

# Case Study: Water Heating Electrification

City of Burlingame



**August 2022**

Compiled by the [Empower Procurement Program](#) implemented by [Prospect Silicon Valley](#), with funding from the California Energy Commission. Send questions or comments to [e-buildings@prospectsv.org](mailto:e-buildings@prospectsv.org).

# Executive Summary

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The Empower Procurement Program, working under a grant from the California Energy Commission, contacted the City of Burlingame about potential building electrification projects. The City agreed to start by replacing two gas water heaters with heat pump units, which was a turn-key project with incentives covering 66% of the total cost. The City then decided to replace the water heaters in four additional buildings. The work was done through the Government and K-12 Energy Efficiency Program (GK12) designed and implemented by Willdan and administered by Pacific Gas & Electric (PG&E).

To meet the City's greenhouse gas (GHG) reduction goals it is critical to electrify existing buildings, which are by far the largest category of reduction potential. These projects alone created 40% of the typical annual, municipal greenhouse gas (GHG) reductions the City achieved between 2005-15.

The Empower Procurement Program's E-Buildings team will use projects such as these to highlight building-specific procurement barriers and make recommendations for reducing them to the California Energy Commission.

## Background

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Building electrification is one of the largest sources of potential GHG reductions in California. Local governments can help lead this market shift by setting an example with their own municipal buildings. Many of the challenges they face are not technical but procurement issues, such as getting approvals for less familiar technology and using total cost of ownership to weigh purchase options.

To study building-specific procurement challenges, the Empower Procurement Program formed an E-Buildings team that helps local government facilities and sustainability managers plan and execute projects. It then describes these projects in case studies, which it will share with municipal facilities and sustainability managers statewide to help start discussions about the challenges of zero-carbon procurement.

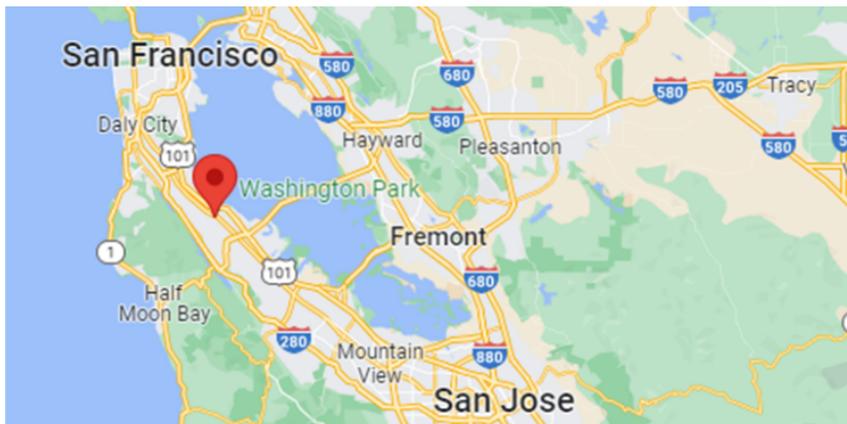
Based on this research gathered from actual projects, the E-buildings team will make recommendations to the California Energy Commission on how to further promote public building electrification. The Empower Procurement Program is implemented by Prospect Silicon Valley, and the E-buildings team can be reached at [E-Buildings@prospectsv.org](mailto:E-Buildings@prospectsv.org).

## Project Description

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The City of Burlingame is 16 miles south of San Francisco. Its population is about 30,000 people and its climate is temperate (Climate Zone 3). The City operates 17 buildings totaling approximately 440,000 sq feet. The E-Buildings team contacted the City of Burlingame through its Facilities and

Fleet Division Manager, Mr. Johnson Woo, to learn if the City would be interested in receiving assistance to replace gas equipment with high efficiency heat pumps.



Burlingame, population 30,000

Mr. Woo provided information about a range of natural gas appliances including two boilers, a furnace, and two hot water heaters. It was decided to start with the water heaters, since they were due for replacement and incentives were easiest to access.

## Pre-visit

Since Burlingame has both gas and electric service from PG&E, the E-Buildings team found the applicable incentive source was the GK12 Program designed and implemented by Willdan and administered by PG&E. The E-Buildings team introduced Mr. Woo to GK12 staff and scheduled a site visit to assess existing conditions.

By email and phone calls with Mr. Woo, the following were confirmed before the site visit:

- The buildings' utility account is eligible for incentives.
- Capacity between 30-80 gallons would be appropriate for the replacement water heater units.
- It would be acceptable for the new units to be enrolled in PG&E's demand response program.

