City of SACRAMENTO

2019 Municipal Energy Benchmarking Report

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Abbreviations

CCS	Department of Cultural and Community Services
CDD	Community Development Department
CO_2e	Carbon dioxide equivalent
DOU	Department of Utilities
DPW	Department of Public Works
EUI	Energy use intensity
Fire	Fire Department
GHG	Greenhouse gas
HVAC	Heating, ventilation, and air conditioning
IO CAP	Climate Action Plan for Internal Operations
kBtu	kilo-British thermal units
kG	kilogram
kWh	Kilowatt-hour(s)
$MTCO_2e$	Metric tons of carbon dioxide equivalent
MMBtu	Million-British thermal units
NACY	North Area Corp Yard
PD	Police Department
SACY	South Area Corp Yard
SMUD	Sacramento Municipal Utility District
Sq. ft.	Square feet
VFD	Variable frequency drive (pump)
YPCE	Youth, Parks, Community and Economic Development

Purpose

The City of Sacramento's 2035 General Plan commits to an energy efficiency goal to "improve energy efficiency of City facilities to consume 25 percent less energy by 2030 compared to the baseline year of 2005" (General Plan Policy U 6.1.4). At the same time, energy rates are expected to continue increasing in coming years.[1] In order to track progress towards the City's reduction goal, prioritize energy efficiency projects, and reduce costs, the City has developed an energy benchmarking system for all municipal buildings and facilities. Energy benchmarking will allow the City to compare building energy use and cost. Ultimately, this will equip the City to evaluate energy efficiency opportunities across departments and facilities to determine which projects have the greatest potential for improvements and savings. Serving as the City's first municipal energy benchmarking report, staff intend to update the report on an annual basis to track progress and changes over time.

This report includes a review of the City's annual municipal energy usage, cost, and energy use intensity. Key data is further broken down at the department and building (or campus) level. This report also highlights some of the City's energy efficiency accomplishments to date and identifies priority and potential future energy efficiency opportunities. The appendices provide additional analysis of energy expenses by fund line, a comparative index of energy use intensity for the largest buildings, and highlights data sources and limitations to further inform key stakeholders and decision-makers.

[1] https://www.smud.org/en/Rate-Information/Business-rates/Business-rate-changes

Introduction

Energy from traffic signals, community centers, parking structures, and City buildings are essential aspects of a city but are often overlooked. Nonetheless, municipal governments around the world work diligently to build, manage, and maintain municipal facilities in more cost-efficient and sustainable manners. Municipal operations can also serve as a testing ground for innovative technologies. The City of Sacramento (City) is no exception; the City's many departments collaborate to maintain municipal facilities so the City can continue to work efficiently to develop a safer, more livable Sacramento.

In 2013, 45% of municipal emissions came from electricity and natural gas usage in City buildings and facilities.

Comparatively, 37% of Sacramento's community-wide GHG emissions came from the energy sector in 2016.

Energy efficiency efforts at municipal facilities support the City's overarching climate goals for the reduction of greenhouse gas emissions and attainment of carbon neutrality. In order to support a healthier and more resilient community, the City has developed GHG emission reduction strategies and targets for the community and municipal operations, including those contained in the City's General Plan and Climate Action Plan for Internal Operations (IO CAP). In 2013, the City exceeded the adopted General Plan goal of reducing GHG emissions from internal operations by 22 percent below 2005 levels, well before the target year of 2020, with a 24 percent reduction in municipal GHG emissions.[2] Longer-term, the City is working to achieve GHG reductions of 83 percent below 2005 levels by 2050, as called for by the General Plan (Policy ER 6.1.5 and ER 6.1.6). These adopted targets guide the City to conduct all services and operations in a more energy and cost-efficient manner. New targets are expected soon due to updates to the City's General Plan and Climate Action Plan that are currently underway as of mid-2020, including a goal to reach carbon neutrality by 2045. The building and energy sectors present significant opportunity for continued GHG emission reductions to help the City of Sacramento achieve local and State climate goals.

The 2016 Climate Action Plan for Internal Operations (IO CAP) identified a trajectory to reduce municipal GHG emissions 33% by 2030, in line with the 2035 General Plan Update goal to reduce GHG emissions by 83% below 2005 levels by 2050, based on a 2013 GHG inventory.

The 2016 IO CAP identified energy efficiency retrofits for City-owned buildings and facilities as a key strategy. Existing buildings provide a wealth of opportunity to reduce GHG emissions through energy efficiency improvements, while saving costs and improving operations.

Older appliances, light fixtures, heating and cooling systems, and water heaters and coolers often require more energy to perform functions than newer models. New, more efficient systems reduce energy waste, costs, and associated GHG emissions while improving lighting, work environments, and/or

[2] City of Sacramento (2016). Climate Action Plan for Internal Operations (Available online): https://www.cityofsacramento.org/Public-Works/Facilities/Sustainability/Climate-Action-Plan-for-Internal-Operations. Note that municipal GHG reductions have been sustained since 2013, as documented in a recent 2016 inventory of emissions for the City's Climate Action Plan update. In 2016, municipal GHG emissions were calculated at 28% below baseline 2005 GHG emissions levels. Publication of documents is forthcoming in late 2020.

400+ City-owned buildings & facilities

1,700+ SMUD accounts

operations. Under the City's current maintenance replacement rotation, as old and aging appliances and systems fail, they are replaced with the most energy efficient options feasible for the City. However, recent studies have revealed that simply waiting to age out old systems and appliances will not provide the energy savings or GHG emissions reductions necessary to achieve local and State climate goals.[3] For this reason, interventions retrofitting older systems in municipal buildings with more efficient ones prior to the end of their life will allow buildings to operate on less energy, reducing the City's GHG emissions and energy costs.

The City has numerous opportunities to implement a wide variety of energy efficiency retrofits across its facilities. Many buildings are old and overdue for retrofits. Due to limited funds, staff time, and resource availability, the City must prioritize energy efficiency projects based on estimated cost savings, energy savings, GHG reduction potential, and overall need.

[3] Global Alliance for Buildings and Construction, International Energy Agency, and the United Nations Environment Programme. 2019 Global Status Report for Buildings and Construction (Accessed 07/05/2020): http://wedocs.unep.org/bitstream/handle/20.500.11822/30950/2019GSR.pdf?sequence=1&isAllowed=y

City-wide Energy Benchmarking

Reviewing energy use and cost at the municipal level allows stakeholders such as elected officials, decision-makers, residents, and City staff to better understand the impact and implications of City operations. Comparing data from the current calendar year to a baseline year allows the City to review changes in cost or energy use and progress towards goals outlined in the General Plan and Climate Action Plan for Internal Operations. The City's General Plan and IO CAP both establish a baseline year of 2005; accordingly, this report compares energy use and cost data for the most recent, complete calendar year (2019) with the 2005 baseline year.

City Energy Use:

2005: 474,215 MMBtu

2019: 314,861 MMBtu

City Energy Expenses:

2005: $11,875,245

2019: $13,386,360

During the calendar year of 2019, the City paid $13,386,360 for electricity and natural gas used at municipal facilities. This includes payments to maintain the five on-site solar photovoltaic systems at City-owned facilities. Despite a significant decrease in City energy use from 2005 to 2019, costs in 2019 were 13% more than the $11,875,245 energy expenses in 2005. This is largely due to energy rate increases. These energy expenses include billed costs for electricity and natural gas use only. [4]

As seen in **Figure 1** below, the City's total energy use (measured in MMBtu), including on-site and off-site solar, electricity, and natural gas, decreased by 34% from 2005 to 2019, exceeding the General Plan goal of a 25% reduction below 2005 levels, eleven years in advance of the target year of 2030 . Natural gas use reduced by 366,000 Therms (41%) from 2005 to 2019, while electricity use reduced by 54,084 MWh (41%) from 2005 to 2019.[5] Not only has total energy use decreased, another indicator of overall efficiency has also improved, as reflected in the energy use intensity (EUI) for energy use at all municipal facilities. The City's overall EUI decreased by 0.03 MMBtu/square foot, from 0.10 MMBtu/square foot in 2005, to 0.07 MMBtu/square foot in 2019. This reveals that, on average, the intensity at which municipal buildings and facilities use energy may have reduced by as much as a one-third, or 33%. The reduction in the City's EUI value may not be due entirely to improvements in energy efficiency but could also reflect underlying factors such as the number of municipal buildings, building occupancy level, and changes or improvements in building area. Nonetheless, this shows that, as a whole, the City is operating with greater energy efficiency in 2019 when compared to 2005.

[4] City Energy Expense totals based on calendar year data from EnergyCAP and SolarCity platform. See Appendix B for more information on data sources and limitations of this report. The systems include some inherent limitations. This report reflects information available in the databases as of May 2020. Updates and improvements in the data will be integrated in future benchmarking reports.

[5] Reduction percentages for Therms and kWh used by the City do not match the City's total energy use reduction percentage because this was measured in MMBtu. See the 'Measure of Energy Use' callout for further differentiation.

Figure 1. Total Energy Use

Total energy used at City facilities in the calendar years of 2005 (royal blue) and 2019 (light blue) are represented by the bars in this graph. Energy use is measured in MMBtu and includes electricity from SMUD, on-site solar, and natural gas from PG&E.

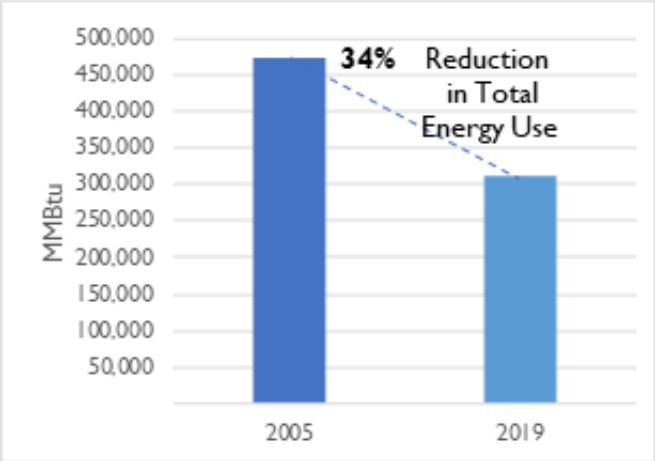
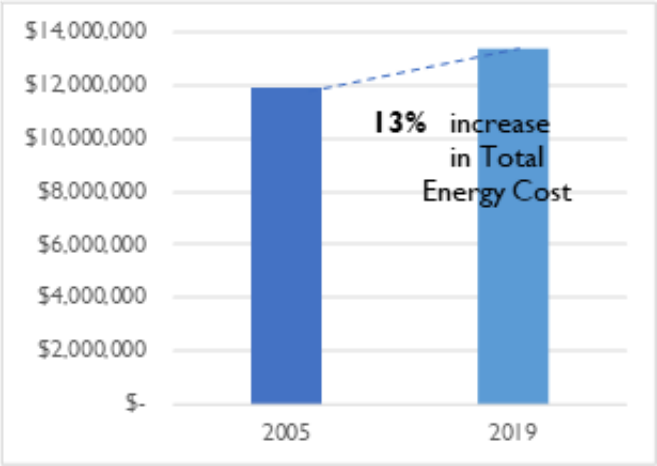


Figure 2. Total Energy Cost

Total energy costs for grid-sourced electricity, natural gas, and on-site solar electricity used by City facilities in the calendar years of 2005 (royal blue) and 2019 (light blue) are represented by the bars in this graph.



These reductions in the City's natural gas and electricity use and overall energy efficiency improvements led to reductions in the City's energy-related GHG emissions as well. GHG emissions from energy use at municipal facilities is estimated to have decreased by 47% from 2005 to 2019.[6] Much of the reduction in GHG emissions is due to SMUD utilizing more renewable energy sources and the City's on-site solar photovoltaic systems. However, as noted above, reductions in building energy use at municipal facilities has also contributed to these energy-related GHG emissions reductions.

Measures of Energy Use

Energy comes in many forms and related units of measure. For example, natural gas is most commonly measured in Therms, while electricity is measured in kilowatts (kW) or kilowatt-hours (kWh).

When trying to compare or compile energy use, such as for an office building, natural gas and electricity need to be converted to a common unit of measure that is compatible for both forms of energy. One such unit both can be expressed in is British thermal units (Btu).

As such, when reviewing total energy use at the City- and Department-level in this report, the common unit of measure presented is million-British thermal units, or MMBtu.

[6] GHG emissions calculations assume utility-verified emissions coefficients as identified for the Climate Action Plan Update – Community Inventory in March 2020. Emissions coefficients are based on global warming potentials derived from the Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change.

Total CO_2 Emissions

2005: 36,231 $MTCO_2e$

2019: 19,047 $MTCO_2e$

Despite the City using less energy per year, the total cost has increased by 13% from 2005 to 2019 ($1.5M dollars). Accounting for inflation does not entirely explain this change. When prices are adjusted for inflation, 2005 energy costs are equivalent in purchasing power to approximately $15.5 million in 2019. In inflation-adjusted dollars, energy cost from 2005 to 2019 have – in theory – decreased by 13%, or $2.1M. However, with a 34% reduction in energy use, even after adjusting for inflation, energy costs did not decrease proportionally to changes in energy use. Keeping in mind that the City has taken initiative and implemented several energy efficiency projects since 2005 (see Accomplishments & Opportunities section for details), these reductions in energy cost and use did not happen naturally, but required concerted efforts by City staff to identify key areas for improvement and secure funding.

This context highlights the impact of increasing rates for natural gas and electricity rates charged by PG&E and SMUD, respectively. In 2005, the City was charged on average $1.18/Therm and $0.08/kWh; while in 2019, average natural gas cost increased to $1.81/Therm and electricity rates doubled to $0.16/kWh. This equates to a 54% increase in average natural gas rate, and a 100% increase in average electricity rate charged to City accounts. Rate changes for grid-supplied energy have been necessary to implement further wildfire prevention, cover the increasing cost of insurance, and prepare for expanding demand. Due to the ever-increasing cost of operation, the City must remain vigilant in tracking budget implications from rate increases and seeking opportunities to increase efficiency and reduce energy usage to keep costs and expenses as low as possible, while simultaneously reducing GHG emissions.

Inter-departmental Energy Benchmarking

2019 Total City Floor Area:
4,714,939 Sq. Ft.

2019 Total Energy Use at City Buildings:
314,861 MMBtu

2019 Total Energy Cost at City Buildings:
$13,386,360

The energy utilized in municipal buildings powers the operations of each City department. The departments within the City of Sacramento are diverse and unique, providing essential services to the City and community. Due to the unique functions of each department, it is important to compare total energy use by department while still considering the many factors that contribute to differences. Through this holistic approach the City can start to identify where projects to address inefficiencies may need to be prioritized due to the inherent intensity of a department or division's activities and operations. Department-level comparisons are made in the following pages based on each department's: contribution to the City's total energy use, costs, and floor area in 2019; GHG emissions from building energy use and correlating EUI in 2005 and 2019; and total building energy use and associated costs in 2019. [7]

[7] The City operates many non-building services that require electricity or natural gas as well. Streetlights, traffic signals, and irrigation systems for City parks and partitions all require electricity to function. Due to the unique demand of each of these outdoor services, it is difficult and imprudent to compare these non-building energy uses to building energy use. Currently the City is unable to accurately extract and compare municipal building and non-building energy use. Limitations in the analysis of City data and database are discussed further in **Appendix B**.

Floor Area, Energy Use, and Cost by Department

Comparing each department's allocated building area and building-related energy use helps to reveal differences in operations, as well as potential inefficiencies in buildings or operations. Total energy use and cost by department is another essential comparison that can help to identify where additional energy efficiency measures can contribute to greater cost savings.

Below, **Figure 3** shows the total square footage or building area for each department as a percentage of the City total building area. **Figure 4** shows the percentage of the City's total energy use by department, and **Figure 5** represents the percentage of the City's total energy cost for each department. If energy intensity, peak demand, and energy rates were constant across all departments, the values for each department in **Figure 3**, **4**, and **5** would be proportionate. As demonstrated below, this is not the case for the City of Sacramento's departments.

Figure 3. 2019 Floor Area (sq. ft.) by Dept.

This pie chart represents the total floor, or building area, each City department utilizes. If energy use and demand were the same across all facilities, the portion of energy use by each department would be directly proportionate to their floor area.

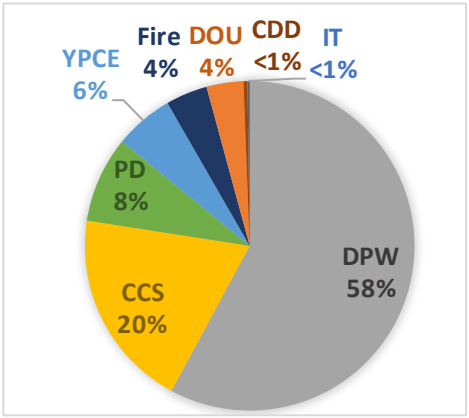


Figure 4. 2019 Total Energy Use (MMBtu)

This pie chart represents the portion each City department contributed towards the City's total energy use at City facilities in 2019. This includes SMUD-sources electricity, PG&E-powered natural gas, and on-site solar electricity

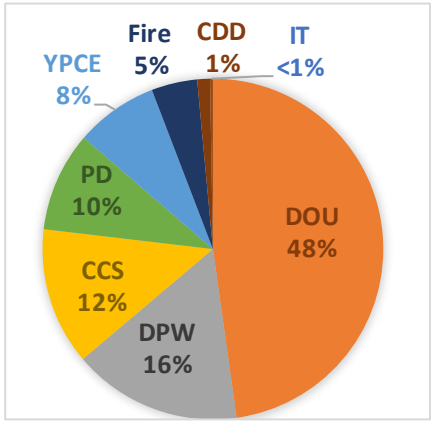
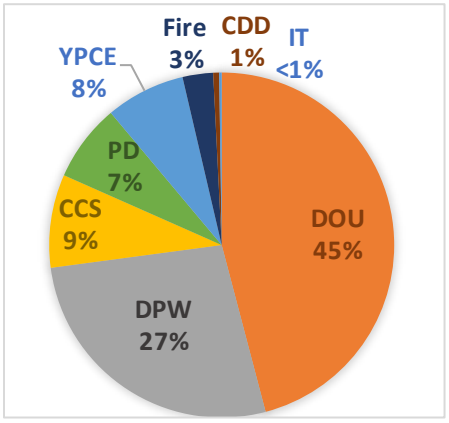


Figure 5. 2019 Total Energy Cost

This pie chart represents the portion each City department contributed towards the City's total cost from energy use at City facilities in 2019. This includes cost incurred from using SMUD-sourced electricity, PG&E natural gas, and on-site solar electricity.



The figures above reveal noteworthy differences across City departments. When comparing relative-energy use and cost, as shown in **Figure 4** and **5**, further discrepancies are revealed. For example, the Department of Public Works accounts for only 16% of the City's total energy use, but 27% of the City's total energy cost. The Department of Public Works (DPW) is responsible for thousands of streetlights, traffic signals, and irrigation systems, many of which operate at unique hours. While these small systems may not utilize significant amounts of energy, due to their unique hours of operation, they may accrue more costs. Additionally, DPW includes the City's non-metered streetlights; for these accounts SMUD charges a fixed rate. The amount of energy used by non-metered streetlights is not captured in SMUD invoices or the City's energy database, and therefore is not included in the DPW's total energy use. As such, these unique accounts likely contribute to the discrepancies in the DPW's energy use and cost contribution.

Figures 3 and **4** show that the percentage of the City's total floor area, or square feet, for each department is not directly proportionate to a department's relative energy use. Using the Department of Public Works again as an example: the department accounts for 58% of the City's total building area, but only utilized 16% of the City's total energy use. This variance is largely due to differences in the number of building and non-building energy accounts and energy demand of each department and will be discussed below.

The Department of Utilities (DOU) utilizes energy to clean and pump all the City's drinking water, as well as pump storm drainage water to prevent or reduce flooding of Sacramento streets. Wells, pumps, and water treatment plants typically have small building area, but require significant power to operate and provide water services to the entire City. Wells and water treatment facilities are operating non-stop, unlike many of the City's office buildings, community centers, libraries, and even streetlights – and must increase activity in large weather events. Thus, water treatment plants and storm drainage pumps cannot and should not be compared so simplistically to buildings with such disparate operations.

Nonetheless, it is important to compare all DOU facilities, to ensure there are no inefficient pumps, wells, or water treatment plants relative to the other similarly operating facilities. Due to the high demand on these systems, it is in the City's best interest to maintain these facilities at maximum efficiency so energy costs can remain as low as possible, water rates are affordable for residents, and cost savings can be allocated to maintenance or other needs.

However, due to the complexity of the DOU operations and energy use, the DOU staff regularly review and analyze the energy use and efficiency of their facilities. For this reason, a thorough review of DOU energy use and efficiency at the meter or building level will not be included in this report.

