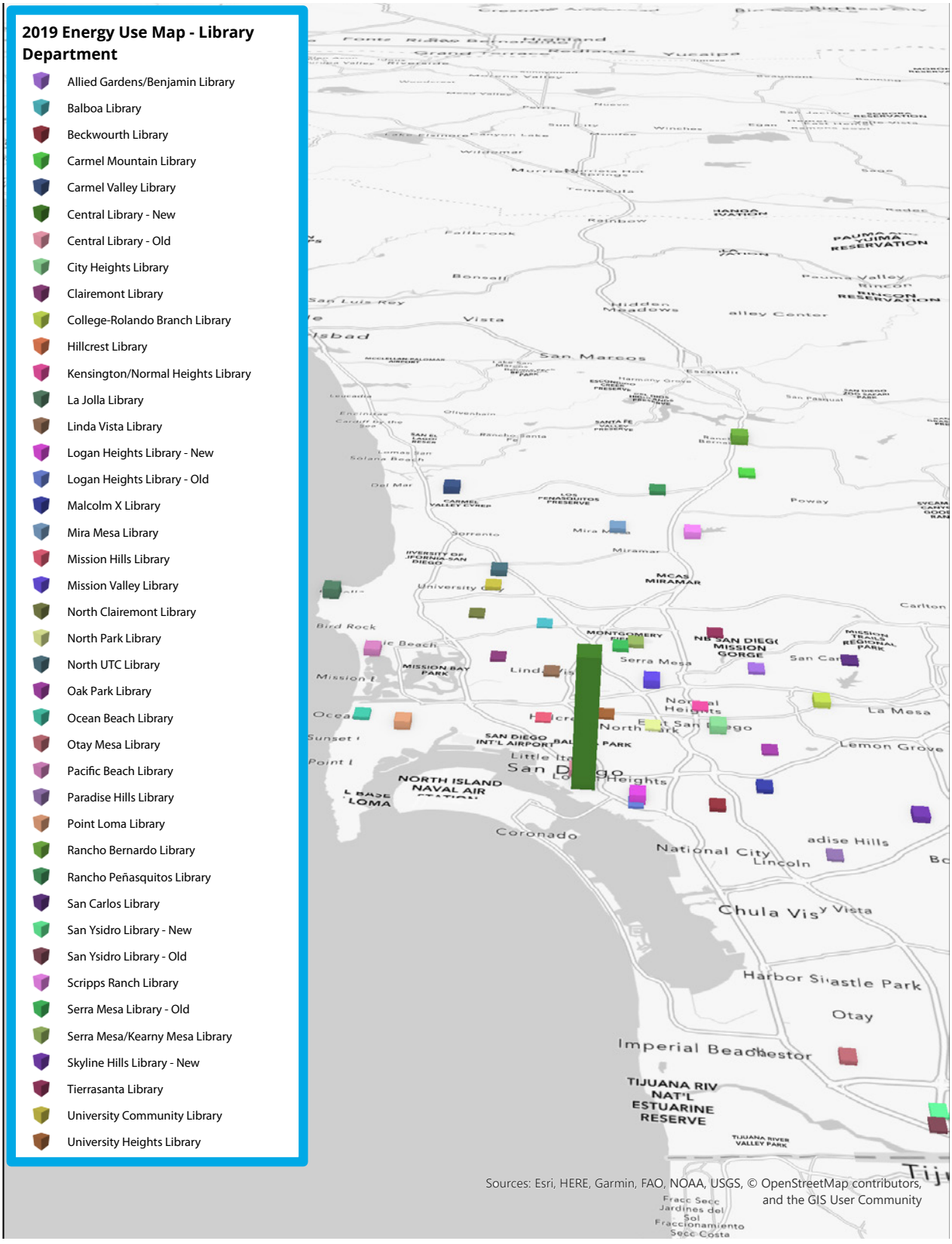


Figure 16. Energy Use Trends – Library Department

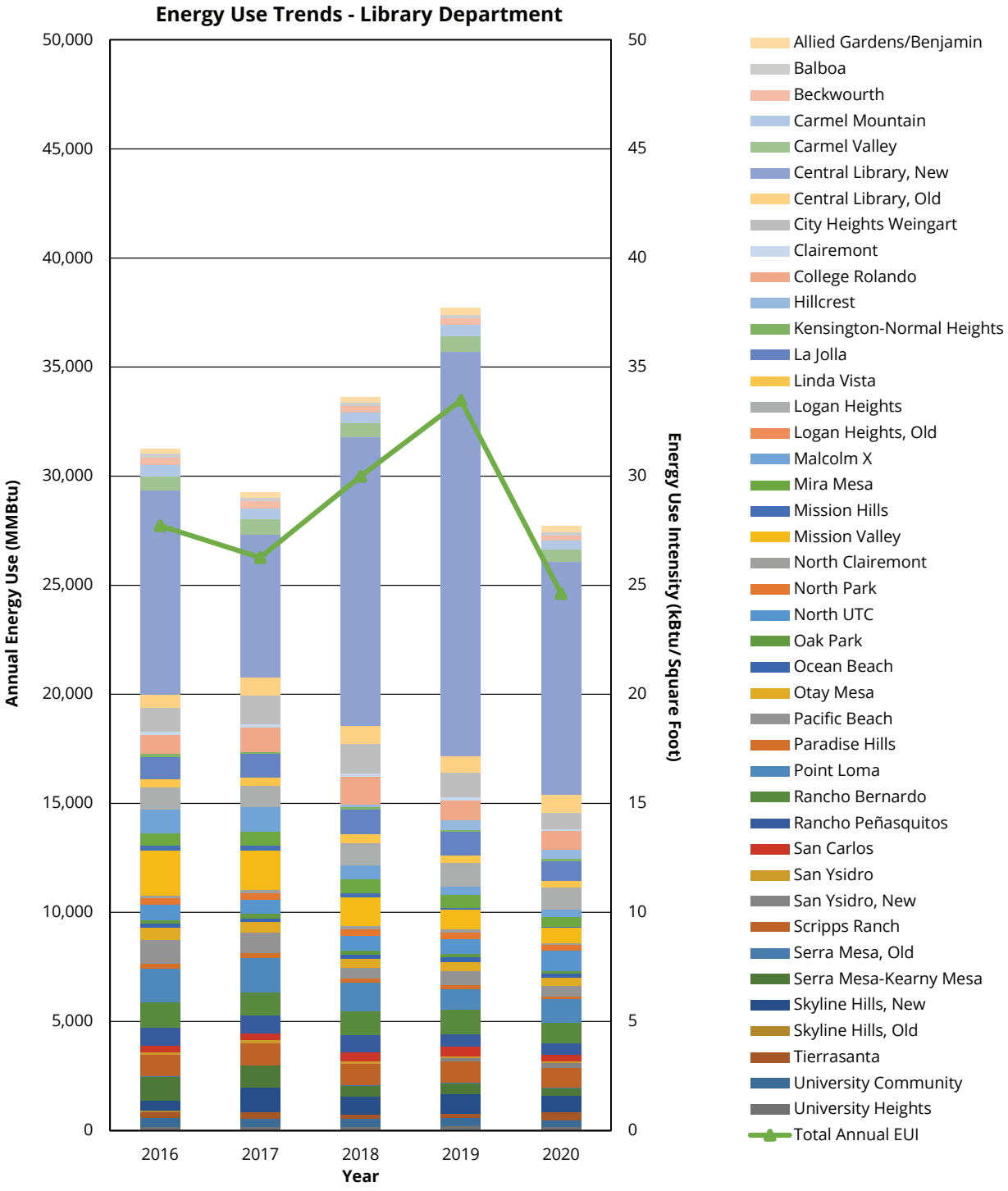
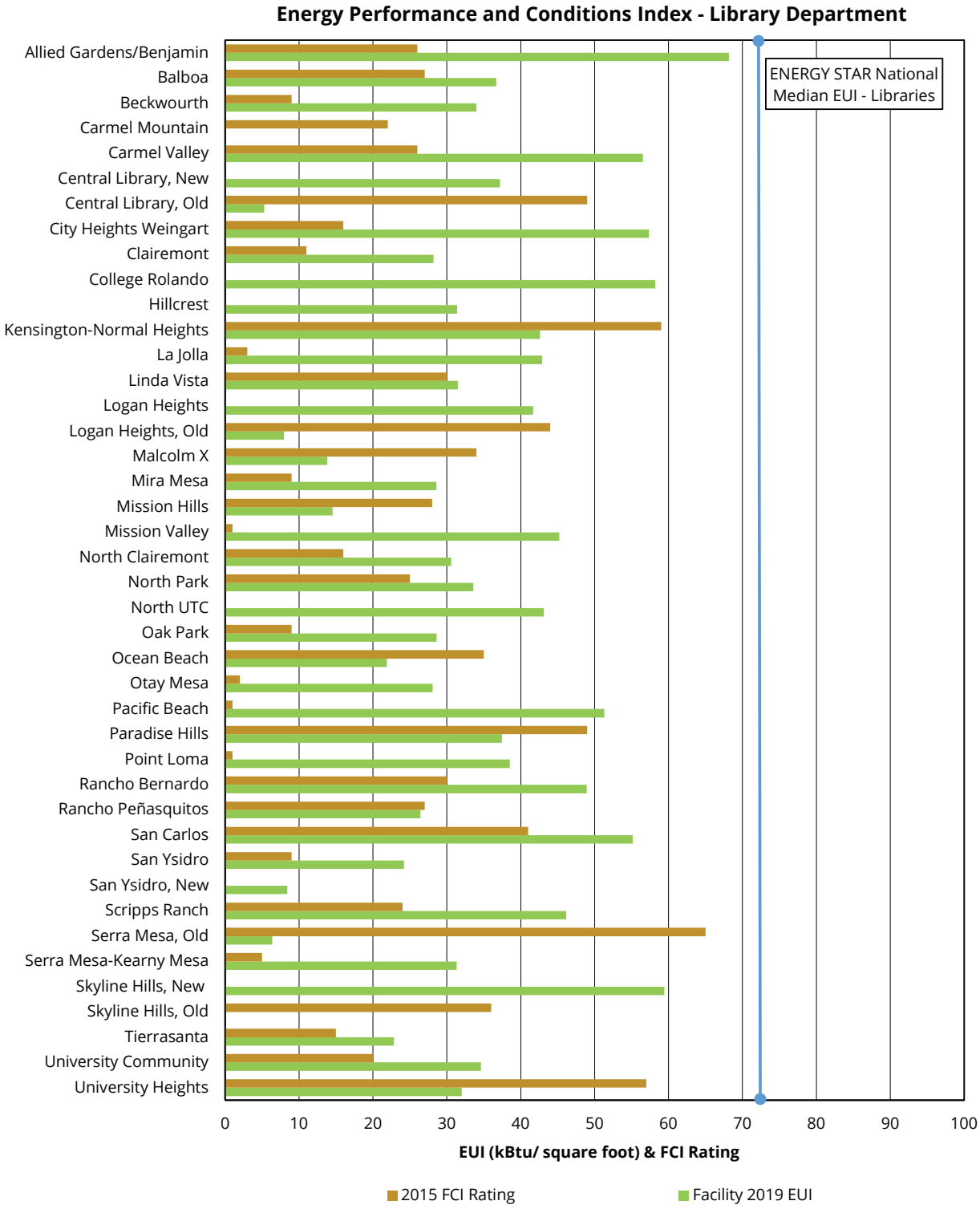


Figure 17. Energy Performance and Conditions Index – Library Department



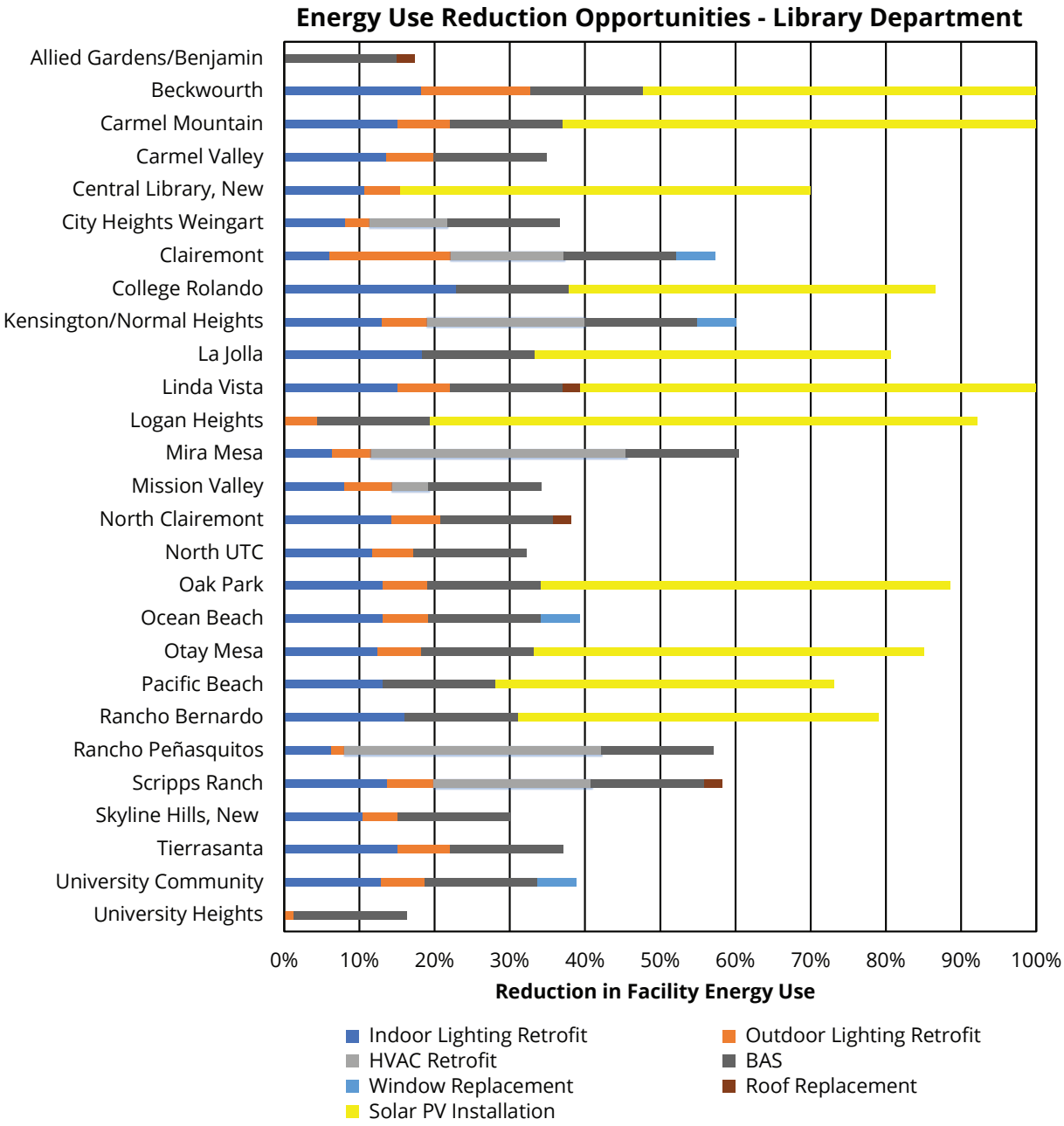
The figures above reflect power purchased from the local utility. Onsite power generation at some facilities is not tracked and has not been included in the annual energy consumption figures nor the EUI calculations.

RECENT ENERGY EFFORTS

Figure 18. Recent Energy Efforts – Library Department

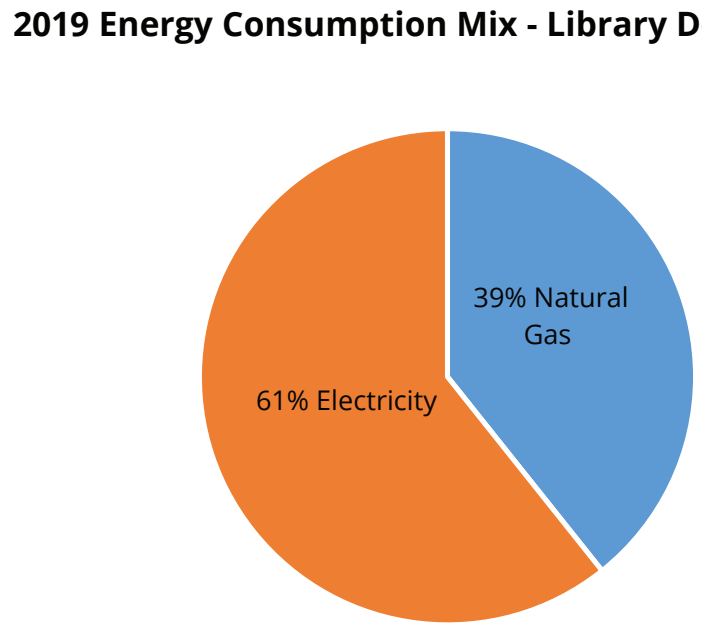
2016	• Skyline Hills Library solar PV installation (57 kW) • Beckworth Library HVAC system replacement
2017	• Rancho Bernardo Library HVAC system replacement • Malcolm X Library solar PV installation (193 kW) • Serra Mesa-Kearny Mesa Library solar PV installation (133 kW)
2018	• Pacific Beach Library HVAC system and roof replacement
2019	• Solar PV installations at Mission Hills (28 kW), Mission Valley (175 kW) and North UTC (87 kW) Libraries
2020	• ZNE Library demonstration project at Malcolm X, Point Loma and Serra Mesa-Kearny Mesa Libraries

Figure 19. Energy Use Reduction Opportunities – Library Department



The energy opportunities shown in the figure above have been deemed feasible based on evaluation of available energy audits and department energy liaison interviews performed by SC Engineers, a consultant to the Sustainability and Mobility Department.

Figure 20. 2019 Energy Consumption Mix – Library Department



ELECTRIC VEHICLE CHARGING

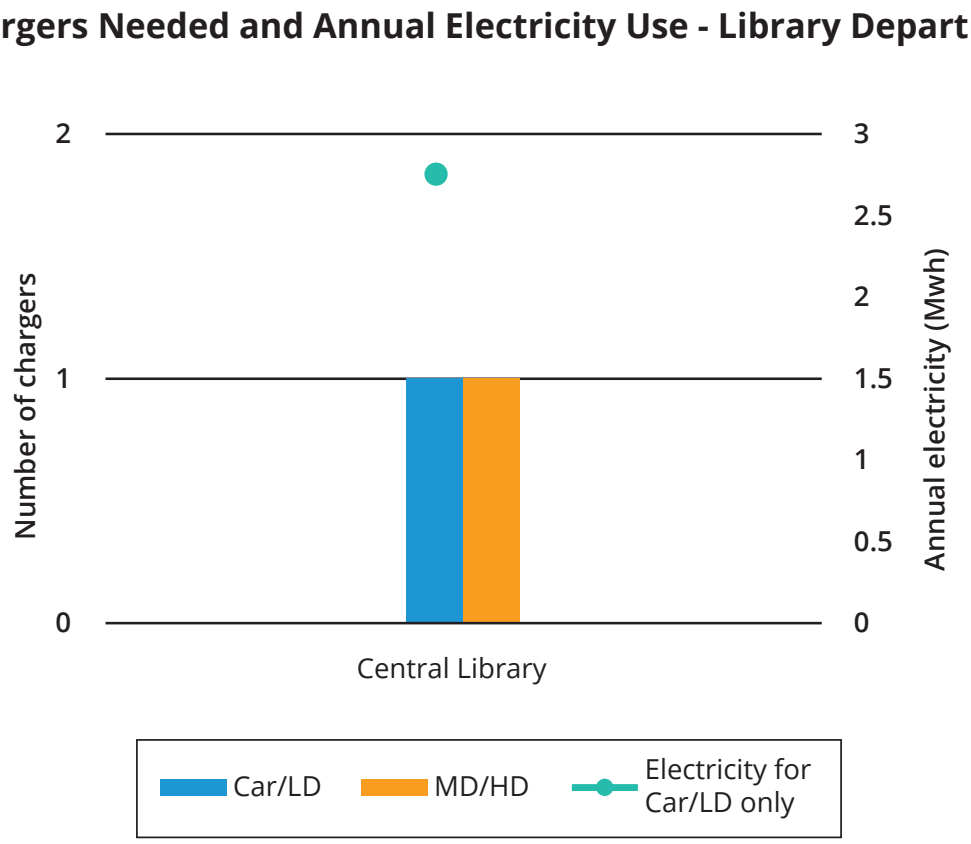
The Library Department owns one LD vehicle and two MD/HD vehicles. All three park close to the downtown Central Library around or below 50% of the time. The Central Library does not support vehicles from any other departments. Estimated annual fuel use and total associated CO2e for the three vehicles that park at the Central Library is shown in the figure below.

Figure 21. FY2019 Estimated Fuel Use and CO_2e Produced – Library Department

	Car/LD	MD/HD	CO2e (metric tons)
	Unleaded (gal)	Unleaded (gal)	
Library facilities (total)	**3,782**	**1,523**	**47**
Central Library (New downtown)	3,782	1,523	47

All three Library vehicles could be supported by a total of two EV chargers (see figure below).

Figure 22. EV Chargers and Annual Electricity (Car/LDV only) Needed – Library Department



No other library facilities currently support library vehicles nor vehicles from other departments.

POLICE DEPARTMENT

The City of San Diego Police Department assets consist of a Police Headquarters, 10 neighborhood substations, an air support facility, a police range, a K9 training center, two police museums and various storefronts. The majority of police facilities were built before 2000 with the exception of the K9 Training Center, Central Substation and Northwestern Substation. This department spans more than 500,000 square feet in total floor area.

Asset Managing Department: San Diego Police Department

Mission: To maintain peace and order by providing the highest quality police services.

Share of 2019 Municipal Energy Use: 2.3%
Summary of Police Facility Energy

Opportunities: Based on the information provided in the figures below, the Police Department has significant opportunities to reduce energy consumption and begin electrifying end uses to achieve the municipal zero emissions goal by 2035. Transitioning its large vehicle fleet to EVs will significantly

decrease GHG emissions for this department. Over the last several years, annual energy use of municipal police facilities from SDG&E has decreased by more than 30%. This is largely due to the police department adding solar canopies to their facilities. The PD Energy Use Intensity (EUI) also has been trending downward, which shows that the police department has significantly reduced their energy consumption from SDG&E over the past five years.

In 2019, Police Headquarters, which covers approximately 33% of the total gross floor area of all police facilities, accounted for 57% of its total energy use. Police Headquarters has significant deferred maintenance and is a strong candidate for energy-efficiency retrofits. The facility is located downtown and has limited space for solar panels; offsetting the facility's energy use with onsite solar is not feasible.

The following eight facilities have been identified by the Sustainability and Mobility and Police Departments for near-term comprehensive energy retrofits in partnership with ESCOs:

- Air Support Facility
- Central Police Substation
- Eastern Police Substation
- Northern Police Substation
- Northwestern Police Substation
- Police Headquarters
- Southern Police Substation
- Western Police Substation

The sites above were selected based on initial research done by SC Engineers. Retrofits at the sites listed above are expected to have a payback under seven years and achieve at least a 30% energy reduction. While most of these sites are already equipped with solar, the Sustainability and Mobility Department will work with ESCOs to explore inclusion of electrification strategies and solar PV in energy project plans for these sites.

The following three sites have been identified and are currently in the design phase for installation of renewable microgrids:

- Southeastern Police Substation
- Northeastern Police Substation
- Mid-City Police Substation

Renewable microgrids can replace backup generators powered by fossil fuels (typically diesel or gasoline). The City will explore installation of renewable microgrids at all facilities where generators are currently installed once the above mentioned microgrid project is completed.

To achieve the zero emissions goal, all Police facilities will need to electrify end uses (i.e. eliminate natural gas equipment), maximize cost-effective onsite solar, and install energy management systems to maintain operational efficiency throughout the day, week and season. Costs associated with transitioning natural gas end uses to electric technologies have not been quantified; further study is required to assess the cost impacts of electrification at existing facilities.

Figure 23. 2019 Energy Use Map – Police Department

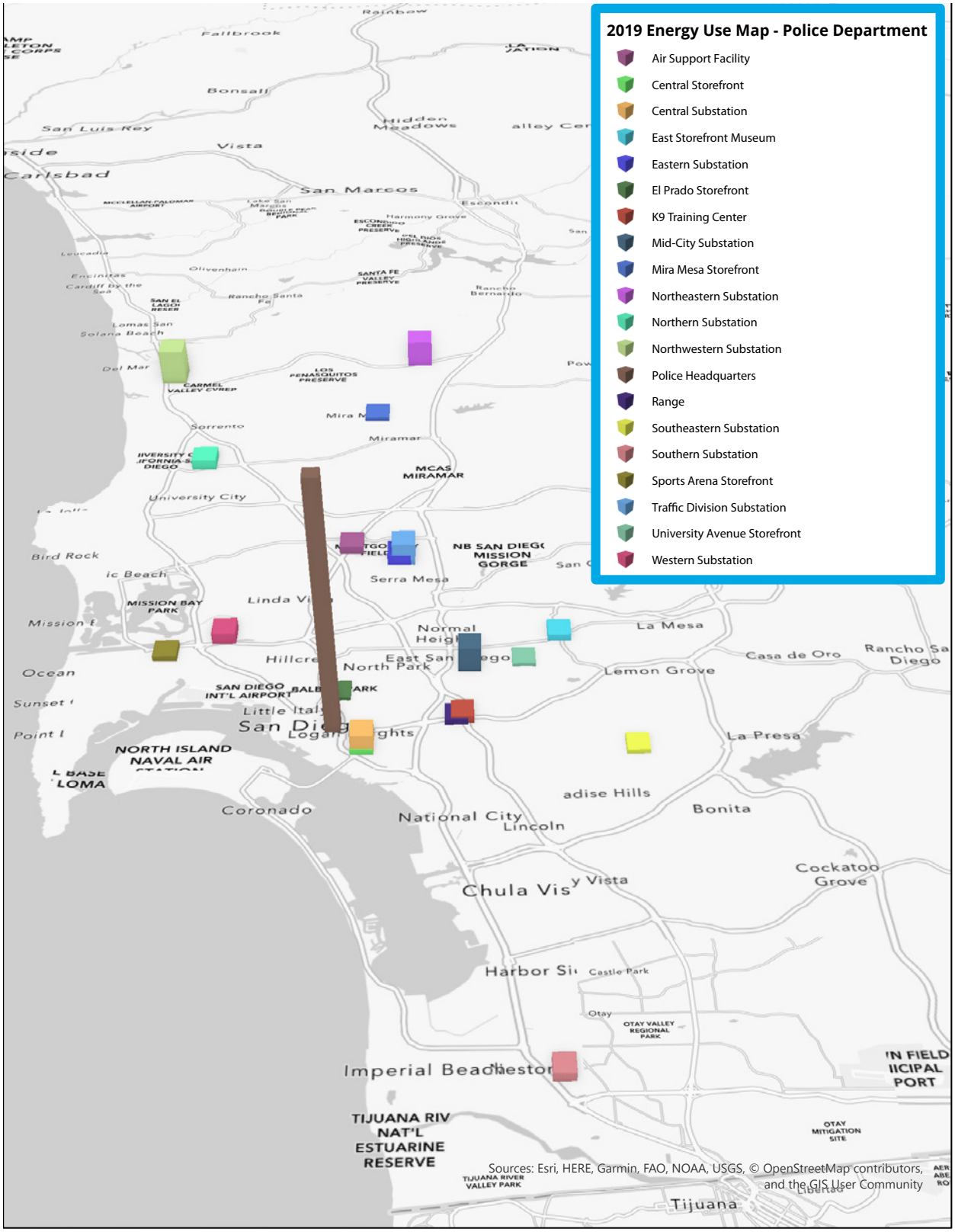


Figure 24. Energy Use Trends – Police Department

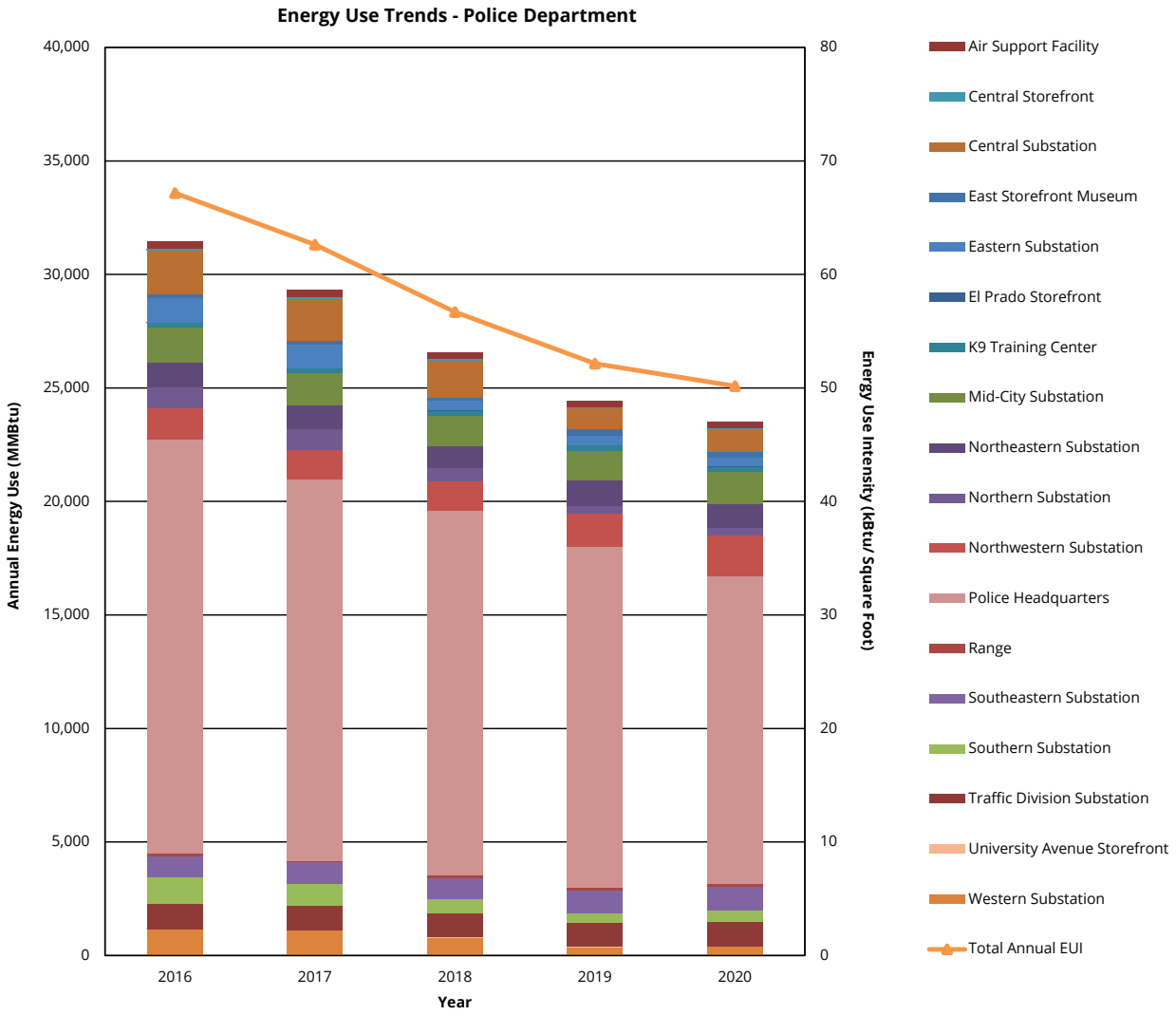
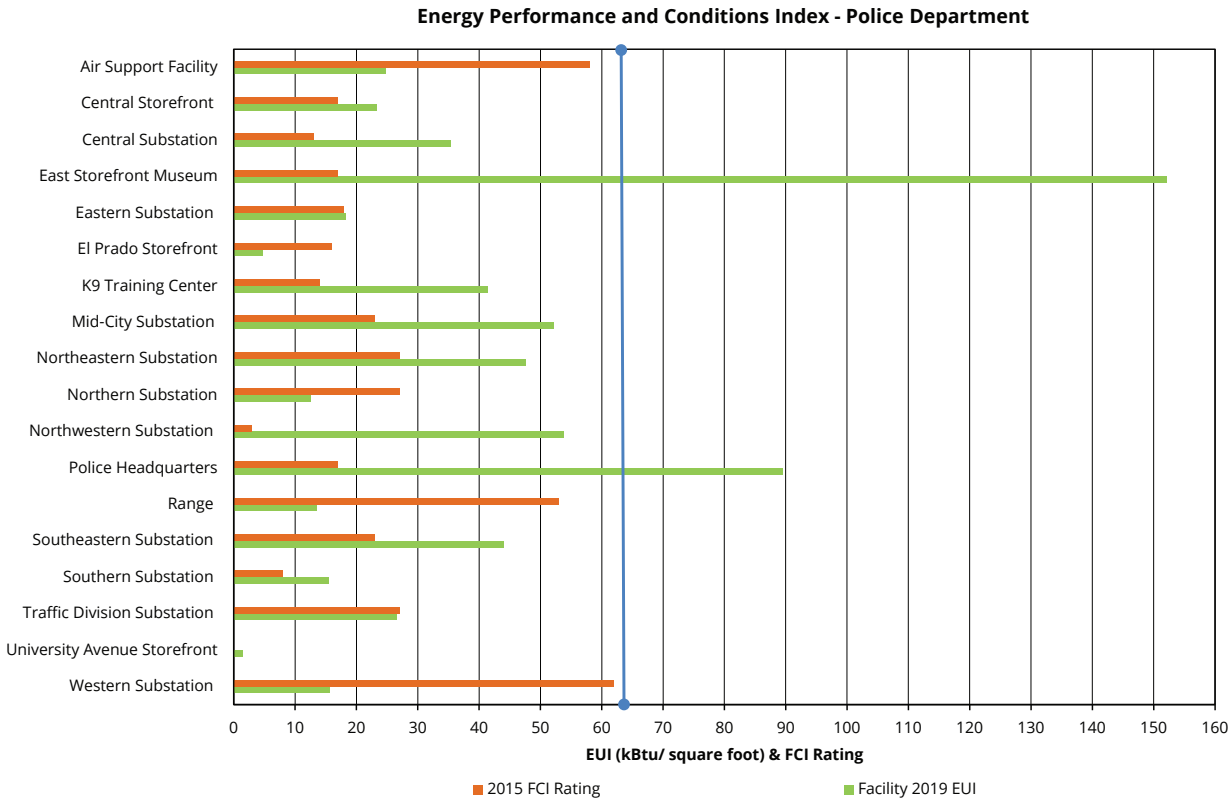


Figure 25. Energy Performance and Conditions Index – Police Department



The figures above reflect power purchased from the local utility. Onsite power generation at some facilities is not tracked and has not been included in the annual energy consumption figures nor the EUI calculations.

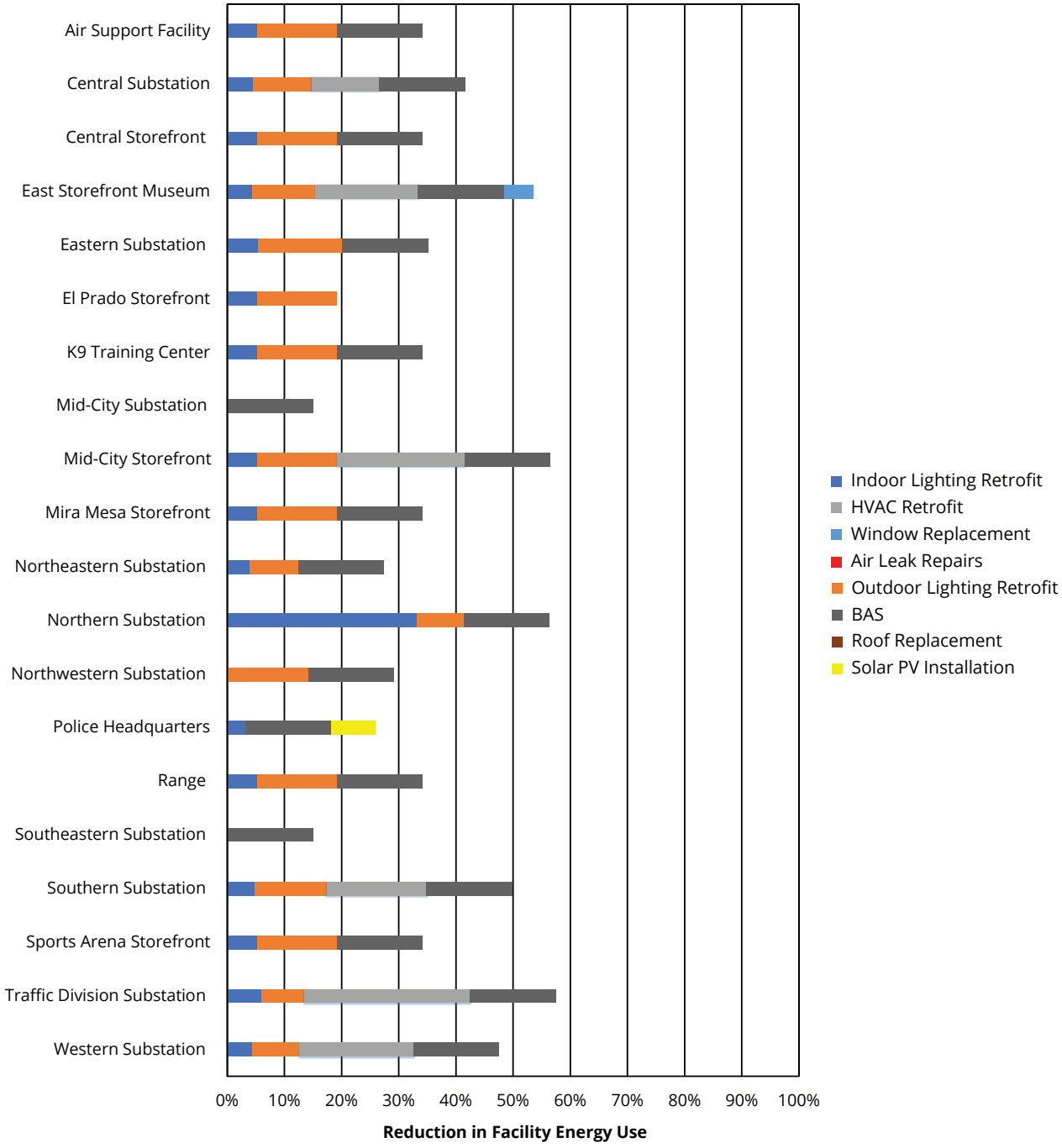
RECENT ENERGY EFFORTS

Figure 26. Recent Energy Efforts – Police Department

2016	• No known projects
2017	• Police Headquarters chiller replacement
2018	• Mid-City & Western Police Substations parking lot lighting replacement • Solar PV installations at Central & Western Police Substations
2019	• No known projects
2020	• No known projects

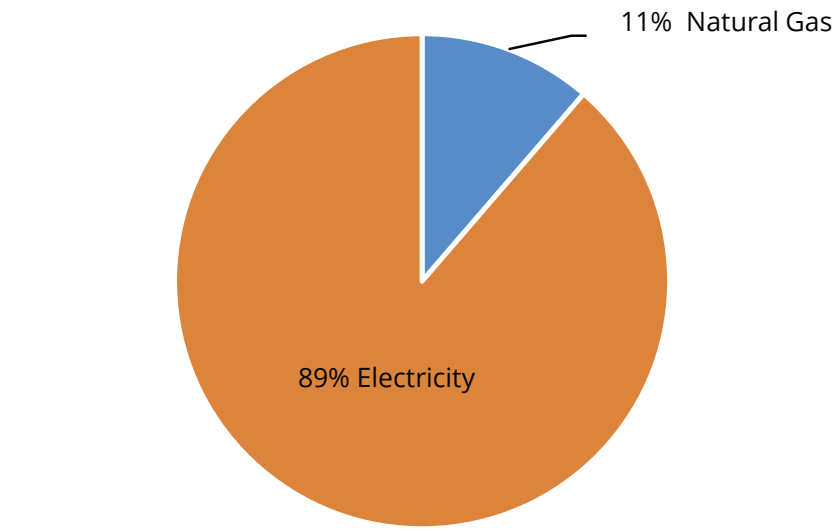
ENERGY PERFORMANCE IMPROVEMENT OPPORTUNITIES

Figure 27. Energy Use Reduction Opportunities – Police Department



The energy opportunities shown in the figure above have been deemed feasible based on evaluation of available energy audits and department energy liaison interviews performed by SC Engineers, a consultant to the Sustainability and Mobility Department.

Figure 28. 2019 Energy Consumption Mix – Police Department



ELECTRIC VEHICLE CHARGING

The Police Department houses 1,393 cars (LD, MD and HD vehicles). Two vehicles are missing station assignments from their records, so they are not accounted for here. Another 27 diesel vehicles, which are more specialized vehicles such as tactical armored vehicles and lack consistent refueling data, are also excluded. The remaining 1,391 vehicles are distributed across 28 locations; estimated annual fuel use and total associated CO2e for those cars (LD and MD/HD vehicles) is shown in Figure 29.