In preparation, questions were also asked about drainage, ventilation, and available space for the new units.

## Site visit

Both water heaters were located in the Corporate Yard. Table 1 summarizes the information gathered.

**Table 1**

|   | <b>Corporate Yard:<br/>Auto Shop</b> | <b>Corporate Yard:<br/>Office and Laundry</b> |
|---|--------------------------------------|---|
| Existing gas water heater   | 76 gallons                           | 76 gallons                                    |
| Installation date   | 2002                                 | 2002  |
| Distance to electrical panel  | Approximately 100' distance          | Panel is adjacent                             |
| Panel space for 220V/30amp breaker                                  | Yes                                  | Yes   |
| Drain for condensation line   | In place                             | In place                                      |
| Air exchange in the room meets specifications for proposed new unit | Yes                                  | Yes   |

One of the most important tasks of the site visit was to confirm access to 220V power, required for all units offered by the GK12 program at the time. Mr. Woo explained the water heaters must be powered from designated panels connected to emergency power sources, because the Corporate Yard is an emergency gathering point for the City of Burlingame.

## Procurement

### Equipment and services to be provided

All units provided by the GK12 Program meet the stringent requirements of CA Title 24, Joint Appendix 13. These include meeting ENERGY STAR standards, being demand-response enabled, and having a 10-year warranty. The City opted for the program's turnkey option, in which the installation and equipment are sole sourced, the installation is performed by program-qualified contractors, and the workmanship has a one-year warranty.

### Project cost

GK12 Program staff provided pricing for 50, 65, and 80-gallon units and discussed sizing with Mr. Woo to understand capacity requirements. The auto shop had a shower that was no longer used and the laundry machines were rarely used. It was therefore decided to downsize the auto shop unit to 50 gallons and the office unit to 65 gallons.

PG&E's GK12 program incentive covered over 75% of the entire project cost for the office/laundry unit. For the auto shop unit, which had higher costs due to the long electric run, the program covered nearly 60% of the total cost including all equipment, labor, and removal of the old equipment. All labor was quoted using prevailing wage, as required by the City of Burlingame.

Before the incentive amounts could be estimated, the City of Burlingame had to finalize its budget for the coming year. Mr. Woo requested \$15,000 for two heat pump water heaters, to be conservative. However, the actual copy for the first two was much lower, so Mr. Woo requested quotations for similar replacements in the fire station, library, police station, and parks yard buildings as well. The fire station had a different decision maker and, in the end, the replacement did not occur. However, the three other replacements that Mr. Woo was in charge of did.

## Documents

For each phase, the GK12 team provided the following documents as a single package through a DocuSign link.

**Table 2**

| Document  | Notes  |
|---|--|
| Incentive Commitment Letter   | For the City's records.  |
| GK12 Program Participation Agreement (PPA)                          | Signature required, to reserve the incentives and file the project with PG&E.                    |
| Contractor Quotes   | Signatures required for each.  |
| Memo to Program Participants, PG&E AutoGrid Demand Response Program | Document explaining the demand response program in which the new water heaters will participate. |
| Participation Agreement, AutoGrid Demand Response Program           | Signature required before installation. The enrollment will be completed post installation.      |

The only additional document needed was a contract with the installer so the City could make its co-payment directly to them.

## Permits

The City of Burlingame confirmed both phases could be treated as water heater replacements. Therefore, the permits were over the counter and did not require construction documents.

## Installation

Both phases were turnkey and were done by Enovative Mechanical and Energy Services, a qualified vendor in the GK12 program. The first two units were installed in June and the remaining four were completed in August 2022.

# Environmental Benefits

Table 3 presents the GHG reductions the City achieved by replacing five water heaters. These calculations use the methods approved by the California Public Utilities Commission and are based on the efficiency of the existing gas water heater, the efficiency of the replacement unit, and typical hot water usage based on building type.<sup>1</sup>

**Table 3: Estimates of GHG reductions using the methods approved by the California Public Utilities Commission**

| Facility   | Corp Yard: Auto shop | Corp Yard: Office and Laundry | Library | Police Station | Parks Yard | Total |
|--|----------------------|-------------------------------|---------|----------------|------------|-------|
| 10-yr lifetime GHG Reduction (MTCO <sub>2</sub> e) | 33                   | 26                            | 46      | 25             | 34         | 164   |

Using the 10-year lifetime that is standard for these calculations, Table 3 estimates annual savings of 16.4 metric tons of CO<sub>2</sub> equivalent (MTCO<sub>2</sub>e). As seen in Figure 1, which presents the data from its [Climate Action Plan](#), the City of Burlingame reduced total annual municipal emissions by 406 MTCO<sub>2</sub>e between 2005-15, or 29% of the 2030 target.<sup>2</sup> This project alone will create almost 40% of the typical annual, municipal reduction achieved between 2005-15. Another 991 MTCO<sub>2</sub>e are needed to meet the 2030 reduction target compared to 2005 levels.