Total Energy Cost by Department

As previously noted, the energy used by City buildings is supplied as natural gas from PG&E, electricity through the SMUD grid (including a percentage from off-site solar through SMUD's SolarShares program), as well as electricity from on-site photovoltaic (PV) systems at five City buildings and campuses. These on-site systems provide clean energy to each building or campus and are maintained and managed by Tesla (formerly SolarCity). Through a solar Power Purchase Agreement (PPA) with Tesla, the City pays for electricity use from the solar PV systems, while Tesla is responsible for maintaining and operating the City's solar systems.[8,9] These photovoltaic systems provide clean energy to two Department of Utilities facilities, two Department of Public Works sites, and one Police Department building.

Figure 6 shows that electricity costs account for the majority of energy expenses by each department, and city-wide. The Department of Utilities accounted for nearly half the City's energy costs in 2019. Of DOU's energy expenses, 97% came from electricity, including electricity sourced from on-site solar. For CCS, DPW, PD, and YPCE, electricity also accounted for over 80% of energy costs. Notably, CDD and Fire Department (Fire) electricity costs accounted for 51% and 72% of total energy cost, respectively. Due to the high City utilization and dependence on electricity, it is important that buildings and systems

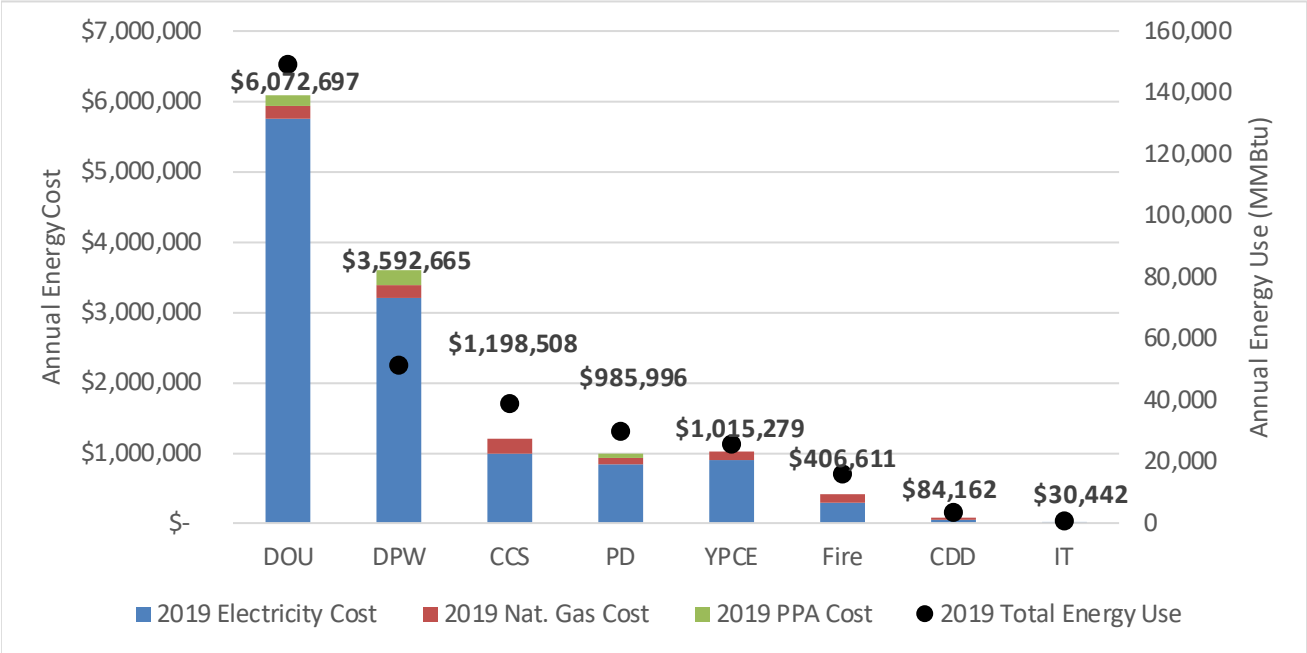
[8] https://www.seia.org/research-resources/solar-power-purchase-agreements
[9] https://www.businesswire.com/news/home/20110404006201/en/City-Sacramento-SolarCity-Announce-Plan-Install-Solar

powered by electricity operate at optimal efficiency. Any opportunity to improve efficiency of electric-powered systems should be prioritized, to provide the most significant cost-savings for the City.

While annual natural gas costs appear low when compared to annual electricity costs per department, from 2005 to 2019, CDD, YPCE, and DOU all reduced their use of natural gas, while CCS, DPW, Fire, and PD saw their natural gas use increase or remain constant over the same time period. If the City is to achieve its GHG reduction goals and initiatives, the City will need to reduce – and eventually eliminate, where possible – the use of natural gas in its buildings. This shift will continue to increase electricity use. The transitions can also serve as demonstrations in building electrification for existing buildings, a topic of growing priority for climate change interventions. Given the likelihood of ongoing increasing electricity rates[10,11], it is imperative that the City continue to make a concerted effort to increase efficiency to reduce financial impacts to departments. This will ensure that energy costs remain as low as feasible given the market and underlining factors.

Figure 6. 2019 Total Energy Cost & Use by Department

The graph below compares the energy used by each department at their facilities and buildings and the total energy costs for each department in 2019. Each bar represents the total energy costs for the department in 2019, including electricity costs (blue), natural gas costs (red), and on-site solar electricity costs (green). The values above the bars represent the total energy costs for each department in 2019, while the black circles represent the total energy used by each department in 2019 (measured on the secondary Y axis).



[10] https://www.smud.org/en/Rate-Information/Rate-Action/2019-rate-change-proposal/Business

What is Energy Use Intensity?

Energy Use Intensity (EUI) is a value used to normalize and compare the energy use of buildings of different sizes and determine a building's energy efficiency level. The EUI is calculated by dividing a building's annual electricity, natural gas, or total energy use by the total square footage or floor area. By standardizing for building size, the impact of this variable is removed, and energy use per square foot can be compared. The EUI is then expressed in kWh, Therm, or Btu per square foot.

A higher EUI value generally reflects that the building requires more energy per square foot than other buildings, on a directly comparable, square-footage basis. While larger buildings tend to use more energy when compared to small buildings, a small building with inefficient lighting, heating, and cooling systems could have a higher EUI than a large building with more efficient systems, for example.

While EUI can help to compare buildings of different sizes, factors other than building size and efficiency of mechanical systems may impact annual energy use. Occupancy level, hours of operation, and the power needed to run unique operations all affect the energy used by a building.

Energy Use Intensity by Department

Comparing energy use and energy use intensity across departments can be challenging due to the significant diversity in operations and services provided by each department. For example, the Department of Public Works operates many of the City's office buildings, which are generally open during business hours only; while the Police Department's 911 Center and Fire Department's Fire Engine Stations are occupied and operate 24/7. Facilities operated by the Department of Utilities house high energy demand operations, resulting in higher energy use intensity, even with the most efficient systems. Despite these high-demand operations, the City has made significant reductions in energy use and improvements in efficiency, as seen in **Figures 7 and 8**.

Figure 7 reveals that the Information Technology Department (IT) saw significant reductions in Energy Use Intensity (EUI) from 2005 to 2019. However, the EUI improvements for IT are largely a result of reclassification of buildings. Many of IT's facilities and operations are co-located at buildings and facilities that also house Police Department (PD) and DPW staff and operations, and therefore IT-specific energy use may often fall under other departments. Many energy accounts that were classified as IT in 2005 have since transitioned to be part of PD and DPW portfolio of energy accounts, due to these departments occupying larger portions of the buildings or facilities. Thus, the reduction in IT's energy use intensity shown in **Figure 7** below is largely exaggerated. This may be a contributing factor for the increase in energy use intensity for PD since 2005, as 300 Richards was added to PD's building list and a portion of IT servers were moved to the 911 Dispatch Facility.

Many departments realized significant reduction in energy use intensity, including CDD, YPCE, DOU, and DPW. The improved efficiency for DPW and YPCE can be attributed to LED and other building system retrofits, where more efficient lights, heating, ventilation, and air conditioning (HVAC), and water heating and cooling systems were installed to replace old and/or inefficient systems. These retrofit projects will be detailed further in the Accomplishments and Opportunities section of this report.

Figure 7. Annual Energy Use Intensity Comparison

This bar graph compares the energy use intensity (EUI) for each department in the baseline year of 2005 (light blue) and the current year of 2019 (green). EUI is the measure of grid-sourced and on-site solar electricity, as well as natural gas use during the calendar year, divided by the total floor area for each department.

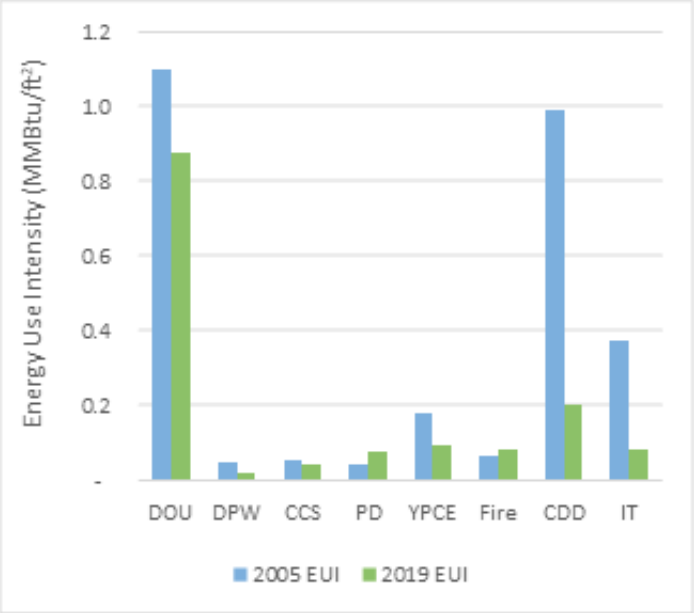
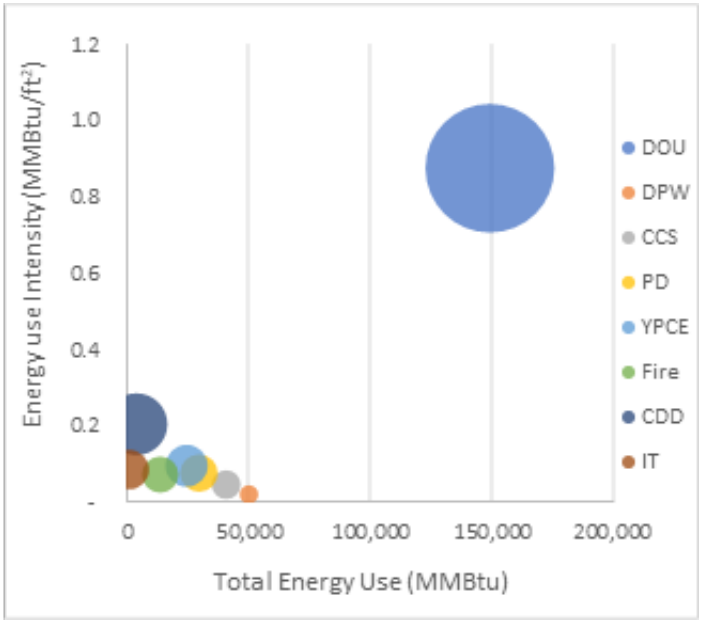


Figure 8. Annual Energy Use Intensity 2019

This bubble graph compares the energy use intensity (EUI) and annual energy use for each department in 2019. Each bubble represents a department. Bubble size is dependent on the department's EUI in 2019. EUI is the measure of total energy use, or grid-sourced and on-site solar electricity, and natural gas use during the calendar year divided by the total floor area for each department.



Greenhouse Gas Emissions

As discussed above, the City's 2016 IO CAP update established a near-term goal of reducing municipal GHG emissions 22% by 2020 and 33% by 2030, in line with the 2035 General Plan Update goal to reduce GHG emissions by 83% below 2005 levels by 2050. With the building energy sector accounting for a large portion of the City's GHG emissions, it is important that the City monitor GHG emissions from municipal building operations. This will allow the City to track progress towards its goals and ensure they are achieved.

GHG emissions from electricity & natural gas use at City facilities is estimated to have reduced 47% from 2005 to 2019.

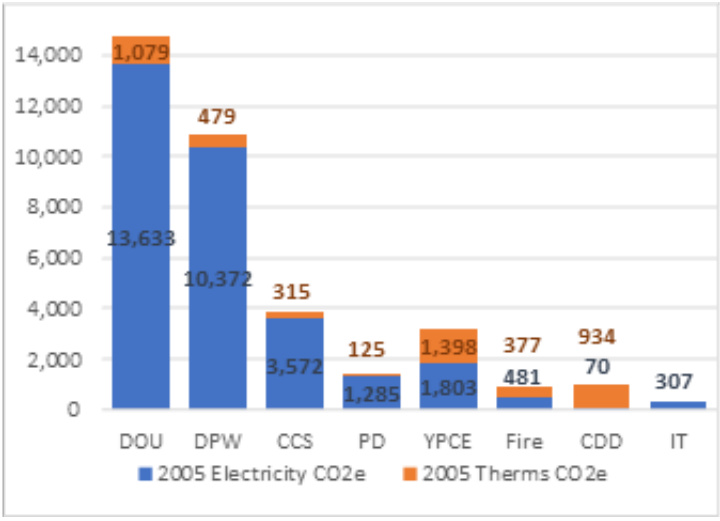
Figures 9 and **10** represent an estimate of GHG emissions produced from municipal energy use by each City department, inclusive of energy consumption from irrigation and outdoor lighting.[12] Due to the complexity of energy data and the City's energy database, the numbers represented in these graphs may not be accurate representations of the true GHG emissions from municipal buildings, and, as such, are termed estimates of the true values.

[12] Unlike the City's municipal GHG inventories, this report only includes a subset of municipal GHG emissions, and does not reflect other municipal GHG emissions sources such as the City Fleet. The GHG emissions totals reported in this report are not directly comparable to totals in the IO CAP or the 2020 Climate Action Plan update.

GHG emissions from electricity and natural gas use in 2005 and 2019 differ significantly for several departments. Both CCS and DOU saw nearly a 40% reduction in emissions caused by building energy use, while CDD, DPW, and YPCE realized an 80%, 75% and 50% reduction in energy-related GHG emissions, respectively. Only the departments of Police and Fire are estimated to have increased energy-related GHG emissions by 26% and 7%, respectively, from 2005 to 2019. Despite this increase, significant department-level reductions all contributed to an estimated 47% reduction in the City's total energy-related GHG emissions from electricity and natural gas use at municipal facilities, supporting overall municipal energy reductions towards the target to reduce municipal GHG emissions by 33% by 2030.[13] While further analysis is required to determine progress toward IO CAP goals, these improvements in electricity and natural gas use bring the City one step closer to achieving its IO CAP target of 33% municipal emissions reduction by 2030.

Figure 9. 2005 Municipal CO_2 Emissions by Department

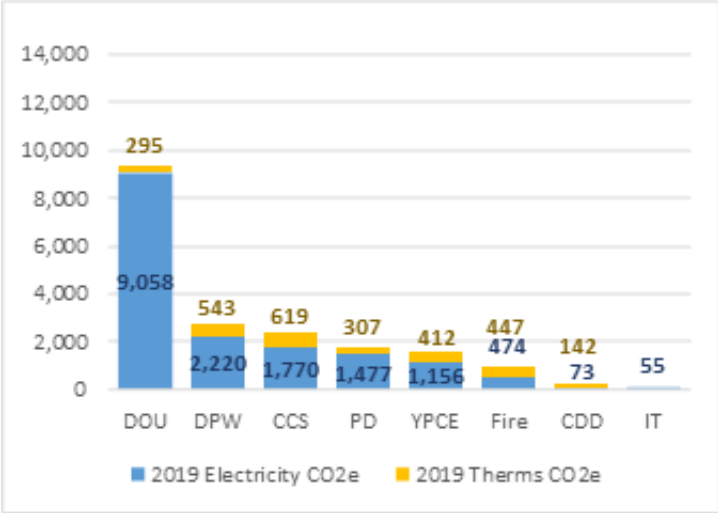
This bar graph presents the estimated CO_2 emission resulting from the use of grid-sourced electricity and natural gas at City facilities in 2005. Each bar represents the estimated emissions resulting from energy use at the specified department's facilities. Emissions resulting from grid-sourced electricity are represented in blue, while CO_2 emissions from natural gas use are represented as the orange portion of bars. The estimated emissions from all City facilities in 2005 is shown below.



Estimated 2005 CO2 Emissions:
36,231 MTCO2e

Figure 10. 2019 Municipal CO_2 Emissions by Department

This bar graph presents the estimated CO_2 emission resulting from the use of grid-sourced electricity and natural gas at City facilities in 2019. Each bar represents the estimated emissions resulting from energy use at the specified department's facilities. Emissions resulting from grid-sourced electricity are represented in blue, while CO_2 emissions from natural gas use are represented as the orange portion of bars. The estimated CO_2 emissions from all City facilities in 2019 is shown below.



Estimated 2019 CO2 Emissions:
19,047 MTCO2e

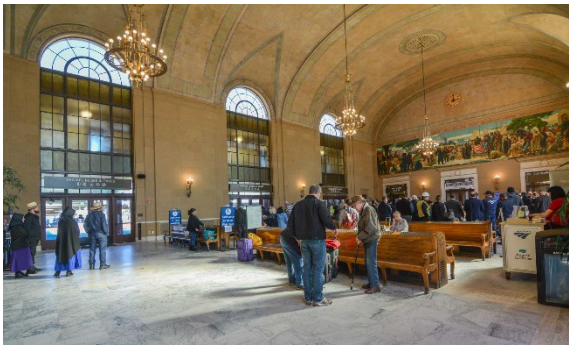
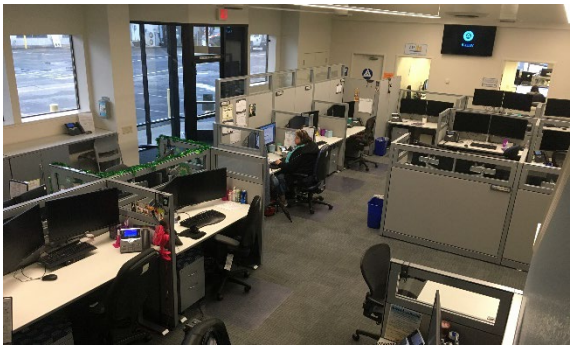
[13] Due to the complexity of the City's energy data and database, the GHG emissions reductions presented in this report are estimates and are not intended to depict current progress to the City's GHG reduction goals. Refer to **Appendix B** for further discussion of the limitations of this report and analysis.

Intra-departmental Energy Benchmarking

Each department within the City plays a specific role in municipal operations. Reviewing energy use and cost for buildings within each department will allow departments to understand successes and areas – or specific buildings – in which energy use improvements and operational cost reductions could be achieved. This will allow each department to see less of a fiscal impact from anticipated rate increases and reallocate cost-savings towards additional cost-saving projects and programs.

This section will provide a brief overview of primary energy-consuming departments responsible for City buildings, as well as their total energy use, cost, and energy efficiency. This section excludes smaller departments that do not occupy or manage discrete buildings, and are not responsible for core, energy-consuming City services. The City's top twenty-five largest buildings or campuses will be called-out and those with the greatest potential need for retrofits will be discussed. [14]



[14] See **Appendix B** to learn the reasoning for only including the City's 25 Largest Accounts.

Convention & Cultural Services (CCS)

The Convention and Cultural Services Department provides culture, education, and entertainment opportunities to Sacramento residents. CCS manages and operates museums, the Sacramento Zoo and Fairytale Town theme park, the Sacramento Convention Center, and more. The Department operates 923,240 sq. ft. of building space, representing 20% of the City's total.

Divisions:

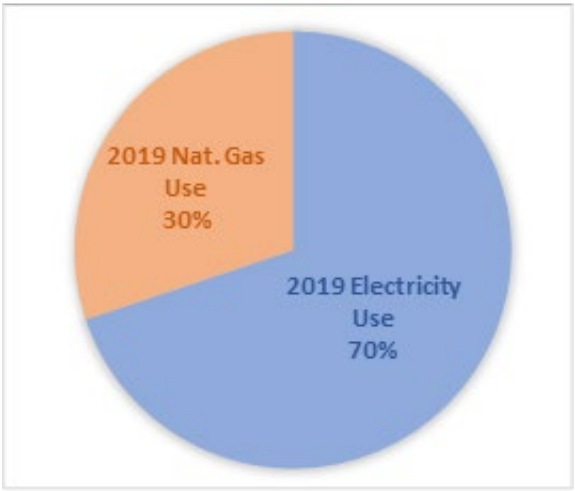
- Center for Sacramento History
- Office of Arts & Culture
- Crocker Art Museum
- Fairytale Town
- Historic Old Sacramento
- Sacramento Convention Center Complex
- Sacramento History Museum
- Sacramento Metropolitan Arts Commission
- Powerhouse Science Center
- Sacramento Zoo

2019 Total Energy Use & Cost

While the Convention and Cultural Services Department represented 20% of the City's total building space, the department accounted for approximately 10% of the City's building energy use and costs in 2019. This energy was used to power Sacramento's Convention Center, Zoo, and educational museums. Two-thirds of CCS total energy use in 2019 was from grid-sourced electricity (SMUD), while one-third was natural gas (see **Figure 11**). SMUD electricity costs accounted for the majority of CCS's energy costs in 2019, as shown in **Figure 12**.