Figure 29. FY2019 Estimated Fuel Use and CO_2e Produced – Police Department

	Car/LD	MD/HD	CO2e (metric tons)
	Unleaded (gal)	Unleaded (gal)	
Police facilities (total)	**1,472,349**	**48,380**	**13,515**
Air Support Unit	418	--	1
Canine Unit	90,482	--	61
Central Operations (PD)	129,349	--	106
Central Shop (VMF)	43,240	352	41
Diamond Gateway Storefront	368	--	2
Domestic Violence Unit	416	--	4
Eastern Ops (includes Eastern Shop, Traffic Ops)	174,411	115	158
Mid-City Ops (includes Mid-City Shop)	93,292	--	82
Northern Ops (includes Northern Beach Patrol, Northern Shop)	98,058	--	75
Northeastern Ops (includes Northeastern Shop)	78,544	--	59
Northwestern Ops (includes Northwestern Shop)	52,893	--	38
Operations Court Liaison	190	--	1
Parking Management	7,863	1,202	21
Police Headquarters (includes Gangs, Homeless Outreach Team)	366,853	21,092	399
Police Plaza	10,305	25,175	39
Police Range	1,700	--	3
Rancho Bernardo Storefront	519	--	2
Scripps/Mesa Storefront	1,401	--	4
Southeast Ops	89,966	--	67
Southern Ops (includes Southern Shop)	75,609	--	64
Special Events Ops (includes Critical Incident Management, Special Events Traffic Control)	4,775	--	8
Special Response Team	31,618	128	25
STAR/PAL Juvenile Admin	1,309	--	7
Training Academy	9,935	317	28
Training/LDU	390	--	4
Volunteers Services	500	--	2
Western Ops (includes Western Beach Patrol, Western Shop)	107,798	--	90

Six hundred eighty-three chargers will be needed at Police facilities to support these vehicles, and the distribution of chargers at each facility is shown in the figures below.

Figure 30. EV Chargers (N<=10) and Annual Electricity (Car/LDV only) Needed – Police Department

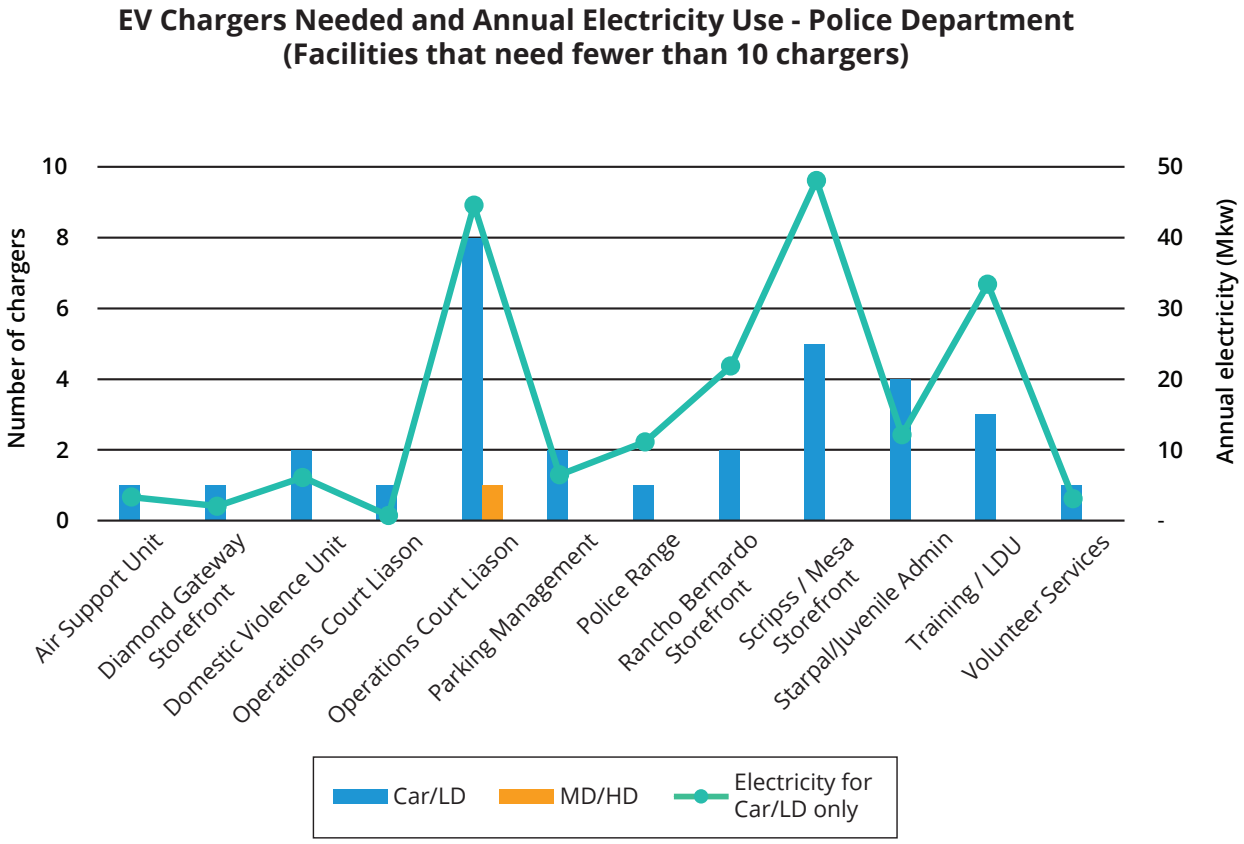


Figure 31. EV Chargers (11<=N<=50) and Annual Electricity (Car/LDV only) Needed – Police Department

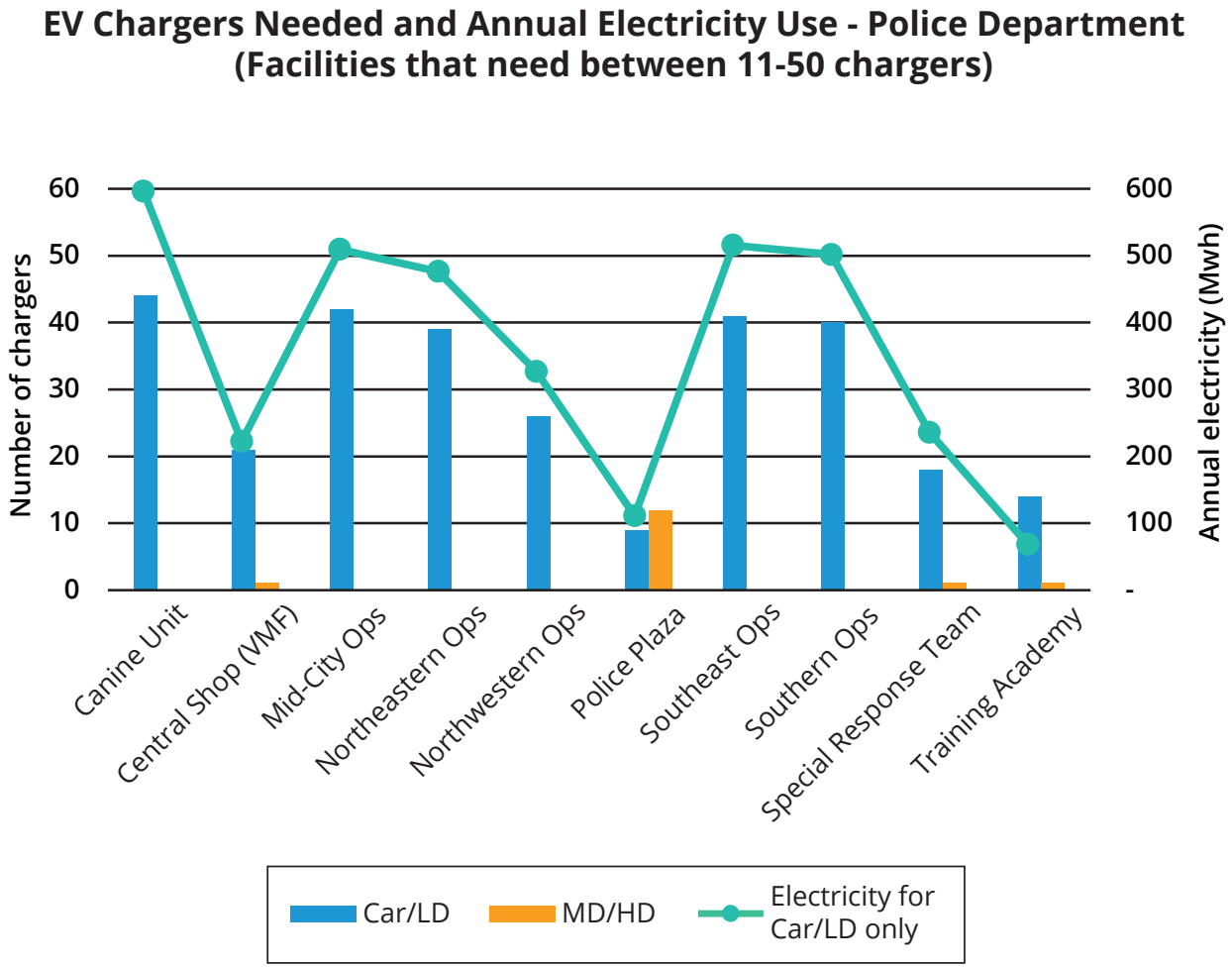
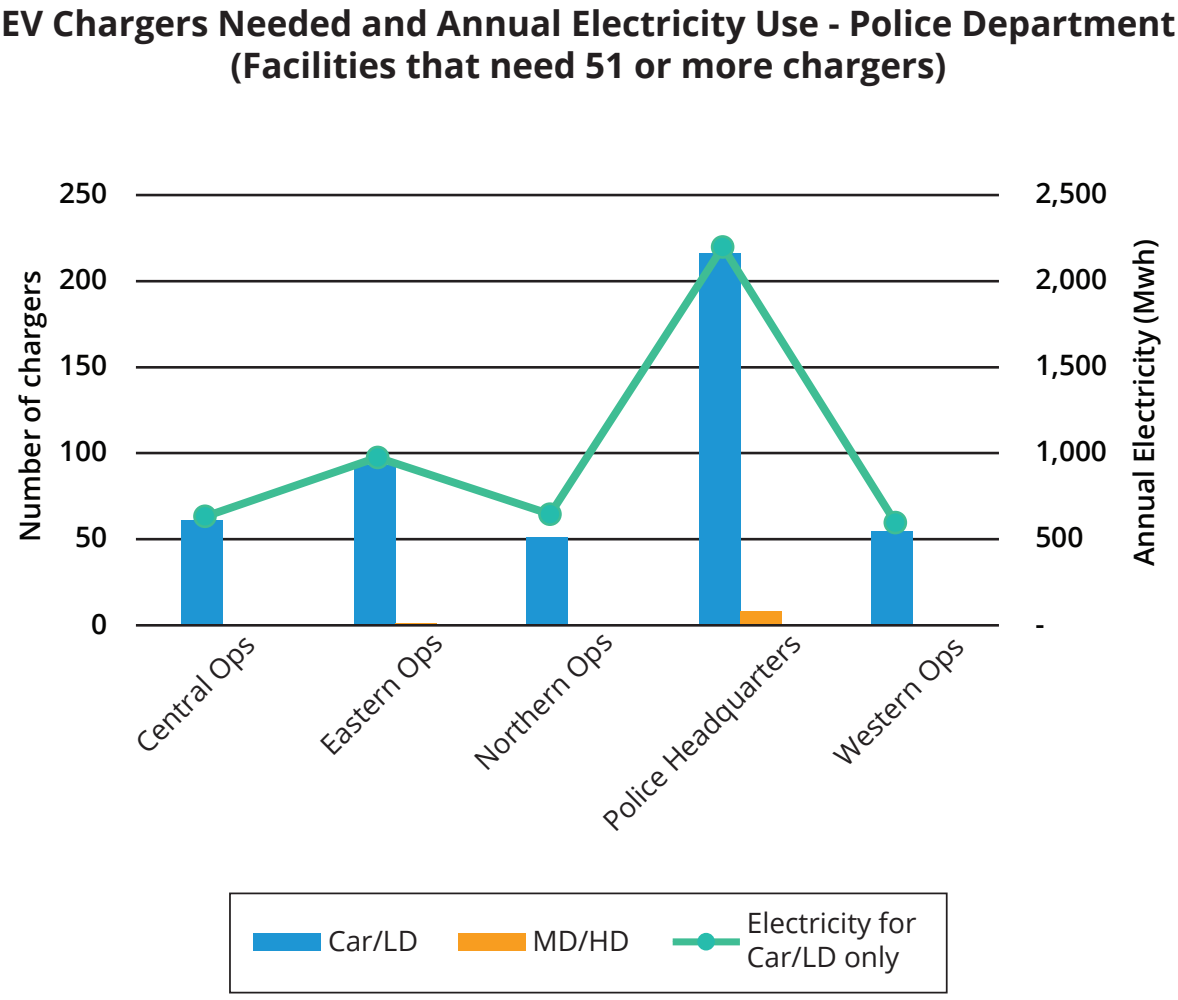


Figure 32. EV Chargers (N>50) and Annual Electricity (Car/LDV only) Needed – Police Department



FIRE-RESCUE DEPARTMENT

The City of San Diego Fire-Rescue facilities consist of 47 fire stations, an air operations facility, a communication center, a training facility, nine permanent lifeguard stations and a boat dock. Fire-Rescue assets total more than 600,000 square feet of building area.

Asset Managing Department: San Diego Fire-Rescue Department

Mission: To serve the community of San Diego by providing the highest level of emergency/rescue services, hazard prevention and safety education, ensuring the protection of life, property and the environment.

Share of 2019 Municipal Energy Use: 1.6%

Summary of Fire-Rescue Facility Energy Opportunities: Based on the information provided in the figures below, the Fire-Rescue Department has significant opportunities to reduce energy consumption and begin electrifying end uses to achieve the municipal zero emissions goal by 2035.

Over the last several years, annual energy use of Fire-Rescue facilities has remained largely the same. Fire Station 28 is a combined facility, which also serves as the Fire-Rescue Logistics Facility. This dual use explains the high energy consumption. Fire Station 28 has been retrofitted with solar panels to help provide onsite renewable energy. Fire Station 45 uses more energy than other stations on average. Lifeguard stations' energy use accounted for 5% of the total energy use of all Fire-Rescue facilities.

The following 11 facilities have been identified by the Sustainability and Mobility and Fire-Rescue Departments for near-term comprehensive energy retrofits in partnership with ESCOs:

- Fire Communications Center
- Fire Station 10
- Fire Station 11
- Fire Station 12
- Fire Station 20
- Fire Station 32
- Fire Station 36
- Fire Station 39
- Fire Station 42
- Fire Station 44
- Fire Station 46

The sites above were selected based on initial research done by SC Engineers. Retrofits at the sites listed above are expected to have a payback under seven years and achieve at least a 30% energy reduction. All of the above-listed facilities are good candidates for near ZNE retrofit projects, meaning approximately 75% of energy consumption can be provided by onsite solar. The Sustainability and Mobility Department will work with ESCOs to explore inclusion of electrification strategies and solar PV in energy project plans for these sites.

Additionally, the following Fire-Rescue facilities are good candidates for near ZNE retrofits that include energy-efficiency improvements, electrification and solar PV to offset approximately 75% of facility energy consumption in the future:

- Fire Station 8
- Fire Station 15
- Fire Station 16
- Fire Station 35
- Fire Station 37
- Fire Station 38
- Fire Station 43

The following two sites have been identified for near-term installation of renewable microgrids:

- Fire Station 19
- Fire Station 29

Renewable microgrids can replace backup generators powered by fossil fuels (typically diesel or gasoline) and will be explored at all facilities where generators are currently installed.

To achieve the zero emissions goal, all Fire-Rescue facilities will need to electrify end uses (i.e. eliminate natural gas equipment), maximize cost-effective onsite solar, and install energy management systems to maintain operational efficiency throughout the day, week and season. Costs associated with transitioning natural gas end uses to electric technologies have not been quantified; further study is required to assess the cost impacts of electrification at existing facilities.

Figure 33. 2019 Energy Use Map – Fire-Rescue Facilities

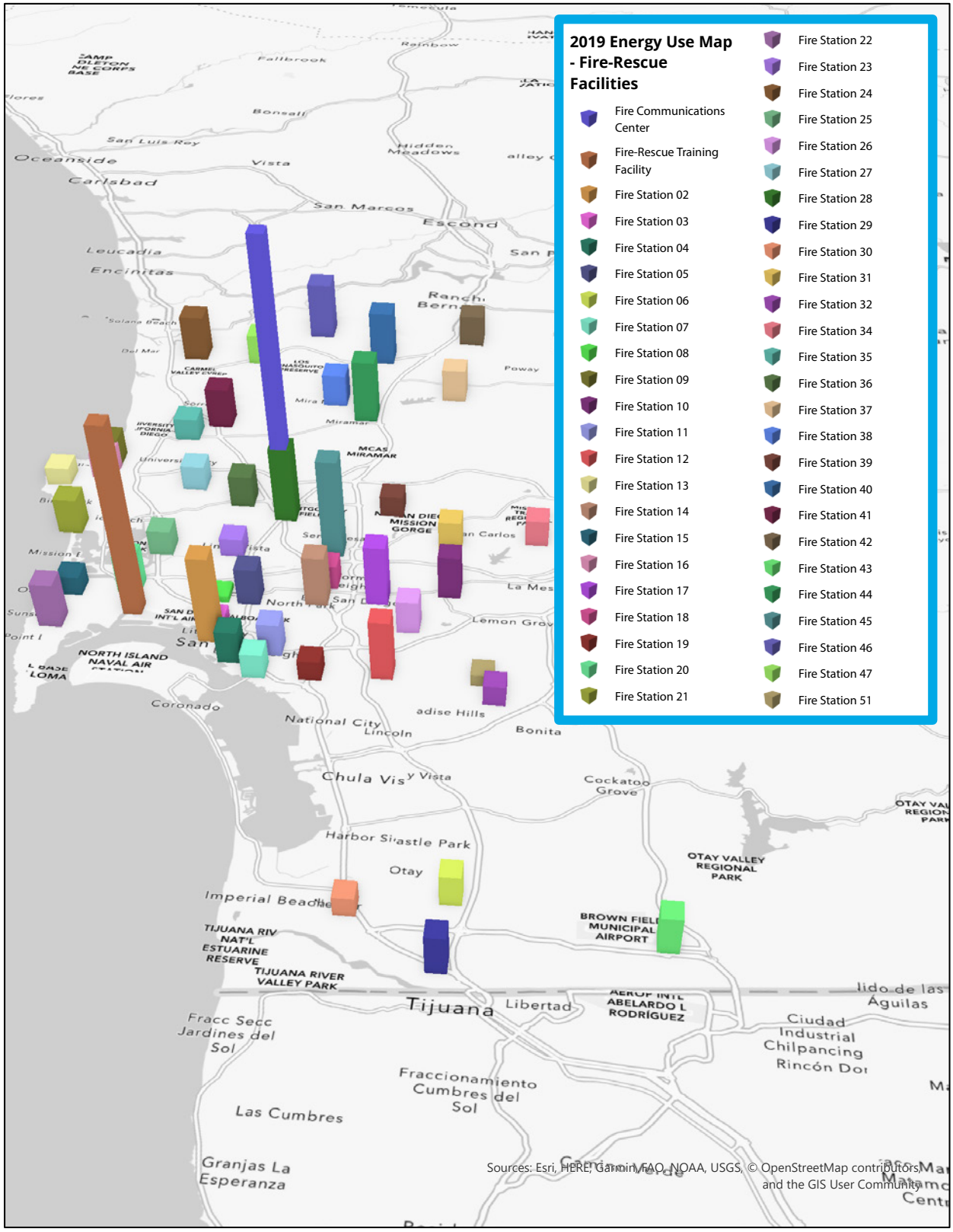


Figure 34. Energy Use Trends – Fire-Rescue Facilities

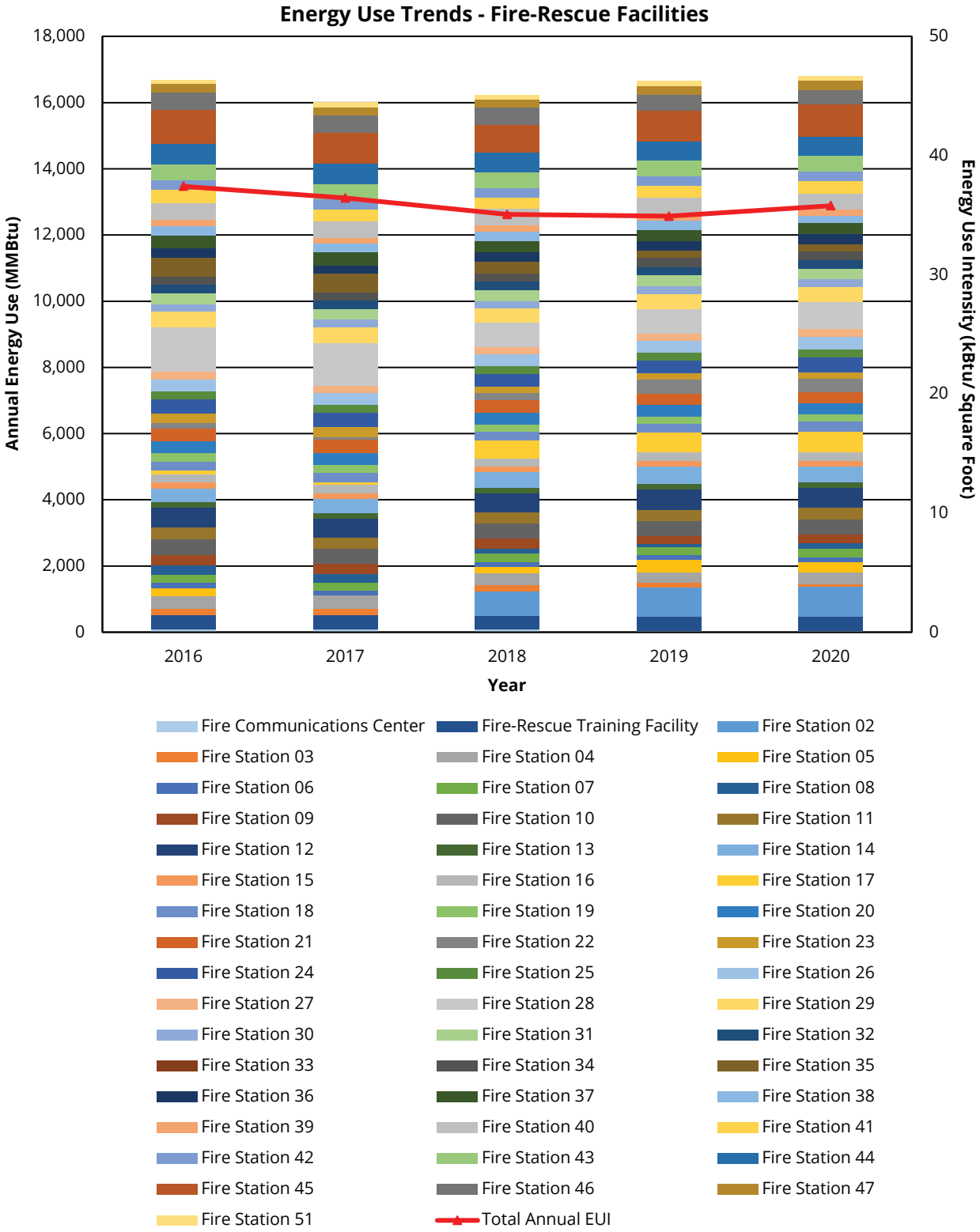
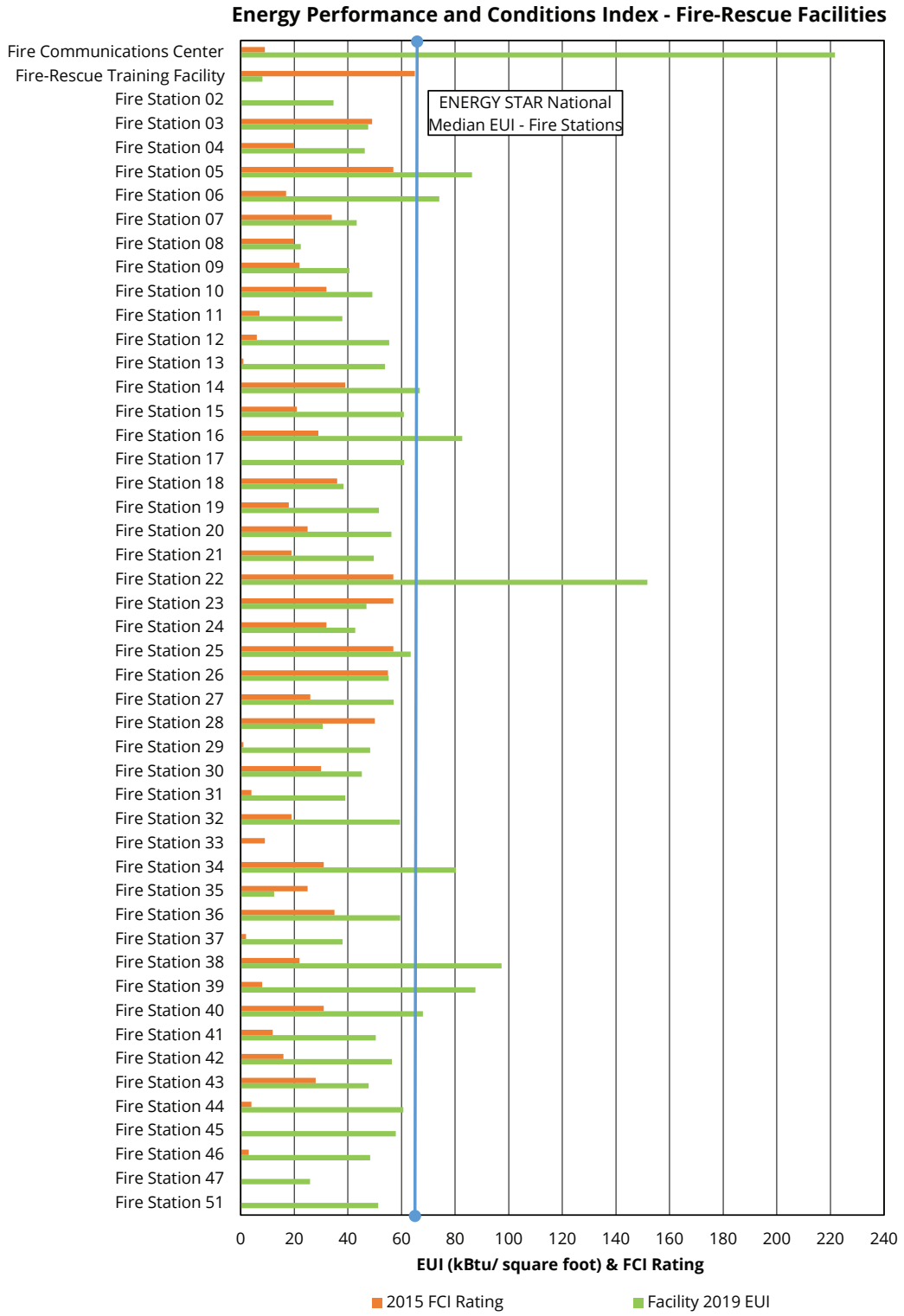


Figure 35. Energy Performance and Conditions Index – Fire-Rescue Facilities



The figures above reflect power purchased from the local utility. Onsite power generation at some facilities is not tracked and has not been included in the annual energy consumption figures nor the EUI calculations.

LIFEGUARD STATIONS

Figure 36. 2019 Energy Use Map – Lifeguard Facilities

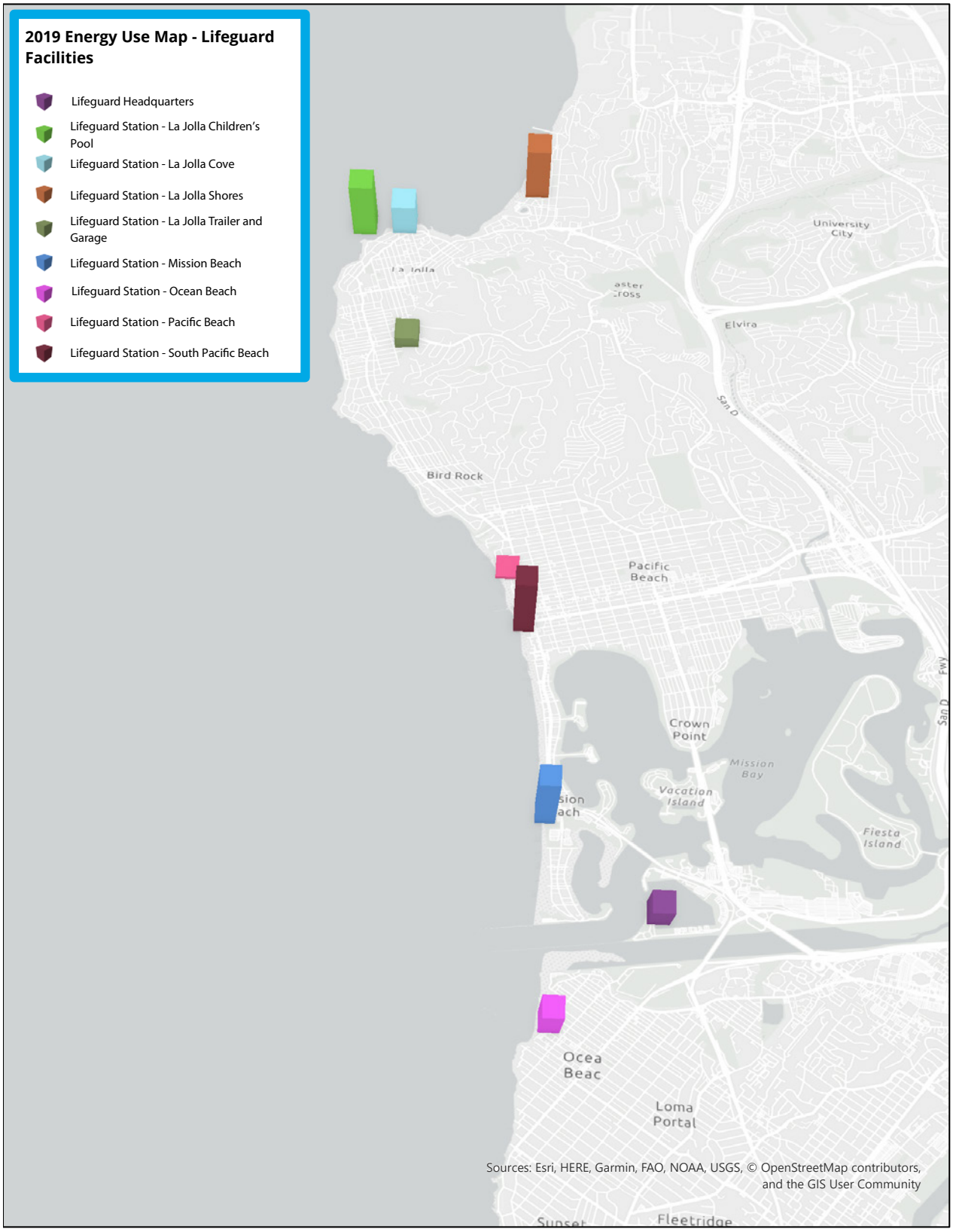


Figure 37. Energy Use Trends – Lifeguard Facilities

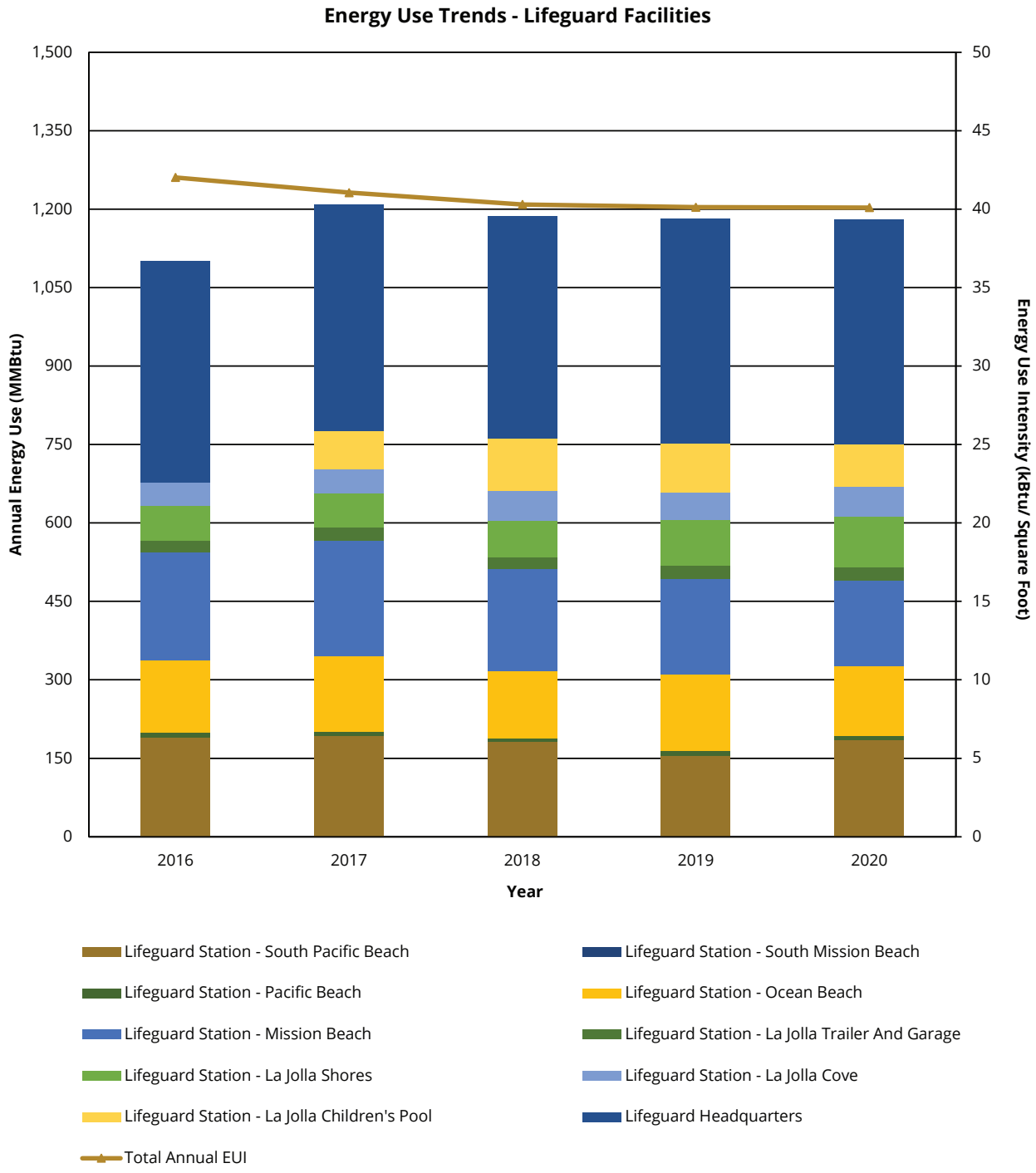
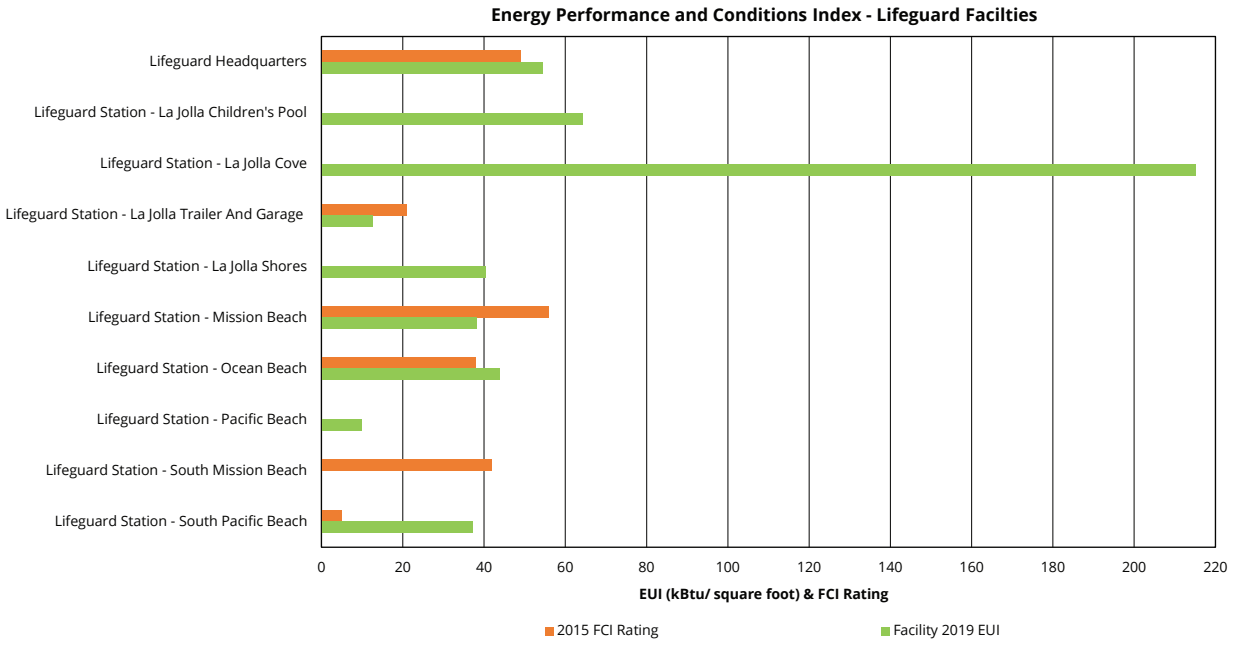


Figure 38. Energy Performance and Conditions Index – Lifeguard Facilities



The figures above reflect power purchased from the local utility. Onsite power generation at some facilities is not tracked and has not been included in the annual energy consumption figures nor the EUI calculations. There is currently no National Median EUI for Lifeguard stations.