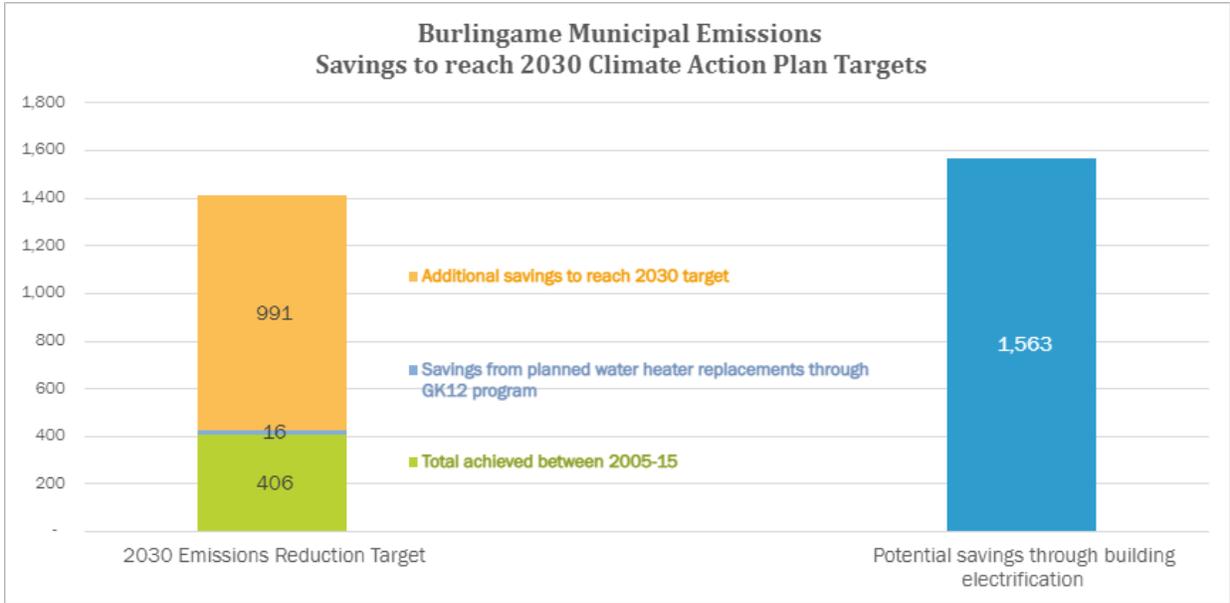


Figure 1: Comparison of savings data (Burlingame Climate Action Plan PUBLIC DRAFT (08-27-2019), p 26)

<sup>1</sup> <https://www.cpuc.ca.gov/about-cpuc/divisions/energy-division/building-decarbonization/fuel-substitution-in-energy-efficiency>

<sup>2</sup> [Burlingame Climate Action Plan PUBLIC DRAFT \(08-27-2019\)](#), p 40

Existing buildings are the largest category of potential GHG reductions by far for Burlingame. As seen in Figure 2a, buildings were responsible for 40% of 2015 municipal emissions but from Figure 2b they were also the source of 77% of recent savings.