Figure 11. CCS – 2019 Energy Use

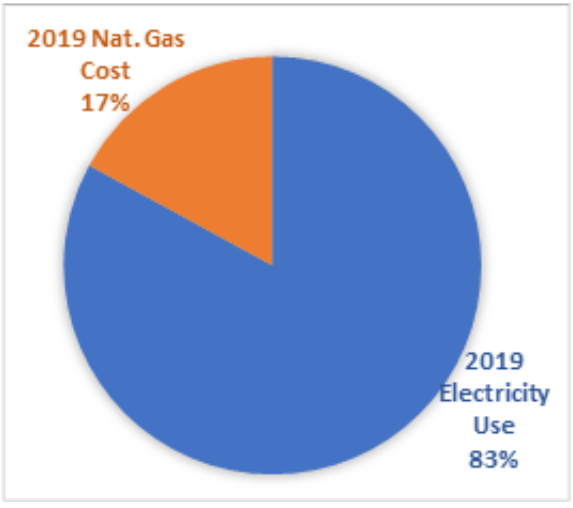
This pie chart shows the portion grid-sourced electricity, natural gas, and/or on-site solar electricity use contributed to the department's total energy use for 2019 (see below).



2019 Total Energy Use: 38,670 MMBtu

Figure 12. CCS – 2019 Energy Cost

This pie chart shows the portion costs from grid-sourced electricity, natural gas, and/or on-site solar electricity use contributed to the department's total energy costs for 2019 (see below).

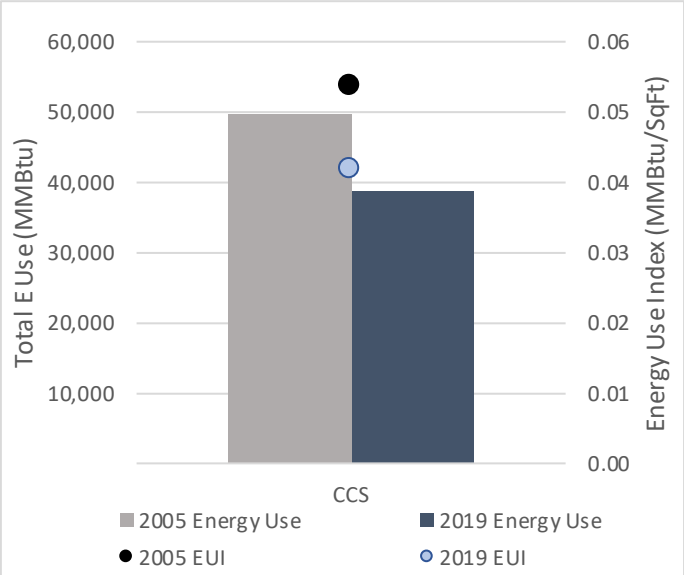


2019 Total Energy Cost: $1,198,508

Comparison to Baseline

Figure 13. CCS - Total Energy Use & EUI Comparison

The bars in this graph represent the total energy used at Convention and Cultural Services Department facilities and buildings in 2005 (grey) and 2019 (dark blue). The EUI for the department is measured on the secondary Y axis, with the black dot representing EUI in 2005 and the light blue dot represents EUI in 2019.

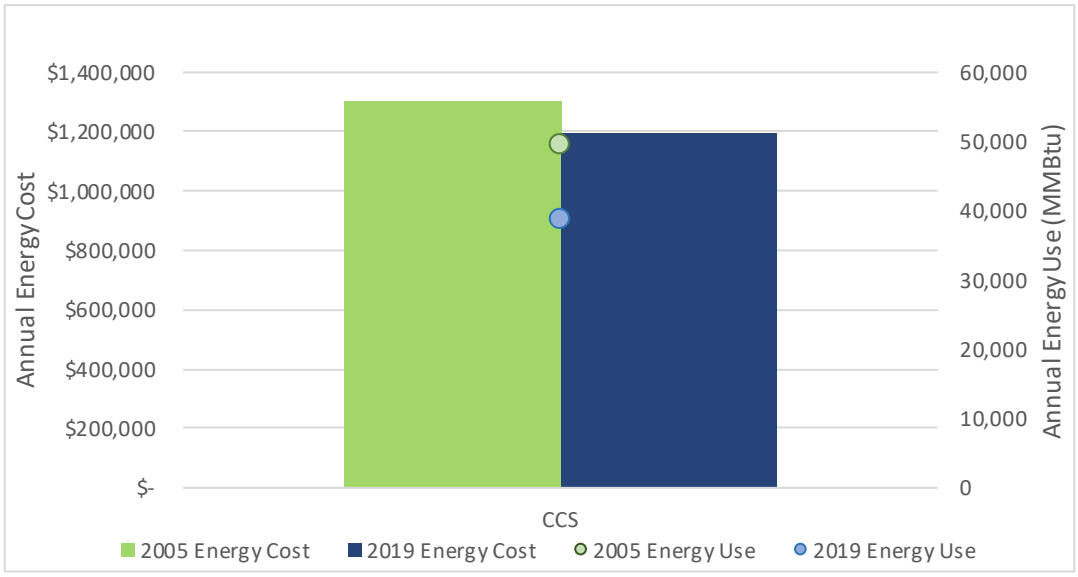


From 2005 to 2019, CCS saw a 22% reduction in total energy use. This reduction is largely due to changes in electricity use, as the department's total electricity use decreased by 38%, while the departments total natural gas use nearly tripled. Nonetheless, the Department's total energy EUI improved, reducing from 0.10 MMBtu/ft^2 in 2005 to 0.04 MMBtu/ft^2 in 2019 (see **Figure 13**).

The increase in natural gas use caused natural gas costs to nearly double from 2005 to 2019, while CCS' electricity costs reduced by 19%. With overall energy use reducing from 2005 to 2019, total energy cost for CCS also decreased, but only by 8% from 2005 to 2019, as shown in **Figure 14**.

Figure 14. CCS Energy Cost & Use Comparison

This graph shows CCS' annual energy cost and use in 2005 (green) and 2019 (blue). The bars represent annual energy cost, while the circles represent annual energy use during the respective years.



Largest Accounts

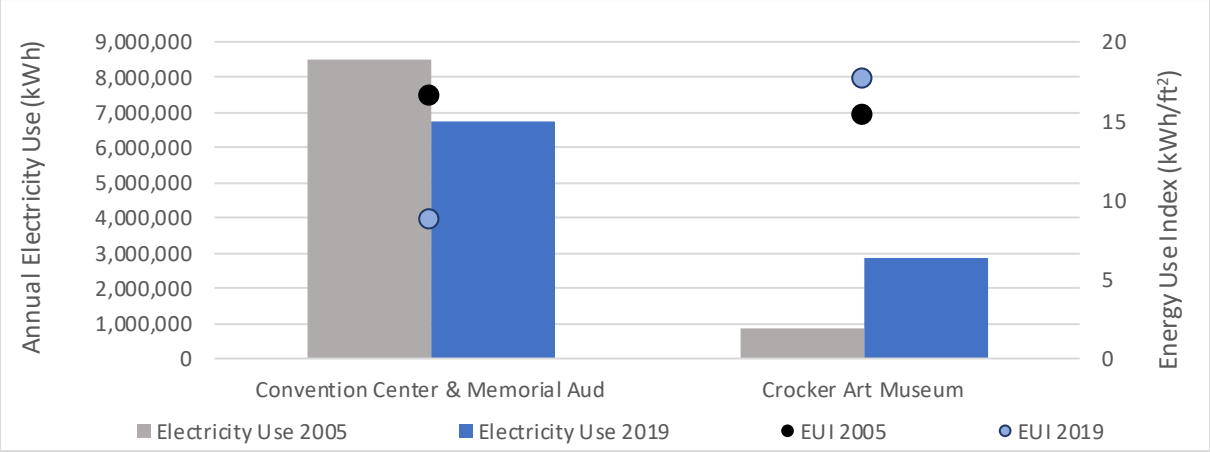
The Convention and Cultural Services Department operates several large buildings that can serve and support large crowds and patrons all while maintaining a climate hospitable to art exhibits, historic artifacts, and veterinary equipment. The Sacramento Convention Center & Memorial Auditorium and Crocker Art Museum, CCS' largest accounts shown in **Figure 15** and **16**, contain art exhibits and expansive conference centers, halls, and theaters. These buildings have robust air conditioning and heating and cooling systems to maintain appropriate indoor air quality during large group gatherings, with additional buildings systems at Crocker Art in order to maintain humidity levels and protect and prevent damage to artwork.

Figure 15 represents electricity use and electricity EUI for the Convention Center campus account and Crocker Art Museum. It is important to note that the Convention Center campus account includes Memorial Auditorium and these two buildings are serviced by the same meter, even though the buildings are two separate, large facilities; thus, electricity use for this account is high compared to the Crocker Art Museum. Nonetheless, the Convention Center and Memorial Auditorium actually experienced a 21% reduction in electricity use and 48% improvement in electricity EUI from 2005 to 2019, while the Crocker Art Museum electricity use tripled. Of note, the reductions in electricity use at the Convention Center may be due to construction and closures occurring at the facilities in 2019. Further, increases in electricity use are likely due to the new Crocker facility opening in this timeframe; while electricity use for Crocker Art Museum tripled from 2005 to 2019, electricity EUI for the facility only increased by 15%, revealing that the increased energy use was likely not the result of significant degradation of the systems' energy efficiency.

From 2005 to 2019, Crocker Art Museum electricity costs were nearly four times higher, while Convention Center Complex & Memorial Auditorium electricity costs have reduced by 27% during this time. Again, these electricity cost trends are likely related to possible expansion at the Crocker Art Museum, and closure seen at the Convention Center & Memorial Auditorium in 2019. Further monitoring and analysis of electricity use at these buildings will need to be conducted to solidify the findings highlighted above, and determine the need for additional energy efficiency projects.

Figure 15. Electricity Use – CCS Largest Accounts

This graph presents electricity use and EUI for Convention and Cultural Services' buildings included in the City's 25 Largest Buildings. Electricity use in 2005 (grey) and 2019 (blue) are represented as bars and measured on the primary Y axis, while electricity EUI in 2005 (black) and 2019 (blue) are represented as dots and measured on the secondary Y axis.

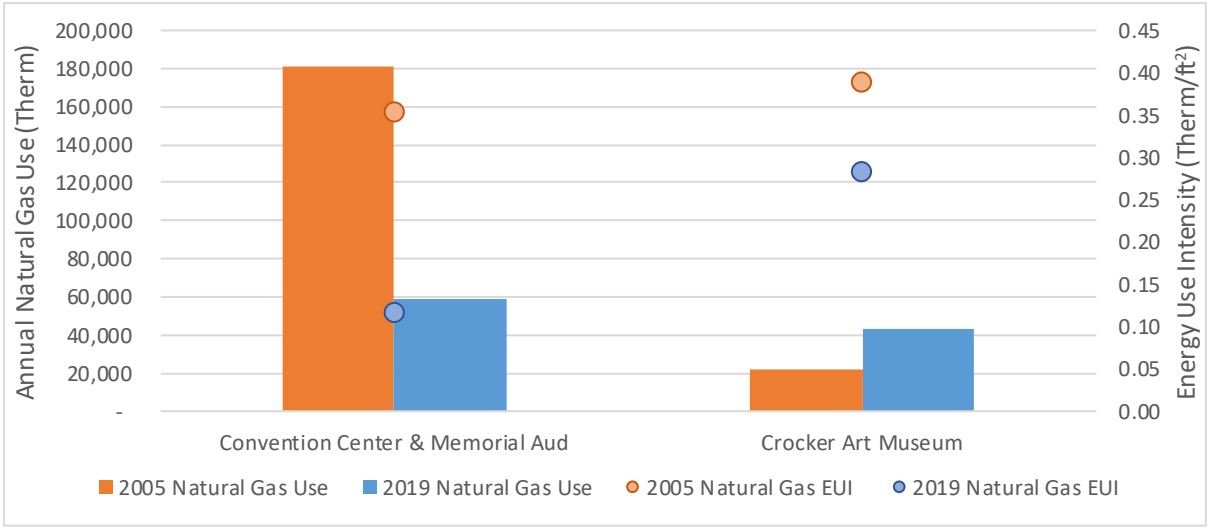


Natural gas use and natural gas EUI for CCS' largest accounts followed similar trends to those seen in the buildings' electricity use from 2005 to 2019. As seen in **Figure 16**, the Convention Center & Memorial Auditorium had a nearly 70% reduction in natural gas use and relative EUI from 2005 to 2019. Again, these apparent improvements may actually be due to ongoing construction and reduced use of these facilities in 2019. Crocker Art Museum's natural gas use nearly doubled from 2005 to 2019. Interestingly, the natural gas EUI for Crocker Art Museum reduced from 2005 to 2019, revealing that expansion of the building may have led to the increased natural gas use, but also improvements in efficiency, from 2005 to 2019.

In line with these use trends, Convention Center & Memorial Auditorium saw a near 70% reduction in natural gas costs, while Crocker Art Museum costs were four times higher in 2019 than in 2005. Review of previous expansion projects and age of the Museum's building systems is necessary to determine whether these changes are due to building expansions, inefficient systems, or other underlying factors.

Figure 16. Natural Gas Use – CCS Largest Accounts

This graph presents natural gas use and EUI for Convention and Cultural Services' buildings included in the City's 25 Largest Buildings. Natural gas use in 2005 (orange) and 2019 (blue) are represented as bars and measured on the primary Y axis, while natural gas EUI in 2005 (orange) and 2019 (blue) are represented as dots and measured on the secondary Y axis.



Community Development Department (CDD)

The Community Development Department serves the community by planning, building, and supporting a healthy, livable Sacramento. Building square footage that is deemed solely CDD accounts for only 18,657 sq. ft., less than 1% of the City's total building area. However, much of their operations are captured in other department's energy use and cost reports, such as the Police Department - the main occupant of 300 Richards. Their costs are handled separately and charged retroactively each year but are not represented in the City's energy data system. CDD is comprised of five divisions:

Divisions:

- Building Division
- Code Compliance Division
- Planning Division
- Animal Care Division
- Administrative Services

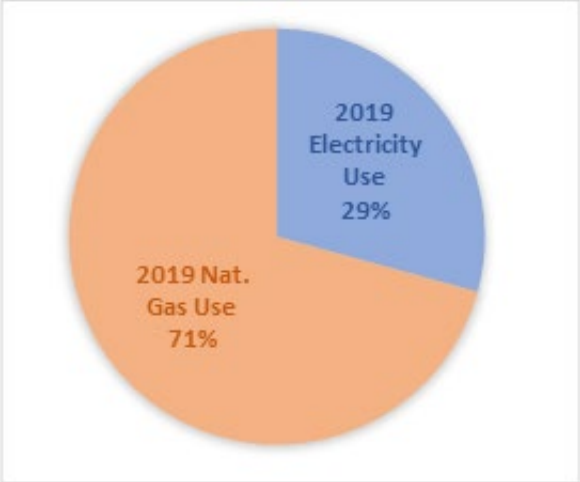
2019 Total Energy Use and Cost

The Community Development Department operates out of several shared buildings, such as 300 Richards, in those cases, the energy from the shared use building is classified under the primary use. Thus, much of CDD's energy use and cost is attributed to other departments in this report. The Front Street Animal Shelter is the main building classified as CDD in the City's energy database. As such, this review of CDD energy use and cost largely focuses on the energy use and costs from the Front Street Animal Shelter.

CDD is one of the only departments for which natural gas accounted for a larger portion of a department's total energy use than SMUD-sourced electricity, as seen in **Figure 17**. Electricity and natural gas costs for CDD were nearly equal in 2019 (see **Figure 18**). As mentioned previously, these values represent energy use at Front Street Animal Shelter. It is evident that the Shelter relies heavily on natural gas use, and therefore should be reviewed or audited to determine potential opportunities to transition to electricity use in order to achieve GHG emissions reductions.

Figure 17. CDD – 2019 Energy Use

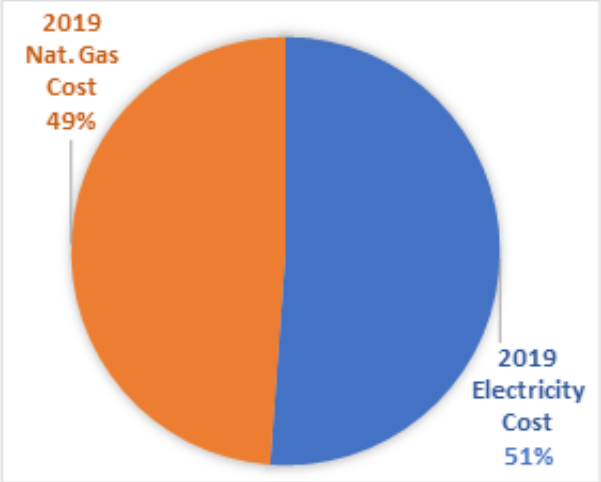
This pie chart shows the portion grid-sourced electricity, natural gas, and/or on-site solar electricity use contributed to the department's total energy use for 2019 (see below).



2019 Total Energy Use: 3,782 MMBtu

Figure 18. CDD – 2019 Energy Cost

This pie chart shows the portion costs from grid-sourced electricity, natural gas, and/or on-site solar electricity use contributed to the department's total energy costs for 2019 (see below).



2019 Total Energy Cost: $84,162

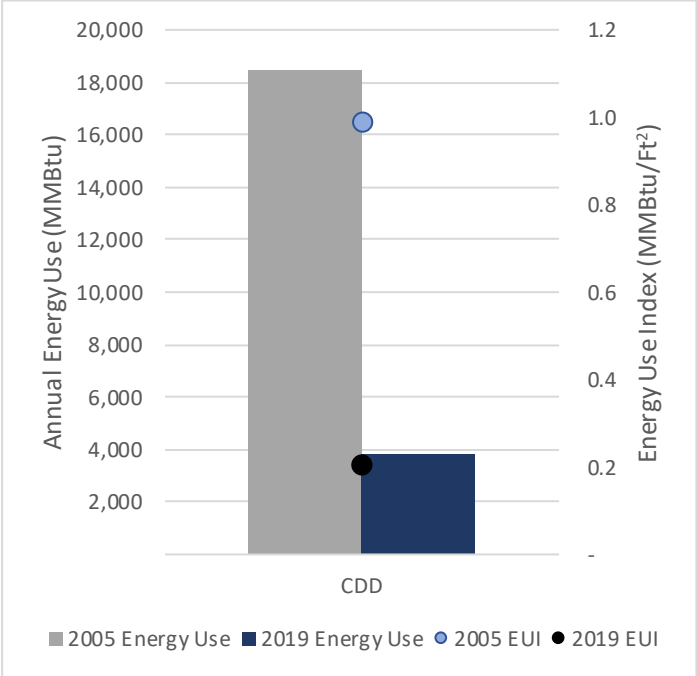
Comparison to Baseline

From 2005 to 2019, CDD saw a dramatic reduction in total energy use and EUI, as seen in **Figure 19**. This is largely attributable to reductions in natural gas use. From 2005 to 2019, natural gas use reduced by 85%, leading total energy use to reduce by 80%. Electricity use for CDD increased by 28% during this time. This provides a unique insight into CDD natural gas use. Despite CDD having the highest percentage of natural gas use of all City departments, CDD natural gas use actually decreased from 2005 to 2019.

Figure 20 reveals that CDD energy cost decreased by 64% from 2005 to 2019. While electricity costs increased by 78%, natural gas costs for CDD decreased by approximately 80%. Further analysis is necessary to determine what led to these changes in energy use and cost.