RECENT ENERGY EFFORTS

Figure 39. Recent Energy Efforts – Fire-Rescue Department

2016	• Fire Station 23 roof and window replacement
2017	• Fire Station 37 HVAC system replacement • Solar PV installations at Fire Station 5 (9 kW), Fire-Rescue Training Facility (39 kW) and Fire Station 17 (8 kW)
2018	• Solar PV installations at Fire Station 2 (14 kW) and Fire Station 22 (19 kW)
2019	• Fire Station 3 and 14 HVAC & roof upgrades
2020	• No known projects

ENERGY PERFORMANCE IMPROVEMENT OPPORTUNITIES

Figure 40. Energy Use Reduction Opportunities – Fire-Rescue Facilities

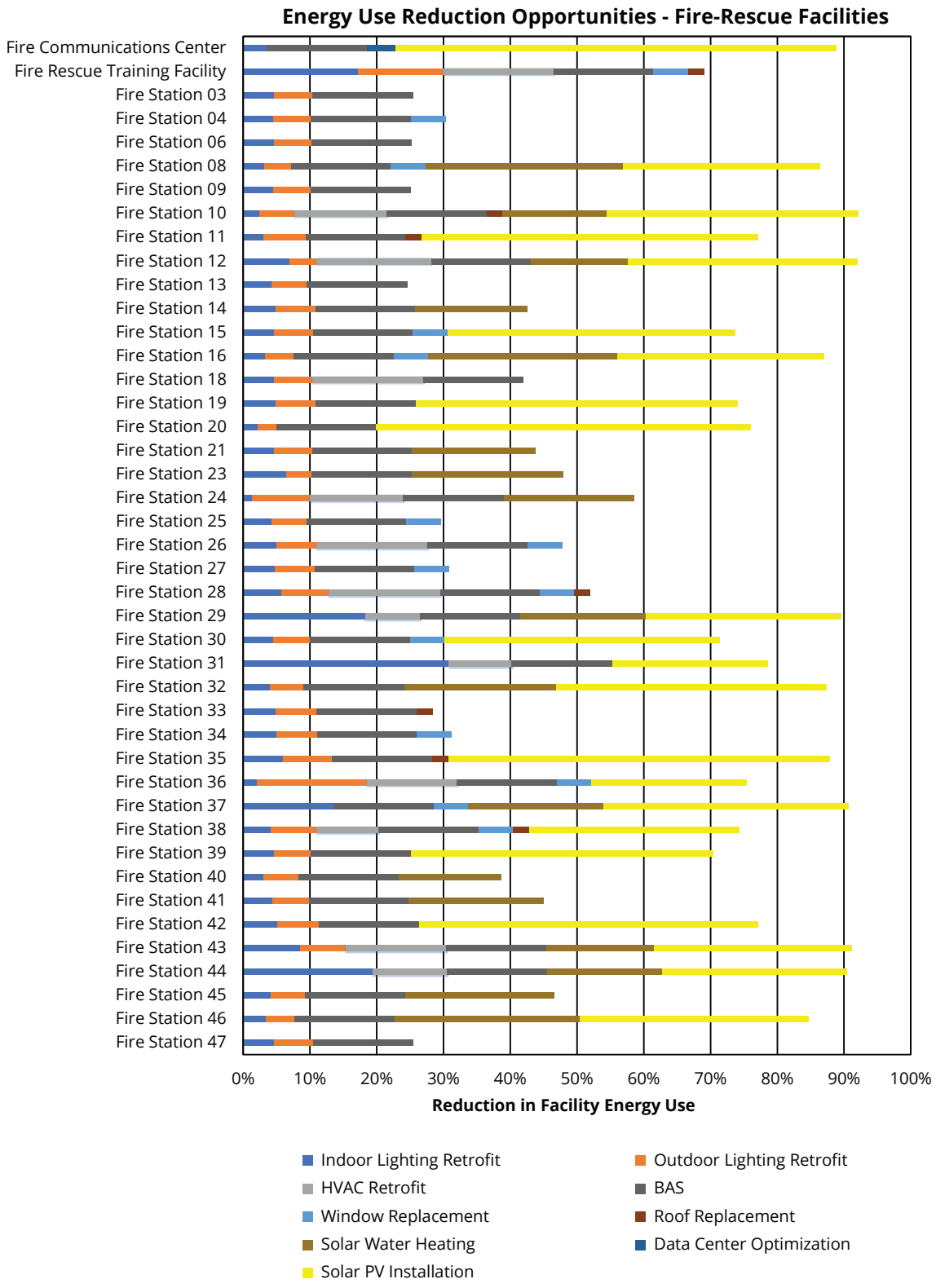
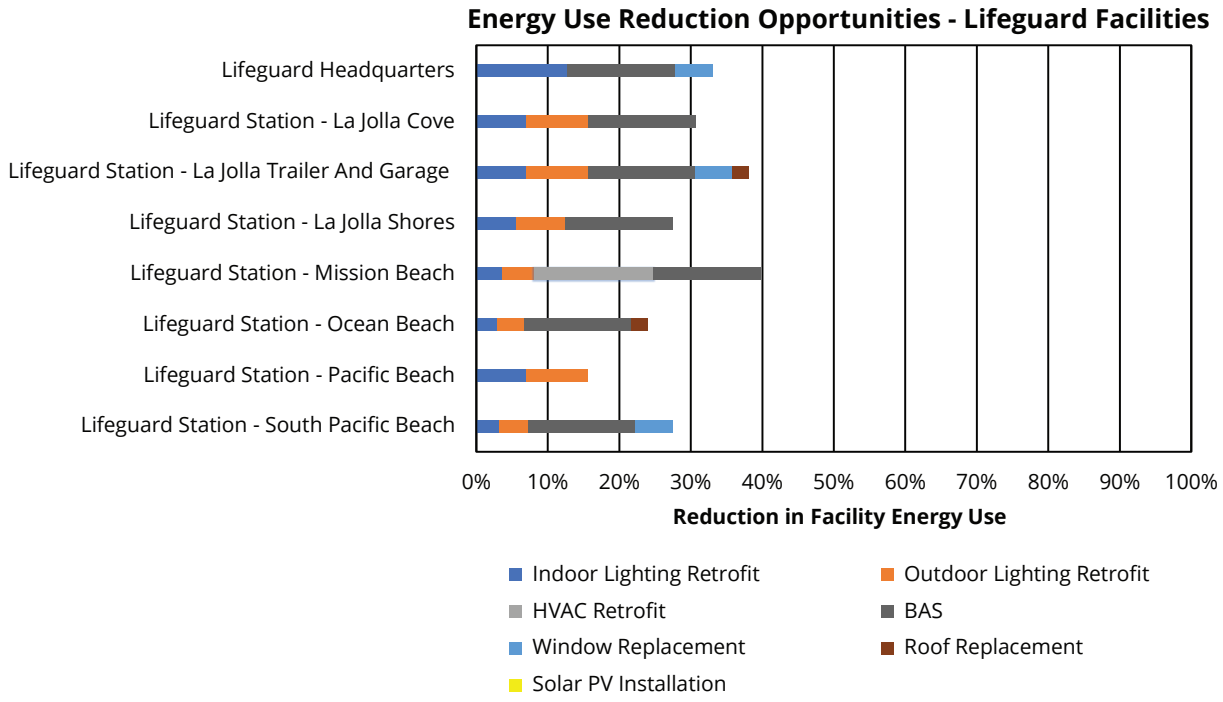
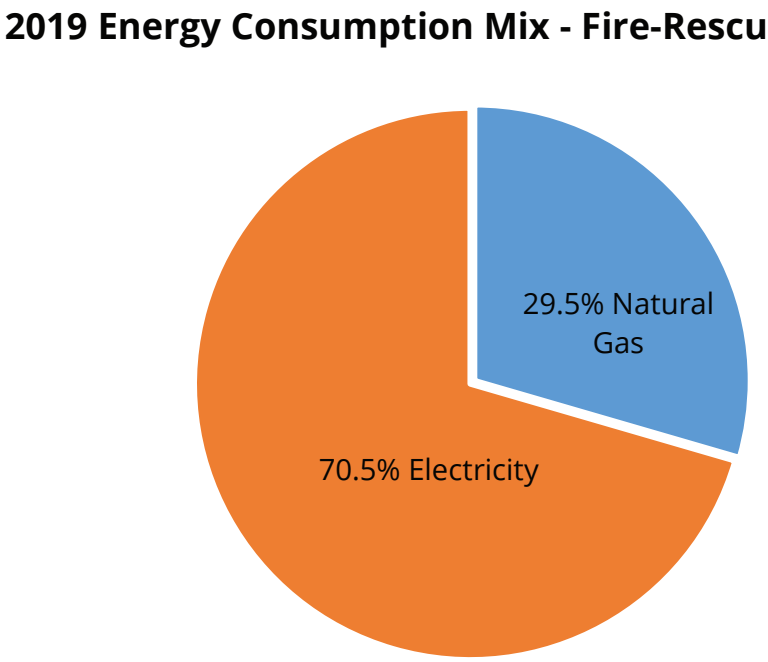


Figure 41. Energy Use Reduction Opportunities – Lifeguard Facilities



The energy opportunities shown in the figures above have been deemed feasible based on evaluation of available energy audits and department energy liaison interviews performed by SC Engineers, a consultant to the Sustainability and Mobility Department.

Figure 42. Energy Use Reduction Opportunities – Lifeguard Facilities



ELECTRIC VEHICLE CHARGING

The Fire-Rescue Department houses 201 LD, MD and HD cars. Diesel vehicles, which are more specialized vehicles such as fire engines, aircraft and aerial ladder trucks, are not considered here because electric options may be more difficult to identify and refueling data on these vehicles is unavailable. Forty-five of those vehicles are missing station names from their records, so they are not accounted for here. The remaining 156 vehicles are distributed across 26 locations. Sixty-three chargers will be needed at Fire-Rescue facilities to support these vehicles, and the distribution of chargers at each facility is shown in the figures below.

Figure 43. EV Chargers and Annual Electricity (Car/LDV only) Needed – Fire Headquarters

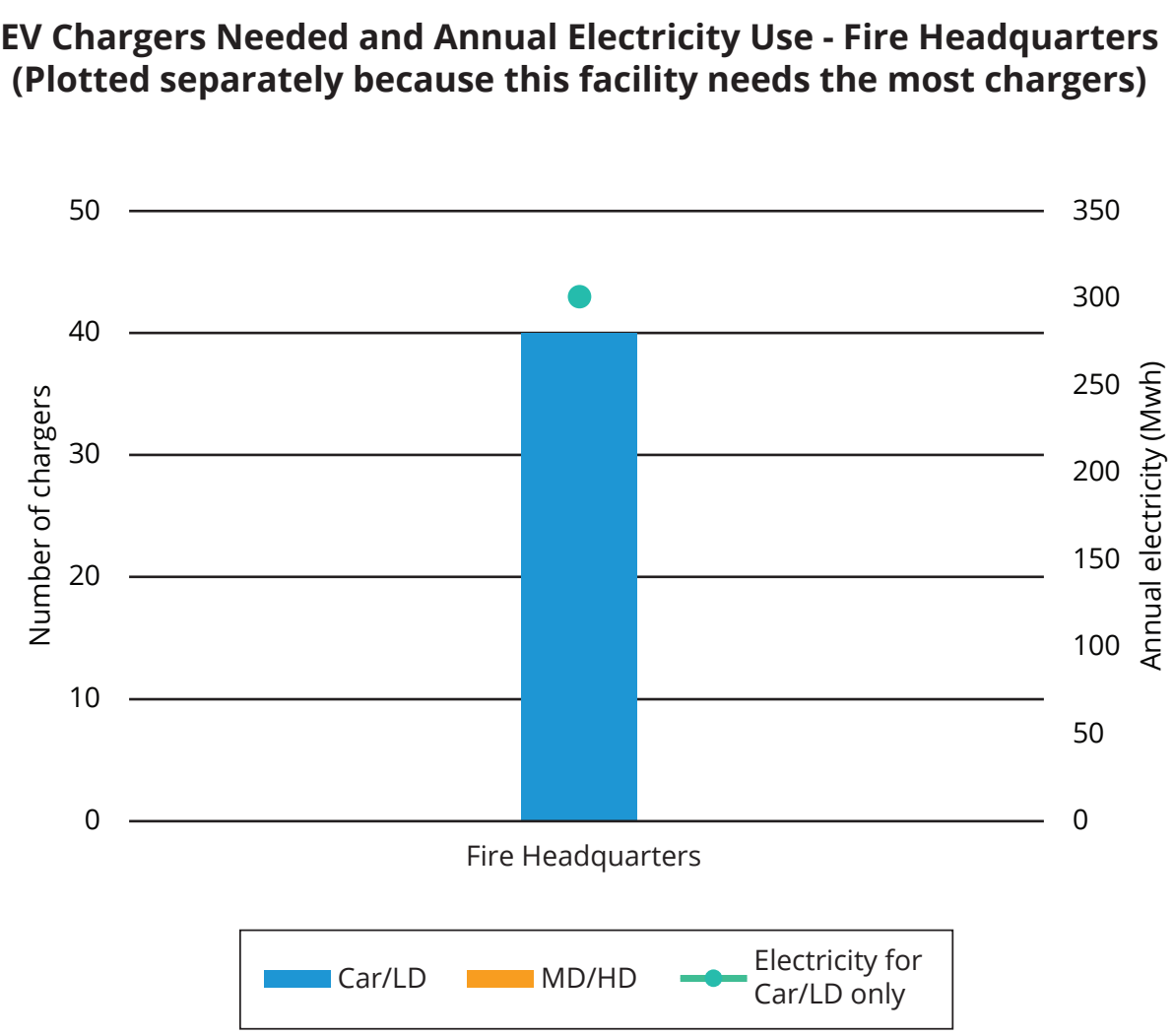


Figure 44. EV Chargers and Annual Electricity (Car/LDV only) Needed – Fire Stations

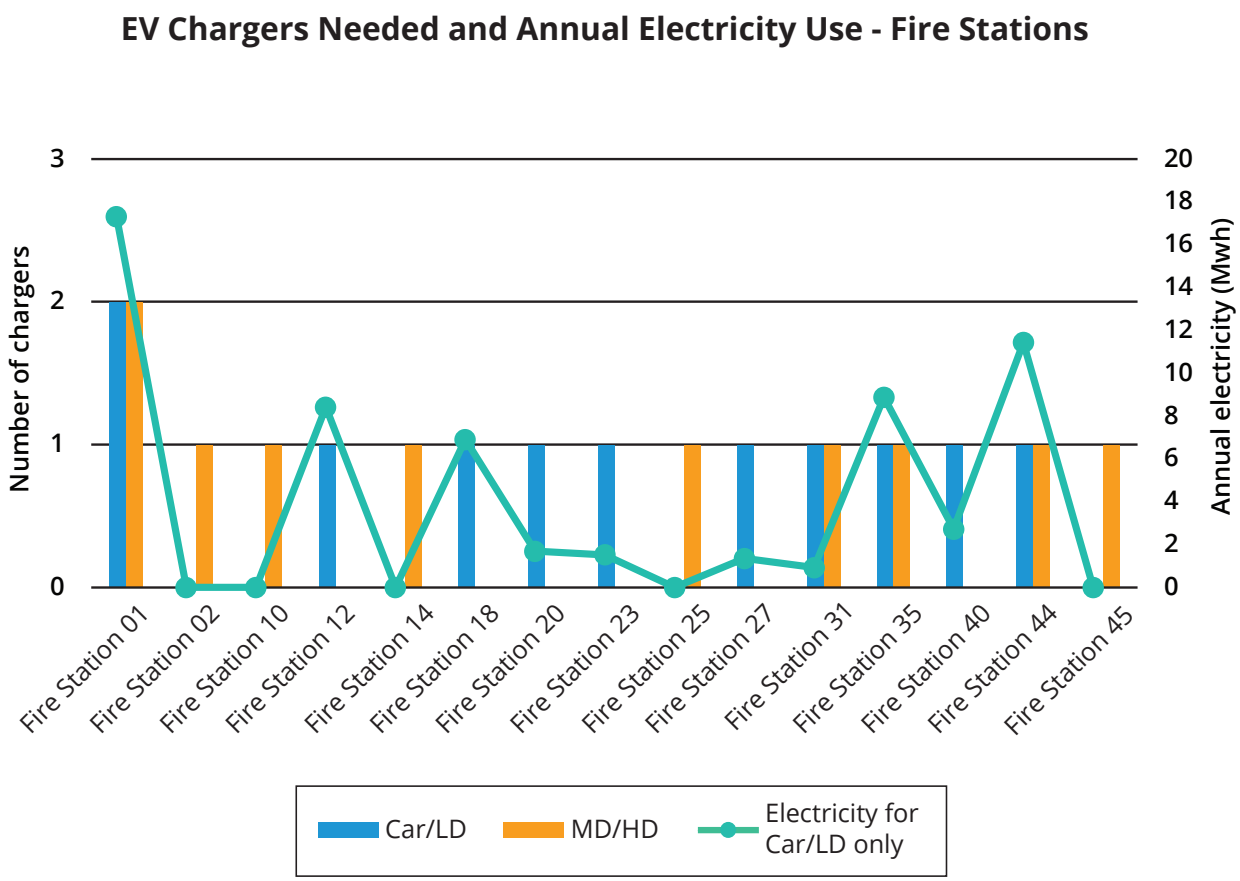
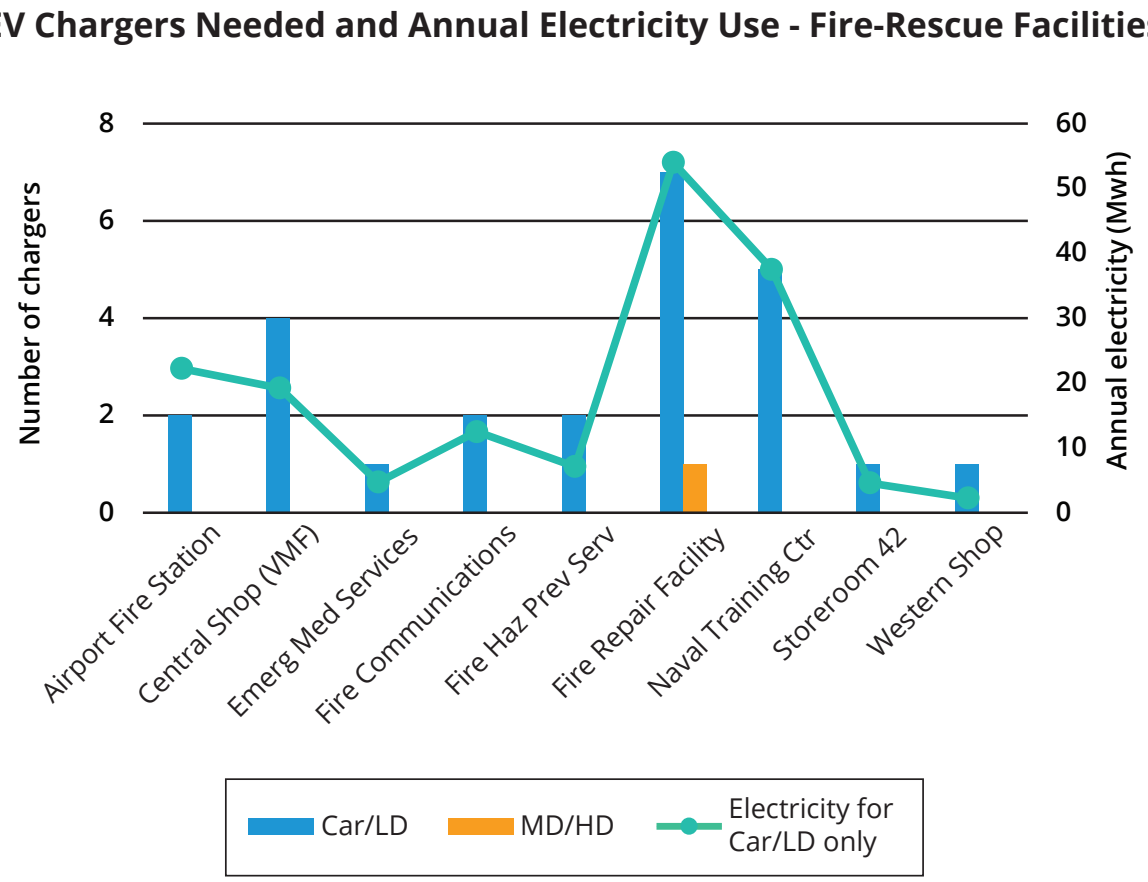


Figure 45. EV Chargers and Annual Electricity (Car/LDV only) Needed – Fire Stations



DEPARTMENT OF REAL ESTATE AND AIRPORT MANAGEMENT

The City of San Diego's Department of Real Estate and Airport Management (DREAM) facilities include Brown Field Airport, Montgomery-Gibbs Executive Airport and Field Engineering Offices. A large number of buildings at Brown Field and Montgomery-Gibbs Executive Airport are leased out. The Field Engineering Offices include a lab building, main engineering office building and a trailer (office), which are occupied by the engineering division of the Public Works Department.

Asset Manager (and Owner): Department of Real Estate and Airport Management

Mission: To serve the San Diego community through excellence in stewardship of the City's real estate assets.

Share of 2019 Municipal Energy Use: 0.3%

Summary of Real Estate Assets Facilities Energy Opportunities: Based on the information provided in the figures below, DREAM has significant opportunities to reduce energy consumption and begin electrifying end uses to achieve the municipal zero emissions goal by 2035.

During the last several years annual energy use of DREAM facilities has remained largely the same until 2020 where there was a significant reduction.

The following two facilities have been identified by the Sustainability and Mobility Department

and DREAM for near-term comprehensive energy retrofits in partnership with ESCOs:

- Field Engineering Offices (Engineering & Capital Projects)
- Montgomery-Gibbs Executive Airport

The sites above were selected based on initial research done by SC Engineers. Retrofits at the sites listed above are expected to have a payback less than seven years and achieve at least a 30% energy reduction.

Field Engineering Offices, Brown Airport and Montgomery-Gibbs Executive Airport are good candidates for adding solar. Additional research is necessary to determine if these facilities can achieve ZNE, meaning onsite solar can offset all energy used by the facilities after energy-efficiency improvements and electrification are addressed. The Sustainability and Mobility Department will work with ESCOs to explore inclusion of electrification strategies and solar PV in energy project plans for these sites. To achieve the zero emissions goal, all DREAM facilities will need to electrify end uses (i.e. eliminate natural gas equipment), maximize cost-effective onsite solar, and install energy management systems to maintain operational efficiency throughout the day, week and season. Costs associated with transitioning natural gas end uses to electric technologies have not been quantified; further study is required to assess the cost impacts of electrification at existing facilities.

Figure 46. 2019 Energy Use Map – Department of Real Estate and Airport Management

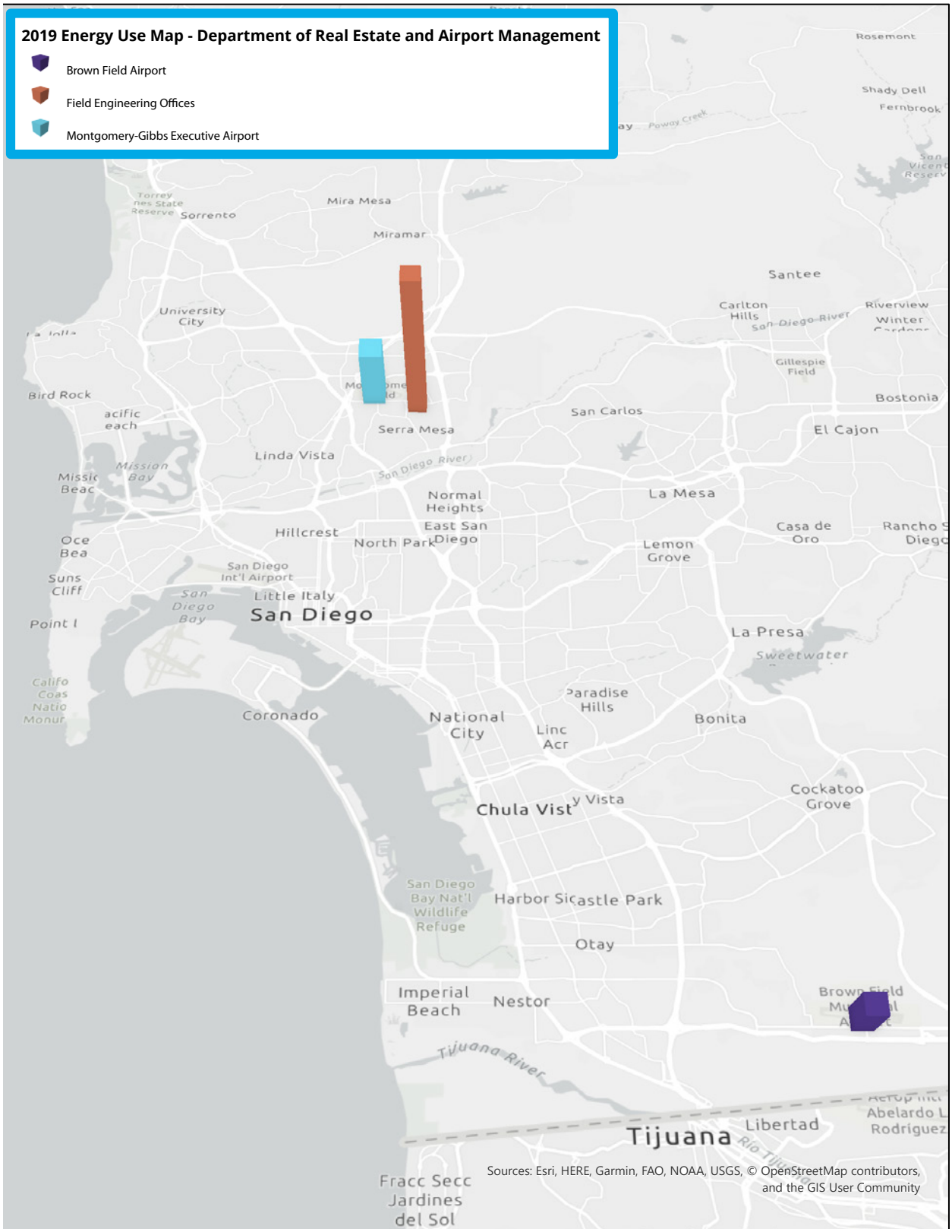
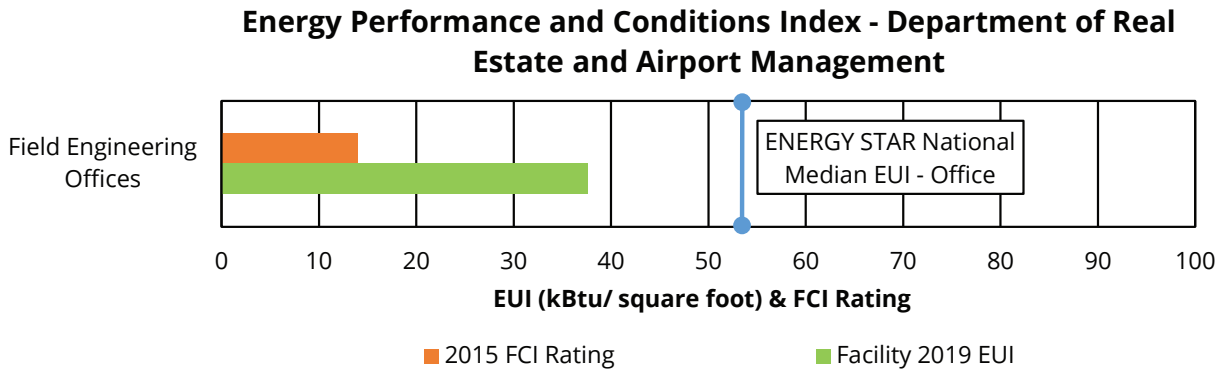


Figure 47. Energy Use Trends – Department of Real Estate and Airport Management

Figure 48. Energy Performance and Condition Index – Department of Real Estate and Airport Management



The figures above reflect power purchased from the local utility. Onsite power generation at some facilities is not tracked and has not been included in the annual energy consumption figures nor the EUI calculations.

RECENT ENERGY EFFORTS

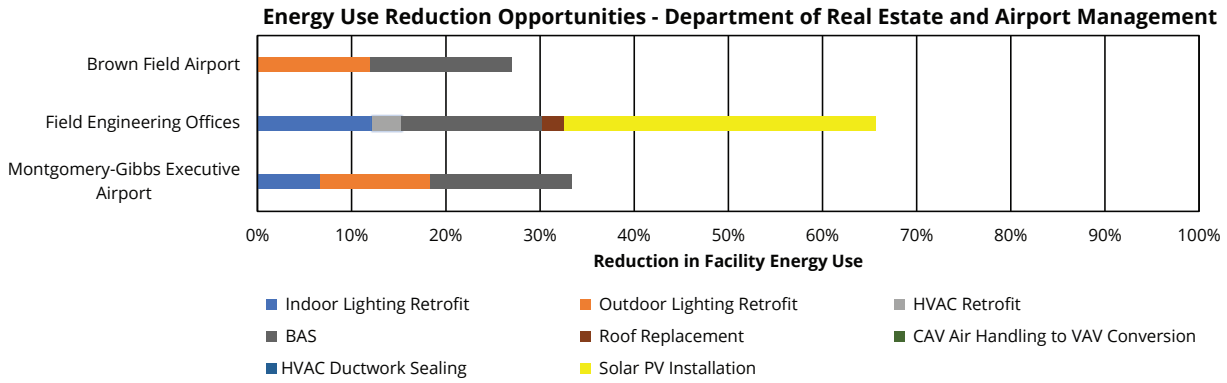
Figure 49. Recent Energy Efforts – Department of Real Estate and Airport Management

2016	• No known projects
2017	• No known projects
2018	• No known projects
2019	• No known projects
2020	• No known projects

ENERGY PERFORMANCE IMPROVEMENT OPPORTUNITIES.

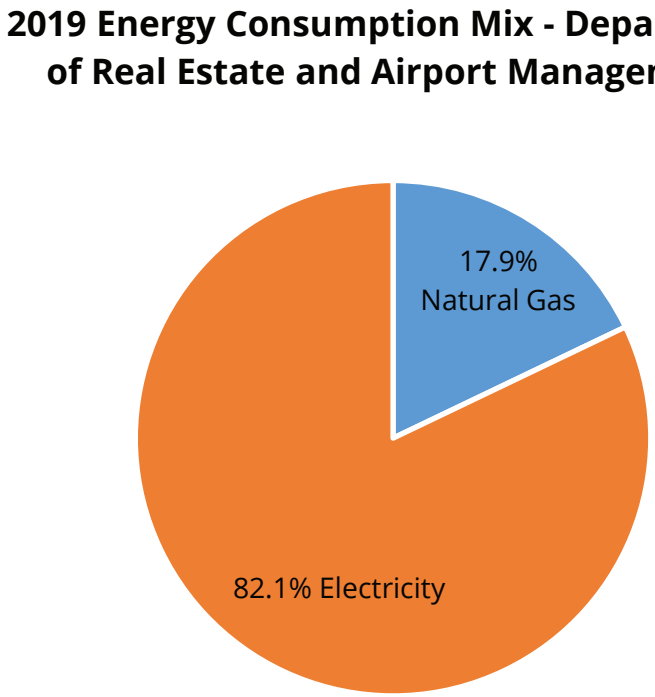
Between 2010 and 2020, facilities at DREAM were audited to identify energy-savings opportunities. Audits indicate that most of the DREAM facilities will benefit from HVAC and lighting retrofits, along with installation of BAS, and solar PV at one facility, as shown in the figure below.

Figure 50. Energy Use Reduction Opportunities – Department of Real Estate and Airport Management



The energy opportunities shown in the figure above have been deemed feasible based on evaluation of available energy audits and department energy liaison interviews performed by SC Engineers, a consultant to the Sustainability and Mobility Department.

Figure 51. 2019 Energy Consumption Mix – Department of Real Estate and Airport Management



ELECTRIC VEHICLE CHARGING

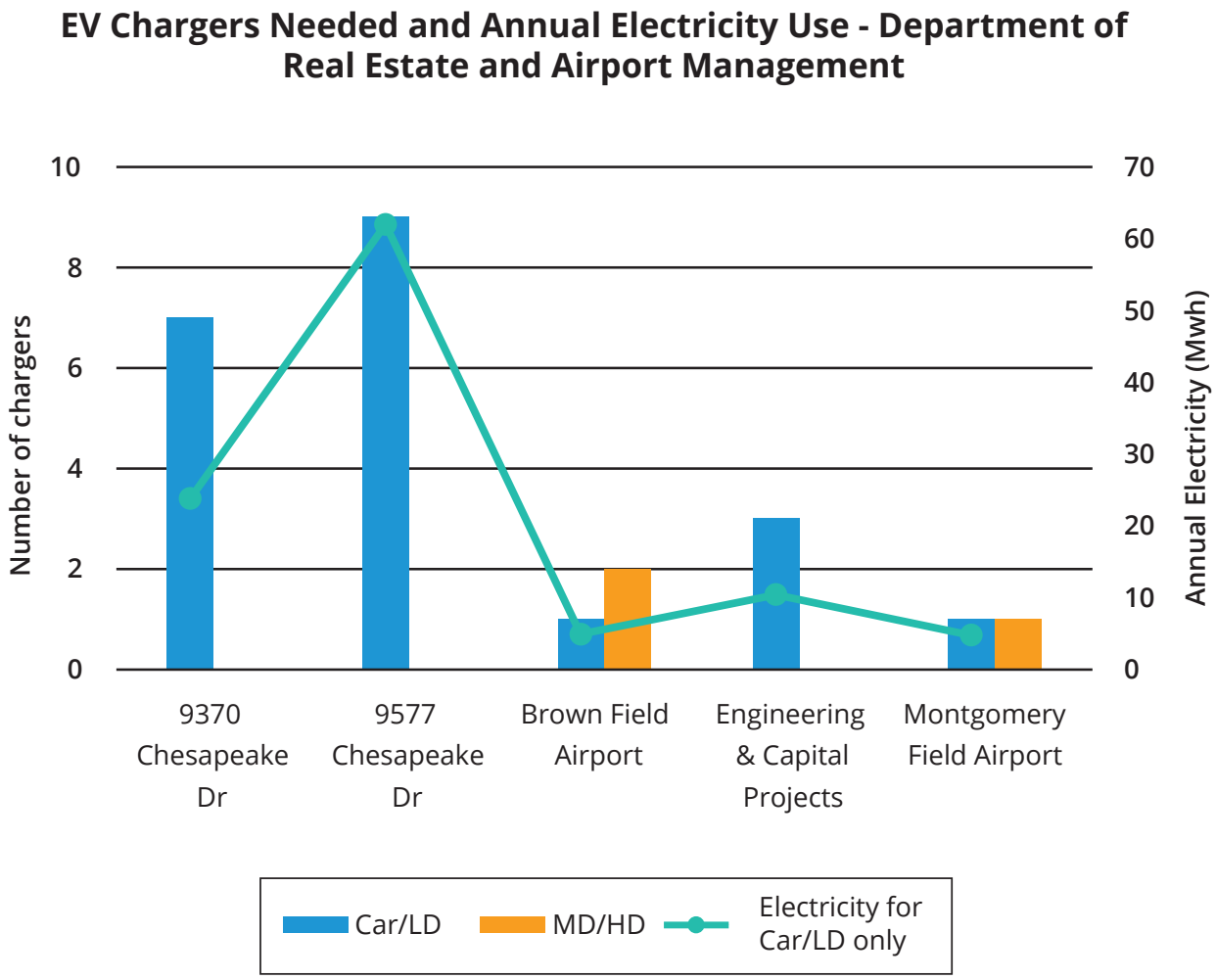
DREAM houses 43 vehicles from different departments across five of its locations. Estimated annual fuel use and total associated CO2e for those vehicles is shown in the figure below.

Figure 52. FY2019 Estimated Fuel Use and CO2e Produced – Department of Real Estate and Airport Management

	Car/LD	MD/HD		CO2e (metric tons)
	Unleaded (gal)	Unleaded (gal)	Diesel (gal)	
DREAM facilities (total)	**11,193**	**1,186**	**783**	**119**
9370 Chesapeake Dr	3,003	--	--	27
9577 Chesapeake Dr	5,138	--	--	46
Brown Field Airport	63	42	783	9
Engineering & Capital Projects	2,223	--	--	20
Montgomery Field Airport	766	1,144	--	17

The charging needs for those 43 vehicles are shown in the figure below. Note that the Chesapeake Drive locations are leased facilities not owned by the City.

Figure 53. EV Chargers and Annual Electricity (Car/LDV only) Needed – Department of Real Estate and Airport Management



DREAM houses vehicles from the departments shown in the figure below.

Figure 54. Parking Distribution of Vehicles from Other Departments – Department of Real Estate and Airport Management

	CARS/LD	MD/HD	TOTAL VEHICLES
9370 Chesapeake Dr	**14**	**0**	**14**
STORMWATER	12	0	12
TRANSPORTATION	2	0	2
9577 Chesapeake Dr	**17**	**0**	**17**
ENGINEERING & CAPITAL PROJECTS	17	0	17
Brown Field Airport	**1**	**3**	**4**
DREAM	1	3	4
Engineering & Capital Projects	**4**	**0**	**4**
ENGINEERING & CAPITAL PROJECTS	4	0	4
Montgomery Field Airport	**2**	**2**	**4**
AIRPORTS	2	2	4

ENVIRONMENTAL SERVICES DEPARTMENT

The City of San Diego Environmental Services Department (ESD) assets consist of Miramar Landfill, Miramar Operations Yard and employee parking lot, and the Ridgehaven Green Building.

Asset Manager: Environmental Services Department

Mission: To reliably manage solid waste, conserve resources and protect the environment.

Share of 2019 Municipal Energy Use: 0.9%
Summary of Environmental Services Energy Opportunities: Based on the information provided in the figures below, ESD has

significant opportunities to reduce energy consumption and begin electrifying end uses to achieve the municipal zero emissions goal by 2035.

Over the last several years, ESD energy consumption and Energy Use Intensities (EUIs)

have been trending upward, indicating that older facilities would benefit from RCx and equipment upgrades to ensure the buildings are performing optimally.

Miramar Operations Yard, which is comprised of an administration building and two maintenance garages, accounts for more than 50% of the energy used by ESD. In 2019, a 62 kW solar canopy at Miramar Operations Yard was removed due to a manufacturer inverter recall. Most of the energy consumption increase can be explained by the solar being decommissioned and from the installation of several high-powered gas compressors to operate the Compressed Natural Gas (CNG) fueling station. Miramar Ops Yard is also the location of the City's compressed natural gas fueling station, which supports over 100 CNG trash trucks. The CNG fueling station accounts for the majority of the energy consumed at this site, but it is important to note the GHG benefits associated with CNG over diesel fuel as a fuel for HD trucks that are not yet ready for electrification based on market conditions.

Miramar Operations Yard and the Ridgehaven Green Building have been identified by the Sustainability and Mobility Department and ESD for near-term comprehensive energy retrofits in partnership with ESCOs. These sites were selected based on initial research done by SC Engineers. Retrofits are expected to have a payback under seven years and achieve at least a 30% energy reduction.

Ridgehaven's HVAC system is a deferred maintenance issue. The system was installed in 1995 and requires significant effort and expense by Facilities Maintenance to ensure ongoing operation. Windows are single pane (highly inefficient) and are due for replacement. The Miramar Operations Yard is primed for a retrofit of parking lot lighting and indoor lighting, as well as installation of a BAS and rapid roll bay door replacement. The two facilities are good candidates for near ZNE retrofit projects, meaning approximately 75% of energy consumption can be provided by onsite solar. The Sustainability and Mobility Department will work with ESCOs to explore inclusion of electrification strategies and solar PV in energy project plans for these sites.

To achieve the zero emissions goal, all ESD facilities will need to electrify end uses (i.e. eliminate the use of natural gas equipment), maximize cost-effective onsite solar, and install energy management systems to maintain operational efficiency throughout the day, week and season. Costs associated with transitioning natural gas end uses to electric technologies have not been quantified; further study is required to assess the feasibility and cost impacts of electrification at existing facilities. Specifically, the Department will evaluate and monitor available technology to fully electrify the refuse packer fleet. Currently, available products do not meet the Department's operational needs.

Figure 55. 2019 Energy Use Map – Environmental Services Department

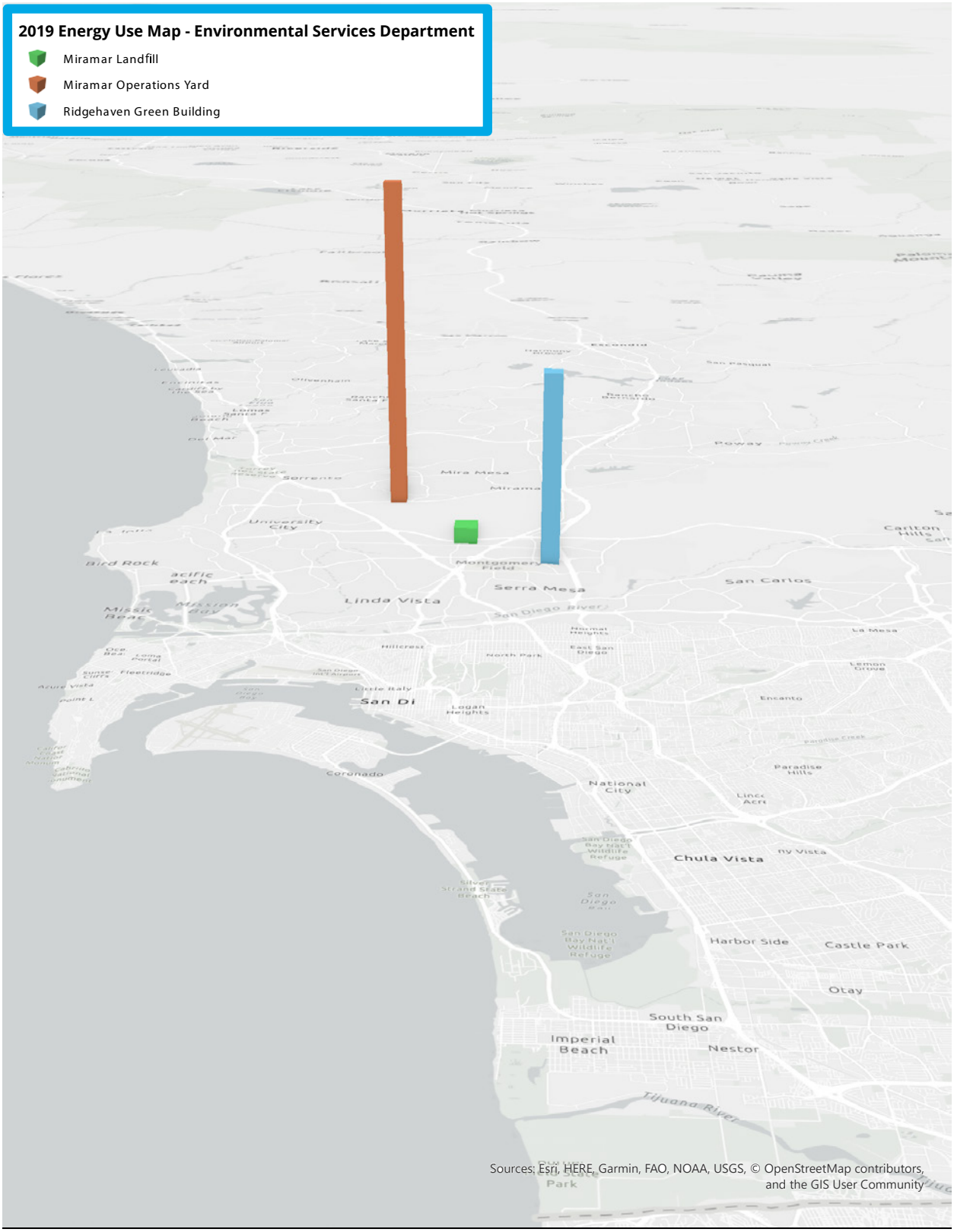


Figure 56. Energy Use Trends – Environmental Services Department

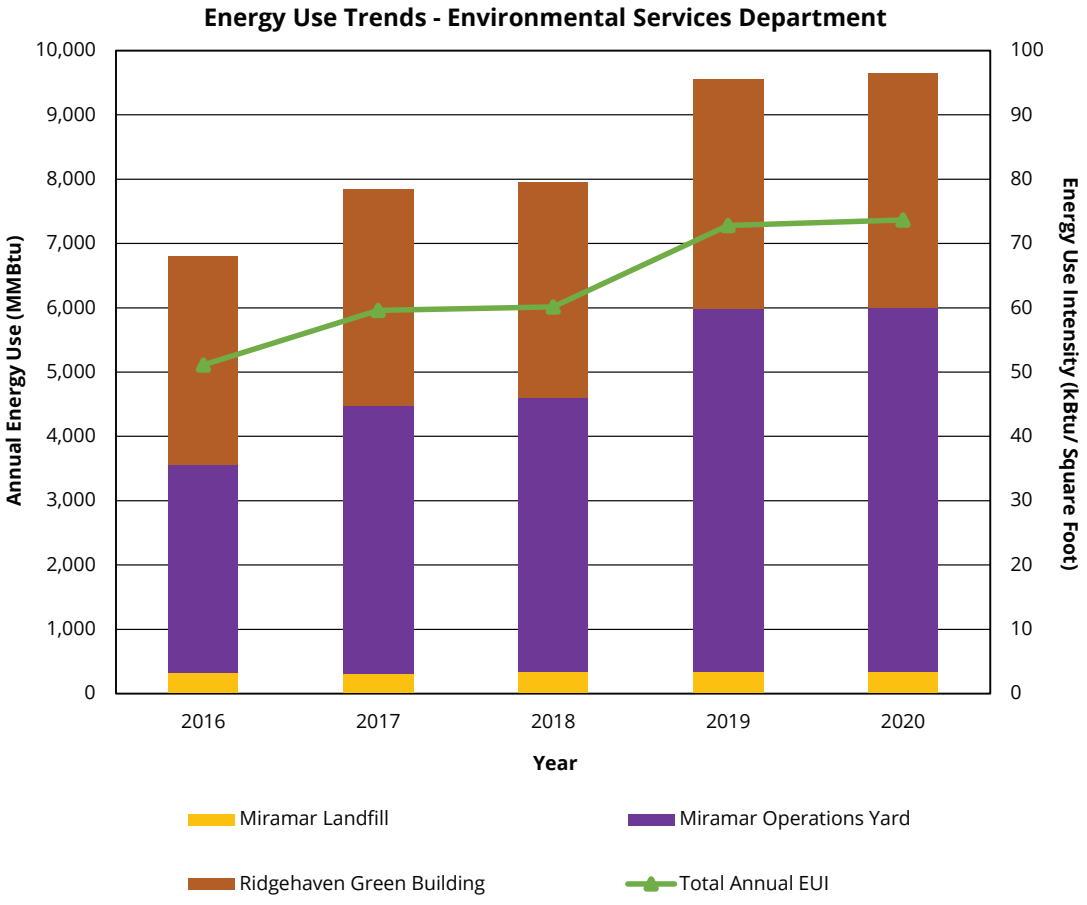
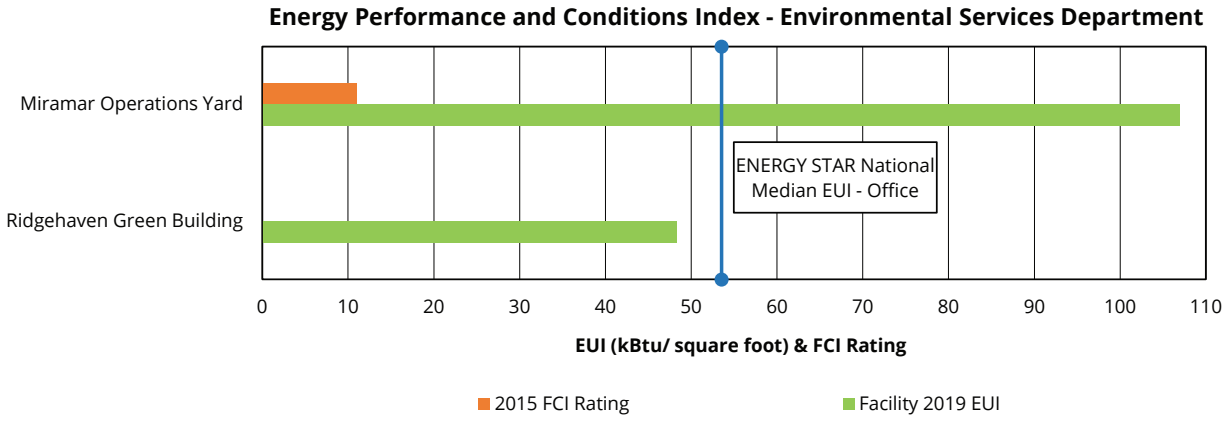


Figure 57. Energy Performance and Condition Index – Environmental Services Department



The figures above reflect power purchased from the local utility. Onsite power generation at some facilities is not tracked and has not been included in the annual energy consumption figures nor the EUI calculations. EUI values do not include energy consumption at the Miramar Landfill.