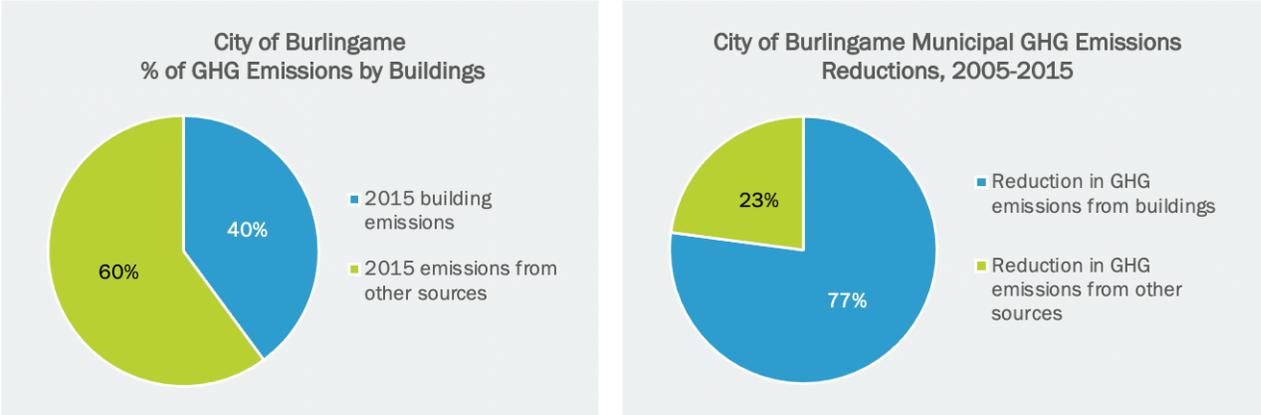


Figure 2a: City of Burlingame municipal energy usage Figure 2b: City of Burlingame municipal GHG reductions

The savings shown in Figure 2b were achieved mainly by upgrading lighting to LEDs and consuming greener electricity. As of 2021, the City purchases 100% renewable energy for its municipal accounts, so the bulk of future savings will come from electrification. The experience gained from this small project will be invaluable when planning electrification projects of larger gas heaters and achieve much larger savings. Doing so as quickly as possible will be necessary for Burlingame to meet its municipal operations GHG reduction goals of 40% in 2030, 60% in 2040, and 80% compared to 2005 by 2050. *Completely decarbonizing all municipal buildings would achieve half of the 2050 goal for municipal operations.*

## Key Learnings / Discussion Points

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1. When the E-buildings team first approached Mr. Woo, his main barriers were cost and time required. The GK12 program, led by Willdan, made procurement easy with large subsidies, high quality products, turnkey installation, and a single package of documents.
2. It should be standard practice to proactively replace any aging gas water heater with a heat pump water heater.
  - a. Each purchase of a gas replacement unit removes a precious opportunity to make progress toward GHG reduction goals.
  - b. With the current incentives in PG&E territory, replacing gas heaters with heat pump units may cost less than buying more gas heaters.
  - c. With current supply chain restraints, heat pump units can have longer lead times, so end-of-life replacements should be done early, rather than upon failure of the existing equipment.
  - d. Electrifying larger equipment such as furnaces, rooftop units, and boilers is much more complex. Cities should therefore replace their water heaters first to obtain GHG reductions as quickly as possible and get experience for larger projects.
3. Between 2005-2015, the City of Burlingame reduced annual, municipal emissions by 406 MTCO<sub>2</sub>e, or about 41 MTCO<sub>2</sub>e/year. The 16.4 MTCO<sub>2</sub>e annual reduction from this project is 40% of this typical annual reduction.
4. Between 2005-15, the City achieved 29% of its 2030 goals. Much of this was likely achieved by upgrading to LED lighting. Now that the City's municipal buildings use 100% renewable electricity, upgrading lighting to LEDs will actually increase GHG emission because the lower heat output from LEDs results in greater natural gas consumption for space heating.
5. The GHG savings calculations presented in this case study assume the typical energy mix determined by the CPUC. Since the City of Burlingame purchases 100% renewable energy for its municipal accounts, its actual savings would be larger.
6. Heat pump units may also have health benefits related to improved indoor air quality.
7. Since this project began, the capacity range of eligible products has increased. The GK12 Program now offers units that are 30, 50, 65, 80, and 120 gallons.
8. Local governments should be aware of all available procurement tools. Although it did not apply for this project, Government Code 4217 is particularly valuable to help municipal governments.

# Questions

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1. To obtain pre-visit information, which is more likely in your organization?
  - a. We would physically look at the equipment.
  - b. We would look up the information in a database.
  - c. We would do some of both.
  - d. Not sure
2. What would be some barriers to scheduling site visits?
3. In your municipal buildings, how likely would it be that installing a heat pump water heater would require increasing 220V panel capacity?
  - a. Not likely
  - b. Somewhat likely
  - c. Very likely
  - d. Not sure
4. The Corp Yard's water heaters were oversized for their current loads. How likely is that some of your current water heaters are also oversized?
  - a. Not likely
  - b. Somewhat likely
  - c. Very likely
  - d. Not sure
5. Being familiar with your procurement standards, GC 4217 and relevant precedent can help you streamline contracting to control project complexity, costs, and schedules. How confident are you that your organization makes full use of these?
  - a. Not confident
  - b. Somewhat confident
  - c. Very confident
  - d. Not sure
6. In your organization, what do you see as the biggest barrier to doing a project similar to the one described for City of Burlingame?
7. Would you like the E-Buildings Team to contact you about potential projects in your existing buildings?