Figure 19. CDD - Total Energy Use & EUI Comparison

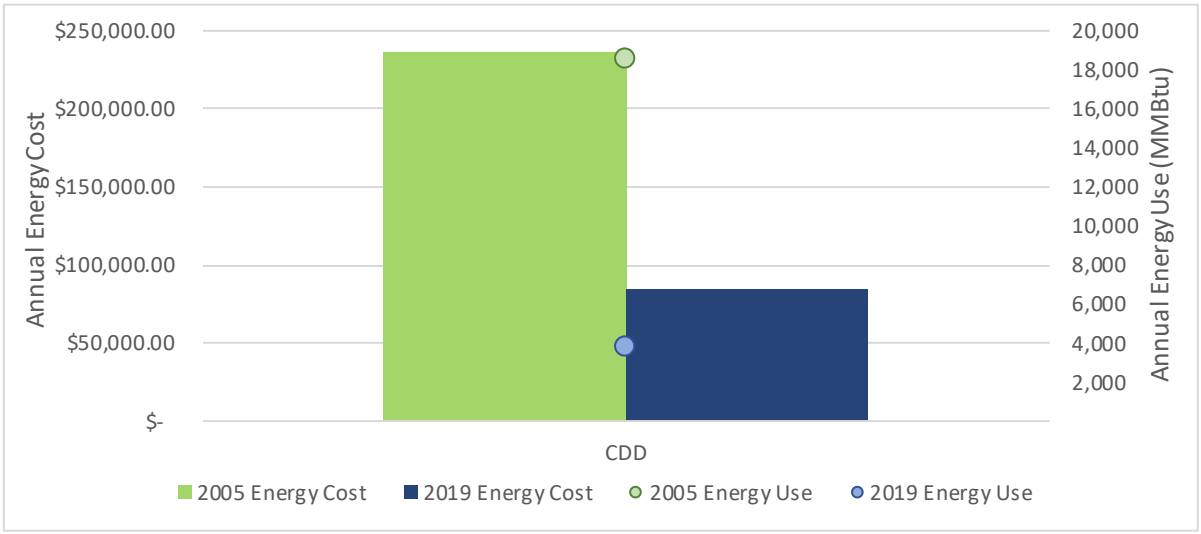
The bars in this graph represent the total energy used at CDD facilities and buildings in 2005 (grey) and 2019 (dark blue), measured on the primary Y axis (left). The EUI for the department is measured on the secondary Y axis (right), with the black dot representing EUI in 2005 and the light blue dot represents EUI in 2019.



As noted above, this analysis of CDD energy use and cost is predominately a review of the Front Street Animal Shelter. However, the Front Street Animal Shelter is not included in the City's Top 25 Largest Accounts, therefore, no further analysis of CDD buildings will be included in this report. [15] It is recommended that further analysis of natural gas use at the Front Street Animal Shelter be conducted to determine if more of the facility's systems can be transitioned from natural gas to electric.

Figure 20. CDD Energy Cost & Use Comparison

This graph shows CDD's annual energy cost and use in 2005 (green) and 2019 (blue). The bars represent annual energy cost measured on the primary Y axis (left), while the circles represent annual energy use measured on the secondary Y axis (right). during the respective years.



[15] See **Appendix B** for a detailed description of the limitations of the City's energy data, database, and benchmarking system.

Department of Public Works (DPW)

The Department of Public Works manages and maintains municipal buildings, facilities, roadways, and related infrastructure throughout the City. In addition, DPW is responsible for solid waste and recycling, management of multi-use City buildings (those occupied by more than one department), and fleet management. DPW maintains more than $10 billion in transportation infrastructure assets, along with more than 400 public buildings, over 2,600 vehicles in the City's fleet, 4,775 public parking spaces, 2,300 miles of sidewalk[16], and a closed landfill. Public Works is composed of seven divisions, and is responsible for more than 1,700 electricity meters. This includes non-building users such as streetlights, traffic signals, landscapes, and City-owned parking lots.
In 2019 Public Works operated out of 2,728,762 square feet, representing 58% of the City's total building area.

Divisions:

- Parking
- Maintenance Services
- Recycling and Solid Waste
- Transportation
- Facilities & Real Property Management
- Fleet
- Engineering Services

Since 2009, DPW completed LED retrofits of all City traffic signals, over 15,000 City-owned and operated streetlights, and five City-owned parking garages.

Meadowview City Service Complex and the Harbor Master building had HVAC replacements in 2014 and 2018, respectively.

2019 Total Energy Use & Cost

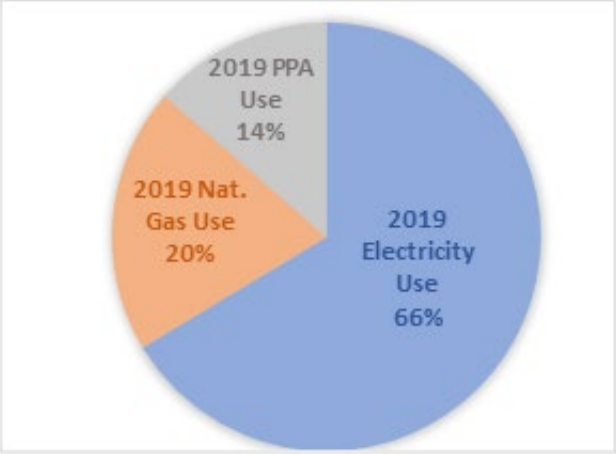
In 2019, the Department of Public Works accounted for an estimated 16% of the City's energy use.[17] This energy is used to power City resources such as New City Hall, median irrigation systems, traffic signals, and facilities where the City's fleet vehicles are maintained and managed. **Figures 21** and **22** show that over 80% of the Department of Public Works' energy use comes from electricity through SMUD and on-site solar PV systems. While SMUD-sourced electricity only accounted for 68% of the Department's total energy use in 2019, costs incurred from SMUD-sourced electricity use accounted for 90% of the Department's total energy costs, revealing that SMUD-sourced electricity has the highest associated costs compared to all other energy sources. Total energy costs for the DPW increased by 18% from 2005 to 2019. These increases in cost are likely caused by multiple factors, including annual inflation, energy rate increases for both natural gas and electricity, reorganization of departments in 2008, and other factors.

[16] https://www.cityofsacramento.org/Public-Works/Maintenance-Services/Sidewalks-Curbs-Gutters#:~:text=Sidewalks,approximately%202%2C300%20miles%20of%20sidewalk.

[17] Note that this total is likely undercounting DPW energy use due to the unavailability of data for non-metered streetlights. Due to these data limitations, while **Figure 21** does not include energy use for non-metered streetlights, **Figure 22** includes costs for non-metered streetlights.

Figure 21. DPW – 2019 Energy Use

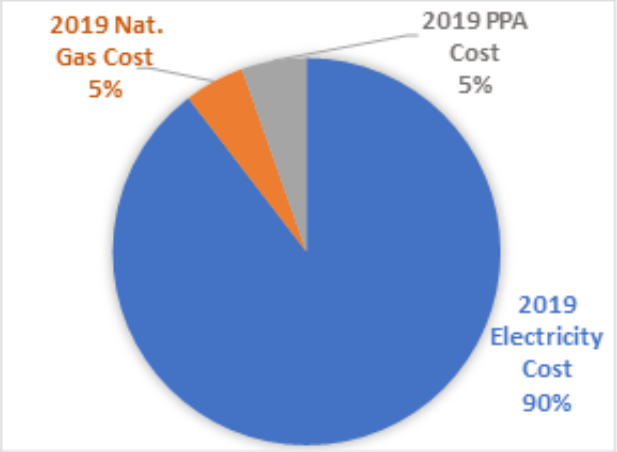
This pie chart shows the portion grid-sourced electricity, natural gas, and on-site solar electricity use contributed to the department's total energy use for 2019 (see below).



2019 Total Energy Use: 51,074 MMBtu

Figure 22. DPW – 2019 Energy Cost

This pie chart shows the portion costs from grid-sourced electricity, natural gas, and on-site solar electricity use contributed to the department's total energy costs for 2019 (see below).

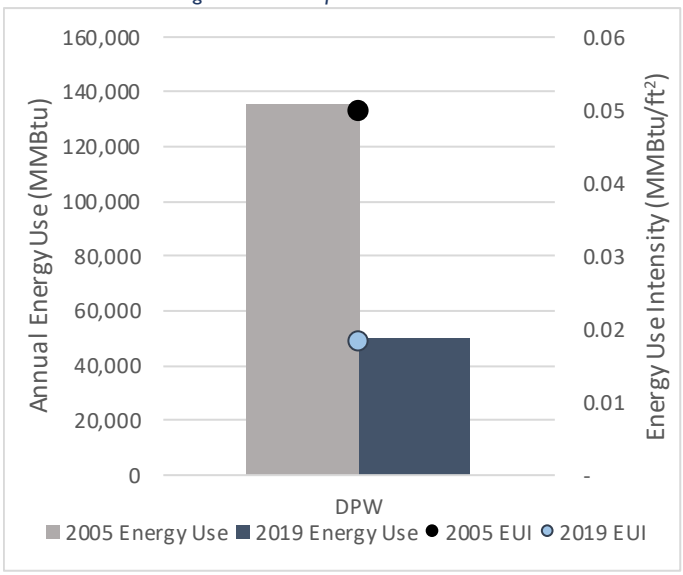


2019 Total Energy Cost: $3,592,665

Comparison to Baseline

Figure 23. DPW - Total Energy Use & EUI Comparison

The bars in this graph represent the total energy used at Department of Public Works facilities and buildings in 2005 (grey) and 2019 (dark blue), measured on the primary Y axis (left). The EUI for the department is measured on the secondary Y axis (right), with the black dot representing EUI in 200 and the light blue dot represents EUI in 2019.



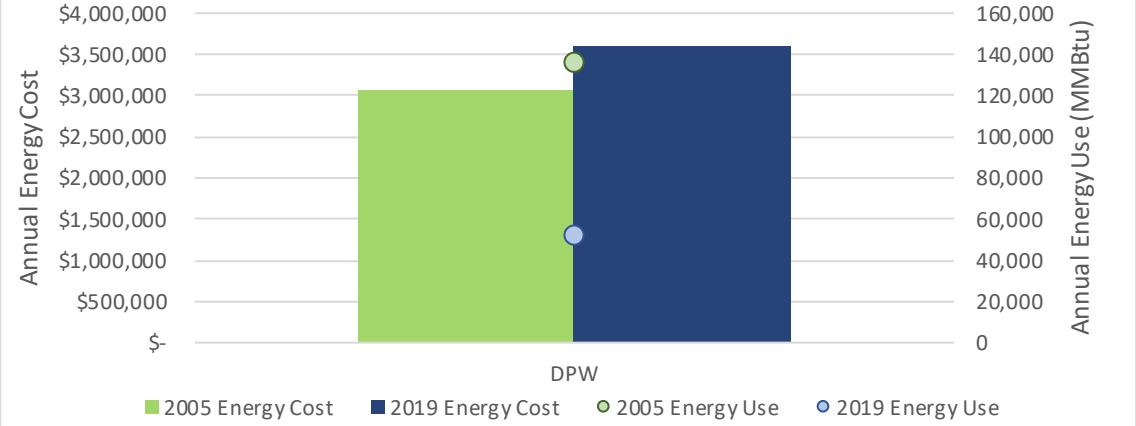
From 2005 to 2019, the Department of Public Works saw an estimated 62% reduction in total energy use, as seen in **Figure 23**. Electricity usage through SMUD saw a 73% decrease from 2005 to 2019. This is partly due to the installation of four photovoltaic systems at DPW facilities. Beginning in 2012, PV systems were installed at Meadowview City Service Complex[18], South Area Corp Yard, and New City Hall. In 2019, electricity sourced from these PV systems accounted for 17% of the Department of Public Works total electricity use. When electricity use from on-site solar is factored in, total electricity consumption still decreased by 68% from 2005 to 2019. While electricity use for DPW reduced from 2005 to 2019, total natural gas use increased by 13% during this time. Nonetheless, DPW also saw a significant improvement to the department's total energy EUI from 2005 to 2019, with a 62% reduction.

[18] Two photovoltaic systems were installed at Meadowview City Service Complex, bringing the total PV systems installed at DPW facilities to four.

Though energy use for DPW was lower in 2019 than in 2005, energy costs for the department increased by 18% from 2005 to 2019. This increase can be seen in **Figure 24**. SMUD-sourced electricity costs increased by 9%, while PG&E natural gas costs increased by 66% from 2005 to 2019 for DPW. When costs for on-site solar powered electricity are factored in, total electricity cost increased by 16% from 2005 to 2019.

Figure 24. DPW Energy Cost & Use Comparison

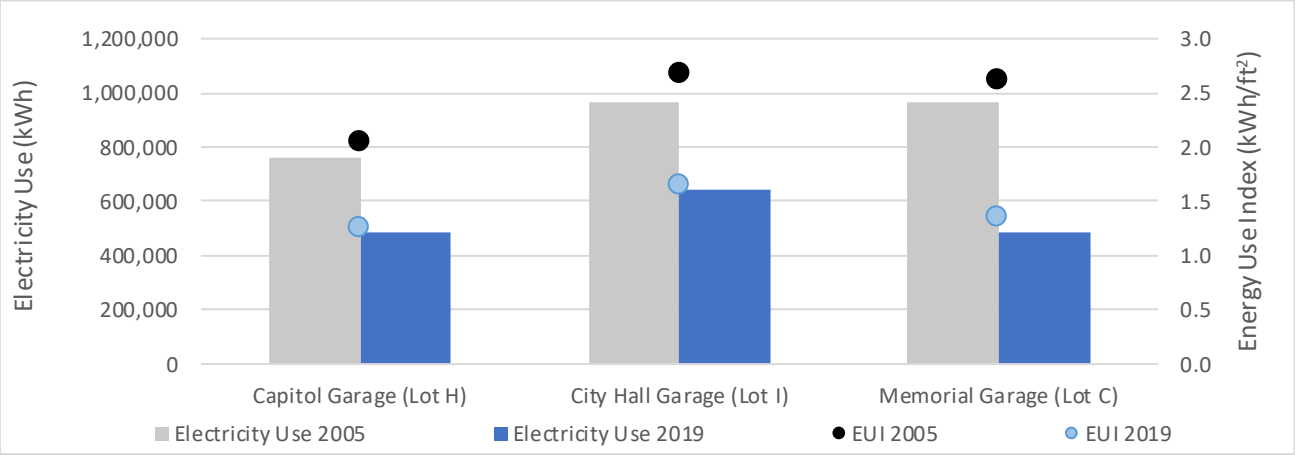
This graph shows the Department of Public Works' annual energy cost and use in 2005 (green) and 2019 (blue). The bars represent annual energy cost and are measured on the primary Y axis (left), while the circles represent annual energy use, and are measured on the secondary Y axis (right), during the respective years.



The significant reductions in electricity use and minimal increase in electricity costs for DPW is largely due to energy efficiency projects completed at City facilities between 2005 to 2019. Many of these energy efficiency retrofits have been completed within the Department of Public Works. In 2009, the City began converting traffic signals to LED; all traffic signals were converted to LED by 2015. In 2010, the City began converting more than 10,000 City-owned and maintained streetlights to LED lights. The City also retrofitted all five City-owned and managed parking garages to LED lights. **Figure 25** reveals the reduction in total energy use, as well as improvements in EUI, or how efficiently energy is being used, for three of the City's largest parking garages from 2005 to 2019.

Figure 25. Parking – Electricity Use & EUI Comparison

City owned and managed parking garages are represented on the X axis, while each garage's electricity use and relevant EUI for electricity are measure on the primary and secondary Y axis, respectively. Electricity use in 2005 is represented by the grey bars, and 2019 electricity use as blue bars. Electricity EUIs in 2005 are represented by the black dots, while EUI in 2019 is represented by the blue dots.



Largest Accounts

The Department of Public Works maintains, repairs, and manages many of the City's resources – including traffic signals, streets, and streetlights in the right-of-way. As such, DPW operates several campuses where supplies and City fleet are repaired as well as stored; many of these campuses are comprised of several buildings and acres of repair shops and warehouses, but are often served by only one or two meters. Three of the Department of Public Works largest accounts represent a campus, including 24th St Corp Yard (SACY), Meadowview City Service Complex, and North Area Corp Yard (NACY). As such, it is difficult to compare these campuses to other accounts (meters) that represent only one building.

Also of note, the Sacramento Valley Station, another of the department's largest accounts, was not purchased by the City until 2005 and the City did not gain ownership of the electricity meter until 2016; therefore, the 2005 energy use and EUI data for the Sacramento Valley Station did not appear on the energy database report and was not included in this report. Furthermore, the Sacramento Valley Station 2019 EUI may be an inaccurate representation of the true electricity use intensity. While submeters to leased areas ensure that tenants cover a portion of energy costs, the City's meter supports some tenant uses in addition to electricity utilized in the public area of the Station.

Figure 26 below shows use of grid-sourced electricity supplied by SMUD and EUI for the Department of Public Works' largest accounts in the baseline year of 2005 and current year of 2019. Electricity produced and used from on-site solar PV systems is not included.[19] As mentioned previously, Meadowview City Service Complex, SACY, and New City Hall all had on-site solar PV systems installed since 2005. Total electricity use in 2019 for these accounts is, therefore, higher than the values shown in **Figure 26** since it does not show on-site solar generation and use. The electricity use reductions shown for Meadowview and SACY can largely be attributed to the PV systems installed at these sites.

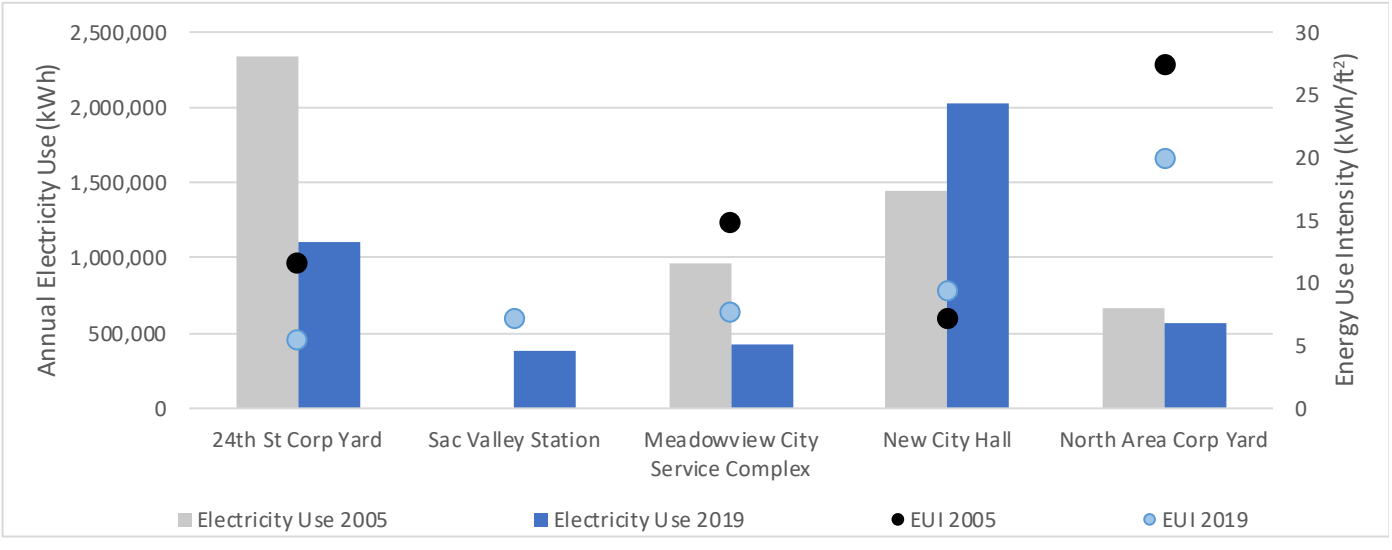
[19] See **Appendix B** for a detailed explanation of the limitations of the City's energy data, database, and energy benchmarking system.

Similarly, while New City Hall saw a 40% increase in electricity use and a 30% increase in EUI from 2005 to 2019, it is important to note again, that 2019 electricity use for New City Hall is higher than what is seen in **Figure 26**, as it does not represent on-site solar-powered electricity. Nonetheless, the increase in electricity use seen in **Figure 26** may be due to the fact that New City Hall was newly built and not yet at full occupancy in 2005, so energy use was lower. Additionally, after 2005, IT Department servers were moved from New City Hall Garage into the New City Hall building. These servers require immense amounts of energy, and likely contributed to this increase in electricity use and electricity EUI at New City Hall. Nonetheless, grid-sourced electricity costs for New City Hall increased by 60% from 2005 to 2019; thus, at 15 years old, opportunities for improvements and cost-savings exist, especially in lighting.

When comparing electricity use across the three DPW campus-level accounts, NACY appears to have realized only minimal (15%) reductions in total electricity use. However, NACY did see comparable improvements in grid-supplied electricity EUI from 2005 to 2019, with a 27% reduction in electricity EUI, while SACY and Meadowview achieved approximately 50% reduction in grid-supplied EUI. In line with these results, SACY and Meadowview saw a 40-50% reduction in grid-sourced electricity costs, while NACY's electricity costs remained constant from 2005 to 2019. As previously mentioned, Meadowview City Service Complex and SACY have exaggerated reductions in total electricity use because electricity powered by on-site solar is not included in **Figure 26.** Therefore, electricity use and EUI reductions at NACY likely represent true improvements, while the improvements for Meadowview and SACY are likely exaggerated. However, it could be assumed that on-site solar panels are powering a significant portion of these campuses electricity use with cleaner, 100% renewable power. Further review of total electricity use and EUI for these campus-level accounts will need to be conducted to provide a more accurate comparison.

Figure 26. Electricity Use – DPW Largest Accounts

This graph presents electricity use and EUI for the Department of Public Works' buildings included in the City's 25 Largest Buildings. Electricity use in 2005 (grey) and 2019 (blue) are represented as bars and measured on the primary Y axis (left), while electricity EUI in 2005 (black) and 2019 (blue) are represented as dots and measured on the secondary Y axis (right).