Due to the diverse portfolio that ESD manages, the EUI values are not easily compared against each other, nor is there an Energy Star National Median EUI for operations yards or nurseries. The Ridgehaven Green building, a flagship LEED-certified building of its time, falls below the Energy Star National Median EUI for office spaces despite offering services that run 24 hours a day, 7 days a week at their location. 2015 FCI for Ridgehaven is not available from the City's records.

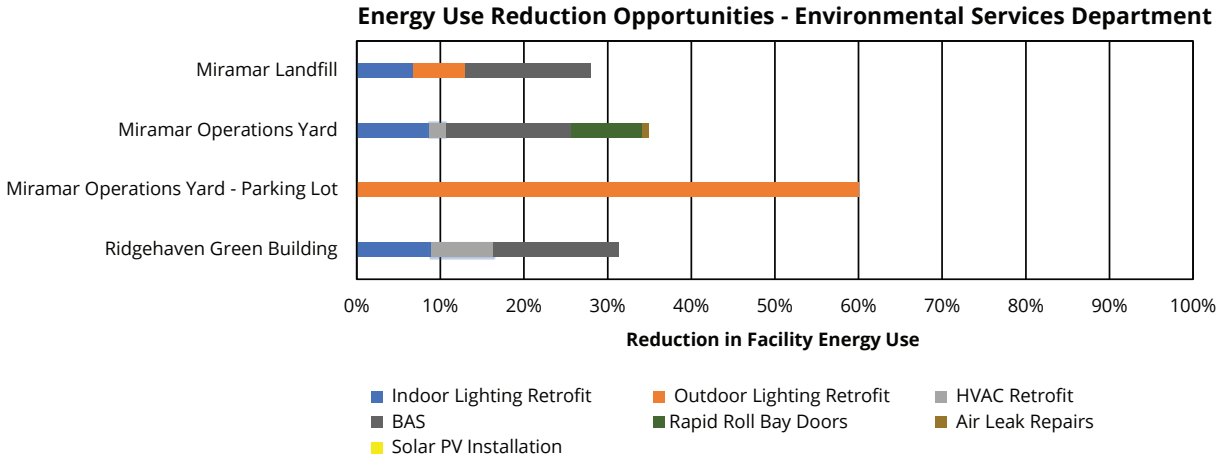
RECENT ENERGY EFFORTS

Since the first release of CAP in 2015, the City has completed the following energy-efficiency projects which have contributed to GHG emission reductions in their ESD facilities.

Figure 58. Recent Energy Efforts – Environmental Services Department

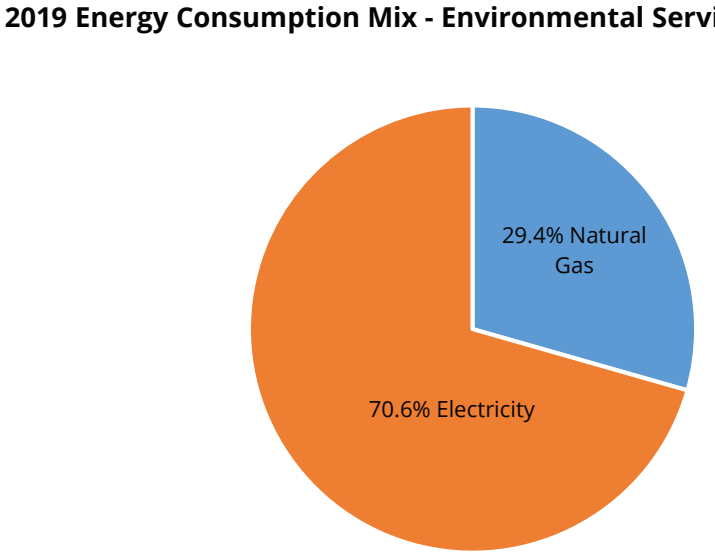
2016	• No known projects
2017	• No known projects
2018	• Installed EV Parking at Ridgehaven Green Building Parking Lot
2019	• Constructed the final phases of the Compressed Natural Gas (CNG) fueling station at the ESD Collection Yard for the new CNG-powered packer trucks in support of the 2015 CAP
2020	• No known projects

Figure 59. Energy Use Reduction Opportunities – Environmental Services Department



The energy opportunities shown in the figure above have been deemed feasible based on evaluation of available energy audits and department energy liaison interviews performed by SC Engineers, a consultant to the Sustainability and Mobility Department.

Figure 60. 2019 Energy Consumption Mix – Environmental Services Department



Note: The data above does not include Natural Gas being used for transportation fuel.

ELECTRIC VEHICLE CHARGING

ESD operates 108 General fleet vehicles, 89 of which park at ESD facilities on a regular basis. Another 18 vehicles from other departments also park at ESD facilities regularly. These numbers do not include 141 packers, as replacement EVs are not anticipated to be on the market in the near-term. Estimated annual fuel use and total associated CO2e for the 108 unleaded- and diesel-using Cars, Light, Medium, and Heavy-Duty vehicles that park at ESD facilities is shown in the figure below.

Figure 61. FY2019 Estimated Fuel Use and CO_2e Produced – Environmental Services Department

	Car/LD	MD/HD		CO2e (metric tons)
	Unleaded (gal)	Unleaded (gal)	Diesel (gal)	
Environmental Services facilities (total)	**49,220**	**12,161**	**35,003**	**902**
Miramar Landfill	8,254	11,347	23,627	415
Miramar Operations Complex	25,099	814	11,377	346
Ridgehaven Green Building	15,867	--	--	141

Sixty-seven EV chargers will be needed at ESD facilities to support all 107 vehicles; charger distribution at each facility is shown in the figure below.

Figure 62. EV Chargers and Annual Electricity (Car/LDV only) Needed – Environmental Services Department

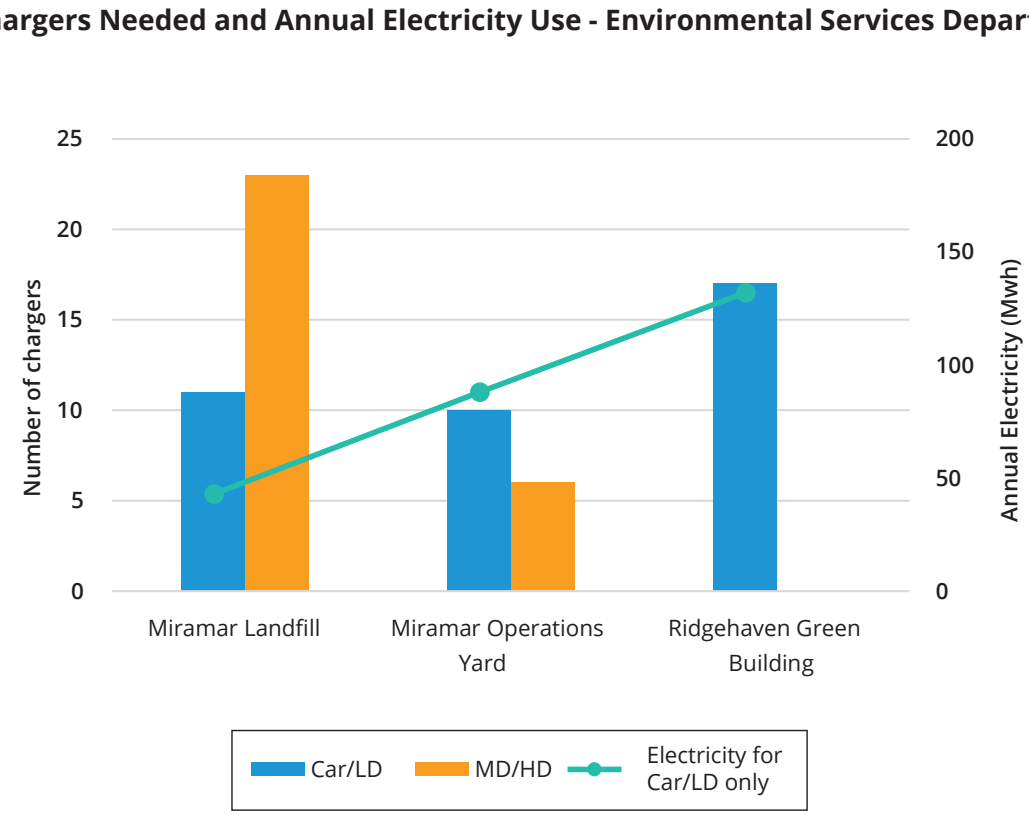


Figure 63 shows the parking locations for all 108 ESD General Fleet vehicles. The charging needs of the 89 vehicles that park at ESD facilities are shown in Figure 62. The charging needs of the eight vehicles that park at Shared Asset Facilities are described in that section elsewhere. Of the remaining 11 vehicles, four either park at a facility that hosts three or fewer vehicles, or park at locations not associated with a CoSD facility. Due to this parking behavior, these vehicles will need to be assigned alternate charging locations potentially including depot-style charging hubs. Parking data is missing for seven vehicles.

Figure 63. Parking Distribution of Vehicles – Environmental Services Department

	CARS/LD	MD/HD	TOTALS
Environmental Services facilities (totals)	**52**	**37**	**89**
Miramar Landfill	13	33	46
Miramar Operations Yard	14	4	18
Ridgehaven Green Building	25	0	25
Other facilities (totals)	**3**	**5**	**8**
SHARED: Chollas Operations Yard (All Facilities)	3	4	7
SHARED: Rose Canyon Operations Yard	0	1	1
Charging unaccounted for (totals)	**6**	**5**	**11**
At sites with 3 or fewer vehicles	1	0	1
Not associated with a CoSD facility	2	1	3
Missing parking data	3	4	7

PARKS AND RECREATION DEPARTMENT

The City of San Diego Parks and Recreation facilities consist of more than 42,000 acres of park space including Balboa Park, 59 recreation and community centers, open space visitors centers and ranger stations, 13 pools, three golf complexes, eight skate parks and one skate plaza, streetlights in Maintenance Assessment Districts (MADs), numerous comfort stations (restrooms), a cemetery and many other public assembly facilities.

Asset Manager: San Diego Parks and Recreation Department

Department Mission: To provide healthy, sustainable and enriching environments for all.

Share of 2019 Municipal Energy Use: 8.8%

Summary of Parks and Recreation Facility Energy Opportunities: Based on the information provided in the figures below, the Parks and Recreation Department has significant opportunities to reduce energy consumption and begin electrifying end uses to achieve the municipal zero emissions goal by 2035.

City pools make up almost 40% of the energy used by Parks and Recreation and are currently using natural gas as the primary heating source. Investigation into electric water heating equipment and solar water heating at pool facilities is critical to ensure municipal pools can achieve the zero emissions goal by 2035. Additionally, energy consumption at recreation centers with outdoor ballfields and courts would benefit from submetering to enable a more granular understanding of the facilities' energy use and energy use intensities (EUIs). Many ballfields are due for lighting replacements and investigation is necessary to determine the impacts of retrofitting existing fixtures to LED, which may require pole upgrades to reduce spill and glare concerns. Note, these same investigations and submetering could assist the Parks and Recreation Department to more accurately set usage fees for their general outdoor, ballfield, pool and general infield facilities.

The following 12 facilities have been identified by the Sustainability and Mobility and Parks and Recreation Departments for near-term comprehensive energy retrofits in partnership with ESCOs:

- Balboa Park Administration Building
- Balboa Park Activity Center
- Balboa Park Blind Community Center of San Diego
- Balboa Park Casa del Prado Theater
- Balboa Park Club
- Carmel Mountain-Sabre Springs Recreation Center
- Colina del Sol Park Recreation Center
- City Heights Recreation Center
- Mount Hope Cemetery
- San Ysidro Senior Center
- Vista Terrace Pool
- Willie Henderson Sports Complex Recreation Center

The sites above were selected based on initial research done by SC Engineers. Retrofits at the sites listed above are expected to have a payback under seven years and achieve at least a 30% energy reduction.

The following three facilities have been identified for near-term installation of renewable microgrids:

- Cesar Chavez Community Center
- Dolores Magdaleno Memorial Recreation Center
- Southcrest Recreation Center

The following 31 facilities represent excellent candidates for ZNE or near ZNE retrofit projects, as onsite solar can offset all energy used by the facilities after energy-efficiency improvements and electrification are addressed:

- Azalea Recreation Center
- Balboa Park Activity Center
- Balboa Park Administration Building
- Balboa Park Club
- Balboa Park Municipal Gymnasium
- Carmel Mountain-Sabre Springs Recreation Center
- Cesar Chavez Community Center
- City Heights Recreation Center
- Doyle Recreation Center
- Encanto Recreation Center
- Hilltop Recreation Center
- Linda Vista Recreation Center
- Martin Luther King, Jr. Recreation Center
- Marie Hitchcock Puppet Theater
- Mid-City Gymnasium
- Mira Mesa Gil Johnson Senior Center
- Montgomery-Waller Recreation Center
- Pacific Beach Recreation Center
- Paradise Hills Recreation Center
- Penn Athletic Area Recreation Center
- Presidio Recreation Center
- Rancho Bernardo-Glassman Recreation Center
- San Ysidro Colonel Irving Salomon Community Activity Center
- San Ysidro Senior Center
- Serra Mesa Recreation Center
- Silver Wing Recreation Center
- Skyline Recreation Center
- South Bay Recreation Center
- Stockton Recreation Center
- Tierrasanta Recreation Center
- Willie Henderson Recreation Center

Costs associated with transitioning natural gas end uses to electric technologies have not been quantified; further study is required to assess the cost impacts of electrification at existing facilities.

Figure 64. 2019 Energy Use Map – Recreation Centers

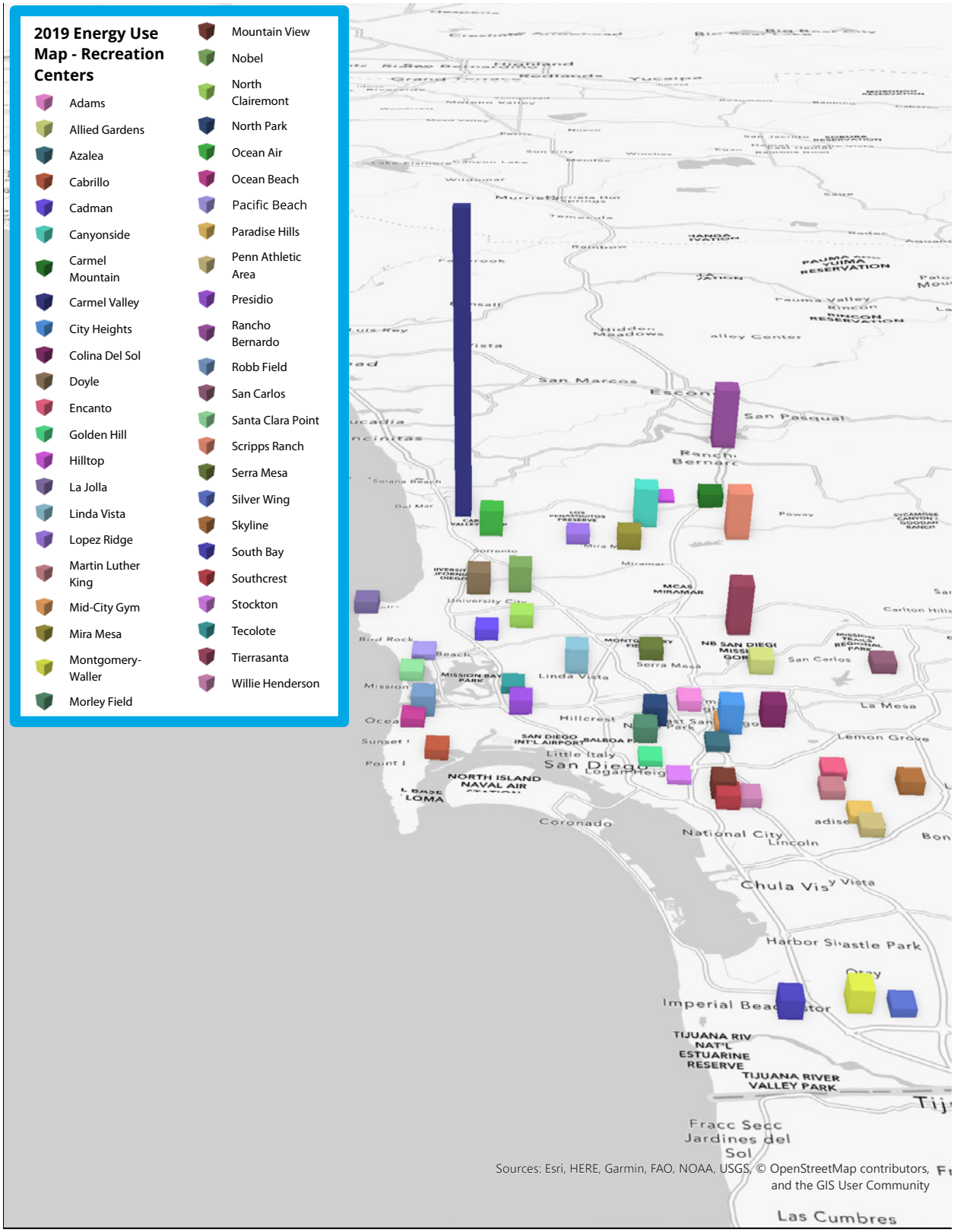


Figure 65. 2019 Energy Use Map – Community and Senior Centers

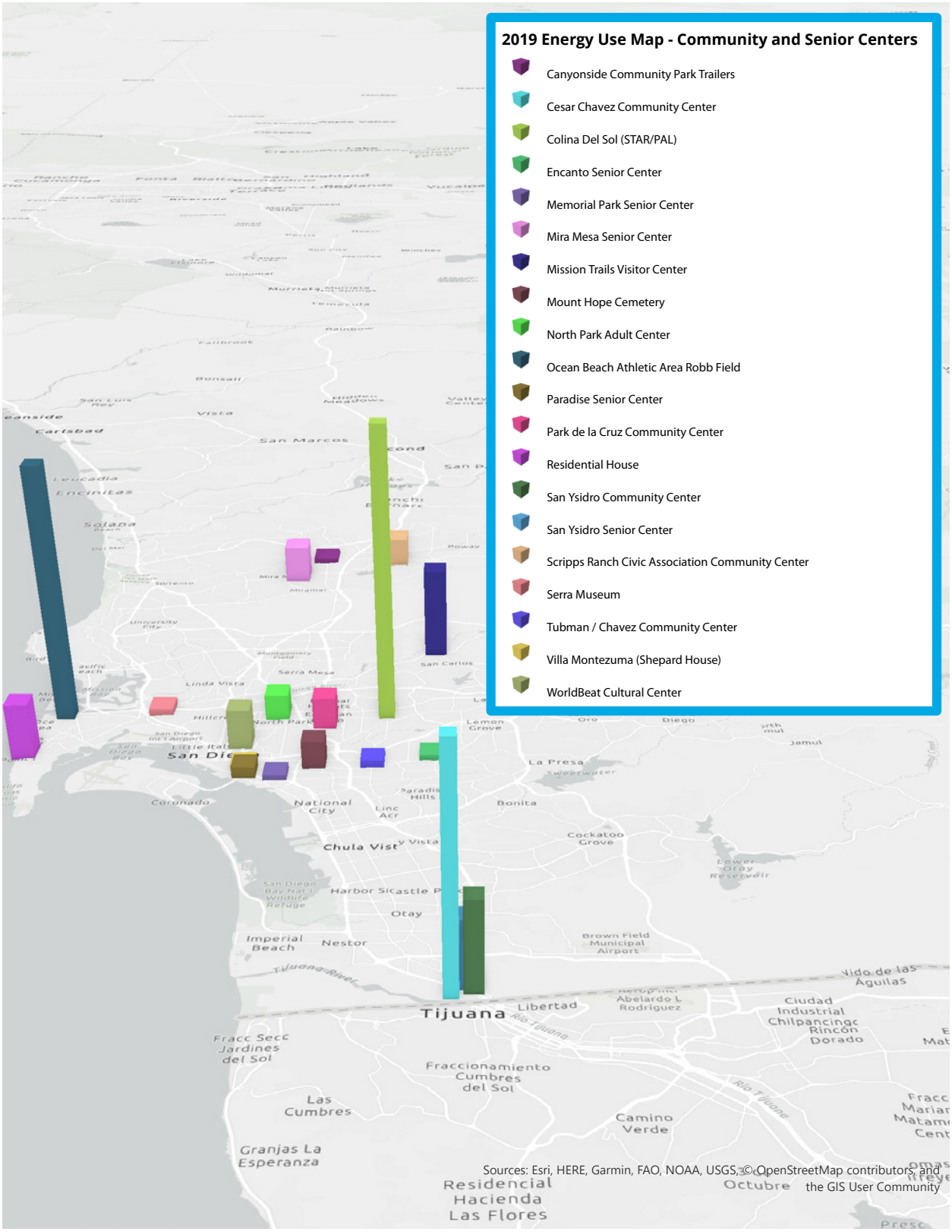


Figure 66. 2019 Energy Use Map – Outdoor Recreation

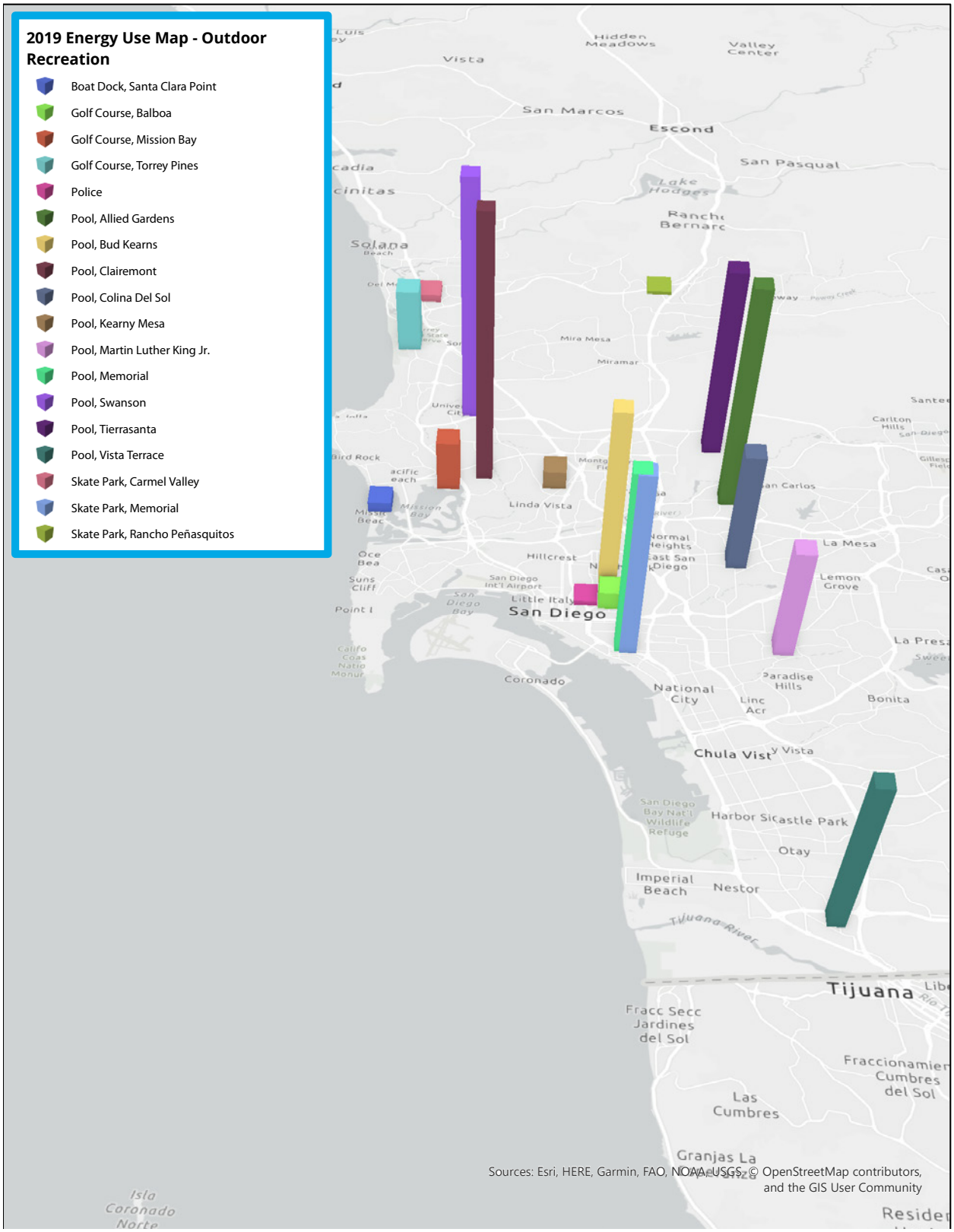


Figure 67. 2019 Energy Use Map – Balboa Park

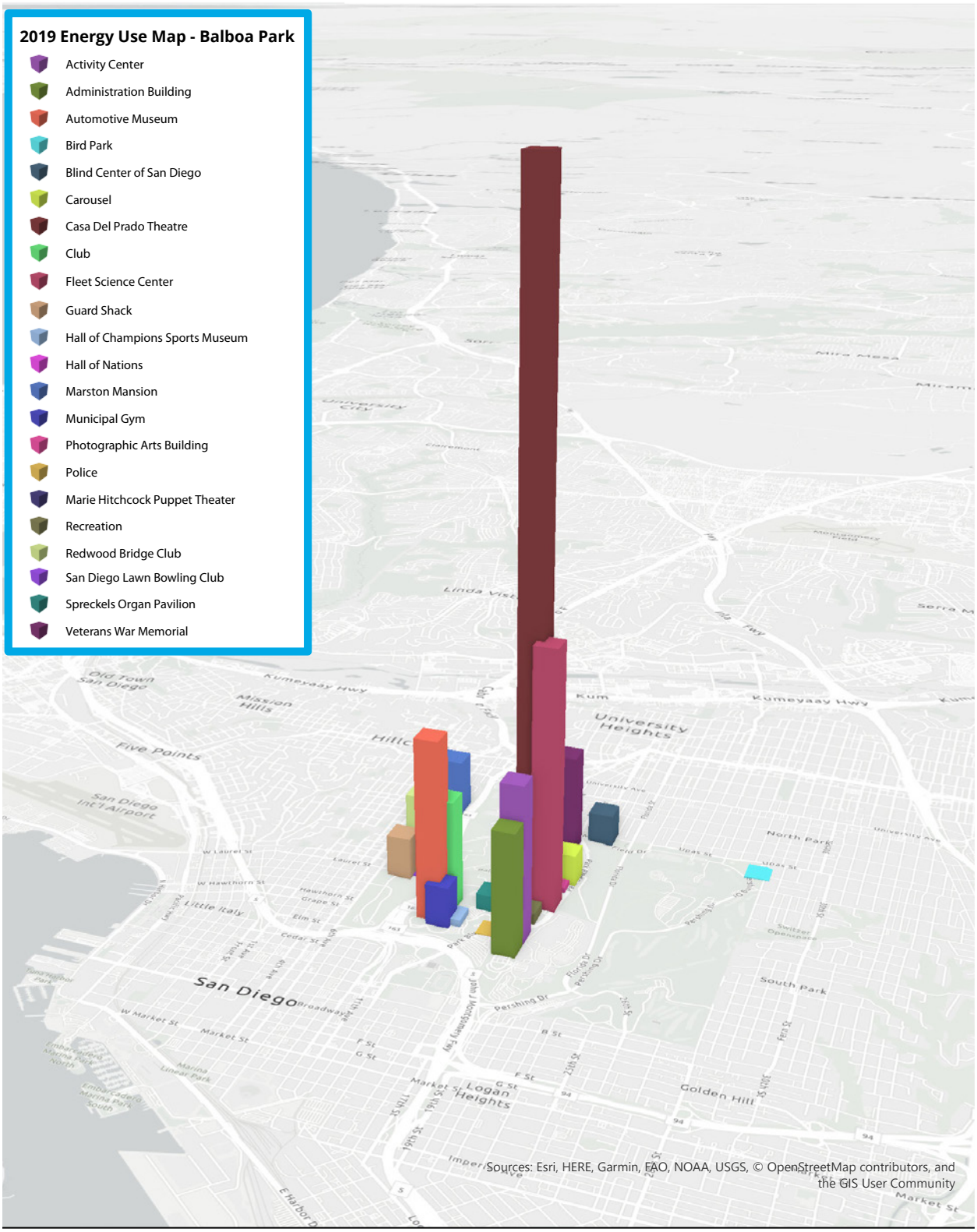
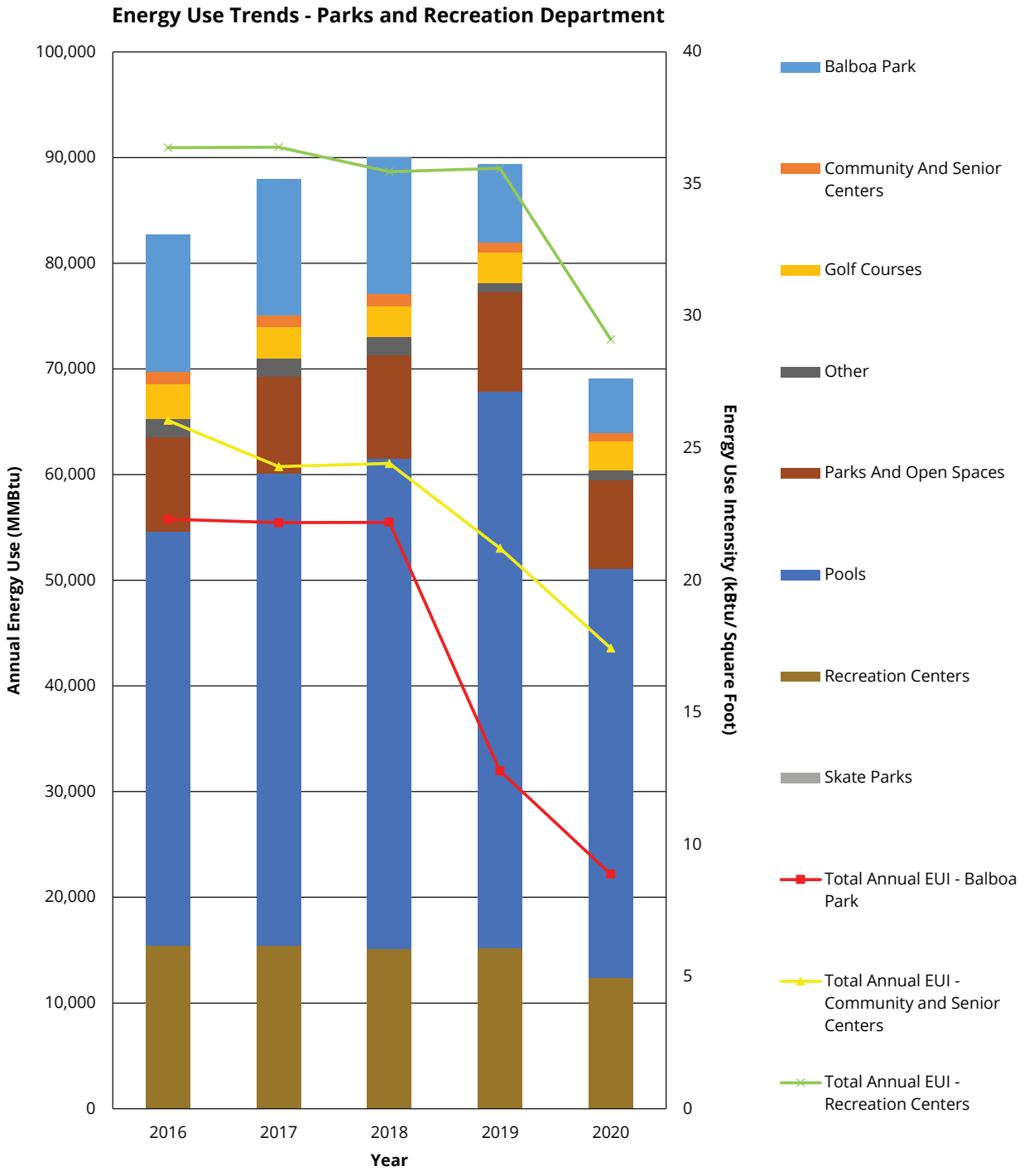


Figure 68. Energy Use Trends – Parks and Recreation Department

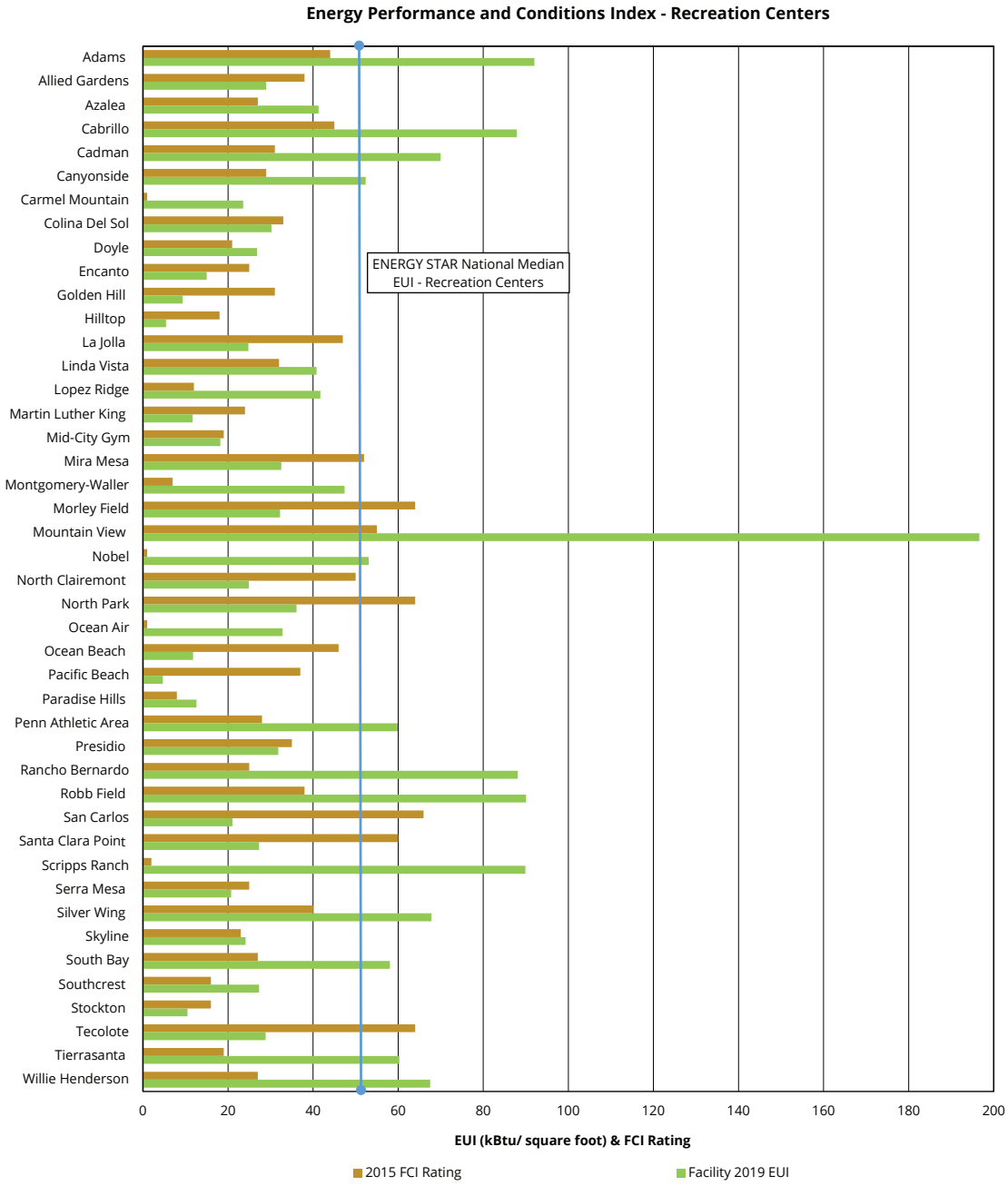


The “Balboa Park” category includes energy purchased from SDG&E by the City. Many Balboa Park facilities are leased out and tenants pay the energy bills; tenant energy use is not included in municipal energy use records. Sustainability and Mobility Department and DREAM are beginning to review City leases and potential future requirements for 100% renewable energy in tenant agreements.

The “Other” category includes energy use of Dana Basin and Santa Clara Point boat docks in Mission Bay Park, broadcasting antennas, an electrical substation, a nursery, an historic chapel, comfort stations and a few other small accounts.

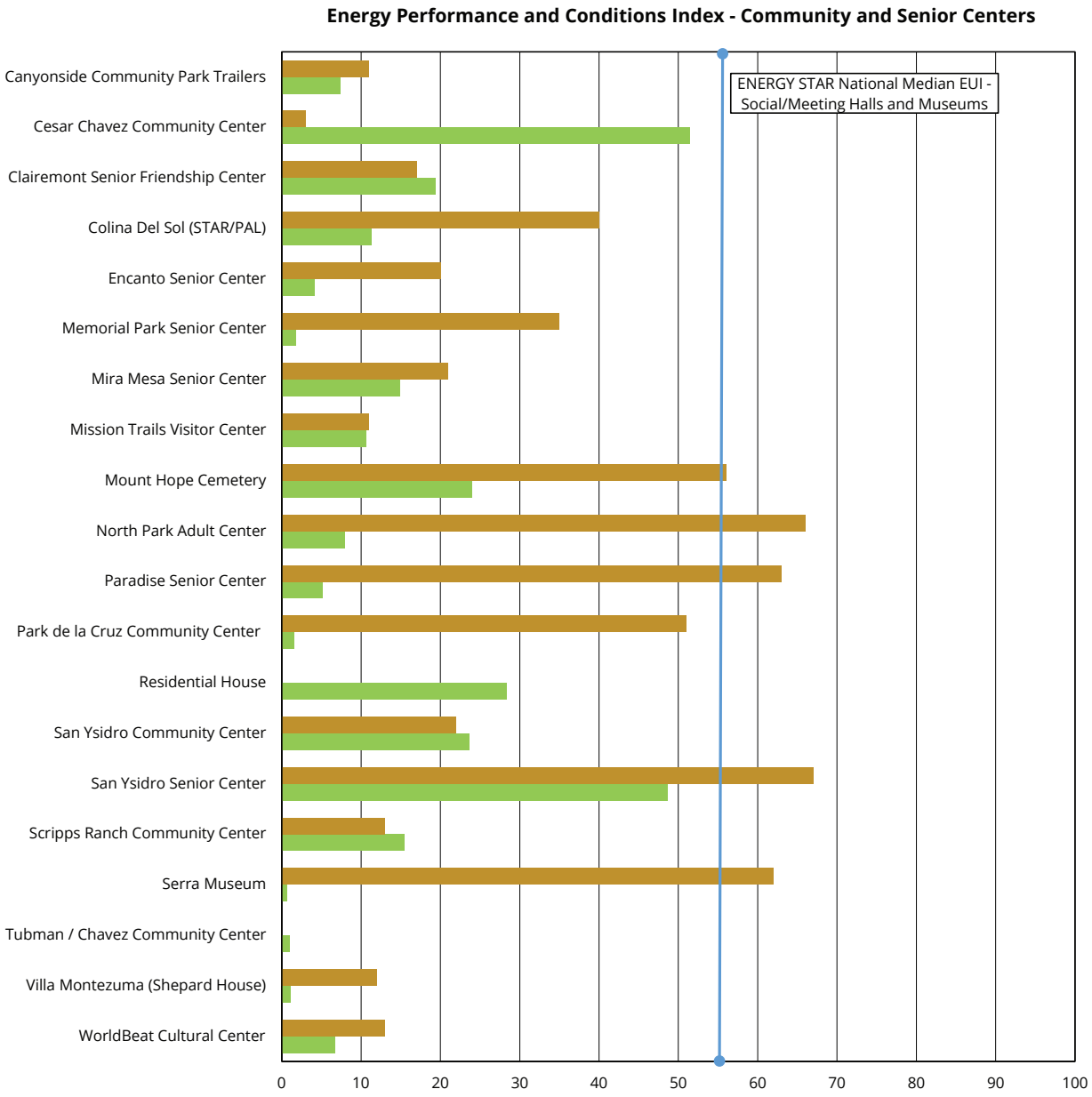
Energy usage values for pools reflect the entire facility, including locker rooms and other indoor spaces.

Figure 69. Energy Performance and Conditions Index – Recreation Centers



Approximately two-thirds of the EUIs reflected above are not accurate due to inadequate energy metering at many Recreation Centers. To accurately calculate a facility's energy index, one must divide total energy used by the square footage of a building. At approximately 30 recreation centers, the entire facility, including gymnasiums, ball fields, tennis courts and other outdoor end uses are all on one electricity meter and therefore total energy use is not a reflection of only the building energy use. The City will need to install submeters on outdoor electricity uses to have a better understanding of the energy consumption and EUIs for most Parks and Recreation facilities.

Figure 70. Energy Performance and Conditions Index – Community and Senior Centers



Data could not be found between 2017 and 2020 for the Clairemont Senior Friendship Center. The 2016 energy consumption value was used for this facility.

Note, several community and senior centers are leased out to tenants. EUI's are calculated based on the City energy use records, which may not include whole building energy use for these sites. Additional investigation is necessary to gain a better understanding of EUIs among Parks and Recreation facilities.

Figure 71. Energy Performance and Conditions Index – Pools

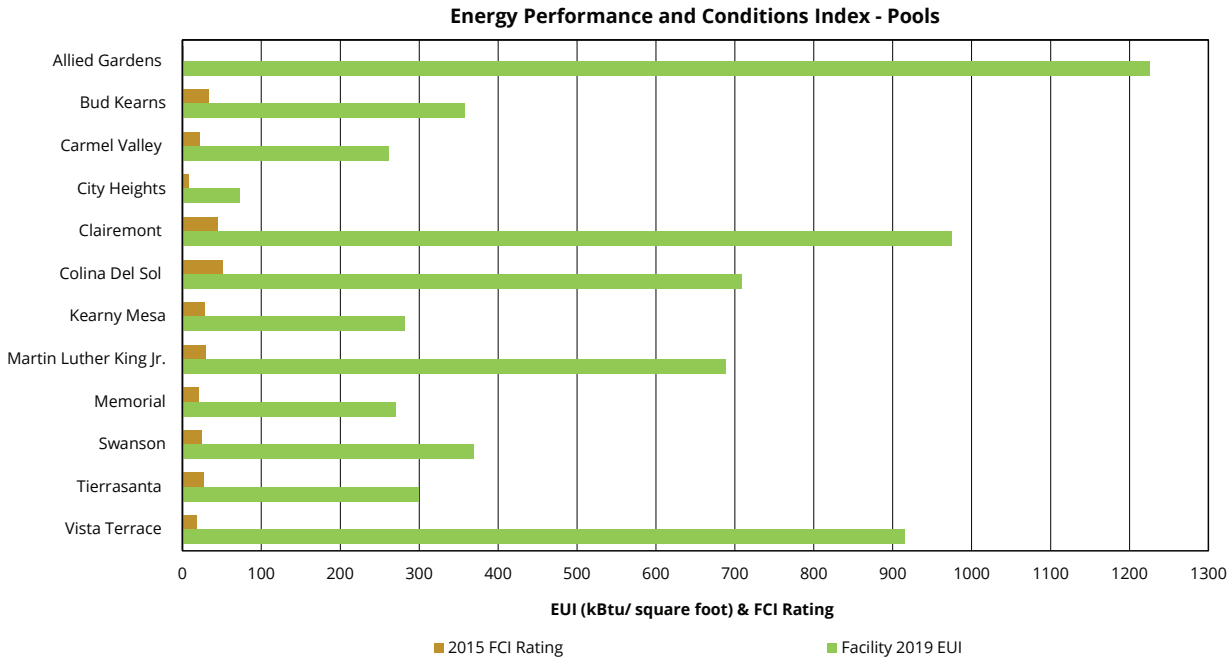
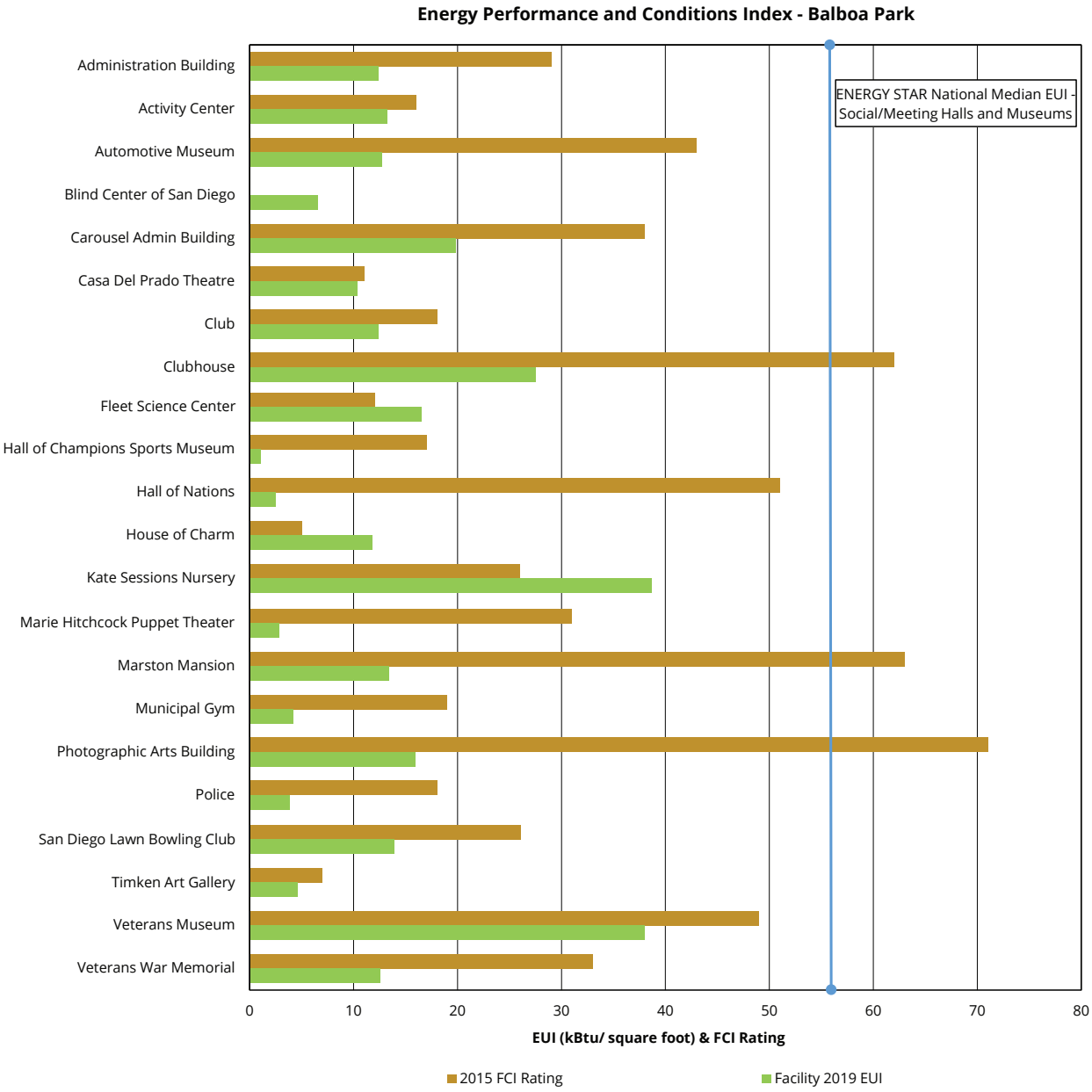


Figure 72. Energy Performance and Conditions Index – Balboa Park



Many Balboa Park facilities are leased out to tenants. EUIs are calculated based on the City energy use records which may not include whole building energy use for these sites.

RECENT ENERGY EFFORTS

Figure 73. Recent Energy Efforts – Parks and Recreation Department

2016	• Mira Mesa and San Ysidro Senior Centers – HVAC upgrade • Mira Mesa and San Ysidro Center Centers – roof upgrades • Clairemont Pool - boiler replacement • Linda Vista Recreation Center - roof replacement • Kearny Mesa Recreation Center - roof replacement • Villa Montezuma Building - systems upgrades • Mission Trails Visitor Center - HVAC upgrade
2017	• Mission Hills MAD area – streetlight retrofits • Carmel Valley Recreation Center – solar installation (180 kW) • Tecolote Nature Center – roof replacement
2018	• No known projects
2019	• No known projects
2020	• Park de la Cruz Community Center – HVAC and lighting upgrades

Figure 74. Energy Use Reduction Opportunities – Recreation Centers

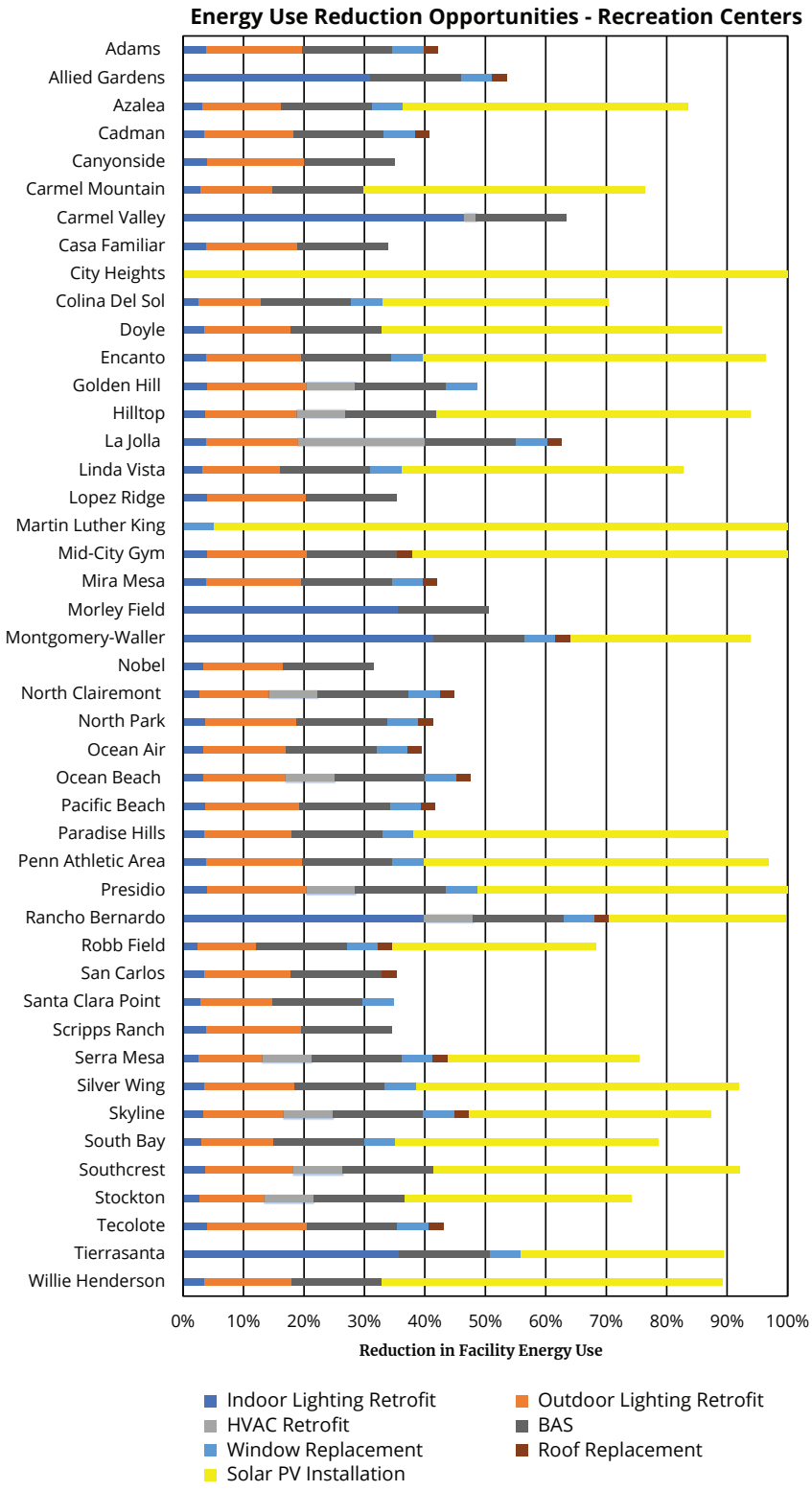


Figure 75. Energy Use Reduction Opportunities – Community and Senior Centers

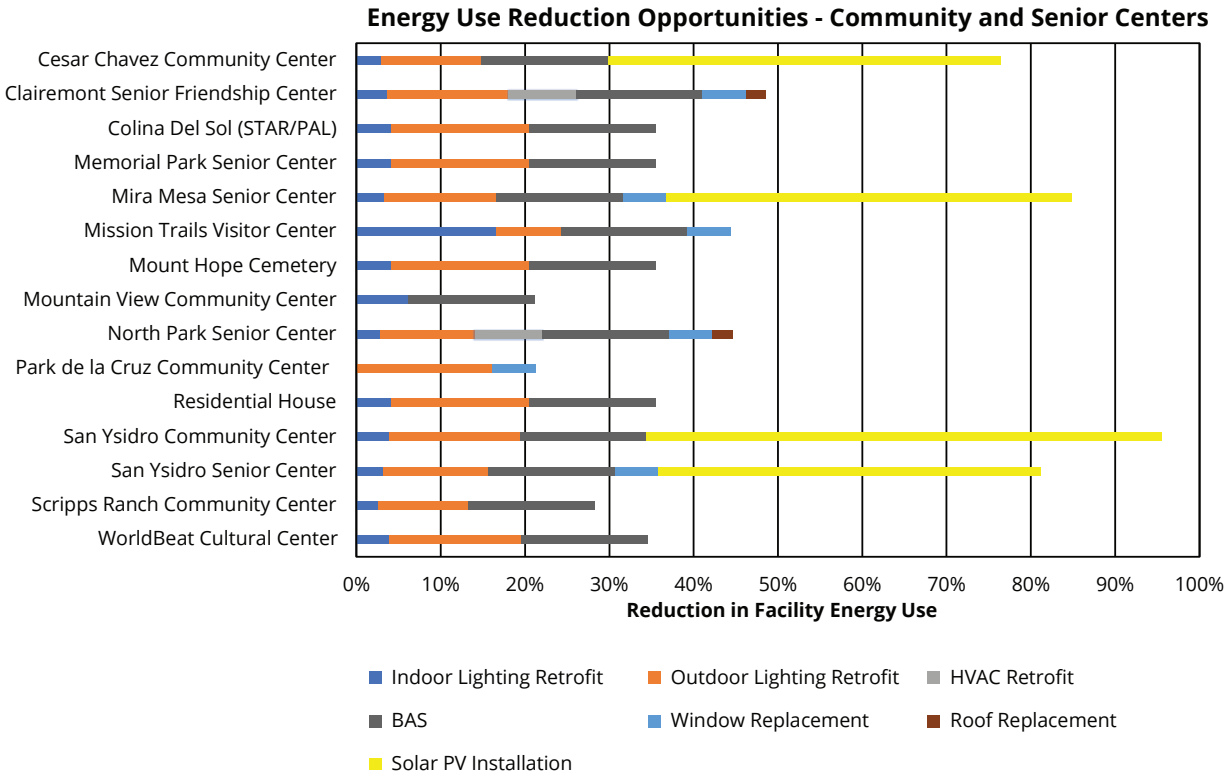


Figure 76. Energy Use Reduction Opportunities – Outdoor Recreation

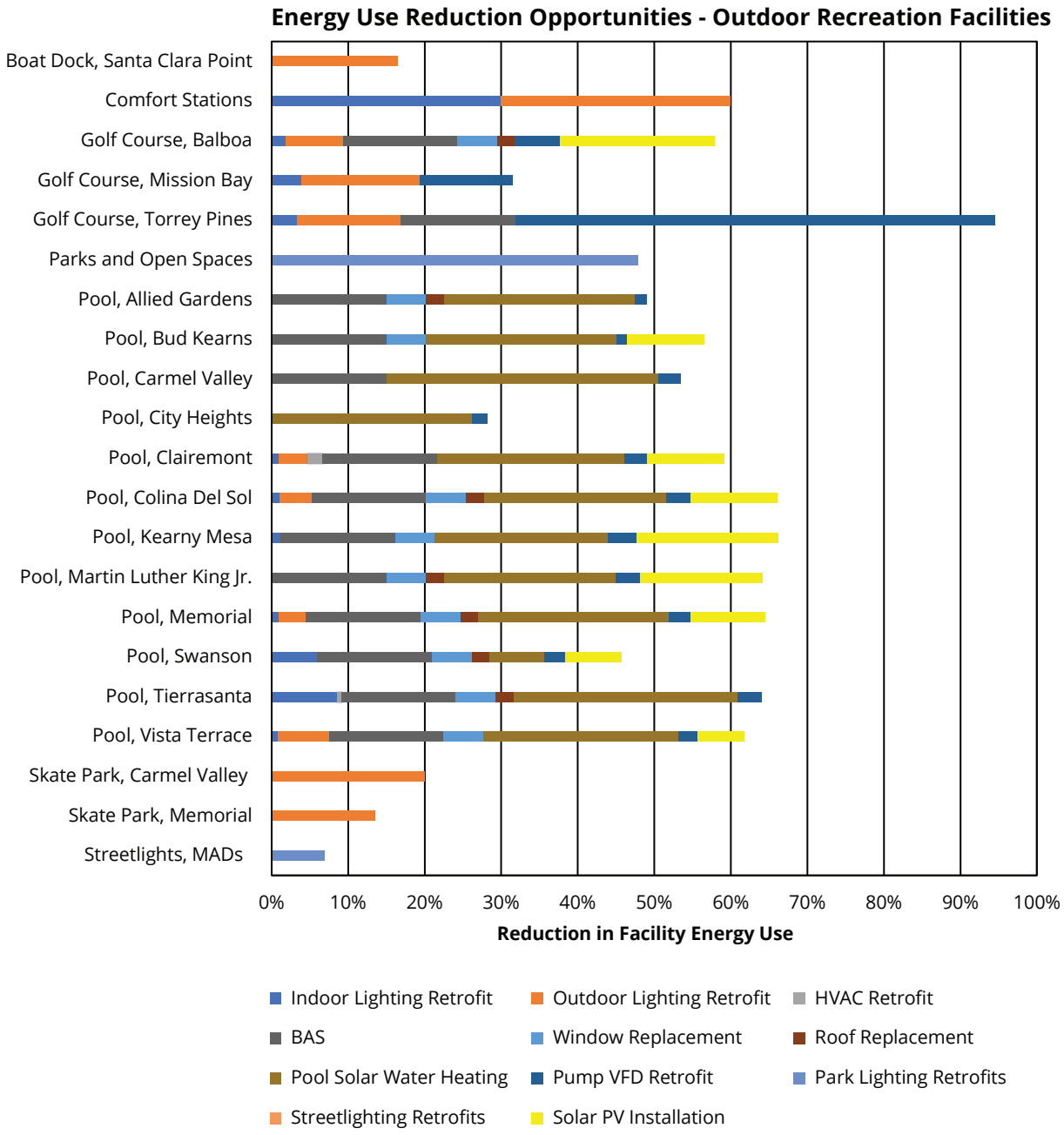
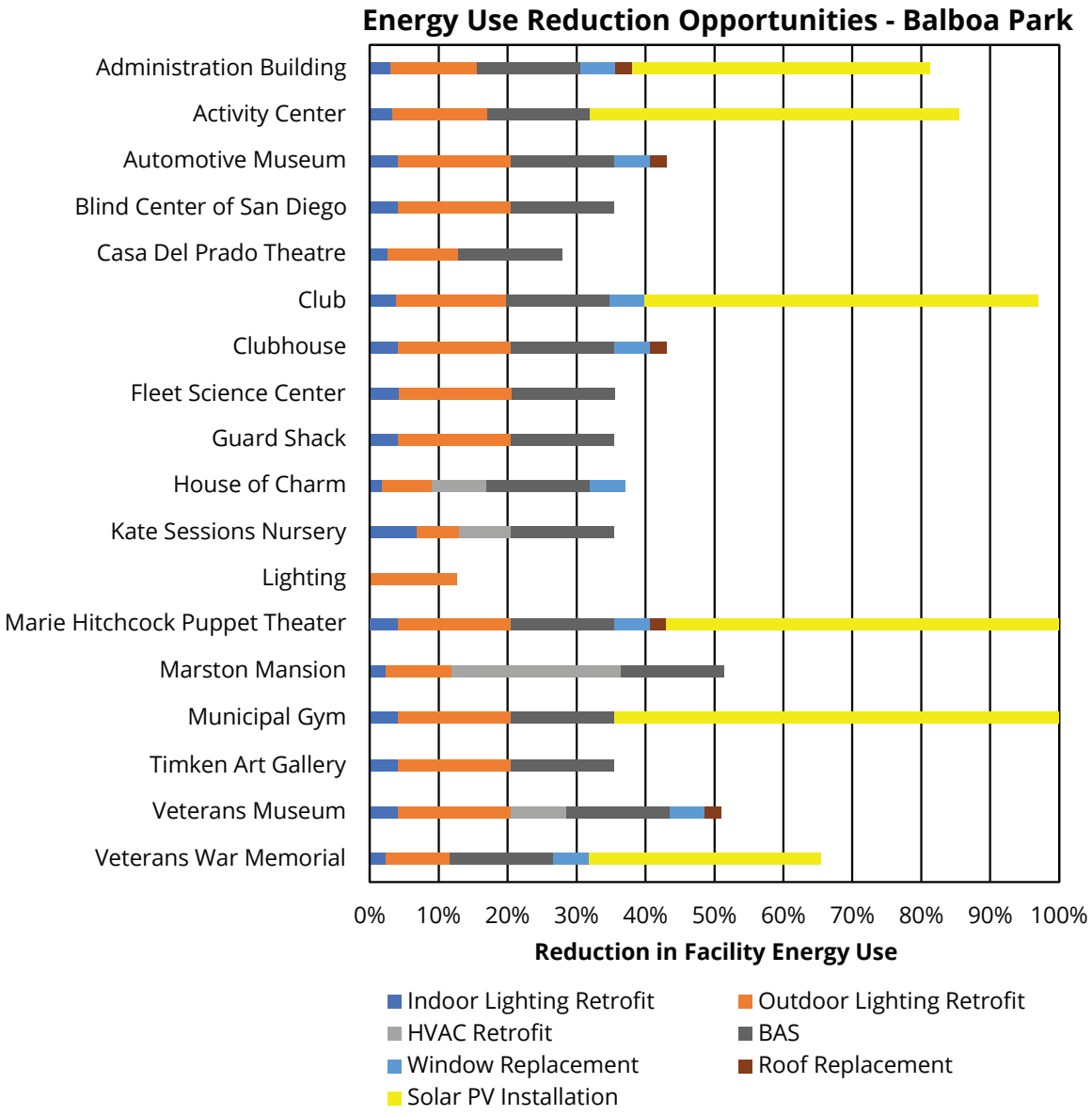


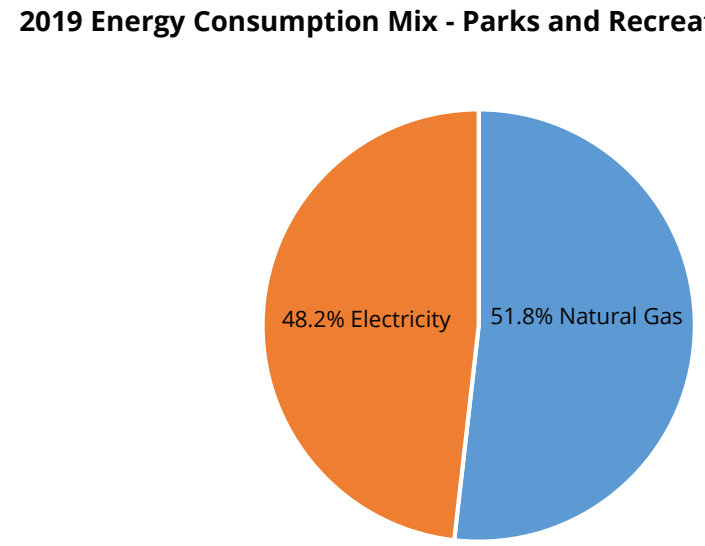
Figure 77. Energy Use Reduction Opportunities – Balboa Park



The energy opportunities shown in the figures above have been deemed feasible based on evaluation of available energy audits and department energy liaison interviews performed by SC Engineers, a consultant to the Sustainability and Mobility Department.

A large number of Parks and Recreation facilities in Balboa Park and several community and senior centers are leased out. For these sites, municipal energy use records only include ancillary electrical/gas loads. These facilities are excluded from the energy saving analysis as historic whole building energy use records are not available to estimate the performance of energy-efficiency measures. Additionally, accounts which fall under 1.5% of the energy use of the Parks and Recreation Department have been excluded as energy improvements and will make virtually no progress toward the City's energy goals.

Figure 78. 2019 Energy Consumption Mix – Parks and Recreation Department



City pools account for the large percentage of natural gas used by the Parks and Recreation Department. The City will continue to assess the market for electric pool heating technologies and related costs.

ELECTRIC VEHICLE CHARGING

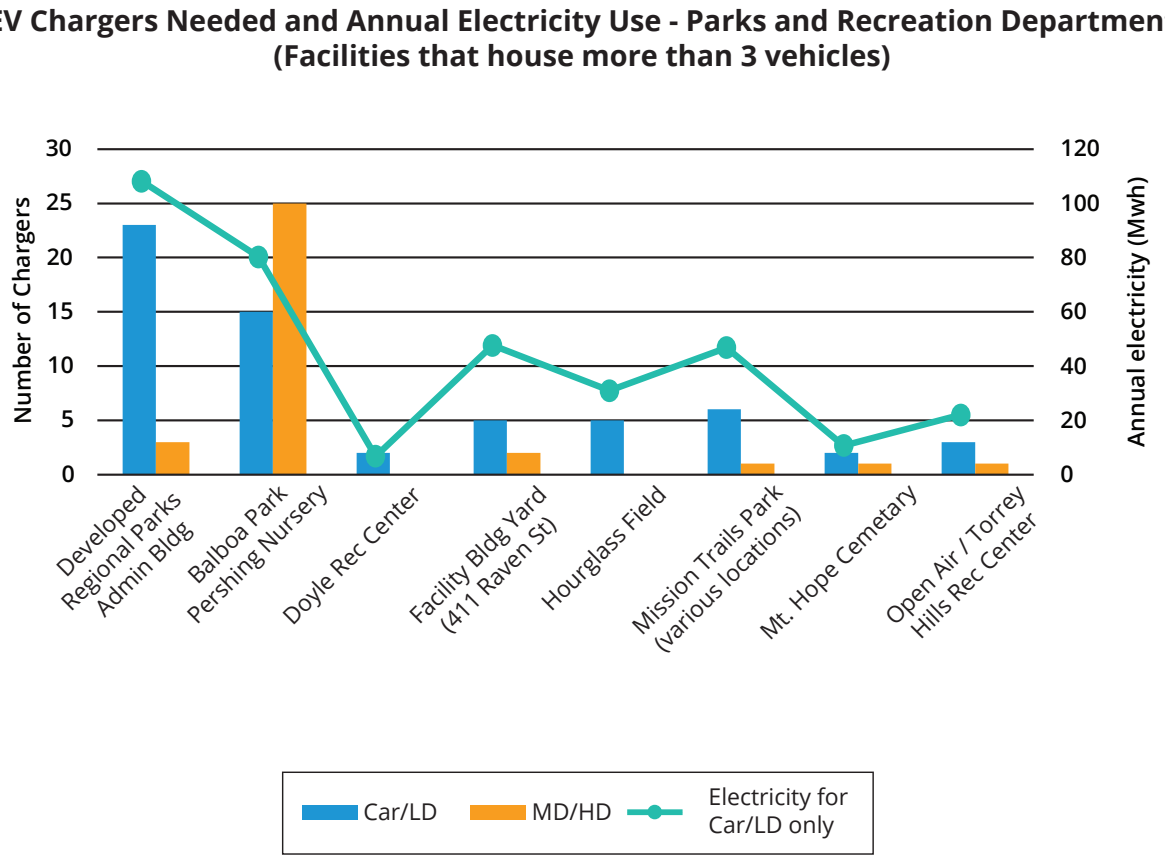
The Parks and Recreation Department operates 433 General fleet vehicles: 351 vehicles park at Parks and Recreation facilities on a regular basis; of those, 19 park at Parks and Recreation locations with a total of three or fewer vehicles; those 19 will be discussed below. The remaining 332 vehicles park at Parks and Recreation facilities that house more than three vehicles. Estimated annual fuel use and total associated CO2e for the 332 Cars, Light, Medium, and Heavy-Duty vehicles that park at Parks and Recreation facilities that house more than three vehicles is shown in the figure below.

Figure 79. FY2019 Estimated Fuel Use and CO2e Produced – Parks and Recreation Facilities that Accommodate 4+ Vehicles

	Car/LD	MD/HD		CO2e (metric tons)
	Unleaded (gal)	Unleaded (gal)	Diesel (gal)	
Parks and Recreation facilities (total)	**79,569**	**5,315**	**39,977**	**1,161**
Developed Regional Parks Administration Building	36,278	2,508	611	351
Balboa Park Pershing Nursery	16,774	491	39,019	551
Doyle Recreation Center	1,602	--	--	14
411 Raven Street Yard	9,827	1,177	28	92
Hourglass Field	5,290	706	129	47
Mission Trails Park (Various locations)	6,283	320	190	63
Mt. Hope Cemetery	621	112	--	16
Ocean Air/Torrey Hills Recreation Center	2,893	--	--	27

Ninety-four EV chargers will be needed at Parks and Recreation facilities to support all 179 vehicles; charger distribution at each facility is shown in the figure below.

Figure 80. EV Chargers and Annual Electricity (Car/LDV only) Needed – Parks and Recreation Facilities that Accommodate 4+ Vehicles



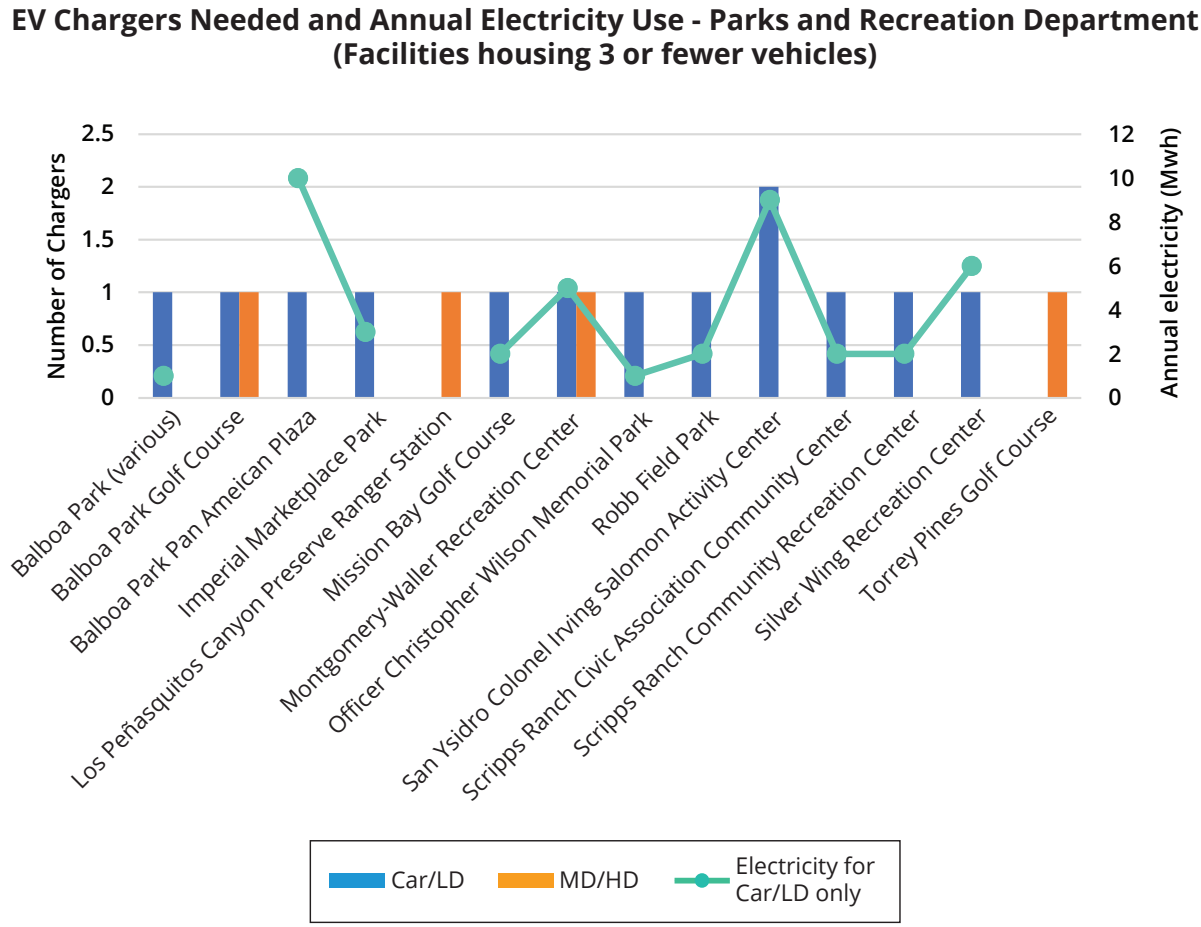
It may not be cost-effective to install EV charging in locations where three or fewer vehicles park; assigning those vehicles an alternate parking location or sending them to depot-style charging hubs may be a better solution. However, the Parks and Recreation Department has 14 of these locations (housing 19 Parks and Recreation Department vehicles and three vehicles from other departments) and may want to consider installing chargers in a select few locations, and/or consolidating vehicles in some of these locations. Estimated annual fuel use and total associated CO2e for the 22 Cars, Light, Medium, and Heavy-Duty vehicles that park at Parks and Recreation facilities that house three or fewer vehicles is shown in the figure below.

Figure 81. FY2019 Estimated Fuel Use and CO2e Produced – Parks and Recreation Facilities that Accommodate 0–3 Vehicles

	Car/LD	MD/HD		CO2e (metric tons)
	Unleaded (gal)	Unleaded (gal)	Diesel (gal)	
Parks and Recreation facilities (total)	**10,049**	**5**	**1,537**	**105**
Balboa Park (various)	128	--	--	1
Balboa Park Golf Course	54	--	80	1
Balboa Park Pan American Plaza	583	--	--	5
Black Mountain Open Space/ Los Peñasquitos Canyon Preserve Ranger Station	--	--	160	2
Imperial Marketplace Park	489	--	--	4
Mission Bay Golf Course	489	--	--	4
Montgomery-Waller Recreation Center	591	--	1,297	18
Robb Field Park	929	--	--	8
San Ysidro Colonel Irving Salomon Activity Center	1,064	--	--	9
Scripps Ranch Civic Association Community Center	489	--	--	4
Scripps Ranch Community Recreation Center	321	--	--	3
Silver Wing Recreation Center	4,735	--	--	42
Officer Christopher Wilson Memorial Park	178	--	--	2
Torrey Pines Golf Course	128	5	--	0

The figure below shows the charging needs to support the 22 vehicles at Parks and Recreation facilities that house three or fewer vehicles.

Figure 82. EV Chargers and Annual Electricity (Car/LDV only) Needed – Parks and Recreation Facilities that Accommodate 0-3 Vehicles



Of the remaining 45 Parks and Recreation vehicles, one parks at a Public Utilities site (and will be accounted for in the PUD section); 44 park at other underpopulated locations, non-CoSD locations, or have missing data and are not accounted for in this document.

PUBLIC UTILITIES DEPARTMENT

The City of San Diego PUD assets consist of seven water and wastewater treatment plants, 49 water pump stations, six recycled water pump stations, 81 wastewater pump stations and 11 reservoirs. They also include two water quality testing labs and the Metropolitan Operations Complex (MOC), which is the headquarters of the PUD.

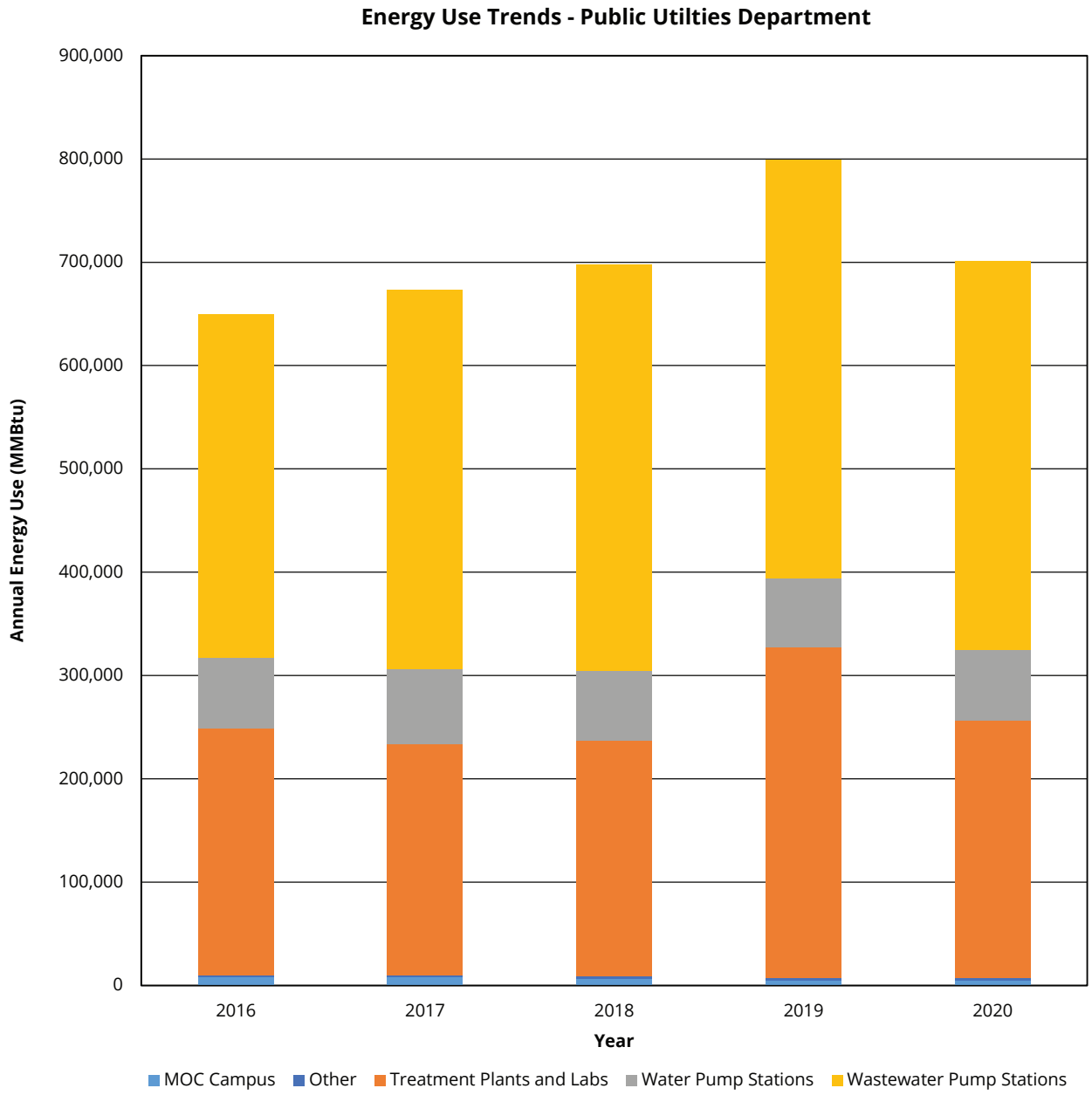
Asset Manager: Public Utilities Department

Mission: To provide reliable water utility services that protect the health of our communities and the environment.