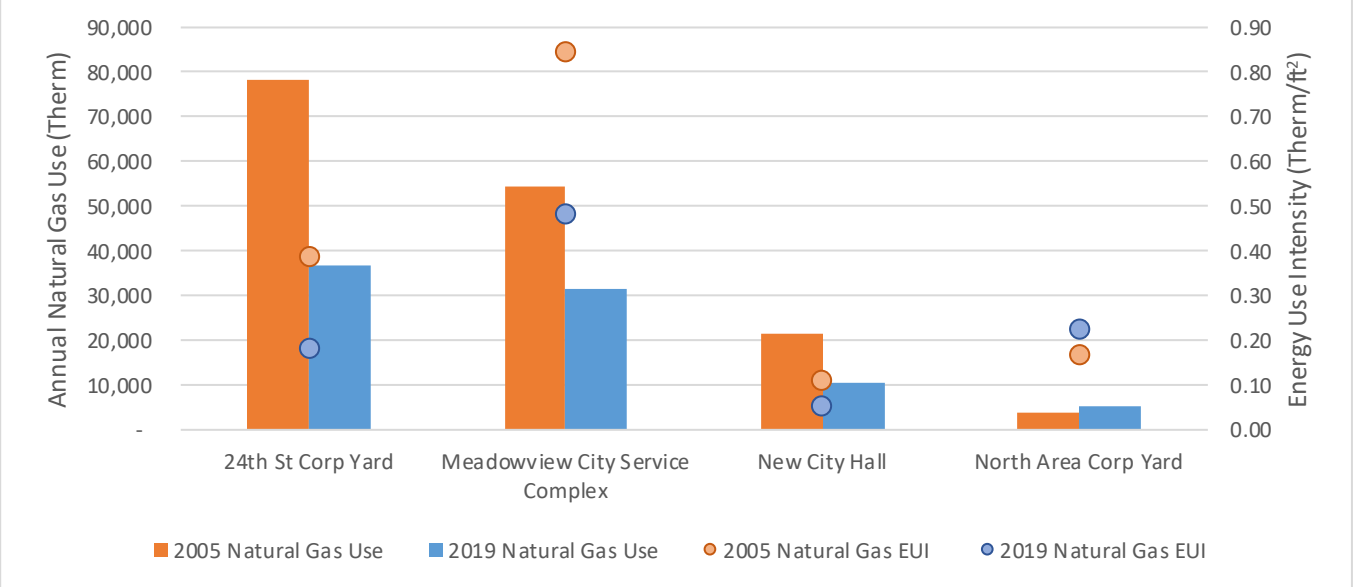


Natural gas use and related EUI for DPW's largest accounts are shown in **Figure 27**. As previously noted, SACY, NACY, and Meadowview City Service Complex represent whole campuses, with one meter that measures and supplies energy for several buildings. Accordingly, comparisons of natural gas use at New City Hall will only be made from baseline to the current year values for this account. Overall, natural gas use reduced by 50% while costs decreased by 22% for New City Hall from 2005 to 2019. This reduction in natural gas use is likely greater than that shown in **Figure 27**, due to malfunction of the City's energy database system.[20] Further analysis is necessary to explain the reduction in natural gas use, and the increased electricity use seen in **Figure 26,** for New City Hall.

SACY and Meadowview City Service Complex both reduced natural gas use by nearly 50% from 2005 to 2019, while NACY natural gas use increased by 37%. Similarly, NACY's natural gas cost increased by 54% from 2005 to 2019, while costs for SACY and Meadowview decreased by 25% and 14%, respectively. Again, further review of building systems and operations at these campuses is necessary to identify specific retrofit opportunities.

Figure 27. Natural Gas Use – DPW Largest Accounts

This graph presents natural gas use and EUI for the Department of Public Works' buildings included in the City's 25 Largest Buildings. Natural gas use in 2005 (orange) and 2019 (blue) are represented as bars and measured on the primary Y axis (left), while natural gas EUI in 2005 (orange) and 2019 (blue) are represented as dots and measured on the secondary Y axis (right).



**Sac Valley Station is not included in this graph because it does not have a natural gas meter*

[20] See **Appendix B** for more details.

Department of Utilities (DOU)

Established in 1873, the Department of Utilities delivers water, wastewater, and stormwater services to over 490,000 community members. For Fiscal Year 2018, DOU supplied more than 29 billion gallons of water. The Department of Utilities manages and operates two water treatment facilities, 27 wells, 12 storage reservoirs or facilities, and 106 pump stations. This equates to 170,528 sq. ft of building area, representing only 4% of the City's total.

Divisions:

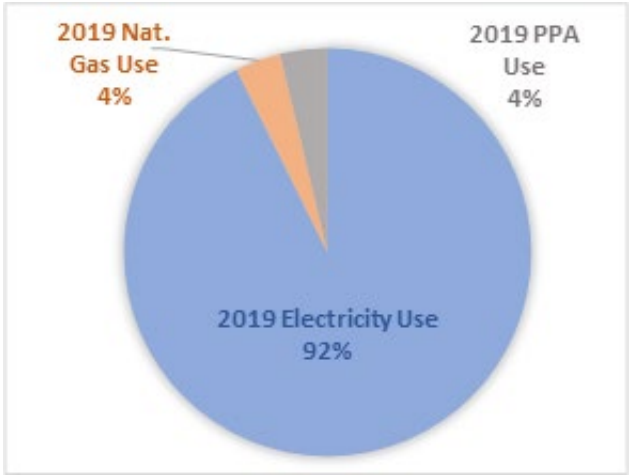
- Wastewater/Drainage Operations & Maintenance
- Water Operations & Maintenance
- Business & Integrated Planning
- Engineering and Water Resources

2019 Total Energy Use & Cost

The Department of Utilities accounted for nearly half of the City's building energy use and costs in 2019 and consumed more energy than any other City department. Nearly all the DOU's energy is powered by electricity from SMUD and on-site solar systems (see **Figure 28**). **Figure 29** reveals that SMUD-sourced electricity costs (95% of total energy costs) for the Department of Utilities were relatively proportional to SMUD-sourced electricity use (92%); this may be because many of the DOU's largest accounts are part of the SolarShares Program, providing off-site solar-powered electricity at a contracted, constant discount rate. The SolarShares Program has allowed the City to receive additional solar-powered electricity at a rate that is not affected by annual rate increases for the 20-year term of the agreement.

Figure 28. DOU – 2019 Energy Use

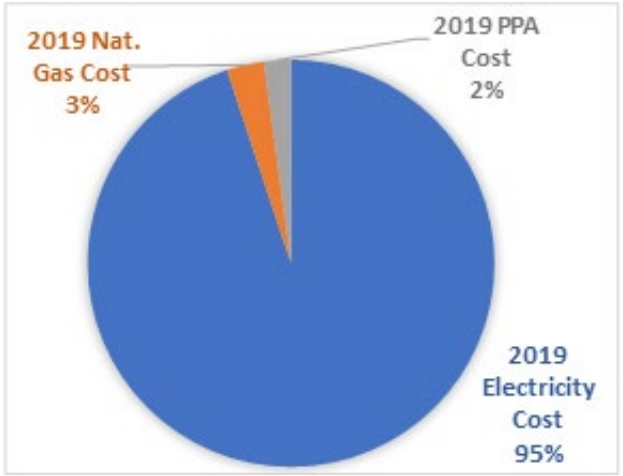
This pie chart shows the portion grid-sourced electricity, natural gas, and on-site solar electricity contributed to the department's total energy use for 2019 (see below).



2019 Total Energy Use: 149,387 MMBtu

Figure 29. DOU – 2019 Energy Cost

This pie chart shows the portion costs from grid-sourced electricity, natural gas, and on-site solar electricity contributed to the department's total energy costs for 2019 (see below).

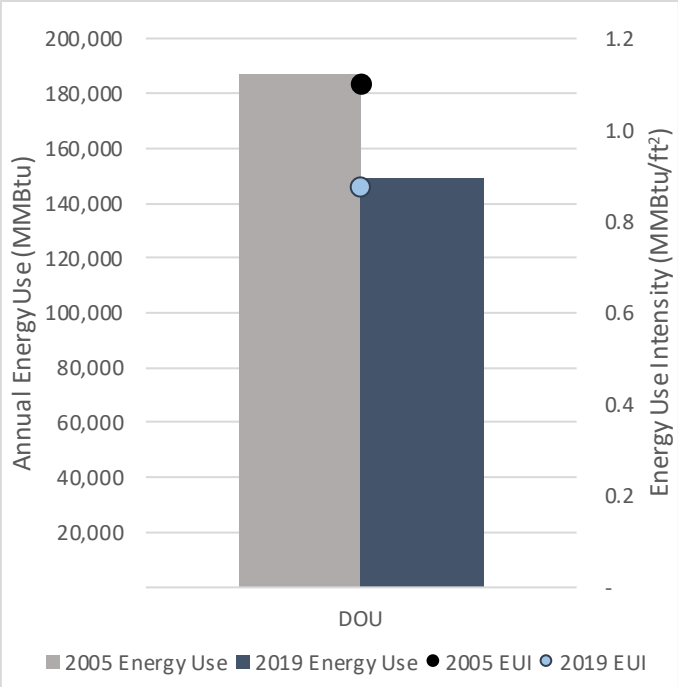


2019 Total Energy Cost: $6,072,670

Comparison to Baseline

Figure 30. DOU - Total Energy Use & EUI Comparison

The bars in this graph represent the total energy used at Department of Utilities facilities and buildings in 2005 (grey) and 2019 (dark blue), measured on the primary Y axis (left). The EUI for the department is measured on the secondary Y axis (right), with the black dot representing EUI in 2005 and the light blue dot represents EUI in 2019.



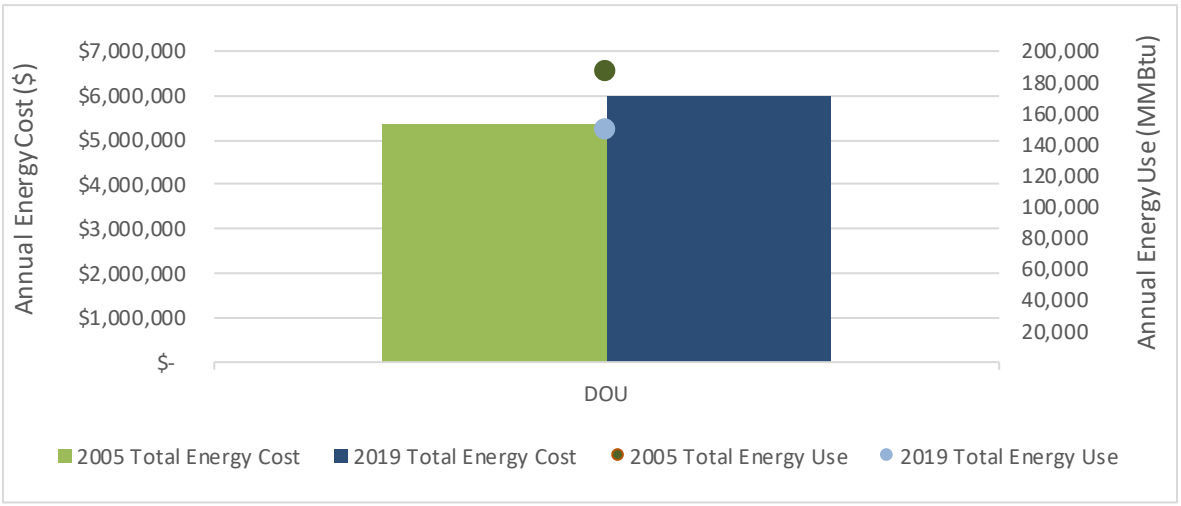
As shown in **Figure 30**, the Department of Utilities saw a 20% reduction in total energy use from 2005 to 2019, despite receiving comparable rainfall in both years.[21] Natural gas use decreased by 73%, while electricity use decreased by 14%. With these energy use reductions, the DOU also saw overall improvements in their energy use intensity, showing that these reductions are likely attributable to energy efficiency improvements. Despite improvements in energy efficiency, the total cost of energy for the DOU increased by 14% from 2005 to 2019 (see **Figure 31**). This is largely due to increase in electricity cost, which saw a 15% increase, whereas natural gas costs reduced by 23%.

As mentioned in the Inter-Department Benchmarking section, the activities and operations performed at DOU facilities are imperative for the City and residents to live and operate safely, comfortably, and work effectively. Wells, storm drainage pumps, sumps, and water treatment plants are essential to maintain order in the City; the energy demand and annual use for these complex systems are dependent on numerous underlying factors. For this reason, DOU has staff specifically focused on monitoring and reviewing the efficiency and functionality of these systems and facilities. For this reason, this report will not include an analysis of the DOU's largest accounts.

[21] Sacramento received 24.5 inches of rain in 2005, and 24.9 inches in 2019.
Source: https://ggweather.com/ca2004rain.htm ; https://www.sacbee.com/news/weather-news/article238824518.html

Figure 31. DOU Energy Cost & Use Comparison

This graph shows the Department of Utilities' annual energy cost and use in 2005 (green) and 2019 (blue). The bars represent annual energy cost and are measured on the primary Y axis (left), while the circles represent annual energy use are measured on the secondary Y axis (right) during the respective years.



Fire Department (Fire)

The Fire Department is responsible for responding to and mitigating incidents involving fires, medical emergencies, hazardous materials, and technical rescues. The department also provides a full range of support and/or administrative services including fire prevention and investigation. The Fire Department has 24 Active Fire Stations, six of which were renovated in 2017. The Fire Department occupies 192,851 sq. ft of building space, representing 4% of the City's total building area.

In 2007, the Sacramento Drill Tower received an HVAC replacement.

Built in 2011, Fire Station 43 achieved a LEED Silver rating.

Divisions:

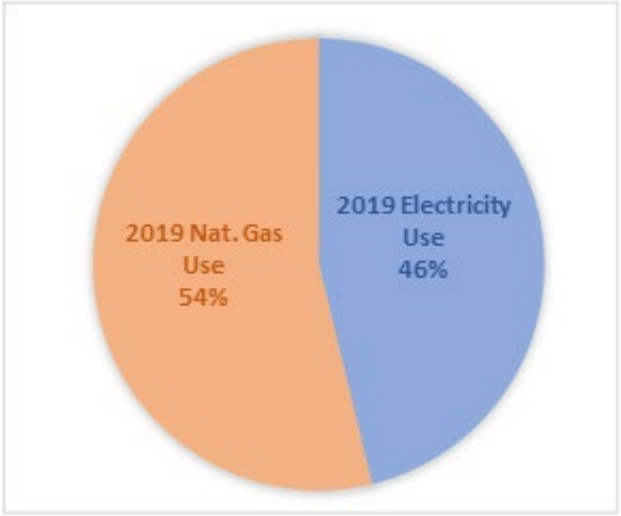
- Office of Emergency Operations
- Office of Risk Reduction
- Office of Resource Management
- Office of the Chief

2019 Total Energy Use & Cost

The Fire Department accounted for less than 5% of the City's total energy use and cost in 2019. Nonetheless, the Fire Department is unique among City departments, as the electricity and natural gas use were nearly equivalent - each accounting for approximately 50% of the Department's total energy use (see **Figure 32).** Similar to other departments, electricity costs still accounted for the majority of the Department's energy costs, as shown in **Figure 33**.

Figure 32. Fire – 2019 Energy Use

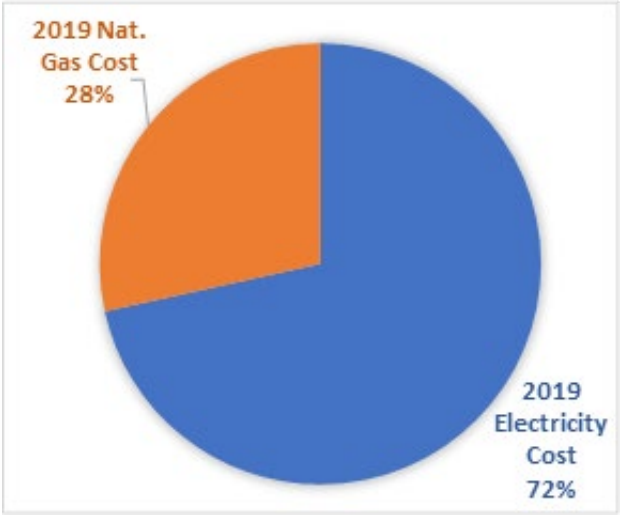
This pie chart shows the portion grid-sourced electricity, natural gas, and/or on-site solar electricity use contributed to the department's total energy use for 2019 (see below).



2019 Total Energy Use: 15,662 MMBtu

Figure 33. Fire – 2019 Energy Cost

This pie chart shows the portion costs from grid-sourced electricity, natural gas, and/or on-site solar electricity use contributed to the department's total energy costs for 2019 (see below).

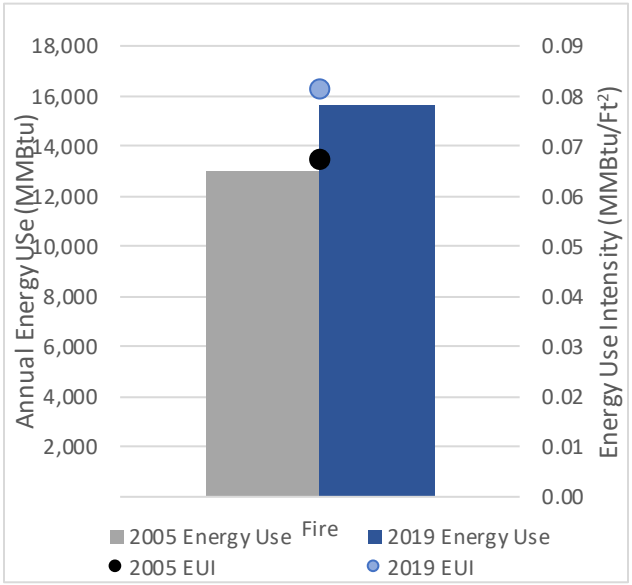


2019 Total Energy Cost: $406,611

Comparison to Baseline

Figure 34. Fire - Total Energy Use & EUI Comparison

The bars in this graph represent the total energy used at Fire facilities and buildings in 2005 (grey) and 2019 (dark blue), measured on the primary Y axis (left). The EUI for the department is measured on the secondary Y axis (right), with the black dot representing EUI in 2005 and the light blue dot represents EUI in 2019.



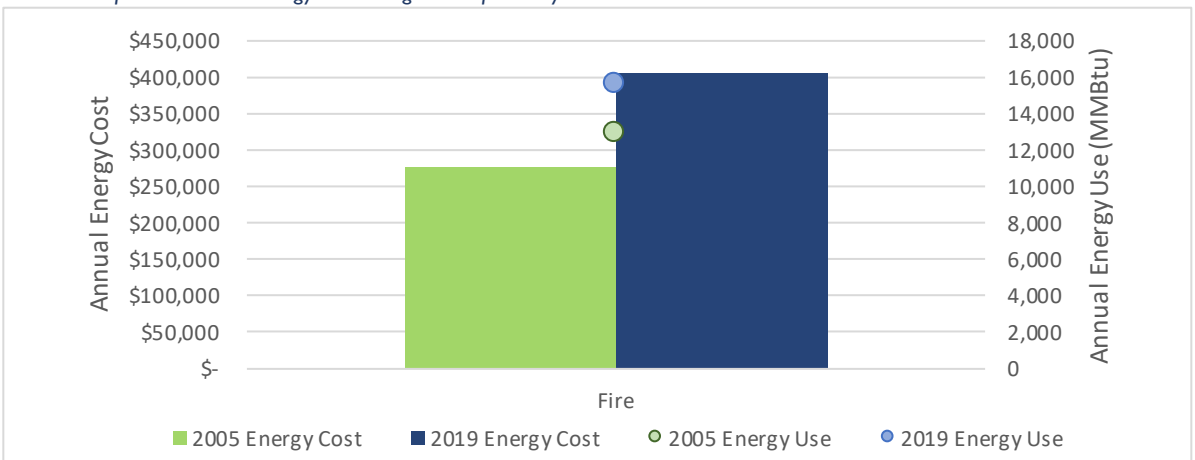
From 2005 to 2019, the Fire Department's total energy use and EUI both increased by 21% (see **Figure 34**). Natural gas use for the Department increased by 19% and electricity use increased by 23% causing the total energy use to increase. As a result, the Department's total energy costs increased by 47% during this time, with natural gas costs increasing by 25% and electricity costs increasing by 58%. These changes in cost are represented in **Figure 35**.

The increase in overall energy use for the Fire Department could be due to the addition of two new buildings within the Department. The increase in electricity use and EUI reveals that the energy efficiency projects conducted at Fire Department buildings was not sufficient to reduce the Department's overall EUI. Further analysis of electricity use at Fire Department buildings and Fire Stations will be necessary to determine which buildings and systems should be retrofitted to more efficient models.