Share of 2019 Municipal Energy Use: 69.4%

Summary of Parks and Recreation Facility Energy Opportunities: PUD is by far the City's largest energy consuming department. Almost all of PUD's electricity and natural gas consumption is used to pump water and wastewater and to power equipment at the water and wastewater treatment plants. PUD has a number of onsite electricity generation facilities, which provide almost all of the electricity consumed at three of its largest wastewater facilities and export surplus power to the grid. The energy consumption figures shown in this section omit onsite generation and reflect only the electricity and gas consumed from the local utility, namely SDG&E.

Figure 83. Energy Use Trends – Public Utilities Department



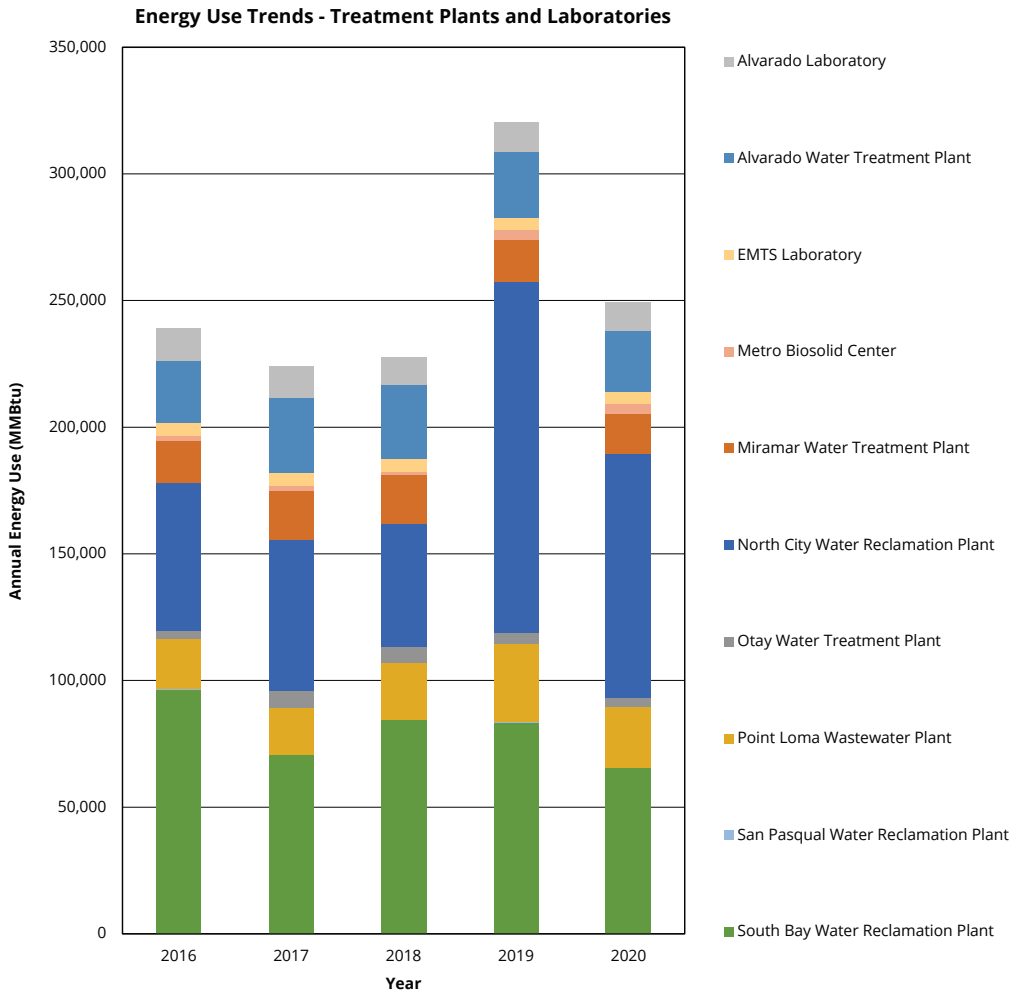
Between 2016 and 2020, the total annual energy use of the PUD increased by 8%. Energy use can be seen to fluctuate from year to year, primarily driven by varying utility energy consumption at the treatment plants. Energy consumption is also gradually increasing, driven primarily by consumption at the wastewater pump stations. Wastewater pump stations and water and wastewater treatment plants are the largest energy consumers in Public Utilities' portfolio and in the City overall. The energy consumption of water pump stations is also substantial.

TREATMENT PLANTS AND LABORATORIES

In terms of their gross energy consumption, PUD's three largest treatment plants are the Metro Biosolids Center (MBC), North City Water Reclamation Plant (NCWRP), and Point Loma Wastewater Treatment Plant (PLWWTP). PLWWTP is the City's main wastewater treatment plant. NCWRP is a smaller capacity wastewater treatment plant which has additional treatment processes to produce recycled water (the "purple pipe" program). Metro Biosolids Center processes biosolids (sludge), which are a waste product of the wastewater treatment process. All three of these plants have onsite renewable power generating facilities which are sized to cover their entire electricity load plus generating a substantial surplus which is exported onto the public electric grid. The generating stations at these plants all consist of multiple internal combustion engines fueled by renewable methane gas. At PLWWTP renewable gas is sourced from the plants' onsite biosolids digesters, which process the biosolids waste generated as part of the wastewater treatment process. North City Water Reclamation Plant does not have onsite biosolids digesters; instead its engines run on landfill gas from Miramar Landfill. The generating station at MBC also consumes renewable landfill gas collected from Miramar Landfill and supplements it with its own digester gas. Normally all electricity used onsite at these treatment plants is provided by the onsite generation, but the plants do consume electricity from the grid during occasions when their generating stations are offline for planned maintenance or if they suffer unplanned outages. In addition to providing renewable power, these onsite renewable gas power stations provide the treatment plants with the ability to operate in island mode should the plants suffer a utility power outage.

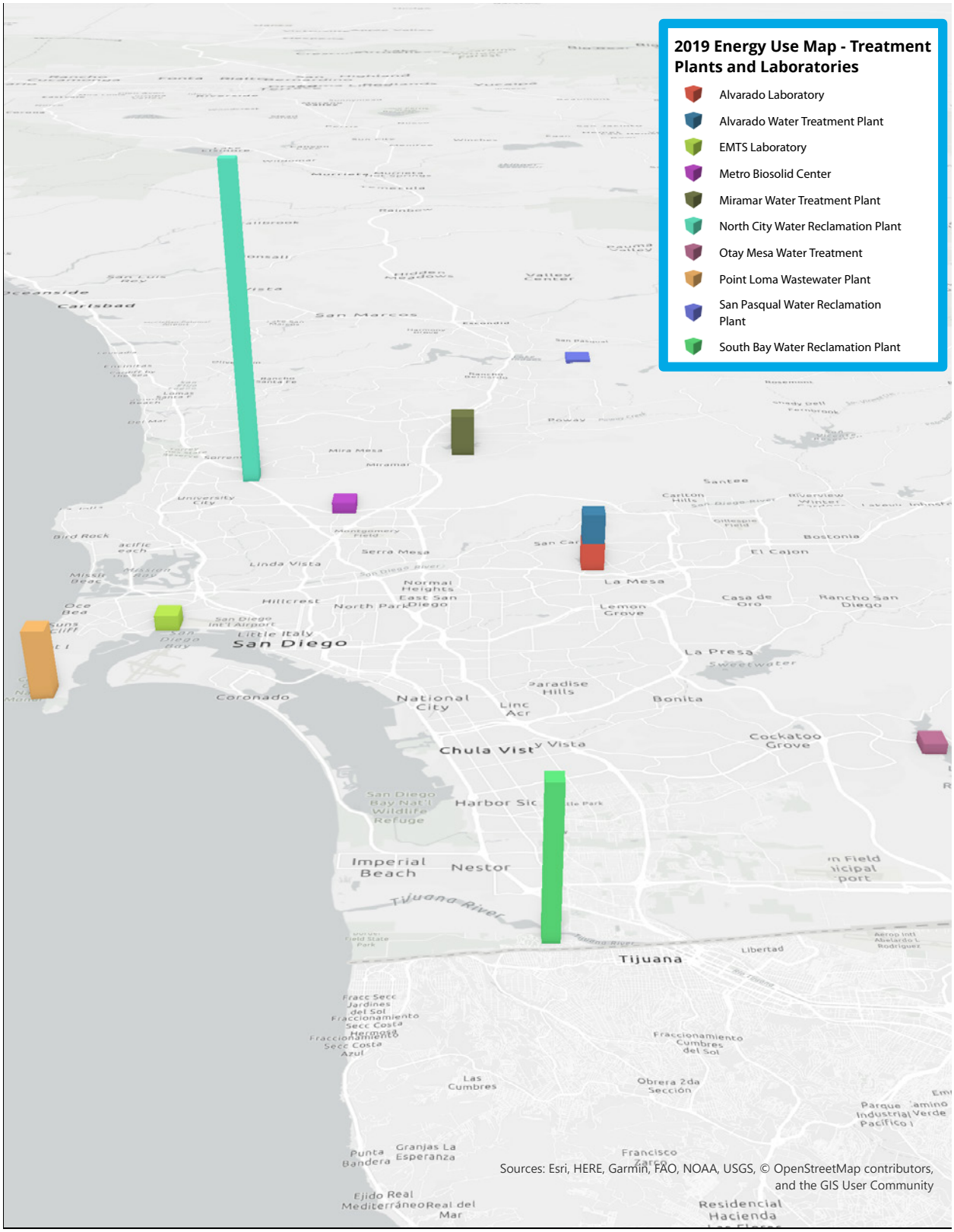
Between 2016 and 2020, the total annual utility energy use of water and wastewater treatment plants and laboratories increased by 4%. Note this does not include behind-the-meter consumption from the treatment plants' onsite electricity generation. Grid energy consumption at NCWRP, PLWWTP and MBC fluctuates from year to year, with NCWRP having particularly high consumption of grid energy in 2019. These fluctuations are driven by varying amounts of downtime at the onsite generating stations from year to year.

Figure 84. Energy Use Trends – Treatment Plants and Laboratories



In addition to hosting an onsite power generating station, PLWWTP also hosts a privately owned and operated facility known as the Beneficial Use of Digester Gas (BUDG) facility. The BUDG is owned by a private company and operates on land leased from the City. The BUDG receives surplus digester gas from PLWWTP and purifies it using membranes and other treatment technologies. The BUDG purifies the gas and raises its energy content so that it can meet the requirements for injection into the utility natural gas grid. Because the gas is sourced from digester gas, the BUDG then is able to sell its gas output to third parties as renewable biogas, with SDG&E providing delivery through its gas grid. The BUDG is a significant consumer of natural gas. The BUDG uses a small (0.3 MW) onsite fuel cell for power, which is powered by natural gas rather than BUDG-produced gas due to natural gas' lower price. Additionally, the BUDG produces waste gas as part of its gas purification process. The waste gas contains air pollutants that must be destroyed using a flare to maintain air quality. The BUDG uses natural gas to fuel the flare and maintain a high enough burning temperature for proper destruction of pollutants. The BUDG's natural gas consumption is received through a PUD meter at PLWWTP, with the BUDG owner reimbursing PUD for that cost. The BUDG gas consumption is excluded from the total for PLWWTP.

Figure 85. 2019 Energy Use Map – Treatment Plants and Laboratories



South Bay Water Reclamation Plant, another large energy consumer, has an onsite fuel cell known as the South Bay Fuel Cell, which is no longer in service. The fuel cell was decommissioned at the end of 2021. The data presented in this report reflects the period when the fuel cell was still in operation. The South Bay Fuel Cell had a 1.4 MW generation capacity and provided roughly half of the treatment plant's electricity requirements. The fuel cell was owned and operated by BioFuels, LLC. From 2011-2018, the South Bay Fuel Cell operated on renewable biogas sourced from the BUDG and delivered to SBWRP through the SDG&E gas grid. That arrangement was ended in 2018, and from 2018-2021 the SBFC ran on nonrenewable natural gas. The City currently does not purchase biogas from the BUDG, and instead the BUDG sells its output to third parties that require a renewable source of gas.

PUD also operates three water treatment plants and two laboratories. The water treatment plants' consumption is mainly electricity and is partially offset by onsite solar. The laboratories consume electricity and natural gas, with natural gas making up the larger part of their energy use. Lastly PUD owns the San Pasqual Water Reclamation Plant, which is a small pilot plant no longer in operation.

The digester gas-powered generating station at Point Loma Wastewater Treatment Plant and the landfill gas-powered station at North City Water Reclamation Plant are both currently enrolled in a utility program called the Renewable Energy Self-Generation Bill Credit Transfer (RES-BCT) program. Through this program, the surplus power generated on these properties generates bill credits, which can then be applied to reduce electric bills at other PUD facilities. PUD is applying these bill credits to reduce its electric bills at many of its other large pump stations and treatment plants.

WATER AND RECYCLED WATER PUMP STATIONS

Between 2016 and 2020, the total annual energy use of all water and recycled water pump stations decreased by 1%. Water pump stations deliver potable water to customers, and therefore the amount of pumping required is proportional to the amount of water consumed by customers. Recycled water pump stations deliver nonpotable recycled water ("purple pipe") to customers for irrigation, building cooling, or various other commercial uses. Despite population growth, customer water consumption has been relatively stable due to water conservation measures. The PUD operational staff have a degree of flexibility in terms of which pump station or combination of pump stations they choose to operate to meet customers' needs in each neighborhood. Therefore, power consumption at individual pump stations fluctuates significantly from month to month and year to year based on operational decisions to best accommodate maintenance, construction and customer needs. All of the water and recycled water pump stations use electric pumps and have little or no gas consumption.

Figure 86. 2019 Energy Use Map – Water Pump Stations

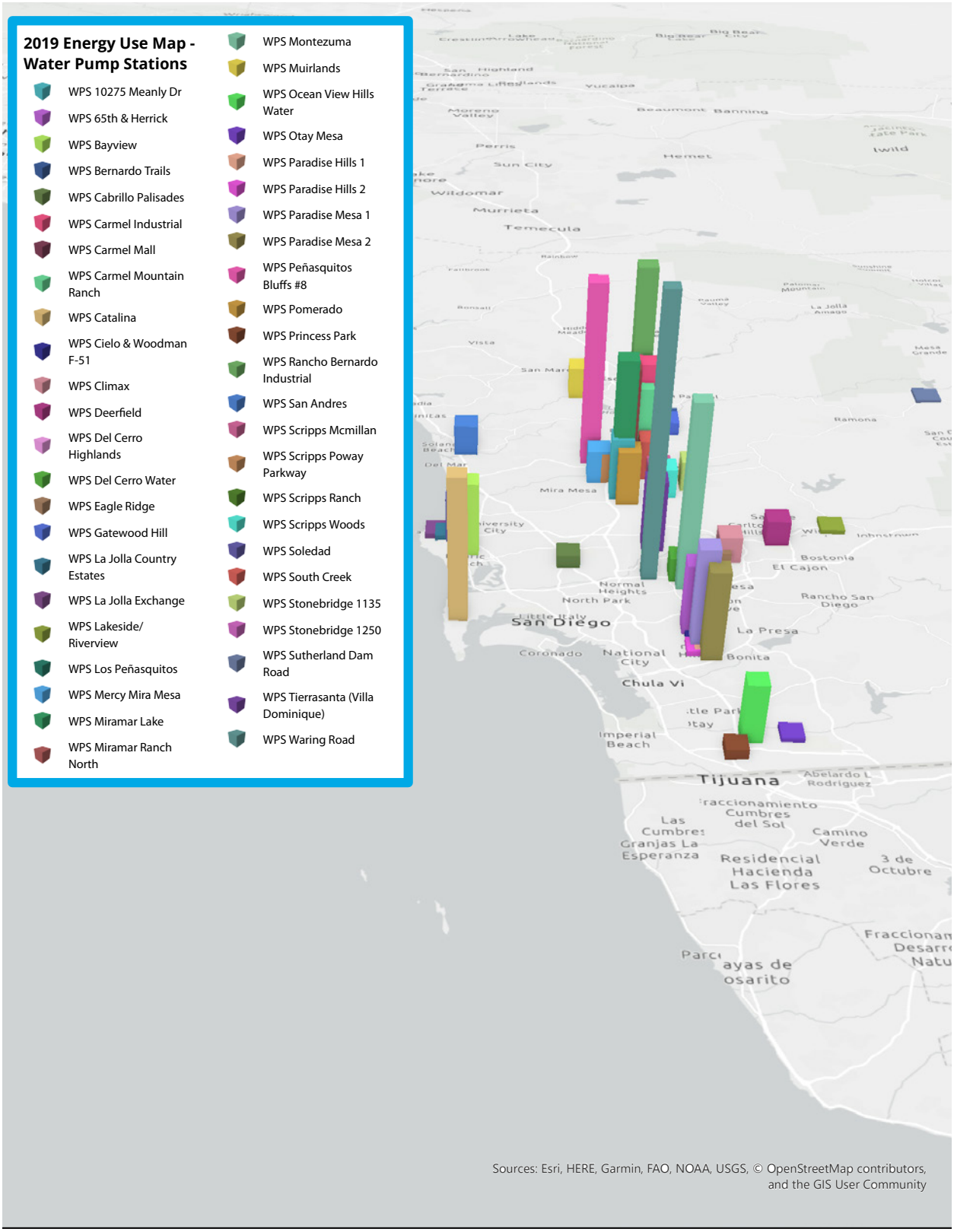
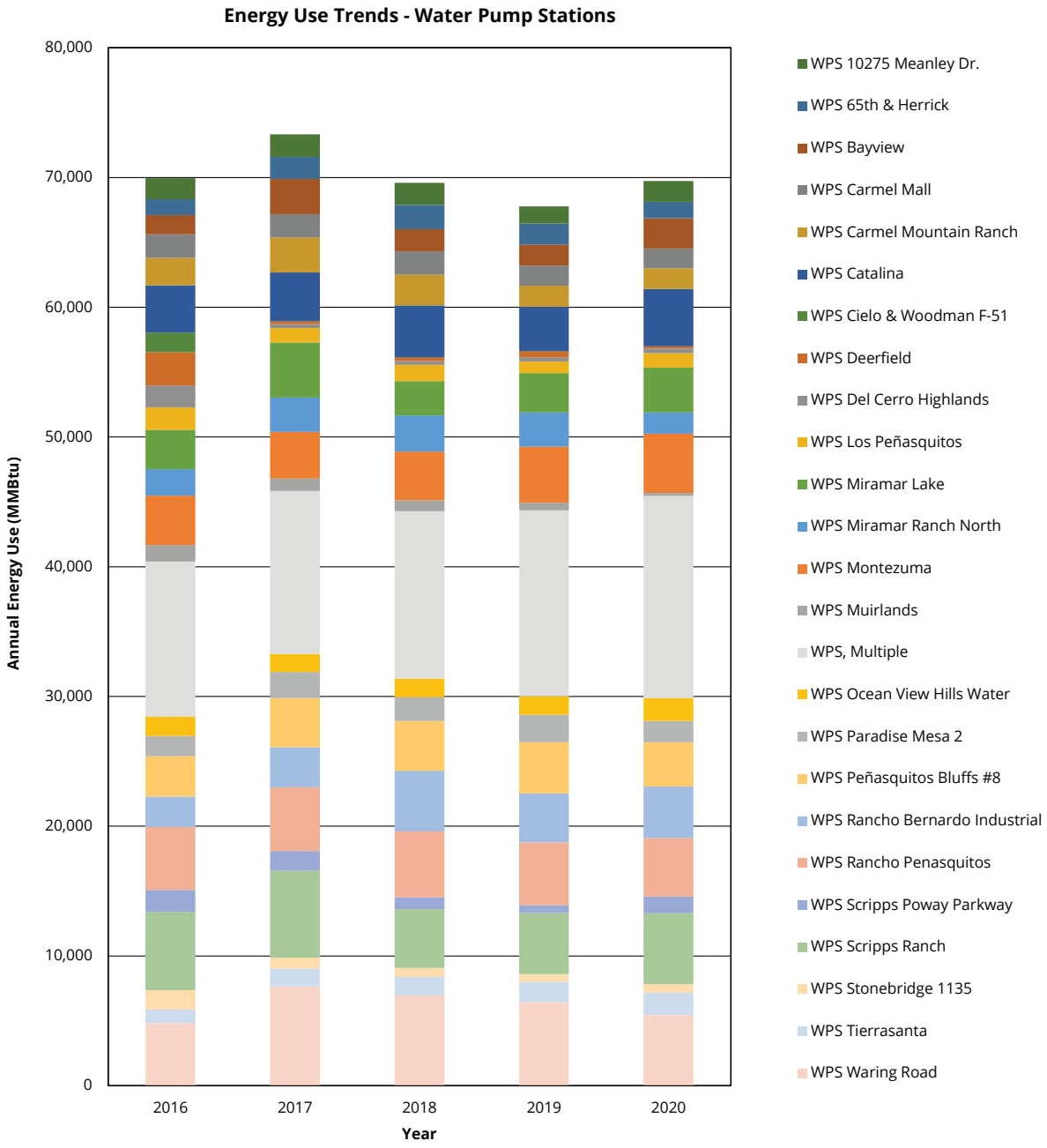


Figure 87. Energy Use Trends – Water Pump Stations



WASTEWATER PUMP STATIONS

Between 2016 and 2020, the total annual energy use of wastewater pump stations increased by 13%. There is a clear upward trend from 2016-2019, with a decline in 2020. Wastewater pump stations move wastewater through the City's sewer system and ultimately to the wastewater treatment plants and water reclamation plants. As with water pump stations, the energy consumption of wastewater treatment plants depends on how much wastewater customers generate. Indoor water conservation measures such as low-flow toilets and showerheads reduce the amount of wastewater generated.

Figure 88. 2019 Energy Use Map – Sewer Pump Stations

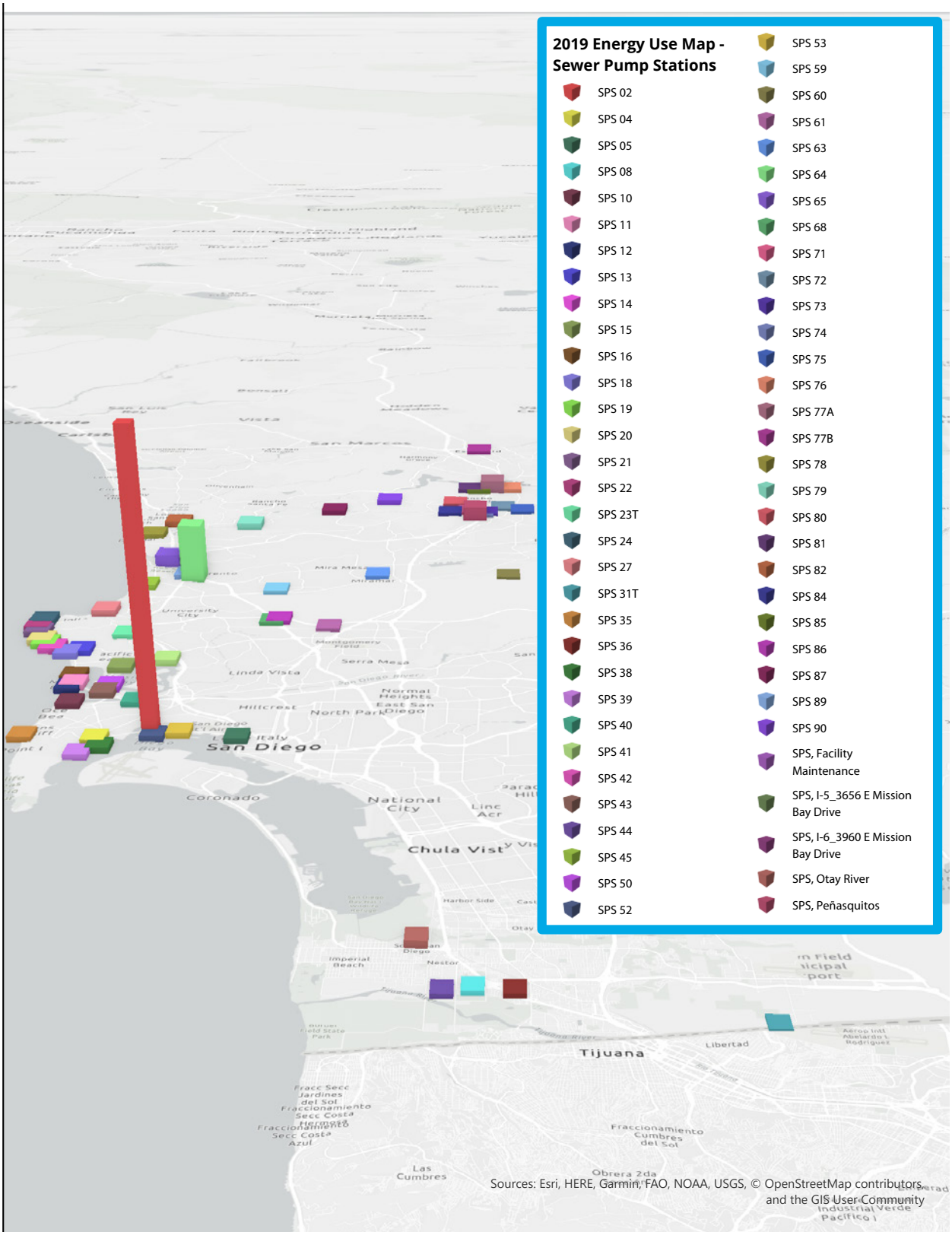
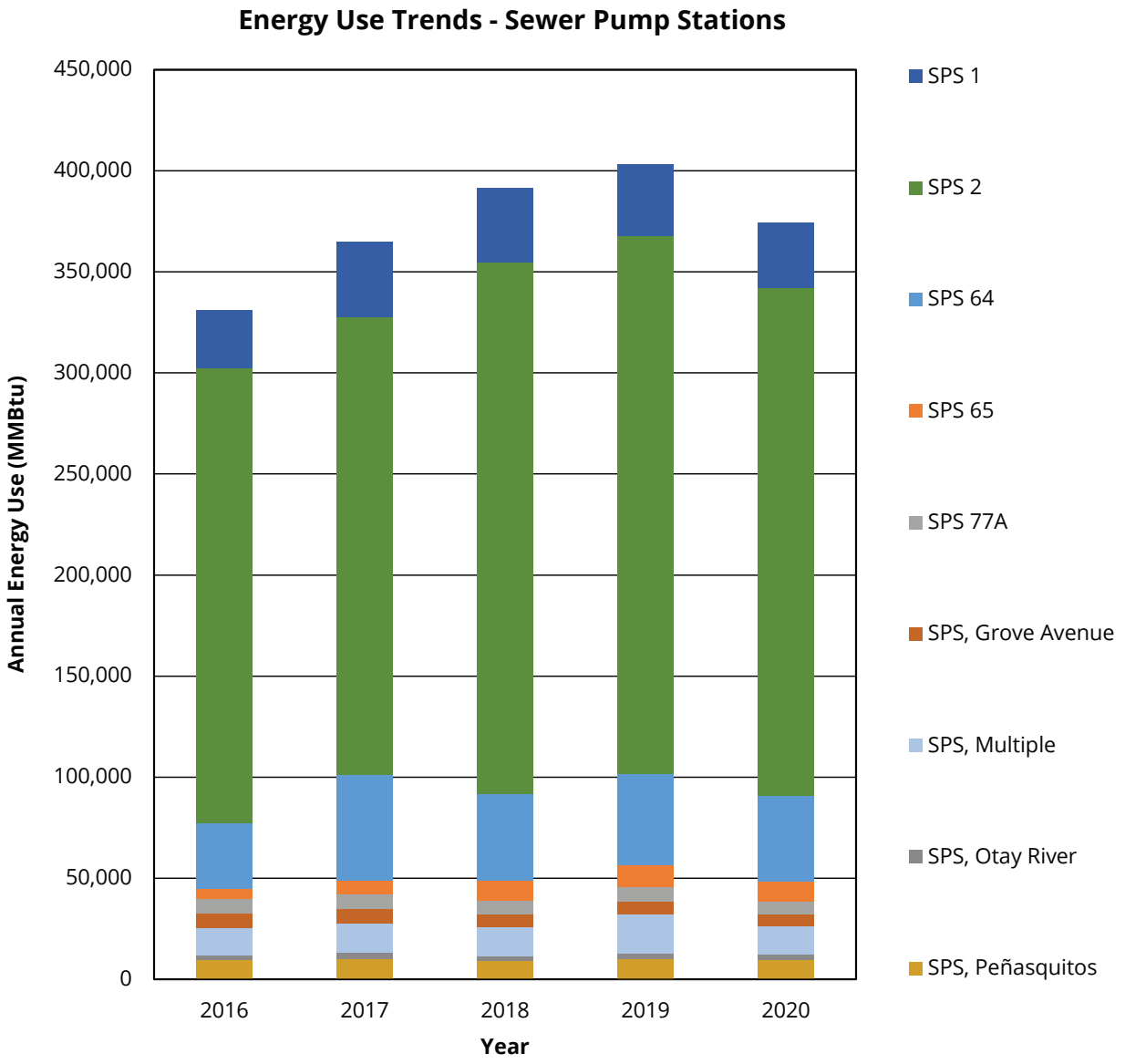


Figure 89. Energy Use Trends – Sewer Pump Stations



Most portions of the City sewer system flow downhill and do not require any pumping. Out of San Diego's dozens of wastewater pump stations, most of them are very small and serve customers at low elevations where the sewer main must run uphill. Meanwhile, most of the energy required for wastewater pumping is consumed at the City's handful of very large wastewater pump stations, which receive large volumes of flow collected from the gravity sewer system and transport it the final distance to the treatment plants.

Sewer Pump Station 2 (SPS 2) is by far PUD's largest pump station and is the single largest energy-consuming City facility. Sewer Pump Station 2 is located on Harbor Drive at the lowest elevation point of the City sewer system—the point to which all wastewater flows. Its purpose is to transport wastewater from that collection point to the Point Loma Wastewater Treatment Plant at the southern tip of Point Loma, which it does by pumping the wastewater through a force main (pipeline) under San Diego Bay. The great majority of San Diego's wastewater, as well as wastewater from several neighboring cities and water districts, passes through SPS 2 and is treated at Point Loma Wastewater Treatment Plant. Because the amount of wastewater to be transported is very large, the energy requirement to run the pumps is also very large.

SPS 2 has for many years had a mix of large natural gas-powered pumps and large electric pumps. PUD has had a policy of keeping at least one natural gas pump always online as the lead pump so that it will continue pumping without interruption in case of a power outage. SPS 2 is therefore PUD's largest consumer of natural gas. Construction is now underway on a project that will eliminate the natural gas pumps in favor of electric pumps, as well as building a natural gas power station onsite, which would operate continuously to power the pumps and protect against electric grid outages.

Sewer Pump Station 1 (SPS 1) and Sewer Pump Station 64 (SPS 64) are also large energy consumers. SPS 1 receives wastewater collected in the South Bay region and pumps it northward to SPS 2 for final delivery to PLWWTP. SPS 64 pumps wastewater collected in northern neighborhoods of San Diego and pumps it uphill to NCWRP. The energy consumption of these pump stations is a function of the volume of wastewater they transport, the distance they must pump it, and the elevation change they must overcome. SPS 64 and SPS 1 exclusively use electric pumps, as do all of the City's smaller wastewater pumps stations.

Note:
"SPS, Multiple" includes the energy use of 68 wastewater pump stations with smaller energy consumption than the ones itemized.

METRO OPERATIONS COMPLEX

The Metropolitan Operations Complex (MOC) is a complex of office buildings, parking lots and maintenance buildings that provides office space for staff, an auditorium and parking for PUD vehicles. Its energy use is mainly for typical building energy needs such as HVAC and lighting. Between 2016 and 2020, the total utility energy use of facilities at the MOC complex declined by 39%. This was due to the installation of a solar parking lot canopy at the MOC 4 parking lot in 2018. The solar system provides power to MOC 1, MOC 2, and MOC 6 through the Net Energy Metering Aggregation program. The MOC 2 Headquarters building is the largest building in the campus and used approximately 64% of the total energy use of MOC Complex prior to the addition of the solar system. In 2016, MOC used approximately 38 kBtus of energy per square foot which is 44% less than the national median energy use per square feet of an office building in the United States. In 2019, MOC's energy use index had declined to 25 kBtu/ft2 net of solar.

Figure 90. 2019 Energy Use Map – Metropolitan Operations Complex

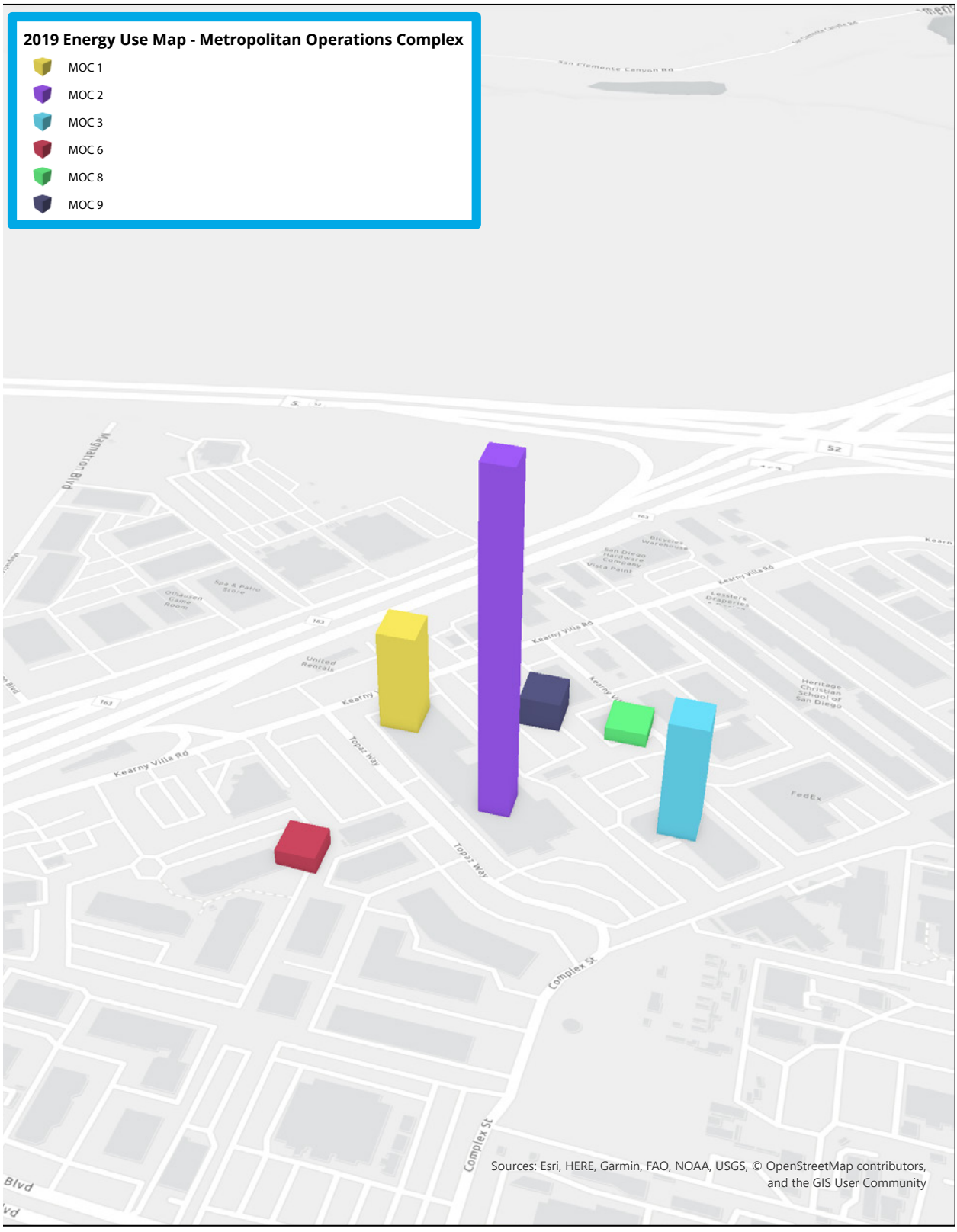
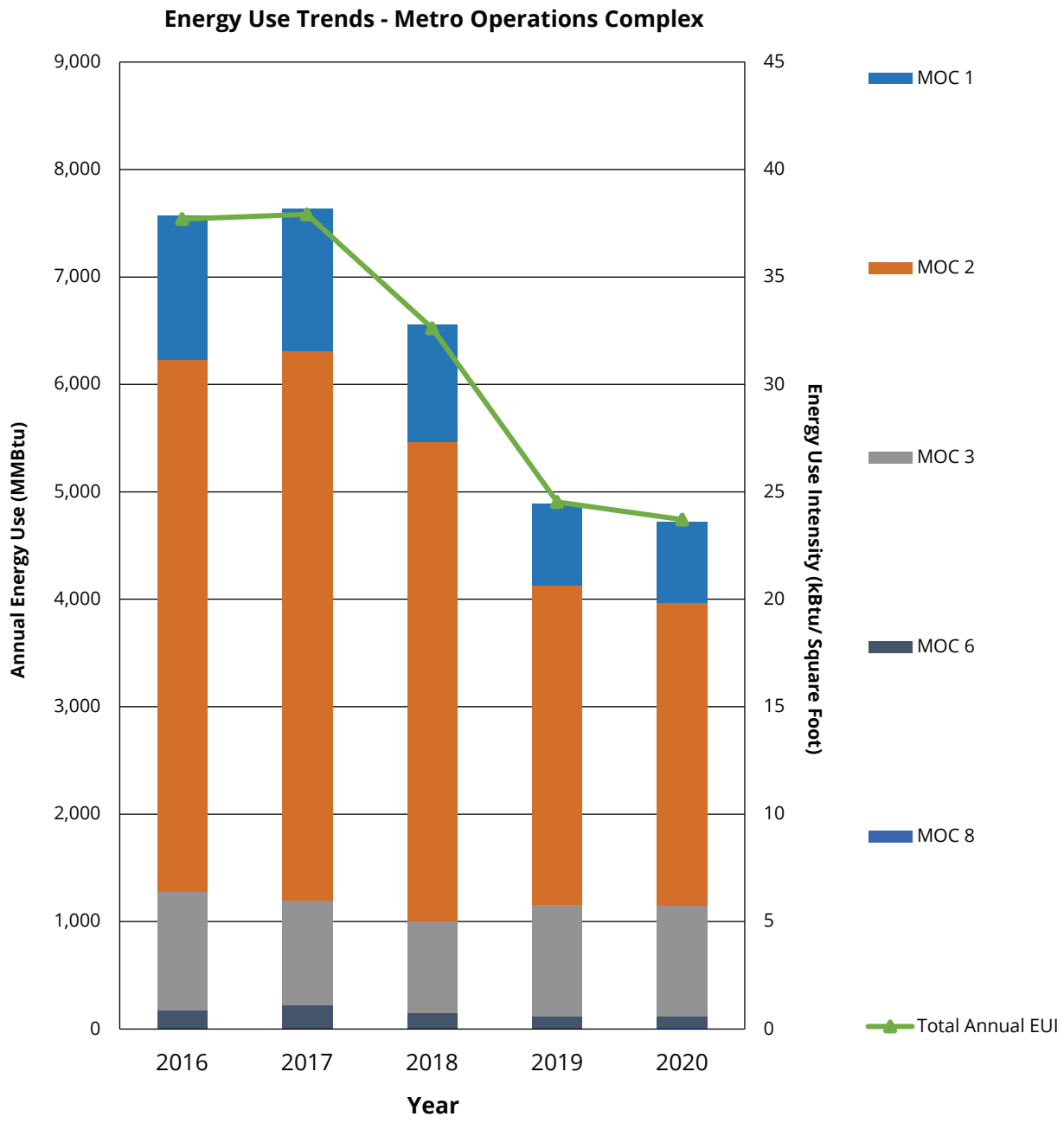


Figure 91. Energy Use Trends – Metropolitan Operations Complex



PURE WATER SAN DIEGO

San Diego is now embarking on a major initiative known as Pure Water San Diego. Pure Water will create a major new local source of potable water by treating and purifying the City's wastewater using advanced water treatment processes. San Diego currently depends on imported water from the Colorado River and rivers in northern California for the vast majority of its water supply. With that supply becoming more scarce and more costly each year, Pure Water will become an important local water source and will allow San Diego to reduce its water imports.

Pure Water has been divided into two phases, each of which will involve construction of major new treatment plants as well as pump stations and pipelines. Phase 1 is already under construction and will produce potable water at the campus of the North City Water Reclamation Plant, which is being expanded and complemented with the North City Pure Water Facility. Phase 2 will construct a larger new treatment plant in the Central San Diego area and will come online in 2035.

Pure Water San Diego will consume a large amount of energy, mainly electricity, and will greatly increase PUD's total energy consumption. The energy will be used to pump wastewater to the water reclamation and purification plants, to pump the produced potable water to City reservoirs for storage, and to power the plants' extensive and state-of-the-art treatment processes. Once operational, the facilities built in Phase 1 are projected to use 132 gigawatt-hours (GWh) (450,000 MMBtu) of energy per year. The new facilities built in Phase 2 will have a larger water production capacity and will use 218 GWh (744,000 MMBtu) per year. The Pure Water facilities are not planned to include onsite renewable power generation and will rely on grid power. Thus, PUD's use of energy from the utility is projected to more than double when both phases are complete.

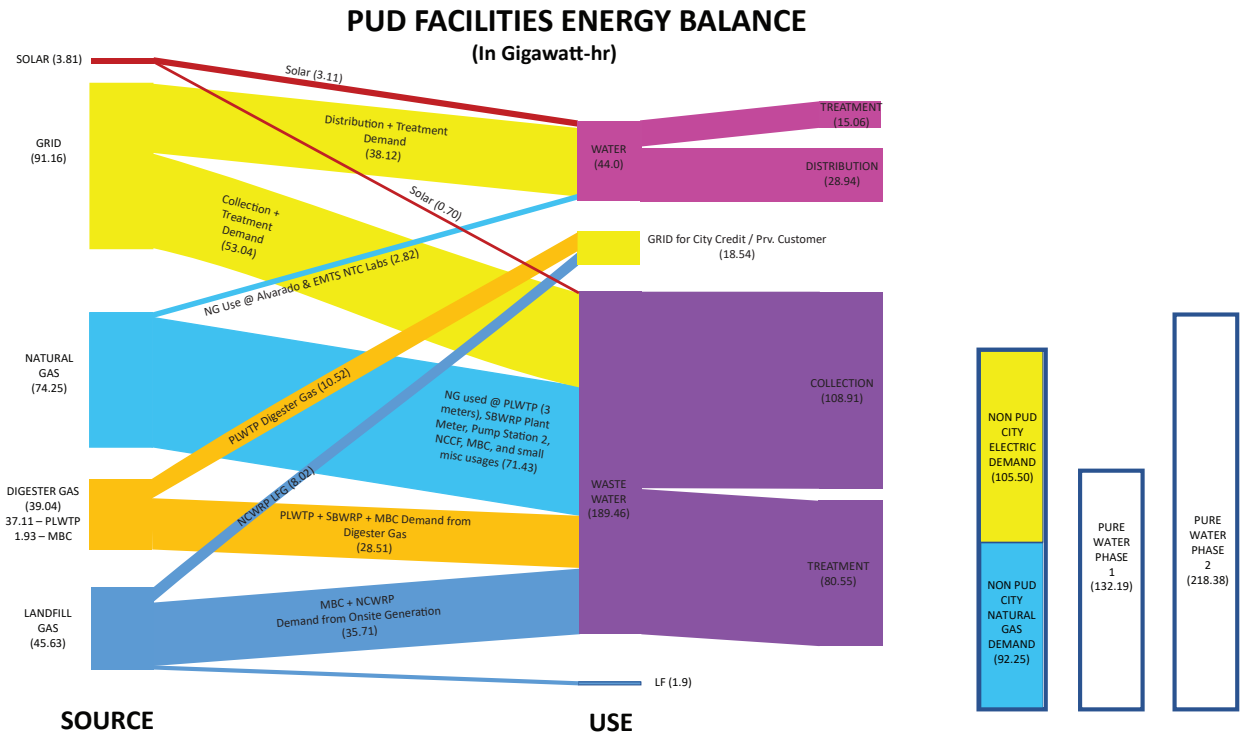
Though the new facilities built as part of Pure Water San Diego will be major energy consumers, it is worth noting that the Pure Water program will indirectly reduce energy consumption at some other locations. Each phase will divert a portion of the current wastewater flow away from Point Loma Wastewater Treatment Plant (PLWWTP) to be treated at the new facilities instead, and therefore energy consumption at both PLWWTP and Sewer Pump Station 2 will decline. More importantly, Pure Water will reduce the City's use of imported water. The City purchases that water from water wholesale suppliers who transport the water through extremely large aqueducts and pump stations. Because the water must travel the long distance from the Colorado River and northern California

and must be pumped either over or around mountain ranges, the wholesale suppliers consume a great amount of energy per gallon delivered. While these wholesale suppliers are not part of the City itself, any opportunity to reduce the energy they consume on the City's behalf is beneficial to the City's big picture sustainability and climate action goals.

ENERGY CONSUMPTION FROM ALL SOURCES

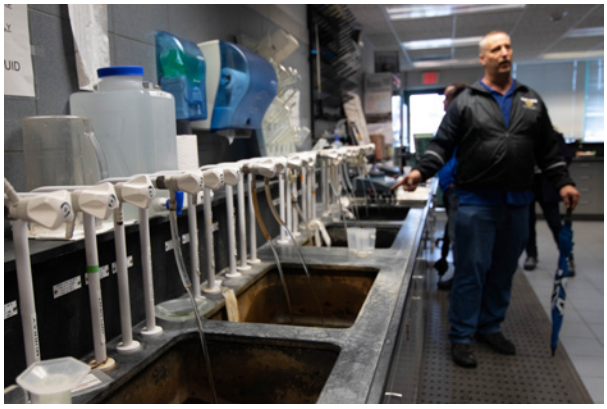
The figure below shows PUD's total annual energy production and consumption, with onsite generation from digester gas, landfill gas and solar included. The energy consumption of other City departments and the future consumption of Pure Water are shown on the right for comparison.

Figure 92. Energy Balance – Public Utilities Department



RECENT ENERGY EFFORTS

Even before the adoption of the CAP in 2015, PUD has proactively planned and executed several large-scale energy-efficiency and renewable energy generation projects aimed at municipal energy use reduction. Many of the PUD facilities are now self-sufficient or produce more energy than their on-site needs by capitalizing on the renewable energy opportunities of solar and methane capture.



The following projects highlight energy-efficiency and renewable energy generation efforts made since 2016 by the PUD:

Figure 93. Recent Energy Efforts – Public Utilities Department

2016	• LED lighting upgrade at Alvarado Laboratory and Alvarado WTP Operations Building • LED indoor and outdoor lighting upgrade at Metro Biosolids Center • New sensors and control system for filter backwashing and scouring at South Bay Water Reclamation Plant • New sensors and control system for aeration basin at South Bay Water Reclamation Plant • LED lighting upgrade at Otay Water Treatment Plant • LED outdoor lighting upgrade at Point Loma Wastewater Treatment Plant
2017	• Dewatering centrifuge replacement at Metro Biosolids Center • Reclaimed water pump refurbishment at South Bay Water Reclamation Plant • Sewer Pump Station 65 upgrade – modified pumps with variable speed drives • Solar PV system installation at Bayview Water Reservoir and Pump Station • Shaded parking solar PV system installation at MOC 4
2018	• No known projects
2019	• Ultraviolet light disinfection system upgrade at South Bay Water Reclamation Plant • Chiller upgrade at Metro Biosolids Center • Indoor and outdoor lighting efficiency upgrade at 54 wastewater pump stations
2020	• 1 MW solar PV system installation at Miramar Water Treatment Plant Clearwell #2 • Lighting upgrade at North City Water Reclamation Plant

PLANNED PROJECTS

- Chiller upgrade at North City Water Reclamation Plant
- 1.2 MW solar PV system installation at Miramar Water Treatment Plant Clearwell #1
- Shaded parking solar PV system installation at Employee Training and Development Center
- Rooftop solar PV system installation at Chollas Operations Yard Buildings A & B
- Solar PV system installation at Environmental Monitoring and Technical Services Lab

Besides the above-mentioned PUD planned projects, PUD has hired a consultant to develop an Energy Master Plan. The goal of this Master Plan is to make the best possible use of the renewable resources available to the Department to meet the City's sustainable energy goals. This document is expected to be complete by the end of the FY2022.

ELECTRIC VEHICLE CHARGING

PUD operates 648 General fleet vehicles, 369 of which park at PUD facilities on a regular basis (16 of those park at underpopulated PUD locations, i.e. locations that house three or fewer vehicles, and will be discussed separately). Another 11 vehicles from other departments also park at PUD facilities regularly. Estimated annual fuel use and total

associated CO2e for the 364 Cars, Light, Medium, and Heavy-Duty vehicles that park at PUD facilities that house more than three vehicles is shown in the figure below.

Figure 94. FY2019 Estimated Fuel Use and CO2e Produced – Public Utilities Facilities that Accommodate 4+ Vehicles

	Car/LD	MD/HD		CO2e (metric tons)
	Unleaded (gal)	Unleaded (gal)	Diesel (gal)	
Public Utilities facilities (total)	**92,154**	**68,044**	**106,203**	**2,511**
Alvarado Water Treatment Plant	23,168	24,780	11,809	553
Miramar Water Treatment Plant	1,764	3,152	--	44
MOC	45,283	24,051	88,646	1,519
MOC Parking Lot (5515 Kearny Villa Rd)	14,233	3,919	--	161
North City Water Reclamation Plant	1,412	512	--	17
Sewer Pump Station 01	958	865	--	16
Sewer Pump Station 02	489	1,480	--	17
San Vicente Trailer Complex	3,409	3,518	5,748	120
South Bay Water Reclamation Plant	490	779	-	11
Otay Lake Filtration Plant	947	4,988	--	53

Two hundred and two EV chargers will be needed at PUD facilities that house more than three vehicles to support those 364 vehicles; charger distribution at each facility is shown in the figures below.

Figure 95. EV Chargers and Annual Electricity (Car/LDV only) Needed – Public Utilities Facilities that Accommodate 11+ Vehicles

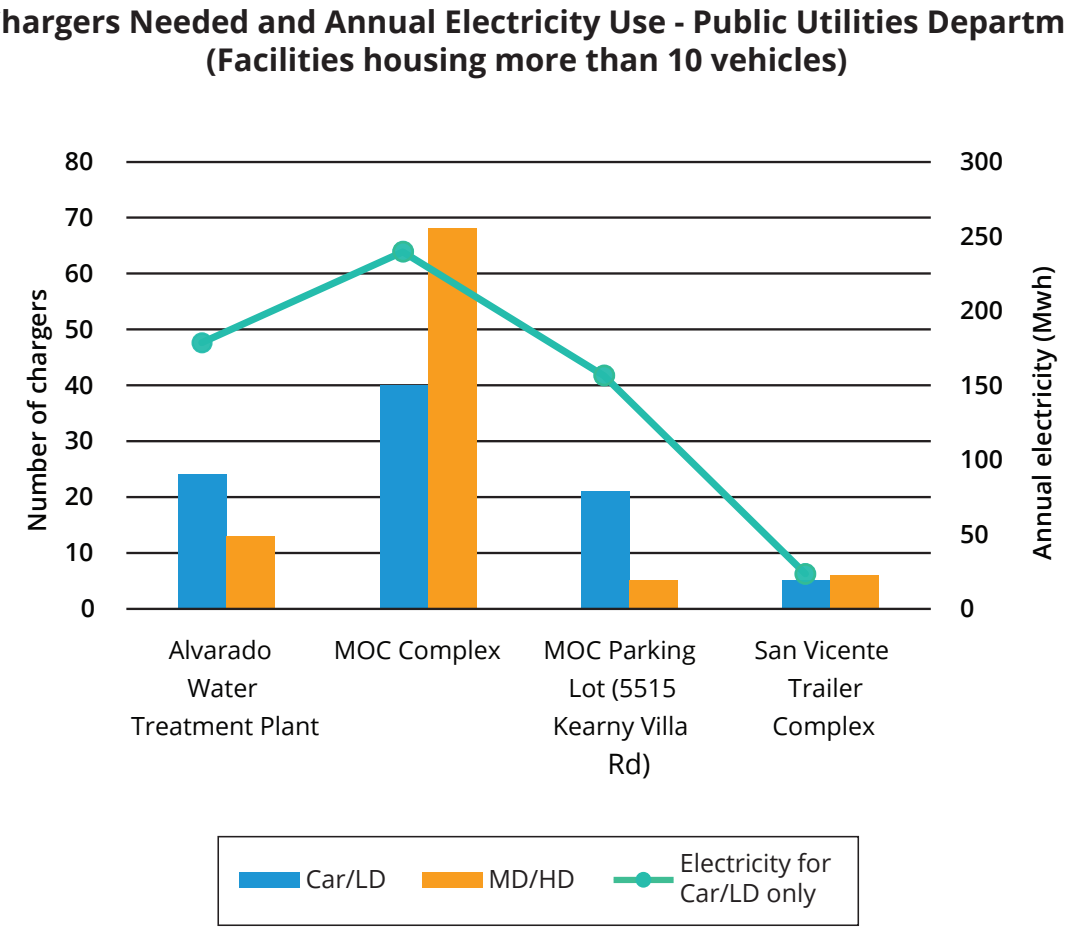
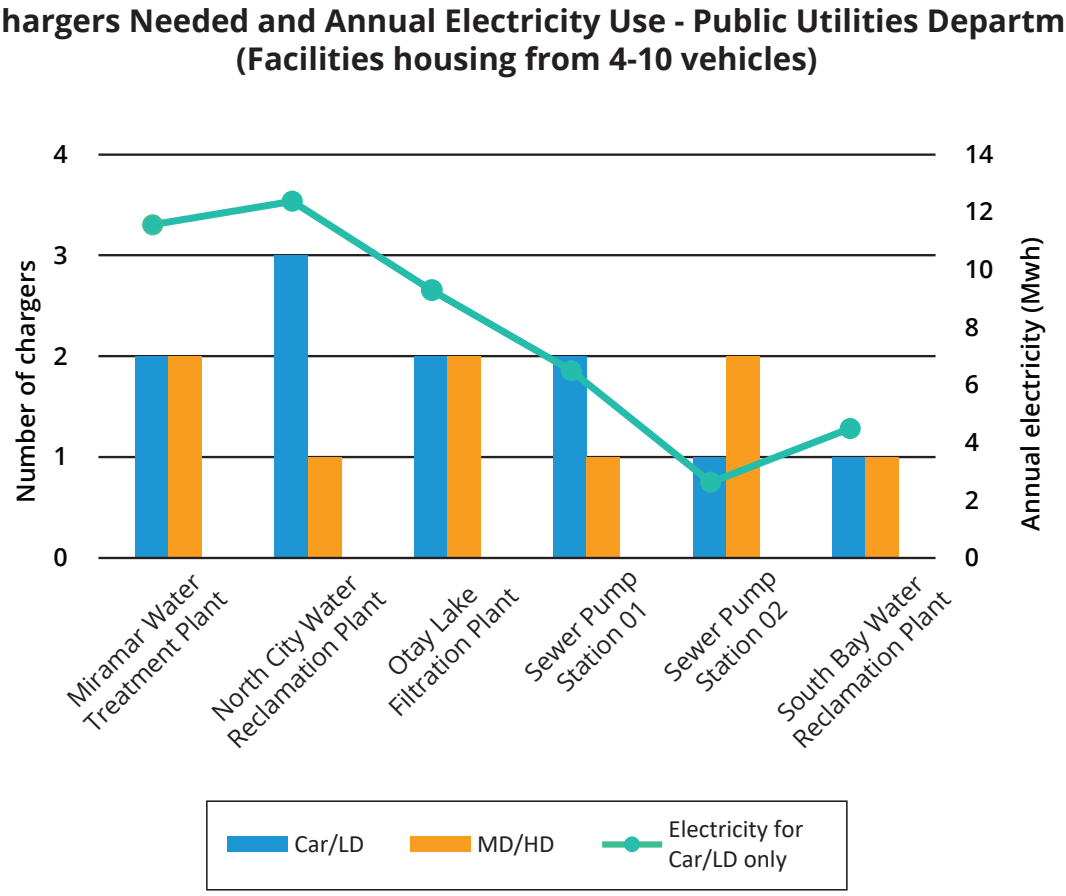


Figure 96. EV Chargers and Annual Electricity (Car/LDV only) Needed – Public Utilities Facilities that Accommodate 4-10 Vehicles



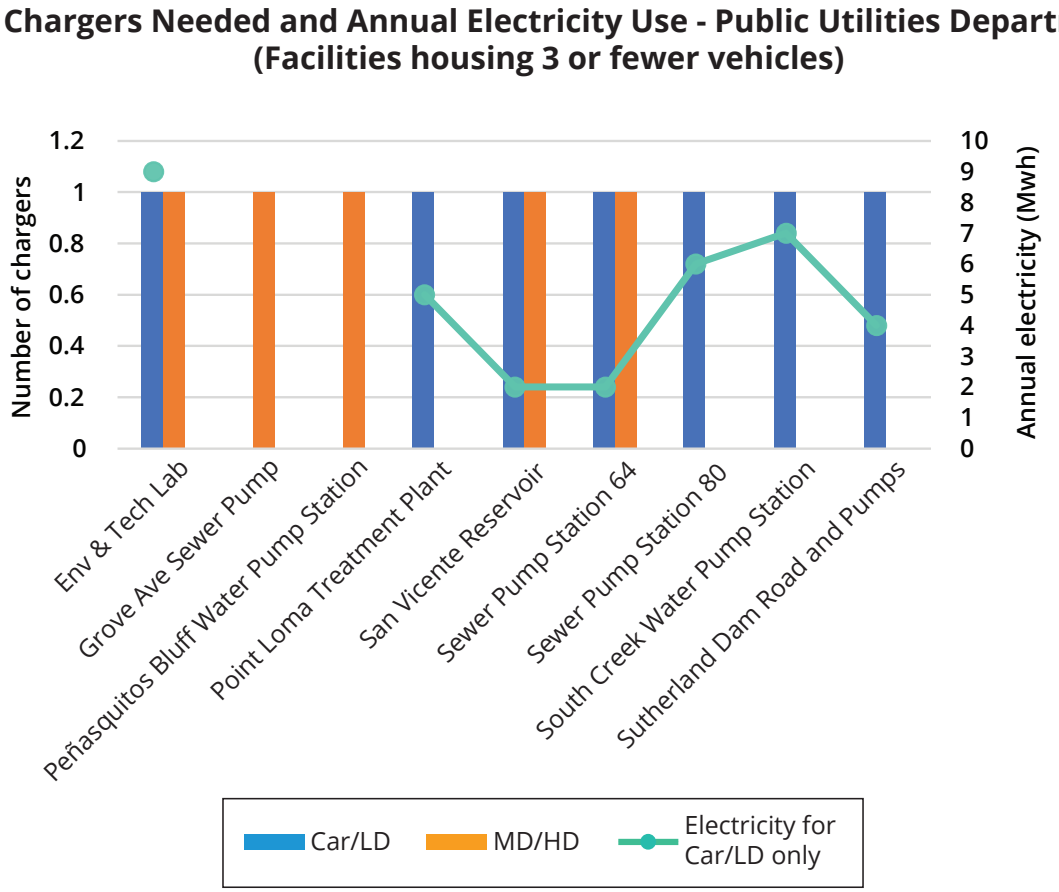
It may not be cost-effective to install EV charging in locations where three or fewer vehicles park; assigning those vehicles an alternate parking location or sending them to depot-style charging hubs may be a better solution. However, PUD has nine of these locations housing 16 PUD vehicles and may want to consider installing chargers in a select few locations, and/or consolidating vehicles in some of these locations. Estimated annual fuel use and total associated CO2e for the 16 Cars, Light, Medium, and Heavy-Duty vehicles that park at Parks and Recreation facilities that house three or fewer vehicles is shown in the figure below.

Figure 97. FY2019 Estimated Fuel Use and CO2e Produced – Public Utilities Facilities that Accommodate 0-3 Vehicles

	Car/LD	MD/HD		CO2e (metric tons)
	Unleaded (gal)	Unleaded (gal)	Diesel (gal)	
Public Utilities facilities (total)	**5,359**	**7,709**	**4,456**	**161**
Env & Tech Lab	708	66	--	7
Grove Avenue Sewer Pump Station	--	--	3,754	38
Peñasquitos Bluff Water Pump Station	--	1,180	--	10
Point Loma Treatment Plant	727	--	--	6
San Vicente Reservoir	489	6,463	--	62
Sewer Pump Station 64	382	--	702	11
Sewer Pump Station 80	541	--	--	5
South Creek Water Pump Station	1,536	--	--	14
Sutherland Dam Road and Pumps	977	--	--	9

The figure below shows the charging needs of the 16 vehicles at PUD facilities that house three or fewer vehicles.

Figure 98. EV Chargers and Annual Electricity (Car/LDV only) Needed – Public Utilities Facilities that Accommodate 0-3 Vehicles



Of the remaining 279 PUD vehicles, 10 park at ESD facilities and 195 park at Shared Asset facilities; the charging needs of these vehicles are accounted for in those departments' sections. Seventy-four other vehicles park at other underpopulated locations, non-CoSD locations, or have missing data and are not accounted for in this document.

STORMWATER DEPARTMENT

The City of San Diego Stormwater Department assets consist of 14 storm pump stations and the citywide stormwater drain infrastructure.

Asset Manager: Stormwater Department

Mission: To effectively manage and enhance the City's stormwater quality and reduce flood risk.

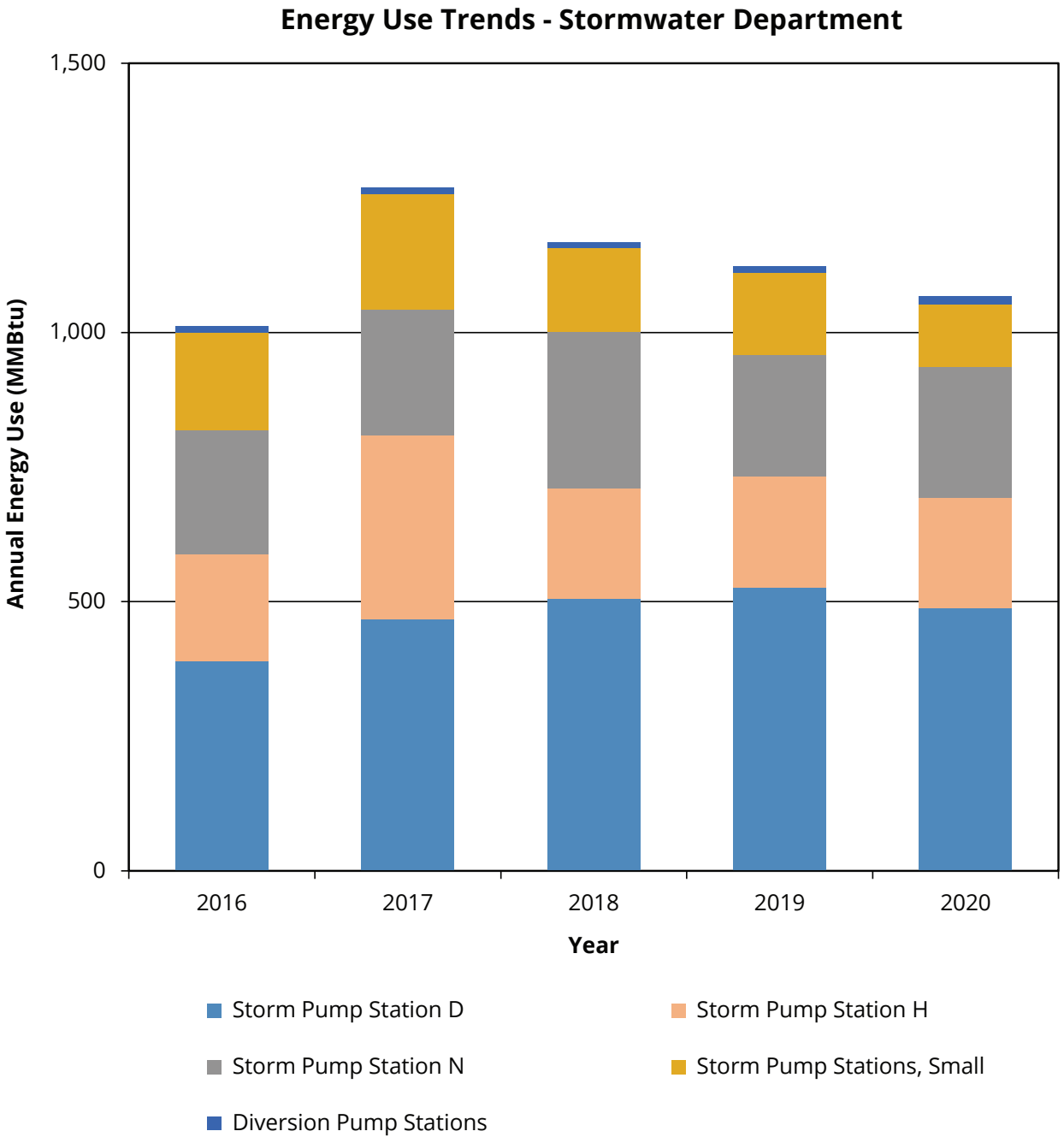
Share of 2019 Municipal Energy Use: 0.1%

Summary of Stormwater Energy

Opportunities: Based on the information provided in the figures below, the Stormwater Department has significant opportunities to reduce energy consumption and begin electrifying end uses to achieve the municipal zero emissions goal by 2035. Transitioning its large vehicle fleet to EVs will significantly decrease GHG emissions for this department.

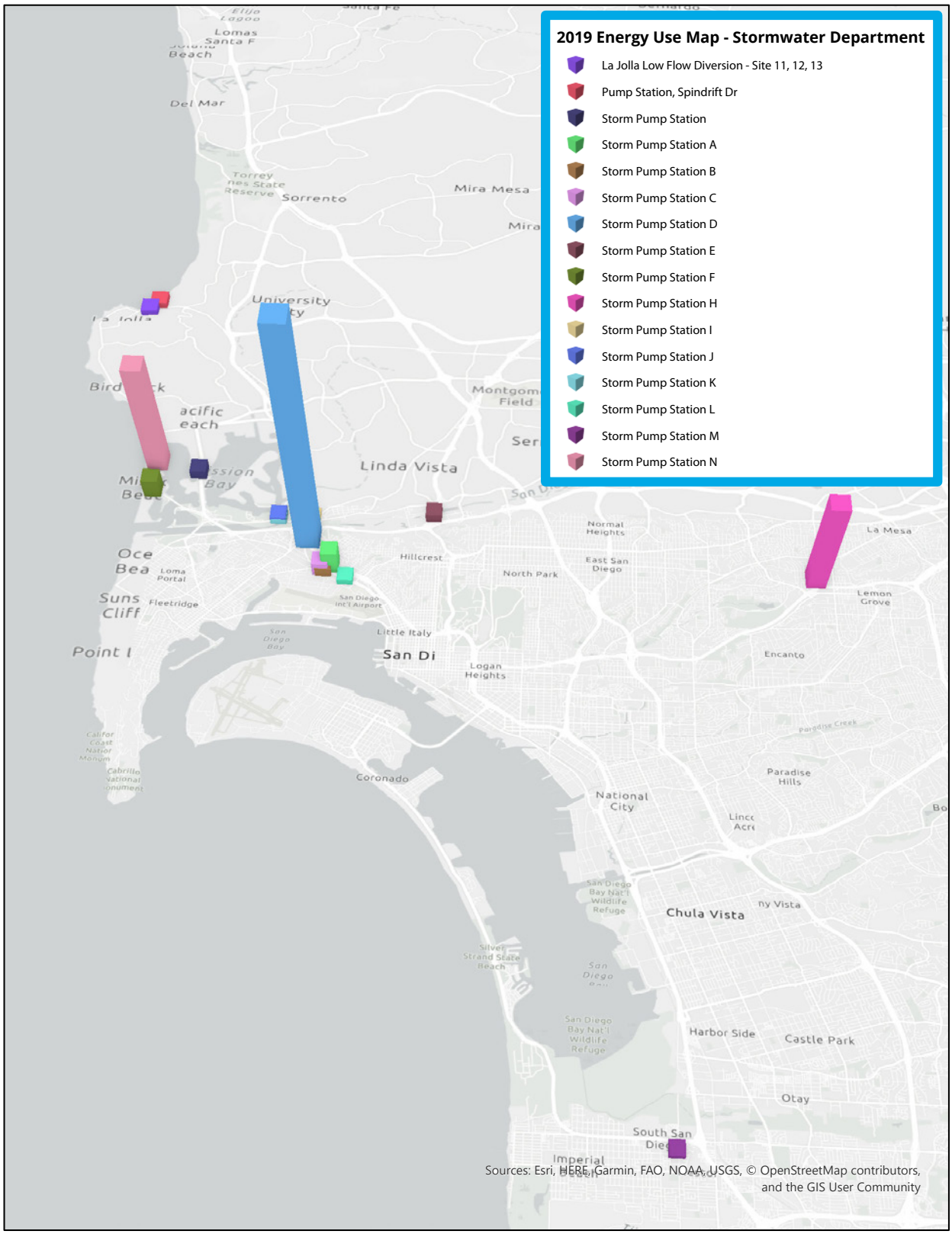
Storm pumps make up approximately 16% of Stormwaters' Energy Consumption. Three storm pump stations - D, H and N - use more than 75% of the total storm pump energy.

Figure 99. Energy Use Trends – Stormwater Department



The figure above reflects power purchased from the local utility. Onsite power generation at some facilities is not tracked and has not been included in the annual energy consumption figures nor the EUI calculations. There is no Energy Star National Median EUI for operations yards so there is no easy way to compare energy performance.

Figure 100. 2019 Energy Use Map – Stormwater Department

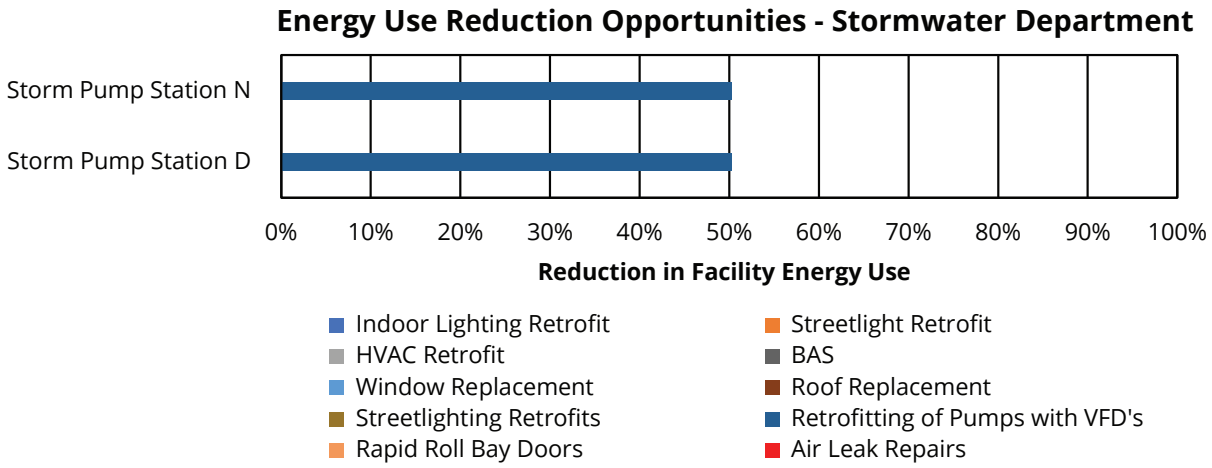


RECENT ENERGY EFFORTS

Figure 101. Recent Energy Efforts – Stormwater Department

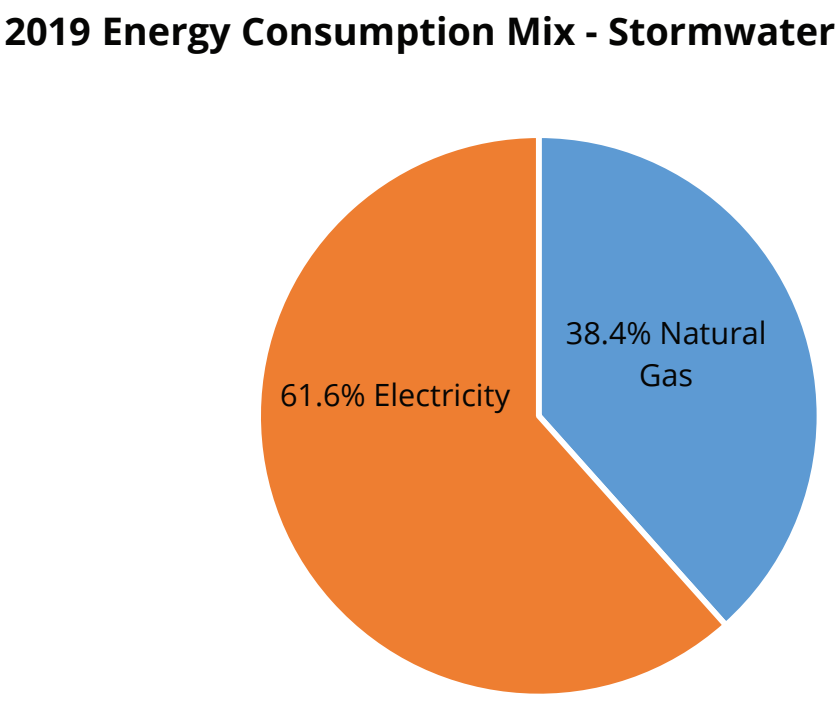
2016	• Installation of VFDs at 23 of 24 Interceptor Pump Stations; Soft start upgrades to Storm Pump Stations G, H, & N
2017	• Storm Pump Station D upgrades
2018	• No known projects
2019	• No known projects
2020	• No known projects

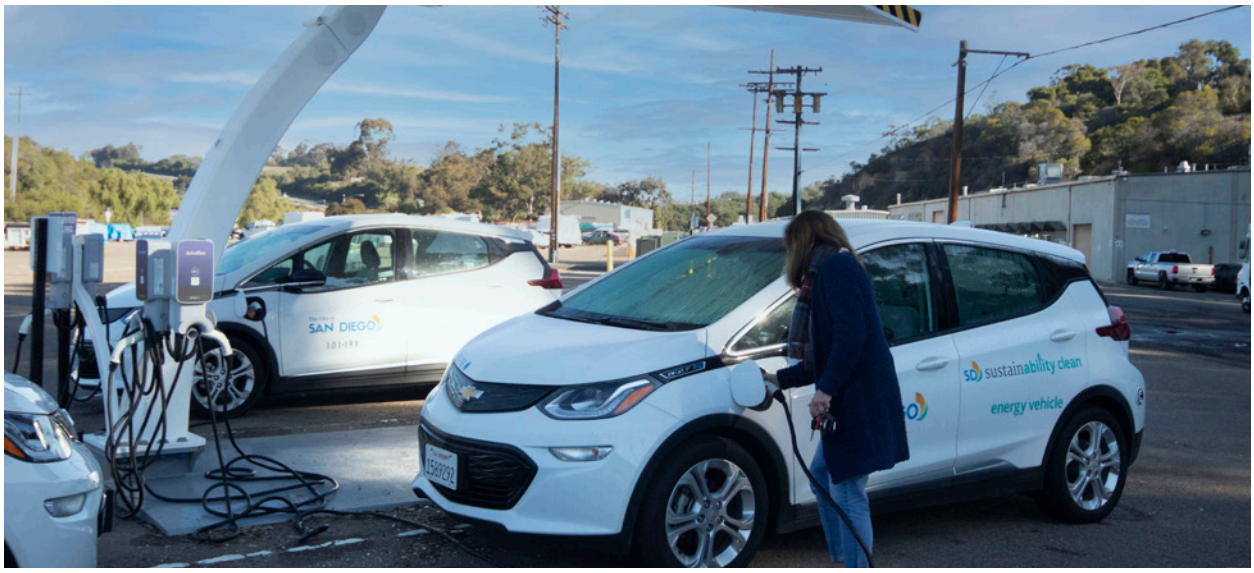
Figure 102. Energy Use Reduction Opportunities – Stormwater Department



The energy opportunities shown in the figure above have been deemed feasible based on evaluation of available energy audits and department energy liaison interviews performed by SC Engineers, a consultant to the Sustainability and Mobility Department.

Figure 103. 2019 Energy Consumption Mix – Stormwater Department





ELECTRIC VEHICLE CHARGING

The Stormwater Department does not maintain facilities that house CoSD vehicles. While SW itself operates 149 General fleet vehicles, none of those park at Stormwater facilities on a regular basis (they park at DREAM and other Shared Asset facilities).

The figure below shows the parking locations for all 149 Stormwater vehicles, none of which park at Stormwater facilities. The charging needs of the 122 vehicles that park at Shared Asset and DREAM Facilities are described in those sections elsewhere. Of the remaining 27 vehicles, seven park at locations not associated with a CoSD facility. Due to this parking behavior, these vehicles will need to be assigned an alternate charging location, potentially including a depot-style charging hub. Parking data is missing for 20 vehicles.

Figure 104. Parking Distribution of Vehicles – Stormwater Department

	CARS/LD	MD/HD	TOTAL VEHICLES
Other facilities (totals)	**42**	**80**	**122**
SHARED: Chollas Operations Yard	29	80	109
SHARED: Central Operations Yard	1	0	1
DREAM: 9370 Chesapeake Dr	12	0	12
Charging unaccounted for (totals)	**19**	**8**	**27**
Not associated with a CoSD facility	6	1	7
Missing parking data	13	7	20

TRANSPORTATION DEPARTMENT

The City of San Diego Transportation assets consist of more than 60,000 streetlights and traffic lights at more than 1,500 signalized intersections.

Asset Manager: Transportation Department

Mission: To effectively manage and enhance the City's transportation network.

Share of 2019 Municipal Energy Use: 8.5%

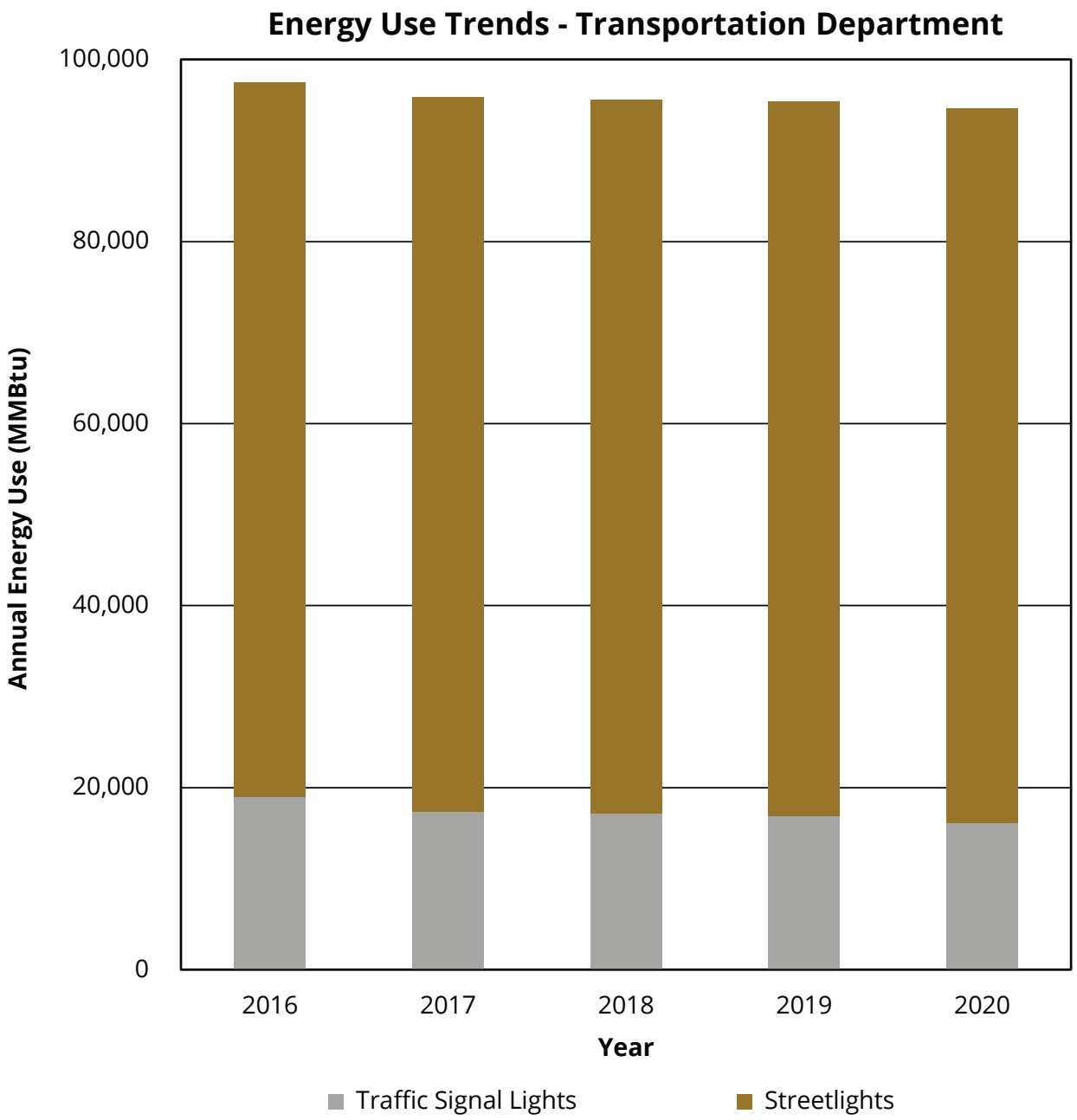
Summary of Transportation Energy Opportunities: Based on the information provided in the figures below, the Transportation Department has significant opportunities to reduce energy consumption and begin electrifying end uses to achieve the municipal zero emissions goal by 2035. Transitioning its large vehicle fleet to EVs will significantly decrease GHG emissions for this department. In addition, continuing streetlight retrofits to LED may reduce emissions and energy costs for the Transportation Department.