None of the Fire Department buildings are within the City's Top 25 largest accounts, and therefore are not included for further analysis in this iteration of the municipal benchmarking report.[22]

Figure 35. Fire Energy Cost & Use Comparison

This graph shows Fire's annual energy cost and use in 2005 (green) and 2019 (blue). The bars represent annual energy cost, while the circles represent annual energy use during the respective years.



[22] See **Appendix B** for a detailed description of the limitations of the City's energy data, database, and benchmarking system.

Police Department (PD)

The Sacramento Police Department is responsible for maintaining public safety throughout the City. This includes patrol, crime investigation, and specialized units, such as those for Sacramento Regional Transit, hospitals, and special events units. The Police Department works out of nine City facilities including 4 substations, one headquarters location, a training facility, and a communication center. This equates to 398,413 sq. ft of building area, representing 8% of the City's total. Four operating offices oversee all divisions and units.

Operating Offices:

- Office of Operations
- Office of Investigations
- Office of Specialized Services
- Office of the Chief

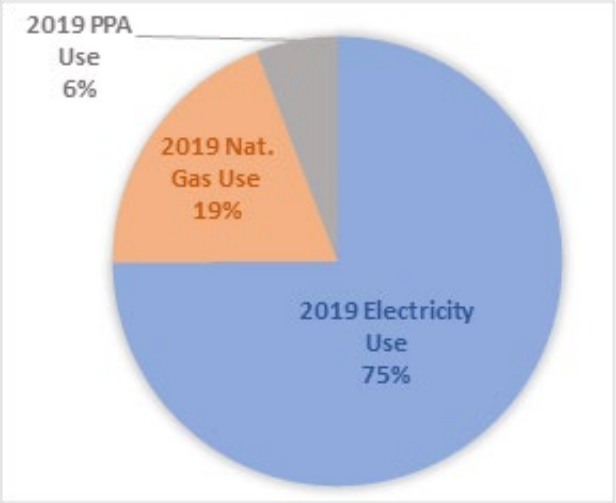
2019 Total Energy Use and Cost

The Sacramento Police Department accounted for nearly 10% of the City's facilities energy use and costs in 2019. PD's energy predominately consists of electricity from SMUD and on-site solar systems, as shown in **Figure 36**. The City has an on-site solar PV system located at 300 Richards. In addition to the Police Department, both CDD and Public Works have offices at 300 Richards, yet the Police Department occupies the largest portion of the building area. Thus, for the purposes of this report and the City's online energy database, 300 Richards and the on-site solar PV system located there are classified under the Police Department.

Similar to other departments, SMUD electricity costs account for the majority of PD's energy costs (see **Figure 37**). This is largely due to majority of energy used by the department in 2019 being SMUD-sourced electricity.

Figure 36. PD – 2019 Energy Use

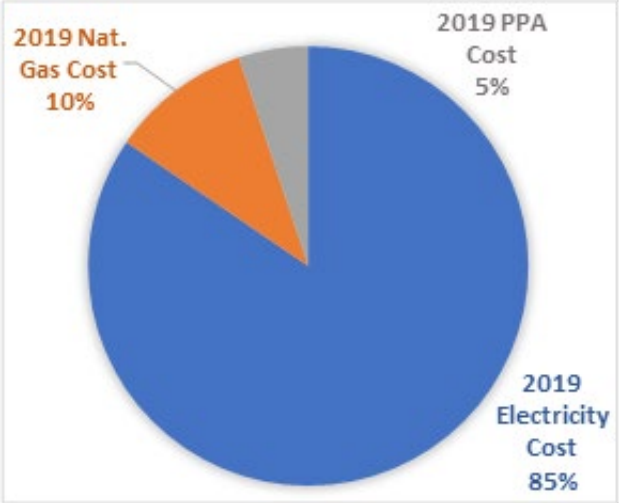
This pie chart shows the portion grid-sourced electricity, natural gas, and on-site solar electricity use contributed to the department's total energy use for 2019 (see below).



2019 Total Energy Use: 30,082 MMBtu

Figure 37. PD – 2019 Energy Cost

This pie chart shows the portion costs from grid-sourced electricity, natural gas, and on-site solar electricity use contributed to the department's total energy costs for 2019 (see below).

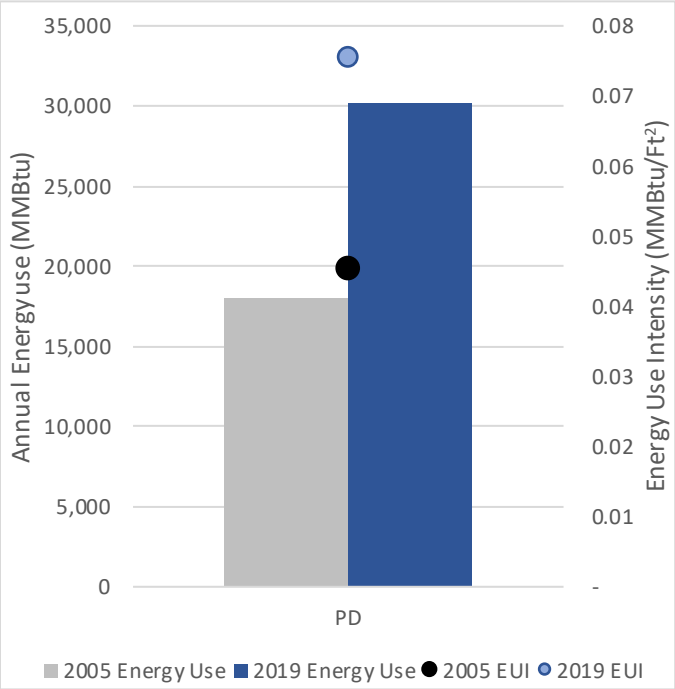


2019 Total Energy Cost: $985,996

Comparison to Baseline

Figure 38. PD - Total Energy Use & EUI Comparison

The bars in this graph represent the total energy used by Police Department facilities and buildings in 2005 (grey) and 2019 (dark blue), measured on the primary Y axis (left). The EUI for the department is measured on the secondary Y axis (right), with the black dot representing EUI in 2005 and the light blue dot represents EUI in 2019.

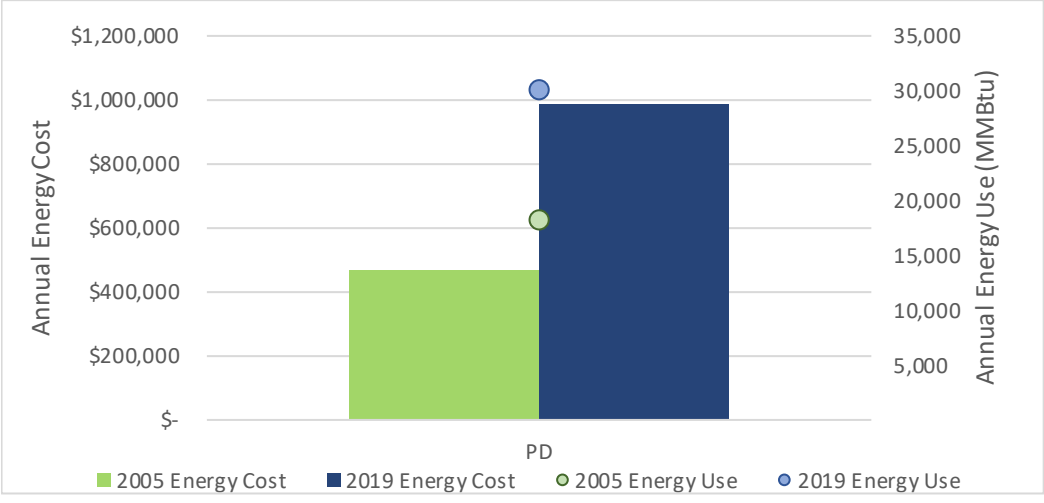


From 2005 to 2019, the Police Department saw a 66% increase in total energy use (see **Figure 38**). Natural gas use more than doubled, and electricity use increased by 43%. PD's overall energy use intensity was also worse, with a 0.03 MMBtu/ft² increase, in 2019 than in 2005. The increase in total energy use likely reflects new buildings being built and added to PD's portfolio, such as 300 Richards and the Public Safety Building being re-classified as PD after 2005. Further analysis is necessary to determine why the departments energy use intensity increased as well.

As seen in **Figure 39**, total energy cost to more than double for PD from 2005 to 2019. This is the result of natural gas costs more than tripling from 2005 to 2019; electricity costs increasing by 91% as well. While inflation and higher energy rates may have been a factor in the increase of total energy cost, higher natural gas and electricity use from new or additional buildings may have contributed more significantly to the increase in PD's total energy costs.

Figure 39. PD Energy Cost & Use Comparison

This graph shows the Police Department's annual energy cost and use in 2005 (green) and 2019 (blue). The bars represent annual energy cost and are measured on the primary Y axis (left), while the circles represent annual energy use, and are measured on the secondary Y axis (right), during the respective years.



Largest Accounts

The Sacramento Police Department works to ensure all residents can work, play, and live in a safe community and environment. The Police Department has multiple office buildings and substations in which they operate. Substations as well as the 911 Dispatch Facility are not easily comparable to other office buildings due to their hours of operation and the energy demand required for their services. These facilities are running 24 hours a day, 7 days a week, unlike an office building which typically operates during standard business hours.

Since 2016, the Kinney Police Facility and Rooney Substation have converted to LED lighting.

Figure 40, below, shows use of grid-sourced electricity from SMUD and EUI for the Police Department's largest buildings in the baseline year of 2005 and current calendar year of 2019. Electricity produced and used from on-site solar PV systems is not included.[23] As such, 300 Richards total electricity use is greater than what is represented in **Figure 40**. As mentioned above, 300 Richards was acquired after 2005, thus there is no baseline data available to compare to. Even still, 300 Richards had the highest grid-sourced electricity costs in 2019 when compared to PD's largest buildings. 300 Richards electricity EUI is in line with the EUI of similar buildings, such as the Public Safety Administration Building. However, further analysis of 300 Richards total electricity EUI, including on-site solar electricity use, is needed to ensure that these buildings truly have comparable EUI values. These buildings both use significant amounts of electricity and should be regularly monitored and audited for potential opportunities to further improve energy efficiency and reduce electricity use.

Most of PD's largest buildings saw a reduction in electricity use from 2005 to 2019, with Kinney Substation realizing the largest reduction of 35% and Rooney Substation achieving the lowest at 14%. These total electricity use reductions led to improvements in EUI from 2005 to 2019, as well. Kinney Substation saw the largest reduction in electricity EUI at nearly 40%, followed by Rooney with 25% reduction in EUI, while PSAB and Police Property saw electricity EUI decrease by approximately 20%.

Despite these improvements in electricity EUI and reductions in electricity use, only Kinney Substation saw their electricity costs decrease by 15% from 2005 to 2019. PSAB saw electricity costs increase by 12%, while Police Property's increased by 3%, and Rooney's electricity costs remained constant. PSAB had the second highest electricity costs out of PD's largest buildings in 2019, as such audits, analysis, and review of PSAB may be necessary to identify energy efficiency improvements that could provide PD with future cost-savings.

The 911 Dispatch Facility stands out amongst PD's largest buildings due to the dramatic increase in electricity use from 2005 to 2019; 911 Dispatch electricity use and costs were nearly five times higher in 2019 than it was in 2005. This dramatic increase in electricity use was potentially caused by IT Department servers being moved to the 911 Dispatch Facility after 2005. Further review and analysis of the 911 Dispatch Facility could identify any necessary retrofits or energy efficiency improvements.

[23] See **Appendix B** for a detailed description of the limitations of the City's energy data, database, and benchmarking system.

Figure 40. Electricity Use – PD Largest Accounts

This graph presents electricity use and EUI for the Police Department buildings included in the City's 25 Largest Accounts. Electricity use in 2005 (grey) and 2019 (blue) are represented as bars and measured on the primary Y axis (left), while electricity EUI in 2005 (black) and 2019 (blue) are represented as dots and measured on the secondary Y axis (right).

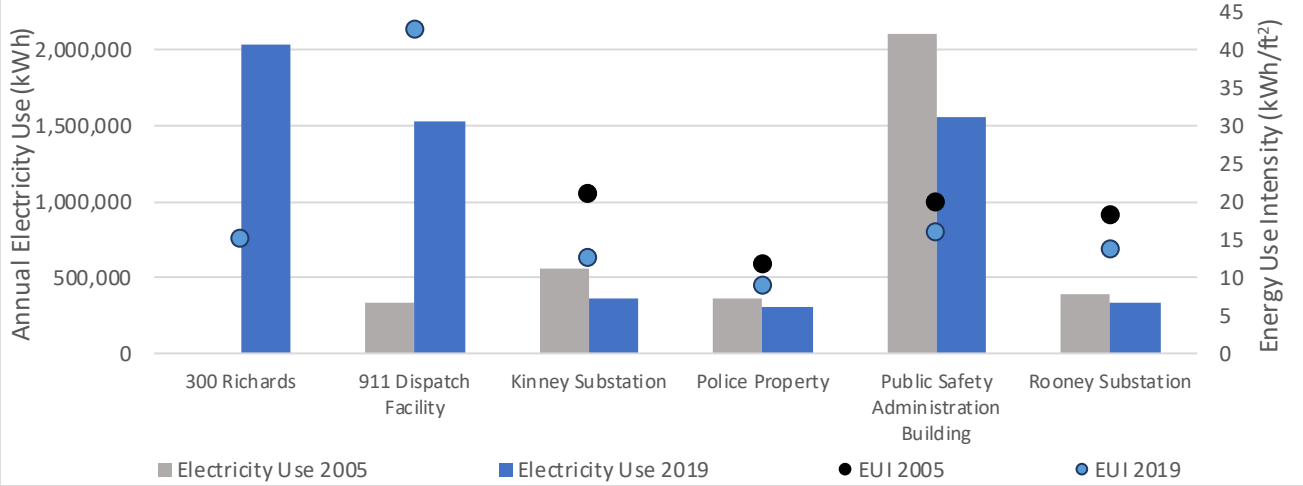
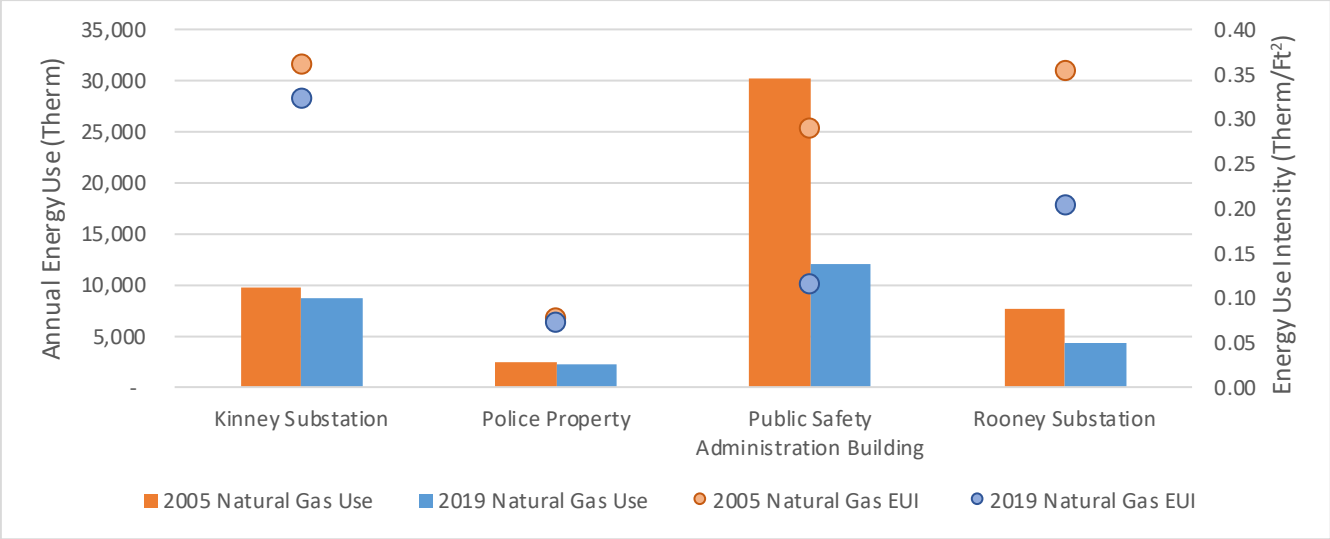


Figure 41 presents natural gas use and related energy use intensity for PD's largest accounts. This graph reveals that all of PD's largest accounts realized reductions in natural gas use and EUI improvements from 2005 to 2019. Public Safety Administration Building (PSAB) saw a 60% reduction in natural gas use, while Rooney Substation reduced natural gas use by 43% from 2005 to 2019. Interestingly, PD's total natural gas use increased during this time; revealing that another account or accounts not included in this graph have seen a significant increase in natural gas use. As such, further analysis and review of PD natural gas accounts is necessary to identify which building or buildings have seen an increase in natural gas use, and therefore could be potential candidates for energy efficiency improvement projects.

Despite reductions in natural gas use for PD's four largest accounts, natural gas costs did not decrease for all four facilities. Kinney Substation saw a 7% increase in natural gas costs from 2005 to 2019, while the Police Property facility's natural gas costs remained constant. In line with their greater natural gas use reductions, PSAB and Rooney Substation realized 40% and 30% reduction in natural gas costs, respectively, from 2005 to 2019.

Figure 41. Natural Gas Use – PD Largest Accounts

This graph presents natural gas use and EUI for the Police Department buildings included in the City's 25 Largest Accounts. Natural gas use in 2005 (orange) and 2019 (blue) are represented as bars and measured on the primary Y axis (left), while natural gas EUI in 2005 (orange) and 2019 (blue) are represented as dots and measured on the secondary Y axis (right).



Youth, Parks & Community Enrichment (YPCE)

The Youth, Parks & Community Enrichment Department works to create healthy, strong, and cohesive neighborhoods throughout Sacramento by providing and maintaining parks and enrichment programs. YPCE manages 16 community centers, over 400 sports fields, courts, and playgrounds, and much more. YPCE operates 261,804 sq. ft. of building space, representing 6% of the City's total building space. YPCE is composed of four divisions.

Divisions:

- Youth Development
- Community Enrichment
- Park Maintenance, Safety, Planning & Facilities
- Neighborhood Services

In 2019, LED retrofits were completed in 12 community centers.

Since 2008, four YPCE buildings have received HVAC replacements.

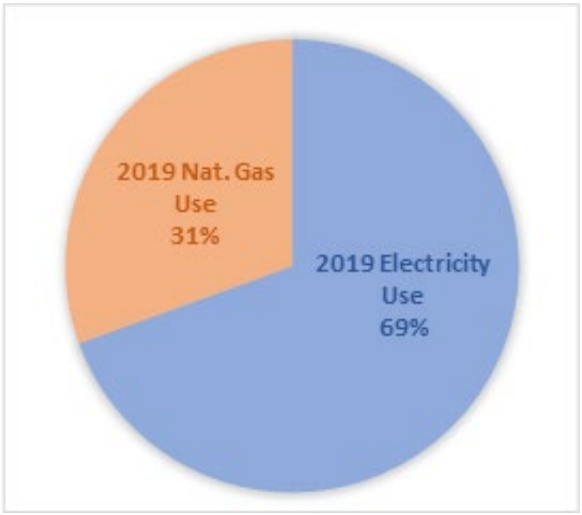
From 2014-2016, ten City-owned public pools had VFD systems installed.

2019 Total Energy Use & Cost

In maintaining and managing the City's parks and public gathering spaces, YPCE accounted for less than 10% of the City's total energy use and cost in 2019. Of the Department's energy use, 69% was from grid-sourced electricity (SMUD), and the remainder was natural gas, as shown in **Figure 42**. Nearly 90% of YPCE's energy cost were for electricity, with natural gas costs accounting for only 12% of YPCE's total energy costs for 2019, as shown in **Figure 43** below. Electricity costs likely comprise a large portion of YPCE's total energy costs due to unique non-building systems such as park lights and irrigation systems, which may operate during peak hours, when electricity rates are higher. Community centers may also be more likely to be open during peak hours, again resulting in higher electricity rates being applied.

Figure 42. YPCE – 2019 Energy Use

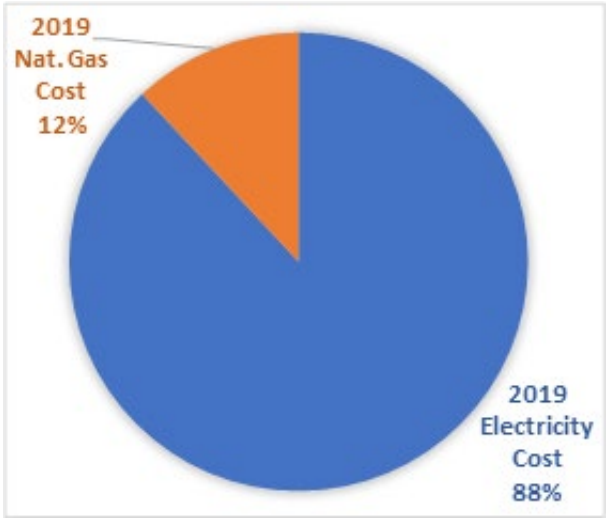
This pie chart shows the portion grid-sourced electricity, natural gas, and/or on-site solar electricity use contributed to the department's total energy use for 2019 (see below).



2019 Total Energy Use: 25,392 MMBtu

Figure 43. YPCE – 2019 Energy Cost

This pie chart shows the portion costs from grid-sourced electricity, natural gas, and/or on-site solar electricity use contributed to the department's total energy costs for 2019 (see below).



2019 Total Energy Cost: $1,015,279

Comparison to Baseline

Figure 44. YPCE - Total Energy Use & EUI Comparison

The bars in this graph represent the total energy used at YPCE facilities and buildings in 2005 (grey) and 2019 (dark blue), measured on the primary Y axis (left). The EUI for the department is measured on the secondary Y axis (right), with the black dot representing EUI in 2005 and the light blue dot represents EUI in 2019.

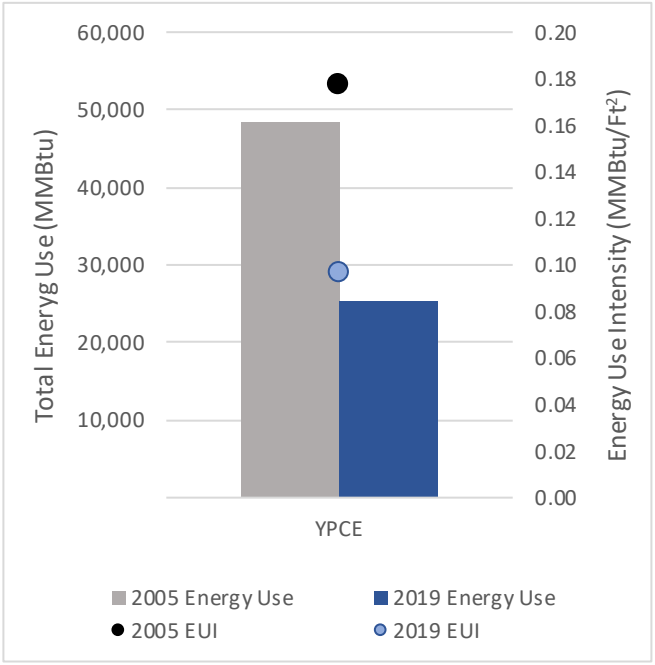
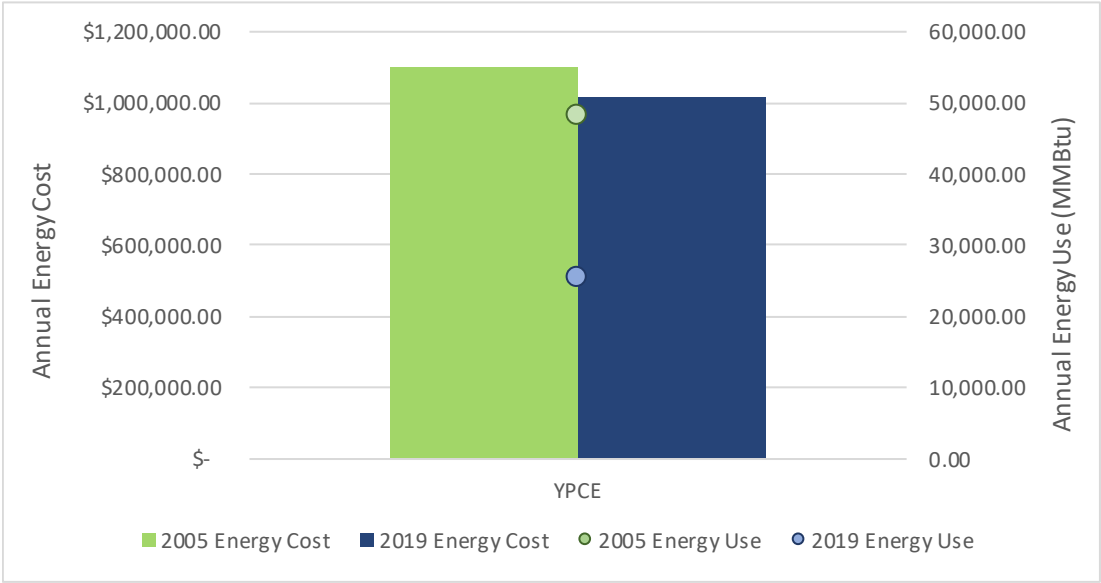


Figure 44 reveals that, from 2005 to 2019, YPCE reduced total energy use by nearly 50% and EUI by 55%. This is largely due to a 71% reduction in total natural gas use, as well as a 20% reduction in total electricity use. The reduction in natural gas use led to a 59% reduction in natural gas cost as well. YPCE saw an 8% reduction in total energy cost from baseline to 2019, despite an 11% increase in electricity cost (see **Figure 45**). These energy and cost reductions could be due to the numerous retrofits and energy efficiency projects completed within YPCE facilities. The City has replaced HVAC systems with more efficient models at four community centers since 2005. In 2014, the City began retrofitting 10 City pools with VFD systems to increase efficiency of the pools water filtration and circulation systems. The Pannell Community Center also received boiler replacements in 2012. And by 2019, LED lighting retrofits were completed in 12 community centers.

Figure 45. YPCE Energy Cost & Use Comparison

This graph shows YPCE's annual energy cost and use in 2005 (green) and 2019 (blue). The bars represent annual energy cost and are measured on the primary Y axis (left), while the circles represent annual energy use, and are measured on the secondary Y axis (right), during the respective years.



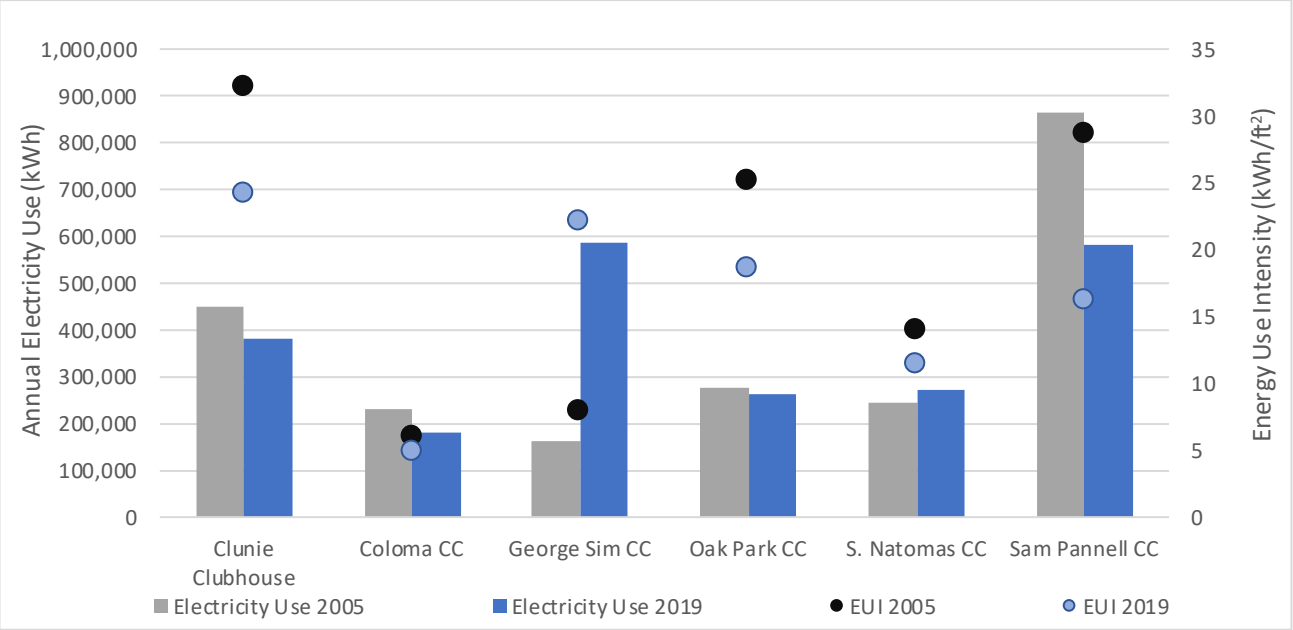
Largest Accounts

The largest buildings maintained and managed by YPCE are community centers and clubhouses. While community centers have similar building systems and hours of operations, some of Sacramento's community centers have public pools on-site. Many of these pools do not have separate meters, and therefore, energy used for a pool filtration system may be included as energy used at respective community centers.

Most of YPCE's largest accounts realized reductions in their electricity use and EUI from 2005 to 2019, as shown in **Figure 46**. South Natomas and George Sim Community Centers saw increases over 10% and 200% in electricity use, respectively. While South Natomas Community Center still achieved an 18% reduction in electricity EUI, George Sim Community Center's EUI nearly tripled from 2005 to 2019. In line with the increase in electricity use, George Sim saw energy costs more than triple from 2005 to 2019. Comparatively, Coloma Community Center achieved a 16% reduction in electricity EUI from 2005 to 2019, and saw electricity costs increase by 10%, while South Natomas Community Center's electricity costs only increased by 4% during this time. Further, Oak Park Community Center achieved a 26% reduction in electricity EUI, and electricity costs for the Center increased by 14% from 2005 to 2019. Sam Pannell Community Center was the only one of YPCE's largest buildings to see their electricity costs decrease (by 20%) from 2005 to 2019. Further analysis of these buildings will be required to determine if inefficient building systems are causing electricity use to increase, or if it reflects an increase in services.

Figure 46. Electricity Use – YPCE Largest Accounts

This graph presents electricity use and EUI for YPCE buildings included in the City's 25 Largest Accounts. Electricity use in 2005 (grey) and 2019 (blue) are represented as bars and measured on the primary Y axis (left), while electricity EUI in 2005 (black) and 2019 (blue) are represented as dots and measured on the secondary Y axis (right).

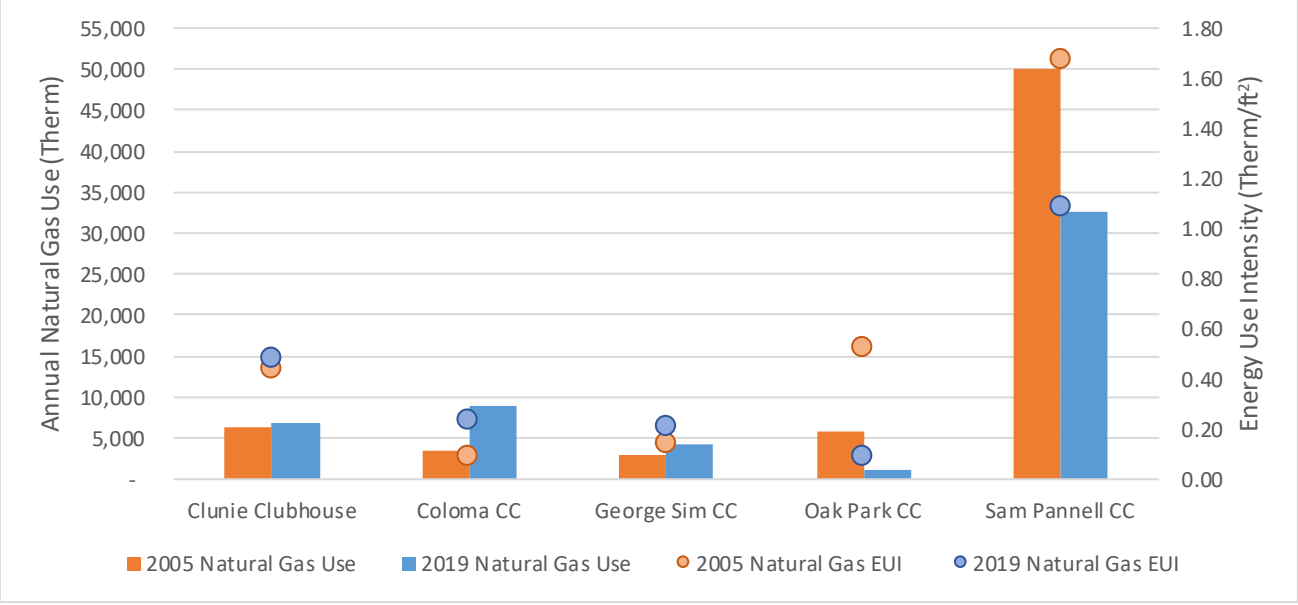


Natural gas use and EUI for YPCE facilities in 2005 and 2019 are represented in **Figure 47**, below. Similar to electricity use at these buildings, Sam Pannell and Oak Park Community Centers saw reductions in natural gas use – with Oak Park's use nearly cut in half - and relative EUI from 2005 to 2019. The 35% reduction in natural gas use at Sam Pannell Community Center was likely due to the retrofits completed there in 2012. From 2005 to 2019, Clunie Clubhouse's natural gas use and EUI increased by approximately 10%. Similarly, Coloma and George Sim Community Centers used more natural gas in 2019 than in 2005, with Coloma's natural gas use nearly three times higher in 2019 than in 2005. In line with this increase, Coloma's natural gas EUI nearly tripled as well. Review or audit of these buildings systems could determine if these increases are due to energy inefficiencies or other underlying factors.

Natural gas costs followed similar trends for YPCE's largest facilities. From 2005 to 2019, Oak Park and Sam Pannell Community Center's natural gas costs reduced by 70% and 11% respectively, while natural gas costs for Clunie Clubhouse, Coloma and George Sim Community Centers increased. Coloma Community Center natural gas costs nearly quadrupled, while George Sim's costs doubled from 2005 to 2019. Review or audits of these buildings could identify cost-saving retrofit options for YPCE and the City as a whole.

Figure 47. Natural Gas Use – YPCE Largest Accounts

This graph presents natural gas use and EUI for YPCE buildings included in the City's 25 Largest Accounts. Natural gas use in 2005 (orange) and 2019 (blue) are represented as bars and measured on the primary Y axis (left), while natural gas EUI in 2005 (orange) and 2019 (blue) are represented as dots and measured on the secondary Y axis (right).



Accomplishments & Opportunities

The City's 2016 IO CAP identified key policies and projects the City should implement to reduce municipal GHG emissions and increase efficiency and sustainability of municipal operations. It identified specific projects and changes that contributed to the 24% reduction in municipal GHG emissions achieved from 2005 to 2013. New goals are expected to be established through the 2040 General Plan update and the Mayors' Commission on Climate Change – both of which are underway during the development of this report and contributing analysis. Below, innovative policies and projects that have contributed to the energy use reductions across City facilities to-date are highlighted along with suggestions for future potential project opportunities for departments, divisions, or buildings.

Accomplishments

The City of Sacramento understands the environmental, social, and economic benefits of building, maintaining, and operating energy efficient buildings and facilities. Since 2005, the City has reduced total energy use at City facilities by 34% as of 2019. This led to a 13% reduction in energy costs when adjusted for inflation, and an estimated 47% reduction in GHG emissions from 2005 to 2019. These reductions in energy use, GHG emissions, and costs would not have been possible without targeted efforts by the City to implement numerous energy efficiency projects and interventions.

Since 2005, the City has **reduced total energy use** at City facilities by **34%** as of 2019.

This led to a **13% reduction** in **energy costs when adjusted for inflation**, and an estimated **47% reduction in GHG emissions** from 2005 to 2019.

These reductions in energy use, GHG emissions, and costs would **not** have been **possible without** targeted efforts by the City to implement **numerous energy efficiency projects.**

In 2004 – prior to adoption of specific energy reduction goals – City Council adopted a resolution establishing a goal that all new and remodeled City facilities meet a minimum Leadership in Energy and Environmental Design (LEED) Sliver building Standard. Since then, seven new City facilities have been constructed to and/or achieved LEED Silver or Gold certification; the Sacramento Valley Station renovation project earned the highest level with a LEED Platinum certification.

The 2035 General Plan was adopted in 2015; this update established the City's Green Building Retrofit policy encouraging that all retrofits and renovation projects meet LEED Silver standards or equivalent, as appropriate (Land Use Policy 8.1.5).[24] These policies have solidified a focus on energy efficiency within the City, ensuring that all new projects utilize the most energy efficient building systems as feasibly possible.

[24] With adoption of the EV Strategy in December 2017, City Council also adopted a policy to require all new or renovated City-owned buildings to provide chargers at all mandatory EV-ready spots required by CalGreen, and to require the provision of additional EV-ready spaces pursuant to CalGreen Tier 2 standards for electric vehicle charging (Motion 2017-0374).

Since 2005, the City has implemented numerous retrofit projects that have saved energy and reduced both GHG emissions and energy costs. Beginning in 2009, the City has implemented numerous LED retrofit projects across the City. To date, the City has completed LED retrofits at all City-owned traffic signals, over 15,000 City-owned and maintained streetlights, 24 libraries and community centers, five parking garages, and three municipal buildings.

All building systems require energy from electricity or natural gas to operate. However, as technology has advanced through the years, so has the efficiency of building systems. For example, variable frequency drives (VFDs) can be installed in HVAC and pool filtration systems to reduce energy waste and maintenance costs. Systems with VFDs are able to operate with less electricity, and only increase demand as necessary, such as when filters become clogged or blocked. The City has completed eight HVAC replacement or retrofit projects since 2007, at four community centers, one library, and three Fire Department and Public Works buildings. In 2014, the City began retrofitting 10 City pools with VFD systems to increase efficiency of the pools water filtration and circulation systems. The Pannell Community Center and Central Library also received boiler replacements in 2012 and 2011, respectively.

Each of these projects have contributed to reducing the City's energy consumption from 2005 to present day. Without these targeted energy efficiency projects, the City's energy costs and GHG emissions would have contributed to creating much more devastating impacts to the City and community to date. It is imperative that the City continue to prioritize and implement decisive energy efficiency projects across municipal facilities to safeguard a sustainable future for City operations, and the community as a whole.

Opportunities

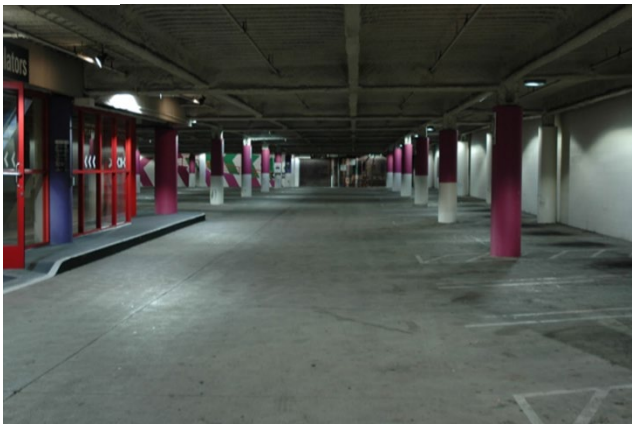
The achievements and retrofit projects mentioned above were implemented when systems reached end-of-life or as funding and political will allowed; these projects were largely implemented without a comprehensive, data-driven decision-making process or prioritization tool. In order to continue to achieve energy usage reductions, cost savings, and GHG emission reductions, buildings and facilities with inefficient systems will need to be identified and strategically prioritized to optimize available funding, resources, and staff time across departments. In spite of progress and improvements the City has made thus far without an energy benchmarking system in place, this report reveals the numerous opportunities for targeted energy efficiency projects that will ensure the City continues to reduce GHG emissions and achieve General Plan and IO CAP goals and targets. Below are some key areas of action; Appendix A also provides a scorecard of the City's 25 largest buildings based on each buildings EUI performance compared against a correlating national average EUI.