Over the last several years, Transportation energy consumption and Energy Use Intensities (EUIs) have been trending upward, indicating that older facilities would benefit from RCx and equipment upgrades to ensure the buildings are performing optimally.

Streetlight energy consumption is based on City records and is an estimate provided in 2016 by SC Engineers, a consultant to the Sustainability and Mobility Department. SDG&E does not individually meter most City of San Diego streetlights; consumption estimates are based on runtime assumptions. Retrofits of streetlight fixtures to more efficient fixtures are ongoing. In 2013, the City replaced 35,311 of 46,000 existing sodium vapor lights to broad spectrum induction lights. The project reportedly reduced energy use of streetlighting by 16 million kilowatt hours and $1.8 million in utility costs annually. In 2019 the City replaced nearly 5,000 inefficient streetlight fixtures with LEDs, saving approximately 2 million kWh and nearly $500,000 annually. Additionally, between 1997 and 2002, the City replaced 90% of the 1,486 signaled intersections to energy-efficient LEDs. The project reportedly saved the City more than $1.3 million annually in energy costs. Recent analysis indicates that approximately 15 percent of current City-owned streetlights are LED; the remaining 85 percent are sodium and induction technologies. LED retrofits of these fixtures should now be explored.

Streetlight retrofits will be explored with ESCOs.

Figure 105. Energy Use Trends – Transportation Department



The figure above reflects power purchased from the local utility. Onsite power generation at some facilities is not tracked and has not been included in the annual energy consumption figures nor the EUI calculations. There is no Energy Star National Median EUI for Operations Yards, so there is no easy way to compare energy performance to national medians.

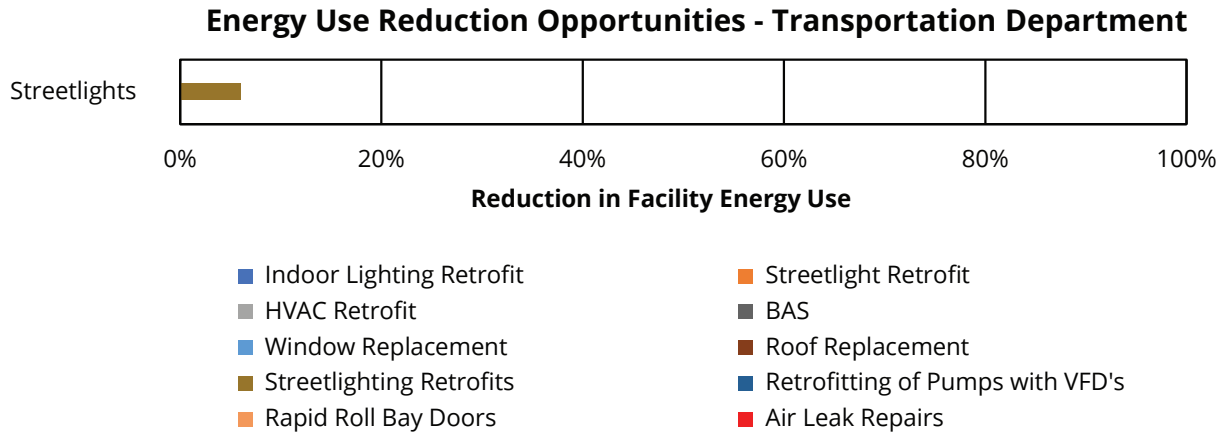
RECENT ENERGY EFFORTS

Figure 106. Recent Energy Efforts – Transportation Department

2016	• No known projects
2017	• Kensington Manor streetlight circuit upgrade
2018	• Intelligent outdoor lighting retrofit
2019	• No known projects
2020	• No known projects

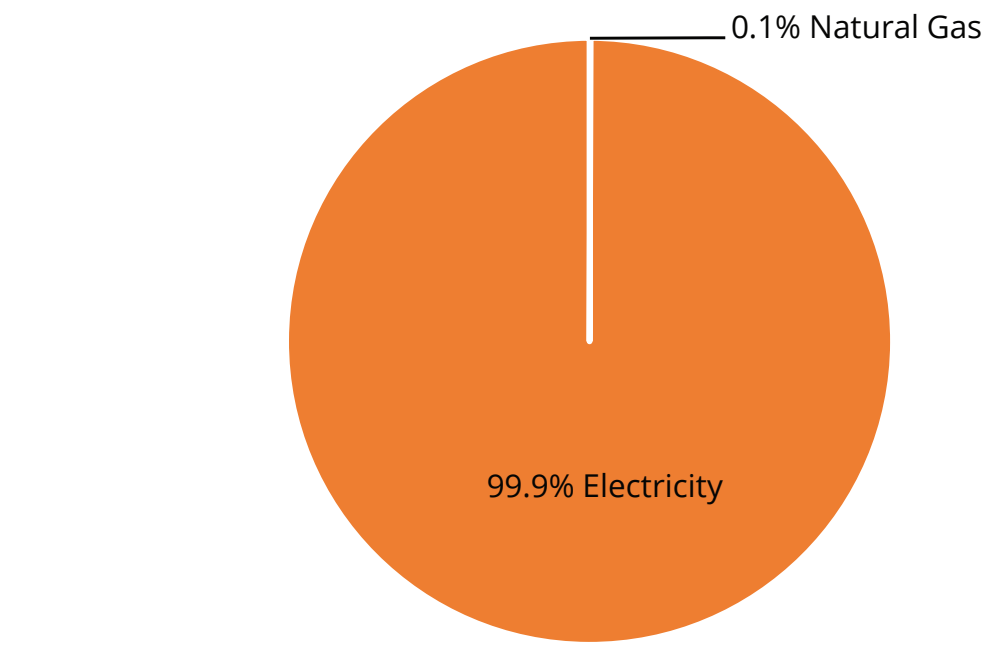
ENERGY PERFORMANCE IMPROVEMENT OPPORTUNITIES

Figure 107. Energy Use Reduction Opportunities – Transportation Department



The energy opportunities shown in the figure above have been deemed feasible based on evaluation of available energy audits and department energy liaison interviews performed by SC Engineers, a consultant to the Sustainability and Mobility Department.

Figure 108. 2019 Energy Consumption Mix – Transportation Department



ELECTRIC VEHICLE CHARGING

The Transportation Department does not maintain facilities that house CoSD vehicles. While Transportation itself operates 204 General fleet vehicles, none of those park at Transportation facilities on a regular basis (they park at DREAM and other Shared Asset facilities).

The figure below shows the parking locations for all 204 Transportation vehicles. The charging needs of the 189 vehicles that park in DREAM and Shared Assets facilities are described in those sections elsewhere. Of the remaining 15 vehicles, one parks at a location not associated with a CoSD facility. Due to this parking behavior, this vehicle will need to be assigned an alternate charging location, potentially including a depot-style charging hub. Parking data is missing for 14 vehicles.

Figure 109. Parking Distribution of Vehicles – Transportation Department

	CARS/LD	MD/HD	TOTAL VEHICLES
Other facilities (total)	**41**	**148**	**189**
DREAM: 9370 Chesapeake Dr	2	0	2
SHARED: Central Operations Yard	1	0	1
SHARED: Chollas Operations Yard (All Facilities)	38	148	186
Charging unaccounted for (total)	**5**	**10**	**15**
Not associated with a CoSD facility	0	1	1
Missing parking data	5	9	14

SHARED FACILITIES

Asset Managing Departments that share facilities: Department of General Services, Department of Real Estate and Airport Management, Environmental Services Department, Park and Recreation Department, Public Utilities Department, Storm Water Department, and Transportation Department.

Share of 2019 Municipal Energy Use: 5.1%

Summary of Shared Facilities Energy Opportunities: Shared facilities include Center Operations Yard, Chollas Operation Yard, Civic Center Complex, and Rose Canyon Operations Yard. These four locations use up more than 5% of the City's total annual energy consumption as well as account for a lot of the City's deferred maintenance.

Since there is no one AMD in charge of the facilities they have not been regularly maintained. The deferred maintenance has led to significant energy-efficiency potential in all of the facilities listed above.

The Civic Center Complex consists of the City Administration Building (CAB), the City Operations Building (COB), Golden Hall, Plaza Hall, the Civic Theatre and the Central Plant. CAB, COB and Plaza Hall are occupied by more than 15 City departments including the San Diego Mayor. The Golden Hall and Civic Theatre are home of the San Diego Opera and Broadway San Diego, and regularly host concerts, musicals, plays, lectures and film presentations.

Based on the information provided in the figures below, the shared facilities have significant opportunities to reduce energy consumption and begin electrifying end uses to achieve the municipal zero emissions goal by 2035. Over the last several years, these facilities' energy consumption and EUIs have

been trending downward largely due to a retrocommissioning project that occurred at the central plant in Civic Center Complex in 2019. This is an example that consumption of all of the shared assets indicating that older facilities would benefit from RCx and equipment upgrades to ensure the buildings are performing optimally.

Civic Center Complex is the largest energy consumer of this portfolio, using more than 72% of the total energy from this portfolio in 2019. The complex has a high EUI and a high Facility Condition Index (FCI) rating, which indicates that the facility is in relatively poor condition. Civic Center Complex buildings were built between 1960 and 1970 and are good candidates for whole building retrofit projects. Civic Center Complex is composed of six different facilities with one electric meter

and one natural gas meter. The Sustainability and Mobility Department is exploring adding submeters to better understand the campus' individual building energy consumption. Installation of separate meters at each facility will significantly improve the ability to assess energy use intensity at each building and compare performance to national medians. Chollas Operations Yard has been identified by the Sustainability and Mobility and the City's AMDs for near-term comprehensive energy retrofits in partnership with ESCOs. This site was selected based on initial research done by SC Engineers. Retrofits at Chollas are expected to have a payback under seven years and achieve at least a 30% energy reduction.

RECENT ENERGY EFFORTS

Figure 110. Recent Energy Efforts – Shared Facilities

2016	• No known projects
2017	• No known projects
2018	• No known projects
2019	• RCx at Civic Center Complex Central Plant
2020	• Replacement of antiquated thermostats with Direct Digital Control thermostats at Civic Center Complex

Fleet Division occupies the majority of the facilities at the Chollas Operations Yards. Typical building types at operations yards include offices, control rooms, fleet maintenance and repair shops, and HVAC repair shops.

Summary of Shared Facilities Energy Opportunities:
At Chollas Operations Yard, energy consumption increased 18% in the last five years, partially attributable to a new PUD facility built on the campus.

Chollas Operations Yard has been identified by the Sustainability and Mobility and Transportation Departments for near-term comprehensive energy retrofits in partnership with ESCOs. The Sustainability and Mobility Department will work with ESCOs to explore inclusion of electrification strategies and solar PV in energy project plans for this site.

The General Services Department occupies the majority of facilities at the Central Operations Yard. Typical building types at operations yards include offices, control rooms, fleet maintenance and repair shops, and HVAC repair shops.

Figure 111. 2019 Energy Use Map – Shared Facilities

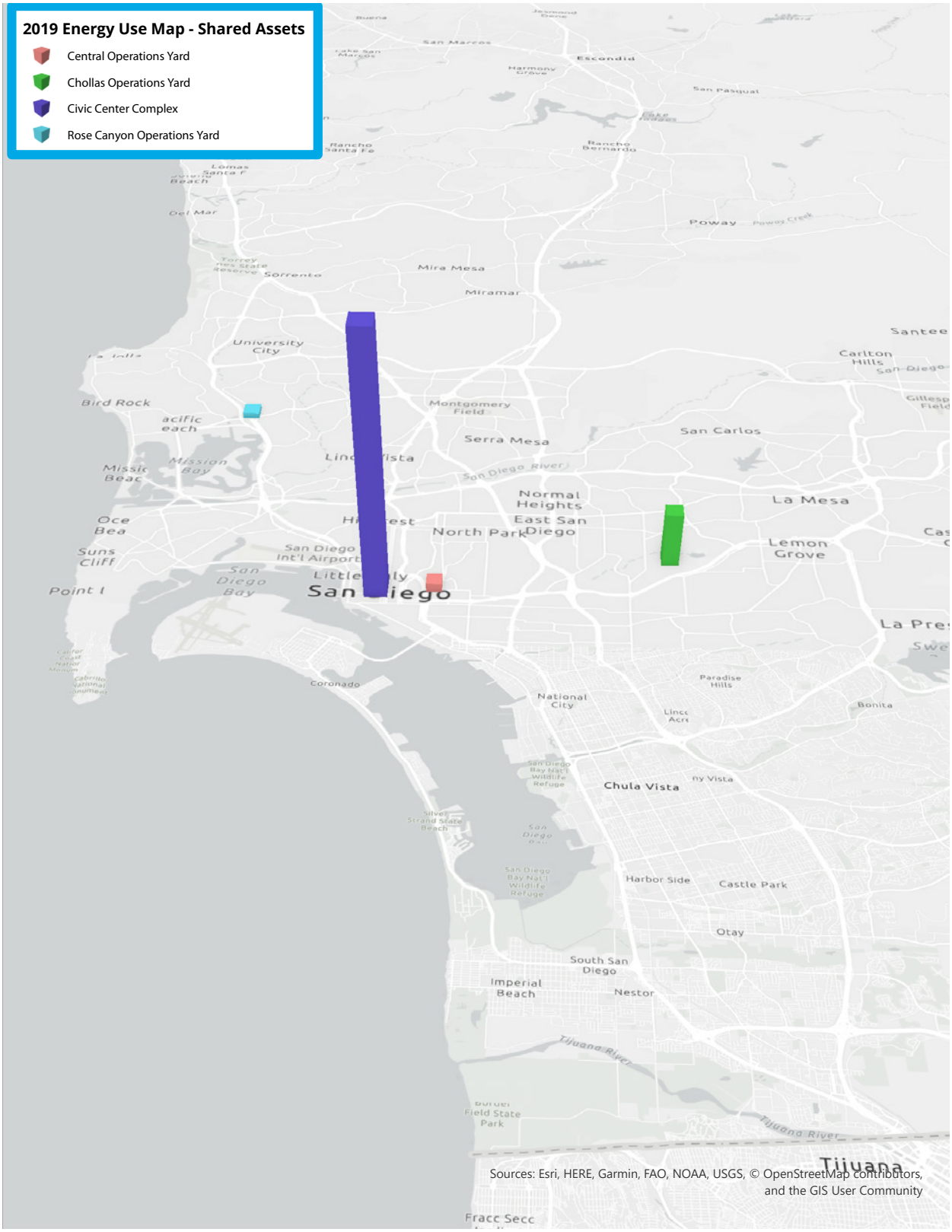


Figure 112. Energy Use Trends – Shared Facilities

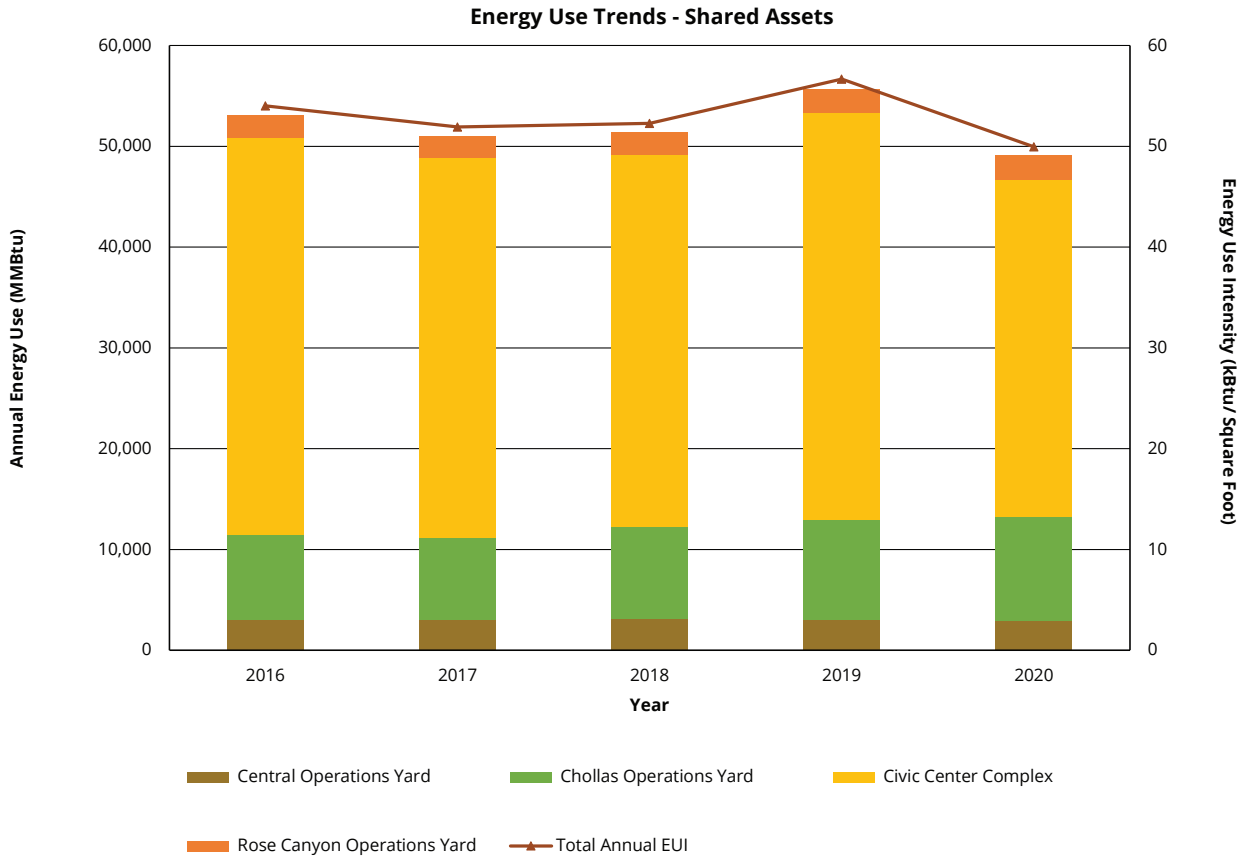


Figure 113. Energy Performance and Conditions Index – Shared Facilities

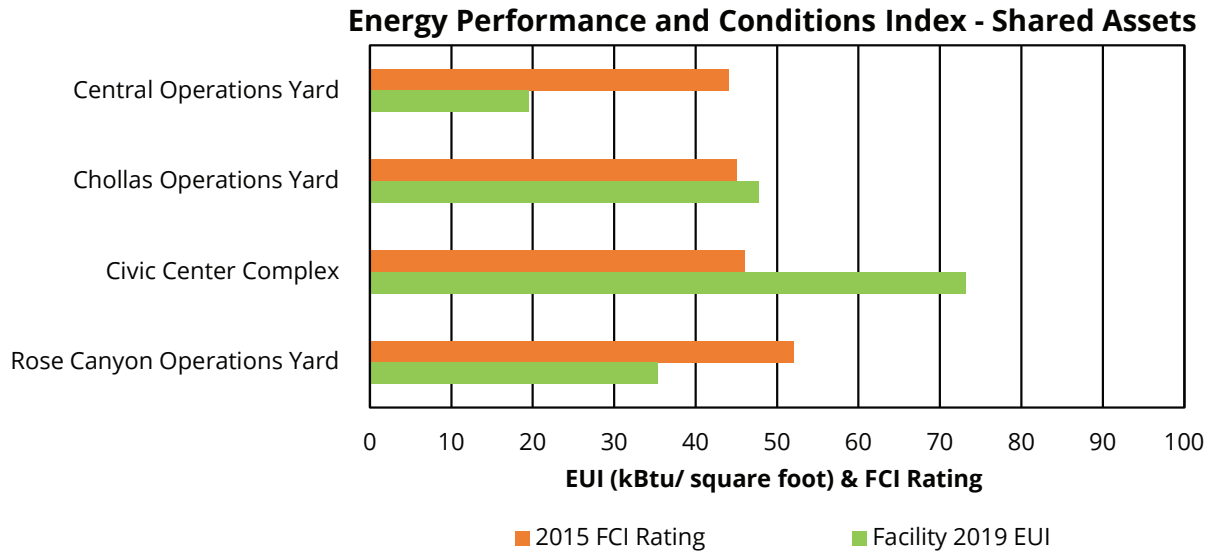


Figure 114. Energy Performance Improvement Opportunities – Shared Facilities

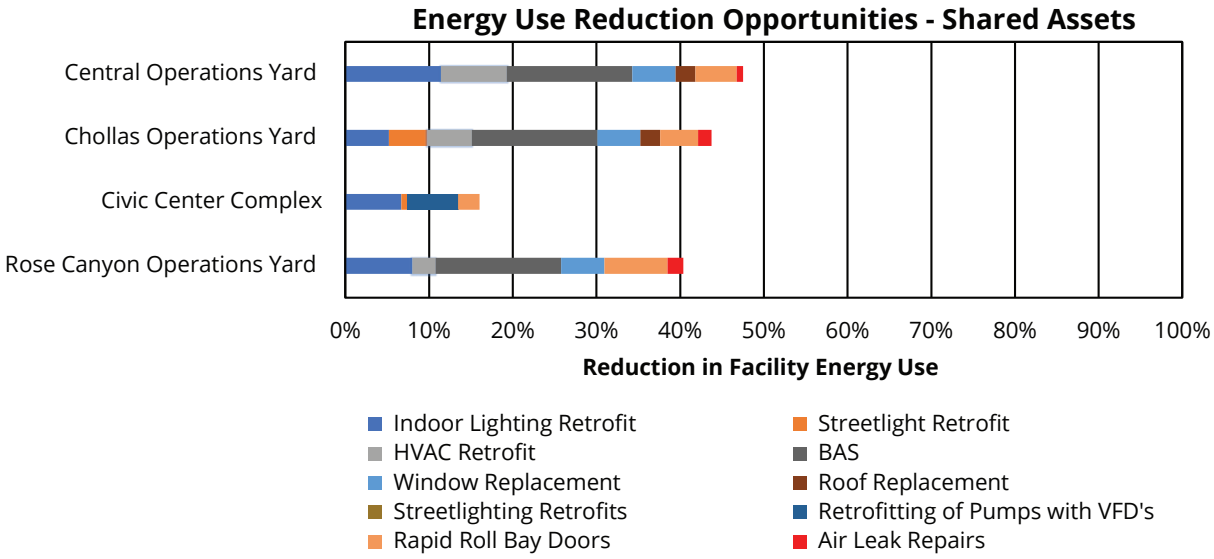
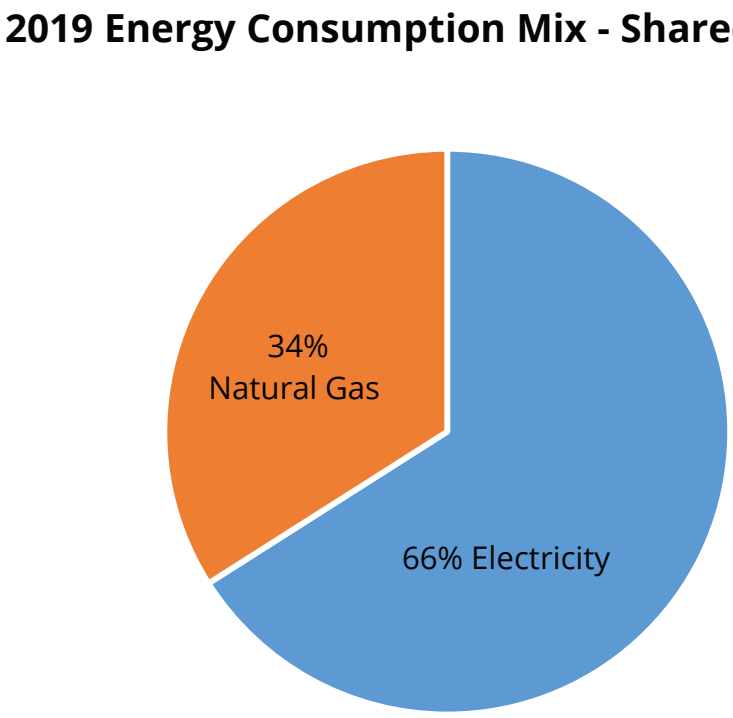


Figure 115. 2019 Energy Consumption Mix – Shared Assets



ELECTRIC VEHICLE CHARGING

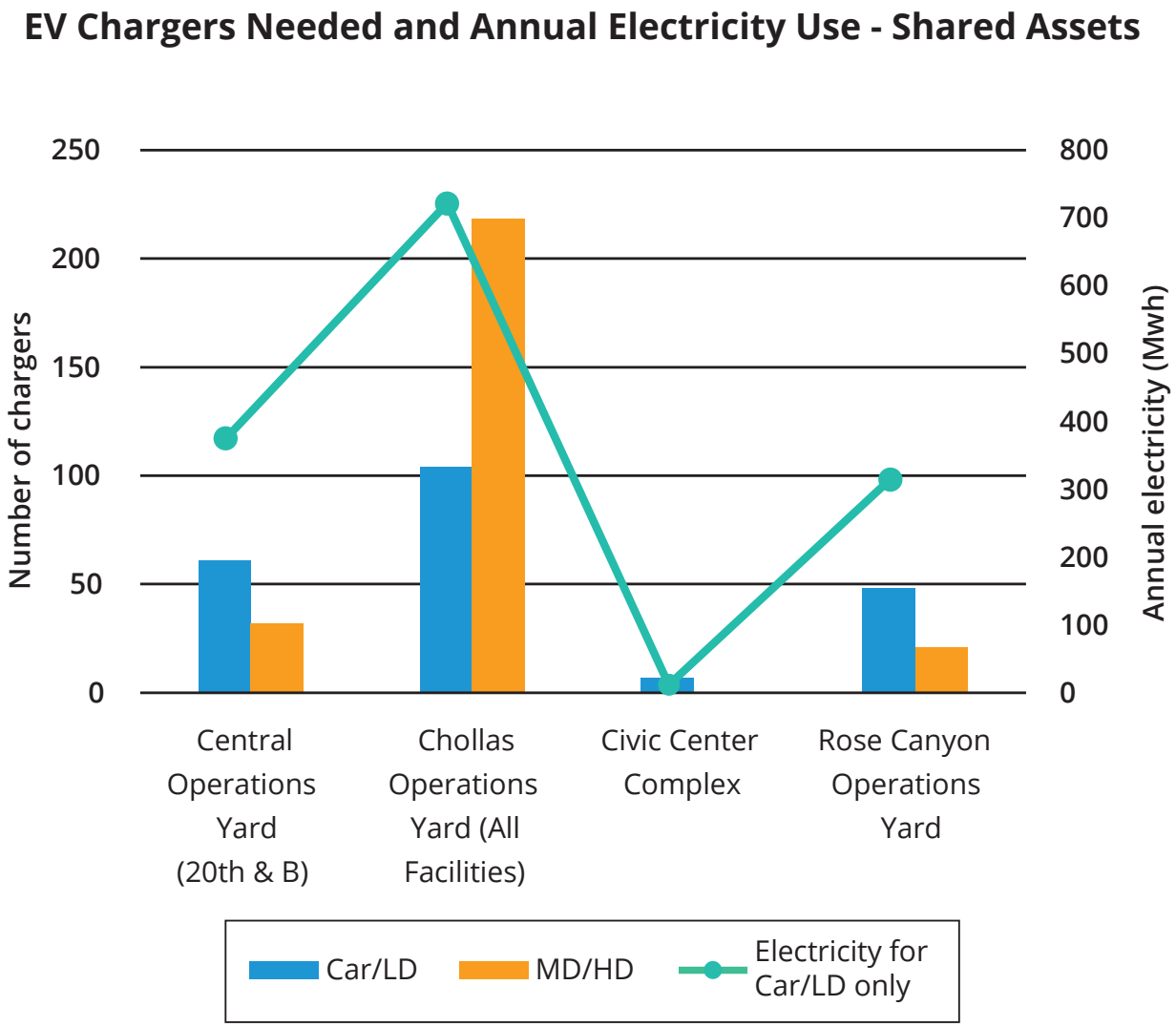
Shared Asset Facilities house 902 vehicles from different departments across four locations described at the beginning of this section. Estimated annual fuel use and total associated CO2e for those vehicles is shown in the figure below.

Figure 116. FY2019 Estimated Fuel Use and CO2e Produced – Shared Facilities

	Car/LD	MD/HD		CO2e (metric tons)
	Unleaded (gal)	Unleaded (gal)	Diesel (gal)	
Shared Asset Facilities (total)	**333,271**	**3,000**	**209,659**	**485,240**
Chollas Operations Yard	198,974	1,231	79,954	448,499
Central Operations Yard (20th & B)	65,134	1,769	104,402	17,051
Civic Center Complex	730	--	--	7
Rose Canyon Operations Yard	68,433	--	25,303	19,683

The charging needs for those 902 vehicles are shown in the figure below. Note that one parking structure in the Civic Center Complex (the Evan V. Jones Parkade) is being leased by the City to a tenant that pays the energy bills.

Figure 117. EV Chargers and Annual Electricity (Car/LDV only) Needed – Shared Facilities



The Shared Asset facilities houses vehicles from the departments shown in the figure below.

Figure 118. Parking Distribution of Vehicles – Shared Facilities

	CARS/LD	MD/HD	TOTAL VEHICLES
Chollas Operations Yard	**192**	**396**	**588**
CITYWIDE OTHER/SPECIAL FUNDS	1	0	1
ENGINEERING & CAPITAL PROJECTS	1	0	1
ENVIRONMENTAL SERVICES	3	4	7
FLEET OPERATIONS	2	8	10
FLEET OPERATIONS – RENTAL	28	22	50
GENERAL SERVICES	4	4	8
PARK & RECREATION	32	5	37
PUBLIC UTILITIES	54	122	176
PURCHASING & CONTRACTING	0	3	3
STORMWATER	29	80	109
TRANSPORTATION	38	148	186
Central Operations Yard (20th & B)	**113**	**58**	**171**
CITY TREASURER	9	0	9
COMMUNICATIONS	0	1	1
DEPARTMENT OF INFORMATION TECHNOLOGY	10	2	12
DEVELOPMENT SERVICES	1	0	1
FLEET OPERATIONS – RENTAL	3	0	3
GENERAL SERVICES	52	42	94
PARK & RECREATION	28	10	38
PUBLIC UTILITIES	7	1	8
PURCHASING & CONTRACTING	1	2	3
STORMWATER	1	0	1

	CARS/LD	MD/HD	TOTAL VEHICLES
TRANSPORTATION	1	0	1
Civic Center Complex	**11**	**0**	**11**
CITY ATTORNEY	1	0	1
COMMUNICATIONS	1	0	1
FLEET OPERATIONS – RENTAL	7	0	7
PARK & RECREATION	2	0	2
Rose Canyon Operations Yard	**94**	**38**	**132**
ENVIRONMENTAL SERVICES	0	1	1
FLEET OPERATIONS	2	0	2
GENERAL SERVICES	1	1	2
PARK & RECREATION	89	27	116
PUBLIC UTILITIES	2	9	11

CONCLUSION

The projects, policies and programs described in this document are designed to achieve the ambitious municipal energy and GHG reduction goals established by the City of San Diego's CAP and MES. Given the vast number of facilities owned and operated by the City, significant work lies ahead to reduce consumption, electrify end uses and the fleet, and bring operations to zero emissions. This work will fall primarily to the AMDs addressed herein. Armed with the information provided in this report, asset managers now have a better idea of the energy performance of their facility portfolio and can begin to make more informed energy management decisions.

The Sustainability and Mobility Department will continue to work with AMDs to help prioritize facilities for participation in clean-energy pilots and facilitate near-term retrofits that significantly reduce energy costs and demonstrate the viability and value of bringing municipal facilities to zero emissions. By reducing energy consumption, increasing onsite renewable energy generation, electrifying end uses and the fleet, deploying smart and connected distributed energy resources, and engaging all San Diegans along the way, we will increase community resiliency and cut energy costs with minimal impact on the General Fund. With every improvement to our facilities, San Diego will continue to lead in the fight against climate change and pave the path to a cleaner energy future.

DEFINITIONS

Assets: Refers to the City-owned buildings, streetlights, park lights, pump stations or any City-owned infrastructure that consumes energy.

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE): An American professional association seeking to advance heating, ventilation, air conditioning and refrigeration systems design and construction.

Asset Managing Departments (AMDs): The City of San Diego departments that own, operate, manage and maintain capital assets. The departments also pay for energy consumed by their buildings, identify and prioritize projects, and work with the Mayor, City Council, and other departments to find project funding.

Baseline Year: Refers to a reference point to assess changes in energy use from year to year. The City of San Diego's Climate Action Plan (CAP) uses 2010 as the baseline year. It serves as an initial performance baseline to track improvements over time.

Battery Energy Storage System (BESS): Refers to a technology developed for storing electric charge by using specially developed batteries. Stored energy can be discharged from the battery to supply building end uses at a later time.

Benchmarking: Evaluate by comparison with a standard. Building benchmarking refers to measuring energy performance of a single building over time, relative to other similar buildings, or to modeled simulations of a reference building built to a specific standard (such as an energy code).

British Thermal Unit (Btu): It is defined as the amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit. 1 kilo Btu (kBtu) = 1,000 Btu, 1 Million Btu (MMBtu)= 1,000,000 Btu. It is the common unit of measurement between different energy types (i.e. natural gas therms, electricity kW, etc.)

Building Automation System (BAS): A controls platform with a digital dashboard that allows continuous monitoring and management of building energy performance.

Building Energy Performance (BEP): Refers to a minimum threshold of energy performance by property type created to drive energy performance in existing buildings to help meet the energy and climate goals of the City of San Diego.

Business-As-Usual (BAU) Energy Use: Refers to the projected energy use of municipal buildings by estimating 1.5% increase in municipal energy consumption from a 2010 level. It serves as a basis for the energy reduction targets set by the CAP.

Carbon Dioxide Equivalents (CO2e): The number of metric tons of CO2 emissions with the same global warming potential as one metric ton of another greenhouse gas.

Climate Action Plan (CAP): Adopted in 2015, the CAP outlines strategies, actions, goals and targets that will reduce greenhouse gas emissions.

Combined Payback Period: Length of time required to recover the cost of an investment from the savings achieved. It is a ratio of the total sum of implementation costs of measures and the sum of cost savings delivered.

Community Choice Aggregator (CCA): An alternative to the investor owned utility energy supply system in which local entities in the United States aggregate the buying power of individual customers within a defined jurisdiction in order to secure alternative energy

supply contracts. The CCA chooses the power generation source on behalf of the consumers.

Distributed Energy Resources (DERs): Also known as distributed energy, on-site generation, or district/decentralized energy, it is electrical generation and storage performed by a variety of small, grid-connected or distribution system-connected devices referred to as distributed energy resources. In the case of the City of San Diego, this is typically photovoltaic.

Energy Efficiency: Refers to the use of less energy for the same function.

Energy Star National Median EUI: A recommended benchmark metric for buildings throughout the United States. It is used to compare the energy performance of a City building to similar buildings nationwide.

Note: The ENERGY STAR National Median EUI's referenced in this report was taken from a previous version of the document available at https://portfoliomanager.energystar.gov/pdf/reference/US%20National%20Median%20Table.pdf.

Electric Vehicle Supply Equipment (EVSE): The device, including the cable(s), coupler(s), and embedded software, installed for the purpose of transferring alternating current electricity at 208 or 240 volts between the electrical infrastructure and the EV.

Energy Use Intensity (EUI): The ratio of energy consumption of a City building recorded by onsite SDG&E electricity and natural gas meters to the gross floor area (GFA) of a building (typically measured in kBtus per square foot). It is used to compare the performance of a building to a building used for a similar purpose. High EUI indicates high energy use per square foot.

Energy Use Reduction: Refers to the reduction in onsite grid-purchased energy use of a municipal asset.

Facility/ Site: Refers to the City of San Diego owned offices, recreation centers, comfort stations, libraries, treatment plants, pump stations, fire stations, police stations, etc.

Facility Conditions Assessment (FCA): Refers to the facilities conditions assessment of 693 City buildings conducted between 2014 and 2016. The assessment identified facilities conditions index (FCI) rating and capital needs of each City building.

Facility Conditions Index (FCI): Refers to a rating of a building identified in the Facilities Conditions Assessment (FCA) of 693 City buildings conducted between 2014 and 2016. It is a ratio of the cost of current maintenance, repair and replacement backlog to the replacement value of the facility. The higher the FCI, the poorer the condition of the facility. FCI scores between 0 to 20 indicate "Good" condition, 21 to 29 indicate "Fair" condition, and 30 or greater indicate "Poor" condition.

GHG (Green House Gas): A gas that traps the sun's heat in the atmosphere, contributing to the greenhouse effect. Greenhouse gases include water vapor, carbon dioxide, methane, ozone, chlorofluorocarbons and nitrogen oxides.

Heavy-Duty Vehicle: A road vehicle with a gross vehicle weight rating greater than 26,000 pounds.

Leadership in Energy & Environmental Design (LEED): Leadership in Energy and Environmental Design is a green building certification program used worldwide.

Light-Duty Vehicle: A road vehicle with a gross vehicle weight rating of 10,000 pounds or less, such as a sedan, sport utility vehicle, pickup truck or utility van.

Measures: Any physical action taken to reduce the energy use of the City assets.

Medium-Duty Vehicle: A road vehicle with a

gross vehicle weight rating of between 10,001 pounds and 26,000 pounds.

Microgrid: A decentralized group of electricity sources and loads that normally operates connected to and synchronous with the traditional wide area synchronous grid, but is able to disconnect from the interconnected grid and to function autonomously in "island mode" as technical or economic conditions dictate.

PPA (Power Purchase Agreement): An agreement or a contract to purchase power at an agreed upon rate. The City installs solar PV systems at municipal sites under a PPA to eliminate high initial investment.

Retrocommissioning (RCx): Process of investigating and re-tuning the mechanical, lighting, and control systems of an existing building to bring them back to their intended performance specifications, typically after many years of operation.

RS Means: An independent third-party provider of building industry construction cost data used to estimate cost for implementation of several identified energy-efficiency measures.

SEER (Seasonal Energy-Efficiency Ratio): It is a metric used to measure how much cooling a system can provide for each unit of energy it consumes (measured in Btu/ watt-hours). The Higher the SEER rating is, the more efficient the system is.

Solar Feasibility Assessment: Refers to the Solar Feasibility Assessment of 171 municipal facilities conducted between 2014 and 2016. The assessment identified sites that are feasible for Solar PV system installation and provided estimated system Solar PV system sizes(kW).

Solar Thermal Heating: Refers to the heating of a building or water using heat energy from the sun.

Stakeholder Departments: The City of San Diego departments that implement various policies and plans, and manage programs that contribute to the City's progress toward municipal energy reduction goals set in the CAP. These departments' daily operations and decisions have a direct impact on municipal energy use.

Therm: Refers to a unit used to track natural gas consumption. MM Therm refers to one million Therms.

Vehicle to grid: Vehicle to grid describes a system by which electric vehicles can communicate with the power grid to sell demand response services by either returning electricity to the grid or by throttling their charging rate.

Watt Hour (Wh): Unit of electricity; equal to the work done by one watt of power in 1 hour. 1 kilowatt-hour (kWh)= 1,000 watt-hour; 1 Megawatt-hour (MWh)= 1,000,000 watt-hour; 1 Gigawatt-hour (GWh)= 1,000,000,000 watt-hour.

Zero Emissions Building: A building that is super energy-efficient and all electric. All electricity consumed by the building end uses comes from renewable sources, either generated onsite or from a 100% renewable electricity grid.

Zero Net Energy (ZNE): A ZNE Building is one where the net amount of energy produced by on-site renewable energy resources is equal to the value of the energy consumed annually by the building.

Zero Emissions Vehicle (ZEV): A zero emissions vehicle is a vehicle that never emits exhaust gas from the onboard source of power, such as bicycles, electric bicycles, battery electric vehicles, fuel cell vehicles or hydrogen vehicles.

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