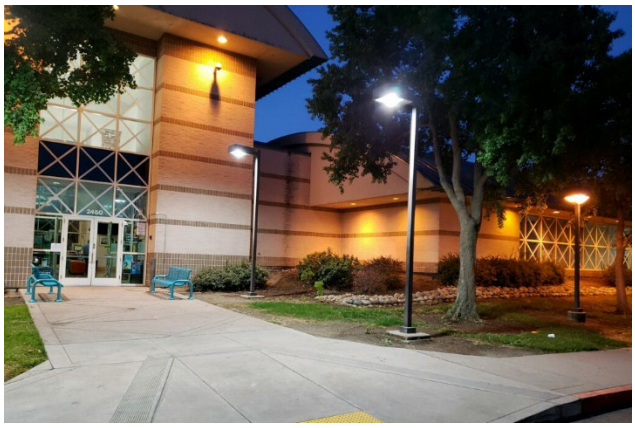
CDD	Identify key projects or retrofits to further **reduce natural gas use**, specifically at **Front Street Animal Shelter**
DPW	Review or audit: • **Meadowview City Services Complex** to understand **natural gas energy use intensity** **New City Hall** for **electricity use** and systems **NACY for natural gas** use and systems Fund and complete **LED retrofit of streetlights** **Reconcile streetlights data** between SMUD & City data management systems
Fire	Identify key projects or retrofits to further **reduce** the Department's **natural gas use** • Further benchmarking of Fire Stations and buildings to determine why overall energy use increased from 2005 to 2019
PD	Identify key projects or retrofits to further **reduce** the Department's **natural gas use** • **HVAC retrofits** for **300 Richards and Kinney** substations, as well as an audit or review of natural gas use and systems at Kinney • Energy audit of **Rooney, Public Safety Administration Building (PSAB) and 911 Dispatch** to identify **electricity retrofit projects**
YPCE	Review or audit: • **Sam Pannell Community Center** should be prioritized for **natural gas** retrofit projects • **George Sim Community Center** prioritized for **electricity** retrofit projects • **Clunie Clubhouse** prioritized for **electricity and natural gas** retrofit projects

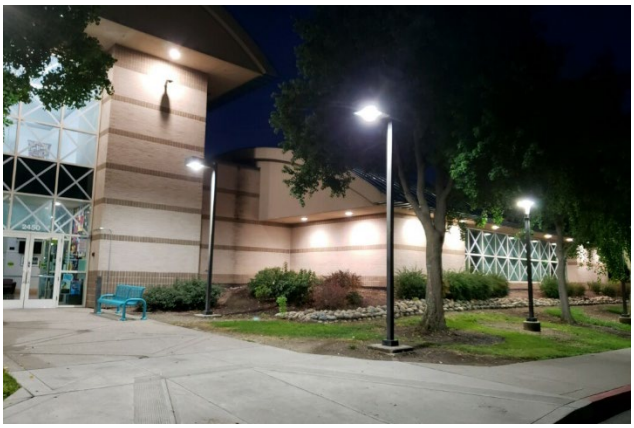
Conclusion

With the adoption of the first IO CAP in 2010 and update in 2016, the City of Sacramento has established bold energy consumption and GHG emission reduction goals, and has since already surpassed 2020 targets. Since the baseline year of 2005, the City has significantly improved and reduced energy consumption associated with municipal operations. Energy used at municipal buildings and facilities has reduced by 34% from 2005 to 2019, and related GHG emissions are estimated to have reduced by as much as 47%. Despite these reductions, energy costs increased by 13% from 2005 to 2019. Analysis of energy use intensity at the building-level and department level revealed potential for systems inefficiencies, which can be resolved through further investigation and retrofit projects. These upgrades will allow the City to continue to realize cost-savings while also achieving energy consumption and GHG emissions reductions goals. The Annual Benchmarking Report and supporting documents will continue to serve as a prioritization tool for staff and decisionmakers to implement essential energy efficiency projects, and continue to see improvements to Sacramento's health, environment, and economy.

Before **After**







Appendix A: Scorecard for City's 25 Largest Buildings

Utilizing Energy STAR's customized reporting capabilities, the energy use intensity, or EUI, of the City's largest accounts was compared to corresponding national benchmarks in Energy STAR. The reference benchmarks include the national median site EUI and GHG emission intensity estimates. In Energy STAR, each City building is classified under a building type; through these classifications Energy STAR compares each building to an appropriate national median EUI based on building type. The City's largest accounts were then evaluated against each other based on the difference between 2019 EUI for each account and the corresponding national median EUI, as well as their GHG emissions intensity, or kilograms (kg) of carbon dioxide equivalent (CO_2e) emitted per square foot. With these values, staff compared efficiency of the largest buildings to help prioritize where retrofits may provide the greatest benefit. Results are depicted in **Table A1** below, ranked based on the percentage difference from national median site EUI.

Table A1: 2019 Municipal Building Scorecard – Largest Municipal Buildings[25]

Property Name	% Difference from National Median Site EUI	Total GHG Emissions Intensity (kgCO2e/ft²)
Animal Control	331.5	14.9
911 Dispatch[26]	271.5	12.8
Sam Pannell Community Center	200.1	12.6
Clunie Clubhouse	176.8	9.3
North Area Corp Yard (NACY)	164.4	6.7
Rooney Police Facility	42.6	5.2
Public Safety Administration	-13.2	4.7
300 Richards Blvd	-15.6	5
Meadowview Service Center	-21.6	2.9
Central Library	-23	3.2
New City Hall	-32.6	2.1
24th Street Corp Yard	-56	2.4
Coloma Community Center	-62.1	1.5
Sacramento Valley Station[27]	-94.7	0.1

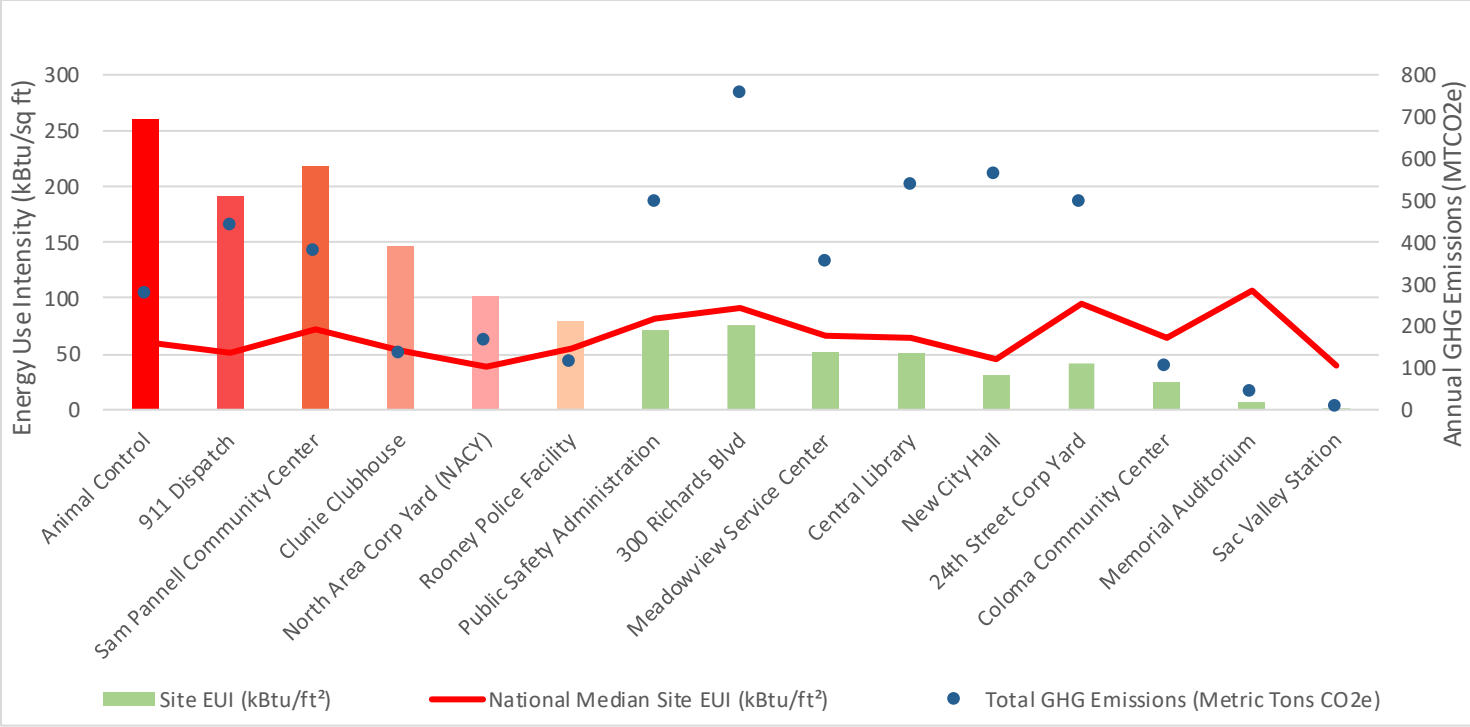
[25] Energy STAR data downloaded 4/27/2020; several of the 25 Largest Accounts such as Memorial Auditorium had missing data and therefore were not included in the table. It is possible that accounts included in the table may have incomplete data as well. Garages are not included in **Table A1**, as Energy STAR did not provide a comparison national median site EUI.

[26] 911 Dispatch building classified as a Police Station in Energy STAR and was compared against the national median site EUI for Police Stations. While police stations operate similar hours to 911 Dispatch, other factors such as level of occupancy and energy demand of services may cause 911 Dispatch centers to require more energy. Further analysis of the systems within this building is necessary to determine if inefficient systems are indeed the lead cause for this discrepancy.

[27] Sacramento Valley Station 2019 EUI may be inaccurate. At present, the City's meter supports some tenant uses in addition to electricity utilized in the public area of the Station.

Figure A2 provides another representation of the Municipal Building Scorecard shown above. The bars represent each building's total energy use intensity (kilo-British thermal units/ft^2). The red line represents the national median site EUI for the respective building type. The bars colored red represent the buildings that are above the associated national median EUI. The blue points represent the annual GHG emissions ($MTCO_2e$) resulting from the energy use at each building.

Figure A2. Sacramento's Largest Municipal Buildings Site EUI, National Median Site EUI, and Annual GHG Emissions.



Appendix B: Data Sources & Limitations

In order to utilize this report effectively, it is important that the strengths, weaknesses, and limitations of the City data and benchmarking process are identified and understood. A detailed description of how this report was developed and the limitations of the City's energy database and data can be found below. The intent of this appendix is to inform readers of assumptions within this report, as well as considerations for understanding the analyses within it.

Municipal Energy Benchmarking Report Development

To accurately portray the full picture of the City's municipal energy data, this Municipal Energy Benchmarking Report, including its data and corresponding narrative, was developed from the sources listed in **Table B1**. EnergyCAP and the Tesla platform were utilized to develop all the figures in the body of the report. The City's financial system, eCAPS, was utilized to validate the energy costs reported in EnergyCAP and the Tesla platform. Finally, the City's General Plan, IO CAP, as well as internal staff interviews shaped the narrative of the report by highlighting the City's energy efficiency and greenhouse gas emissions reduction goals, identifying causal factors contributing to outliers in the data, potential limitations in the data, and projects resulting in energy reductions.

Table B1. Data Sources for the Municipal Energy Benchmarking Report

This table displays the main sources of data used to develop the Municipal Energy Benchmarking Report. Column 1 includes the names of each data source, while Column 2 details the purpose or use for data from the respective source.

Data Source	Purpose
EnergyCAP[28]	• SMUD & PG&E-provided energy use and cost data on a calendar year-basis • Building area and information (year built, etc.)
eCAPS[29]	• Expenses paid to SMUD, PG&E, and Tesla (formerly SolarCity, parent company Sequoia Pacific Solar) in the baseline and current fiscal year
General Plan[30]	• City greenhouse gas reduction goals, Building standard for new municipal buildings[31]
IO CAP[32]	• City's internal energy efficiency and greenhouse gas reduction goals, strategies, and accomplishments or progress made as of 2013
Tesla platform	• On-site solar PV system energy production and cost for current calendar year
Internal Staff Interviews	• Develop narrative around outliers (i.e., evaluating high or low energy use, cost, etc.) • Identify potential gaps or misleading data • Confirm projects and efforts to date

[28] EnergyCAP

[29] Electronic Citywide Accounting and Personnel Systems (eCAPS); the City currently uses Oracle's PeopleSoft Enterprise Resource Planning (ERP) system. eCAPS is the City's core business system used by all City departments, Charter Offices and Mayor/Council to process financial transactions, payroll operations, budget activities, and human resources (HR) administration.

[30] General Plan

[31] Policy LU 8.1.5 states new or renovated City-owned buildings meet LEED Silver or equivalent standards

[32] IO CAP

Municipal Energy Benchmarking Report – Figure Development

Data was pulled from the City's building energy database, EnergyCAP, in order to create the graphs throughout this report. This online system stores energy bill data for all City accounts and meters (SMUD and PG&E), but does not include on-site solar data, or energy use for non-metered accounts such as SMUD-owned, City-maintained streetlights. Each month City staff upload bill data provided by SMUD and PG&E on a weekly basis, and this data is stored in the system under the associated meter or account name and number. Within the system, each meter has additional data stored, such as the SMUD or PG&E assigned meter name, account number, and additional descriptive information such as building name and floor area. Each meter is classified within EnergyCAP under one specific City department (it does not allow for one meter or account to be classified for multiple departments), and the corresponding department division or other sub-classification, such as Split Accounts or Streetlights for the Department of Public Works.

EnergyCAP provides automated energy report outputs, which simplify aggregating and presenting energy use, energy cost, EUI, and other values for electricity and/or natural gas at the department, sub-classification, building, account, or meter level. Reports can also present data from lists or classifications created by the user. For example, the City of Sacramento developed a classification for the City's 25 Largest Accounts, or those with the largest associated building area. These reports can show data by monthly values, or aggregate data to be shown as a yearly total for building-related accounts only. EnergyCAP reports for energy use, cost, and EUI for the calendar years of 2005 and 2019 were downloaded and analyzed at the department level and for the City's 25 Largest Accounts.

Data from the EnergyCAP reports was then cleaned and compiled in various Excel worksheets in order to develop the graphs used in this report. The department totals for electricity and natural gas use and costs were added together to find the City values. In order to calculate total energy use and EUI for the departments and City total, the electricity use and natural gas use values were converted to MMBtu and added together; these values were then divided by the corresponding department or City total floor area to provide the total energy EUI value. The GHG emissions from municipal building energy use was calculated by multiplying the electricity and natural gas use by electricity and natural gas $MTCO_2e$ coefficients from the City's IO CAPs, for both 2005 and the coefficients from the City's most recent 2016 GHG emissions inventory for 2019 emissions calculations. As noted throughout the report and in this Appendix, data limitations within EnergyCAP and other underlying factors result in potential inaccuracies in the graphs and data presented in this report. These potential issues and considerations are addressed below.

Data Limitations

EnergyCAP serves as an effective online database to store, track, and monitor the City's building energy data. Nonetheless, some limitations still exist. In previous analyses of municipal building energy use, staff discovered that when EnergyCAP reports were run at the department level – compiling all electricity and/or natural gas use for all associated accounts – some accounts were dropped from the report. For example, a report for 2005 energy use may have dropped energy use for any account that was operational in 2005 but had been closed since. This resulted in inaccurate department totals, as well as inaccurate City totals for energy use and cost. In order to mitigate this reporting inaccuracy, the dropped accounts would have to be manually identified and added into the department and City totals. In an attempt to keep this report replicable on an annual basis, this thorough and complex manual

correction process was not conducted. As such, the department level and City values for energy use, cost, and EUI may be underrepresented in this report.

Within each account, there are concerns of missing data as well. Bills are generally reported on a monthly cycle. Once a month, after the data has been shared by the energy provider, a City staff member uploads the previous month's billing data from SMUD and PG&E. Due to the manual nature of this work, there have been some accounts that are missing for a few to several months, resulting in omissions of energy use and cost data. On occasion duplicates of the same bill have been uploaded for several accounts. Further, several buildings have had their account or meter numbers changed, leaving the City with a list of active and inactive accounts. When comparing energy use from 2005 to 2019, active and inactive accounts were included to ensure calculations for building energy use are inclusive of all historical data, including from accounts that are currently inactive, but were active in 2005. Nonetheless, due to errors in coding these inactive accounts, natural gas use data from 2004 to 2008 was not included in EnergyCAP reports for some buildings and facilities, resulting in a potential undercounting of natural gas use in 2005. While City staff have corrected and removed most of the bill duplicates, missing data has been unresolved for several accounts and can be difficult and extremely tedious to locate in all cases. As such, comparisons of energy use and cost in 2005 and 2019 may be slightly inaccurate, since missing months of data could have led to a more significant, false reduction in energy use and cost. Notwithstanding the foregoing, City staff believe that data is within a reasonable margin of error.

Data from EnergyCAP was analyzed on a calendar year basis. This was done to provide an accurate picture of energy use throughout the entire year, as weather and seasons have an impact on building energy use. Energy cost data in EnergyCAP was also analyzed by calendar year simply for ease of data downloads to ensure a replicable benchmarking system is established. The energy costs in the City's eCAPS system are analyzed by fiscal year (July 1 – June 30) and differ slightly from data in EnergyCAP. Due to the fact that eCAPS data represents actual payments made, it was determined that these numbers may be more accurate and reliable for internal planning. It is important to note, unlike EnergyCAP, energy expenses in eCAPS are only available at an aggregated level: total energy expenses paid to utility vendors are available by department ID and operating unit. However, eCAPS does not track energy payments by account. All energy expenses are aggregated by the utility provider receiving the payment. By comparison, EnergyCAP does not include fiscal account information; rather than organize data by fiscal codes, data is sorted based on utility account code and occupant department. EnergyCAP costs do not reflect any true-ups or cost allocations that occur through the annual cost plan allocation process. For example, while eCAPS indicates that minimal costs are assigned to the City Manager's Office and Human Resources, neither of these departments are responsible for entire buildings or utility accounts, and neither is indicated in EnergyCAP.

As a test to validate energy cost data stored in EnergyCAP, EnergyCAP reports were run on a fiscal year basis for 2019. The EnergyCAP and eCAPS energy expense values for fiscal year 2019 reported $14.3 and $13.9 million in SMUD-sourced electricity and PG&E natural gas expenses, respectively (see **Table B2**). The inconsistencies could reflect accounting omissions in eCAPS, such as invoices that are paid but not attributed to the utility account code (462011) and fall within other general expense categories. Additionally, the billing period for SMUD and PG&E differs slightly for each account; this could cause certain bills to be included in a later month, or even calendar or fiscal year. For example, payments made for June 2019 energy use may not have been processed prior to the end of the fiscal year; as such these payments would have been excluded from the eCAPS report, while it may have

appeared in the EnergyCAP system. Conversely, the inconsistencies could also reflect double billing in EnergyCAP, or double-counting accounts in the EnergyCAP reports or downloads, as several City accounts are split accounts and house several departments. In all, costs are relatively comparable and indicate a low margin of error.

Table B2. eCAPS v. EnergyCAP SMUD and PG&E Cost Comparison

This table represents the differences in Department allocations/titles and values for SMUD and PG&E payments in FY19 found in eCAPS (column 2) and EnergyCAP (column 3). These values may differ due to: report downloading process for EnergyCAP, variance in when expenses are recorded (eCAPS only captures once payments made, EnergyCAP captured from when bill shared), as well as other potential coding/reporting errors noted in the Appendix B.

Department	eCAPS Total (FY19)	EnergyCAP Total (FY19)
ICS / IT*		$35,518
City Manager	$2,658	-
Police	$359,250	$960,506
Fire	$421,329	$420,497
Public Works	$2,884,962	$3,826,803
Convention and Culture	$1,516,968	$1,528,432
Parks and Rec	$1,217,459	$1,081,605
Community Development	$87,825	$90,084
Citywide and Community Support	$1,109,280	-
Utility	$6,302,728	$6,342,459
HR	$11,698	-
TOTAL	**$13,914,157**	**$14,285,904**

While eCAPS allowed a review of all energy payments to SMUD, PG&E and SolarCity/Tesla for the City's on-site PV systems, SMUD and PG&E are the only two energy providers for which the City stores energy data in EnergyCAP. The City utilizes on-site solar photovoltaic systems owned by Tesla (formerly SolarCity) at five City facilities to power electricity; however, electricity produced and payments made to SolarCity/Tesla for maintaining and operating these systems is stored in a separate online database. Thus, the electricity consumption for these five City facilities is underrepresented in EnergyCAP reports. While total energy use, costs, and EUI at the City and department level were calculated in Excel in order to include on-site PV energy use and costs, these values were not included at the building level. Electricity use, cost, and EUI values were pulled straight from EnergyCAP reports on the City's Top 25 Largest Accounts. This was done, again, in an effort to keep the benchmarking system simple enough to replicate on an annual basis. Thus, the electricity use, cost and EUI represented in the Largest Account graphs do not represent the total electricity and EUI for New City Hall, Meadowview City Complex, South Area Corp Yard, and 300 Richards.

Finally, the diversity in the classifications of City accounts can also lead to data limitations. Streetlights are a prime example. The City has operated streetlights served by SMUD grid-electricity for years. Older lights were installed without a meter and remain unmetered, while new streetlights and some retrofitted streetlights have had meters added. Many of these unmetered streetlights are fully functional and charged by SMUD at a fixed rate. However, because these streetlights are not metered, the City does not know exactly how much electricity is used by these lights each month. These non-building

accounts are included in the EnergyCAP reported totals for each Department. As such, this leads to an under-representation of the Department of Public Works' total electricity use. While the complex nature of streetlight data under-represents the Department of Public Works total electricity use, including non-building energy use in department level EUIs can skew these values as well.

Energy use intensity per floor area, or EUI, is a measure for normalizing and comparing building energy use. When non-building energy use is included when calculating a building or department's EUI, this value is falsely inflated, due to the increase in energy use with no relative increase in building area. As such, including non-building accounts in department level EUI can lead to inaccurate portrayal of a department's building energy efficiency. For example, departments such as DOU or DPW have more non-building meters than other departments. This will cause DOU and DPW EUI to appear higher than reality. Thus, care must be taken when reviewing and comparing department-level EUI values seen in this report.

In developing the Municipal Building Energy Benchmarking Report, City staff gained great insight into the strengths, weaknesses, and complexity of the City's energy use data. As staff capacity increases and systems improve, data quality and reliability will continue to improve as well. As the first iteration of this report, the development process was a learning experience for all involved. Improvements will be made as feasible in the years to come.