

## Introduction

Davis's University Retirement Community (URC) is one of many retirement communities styled to provide on-site medical services, a community similar to a university, and a quiet place to live. The URC was built in 2000 on five acres and has 208 full-service community units, serving around 600 meals a day. In addition, the URC has a 51-bed nursing center, a spa, indoor and outdoor swimming pools, and other amenities. The URC provides these amenities to over 400 residents ensuring their health and prosperity. To help them continue to offer their services at a stable price with the rising cost of energy and the ever-changing weather events, we will outline steps to achieve energy efficiency. To ensure that California's progressive electric vehicle policy is supported we will also provide a feasibility study of installing electric vehicle charging stations.

## Objectives

- **Complete energy audit**
  - Provide insight into energy efficiency for:
    - Hot water system
    - Chiller
    - HVAC
- Options for adopting **electric vehicle charging infrastructure:**
  - Partnering with a vendor for operation and management
  - Fully owning and operating

## Methods

- Completed an energy audit for the entire URC
- Does not include the commercial kitchen because we were not able to collect equipment information
  - Assumed remaining energy after adding all other current equipment to be from the kitchen

- Two site visits at the URC
- Collected information on all current equipment including:

- Residence appliances
- HVAC system
- Heat pump
- Generators/pumps
- EV Chargers
- Water heater
- Lighting



Figure: The University Retirement Community (Davis Enterprise, 2014).

Electric Vehicle Charging Station with Operation and Management Partner:

- ChargePoint as operation and management partner
- Considerations:
  - Ease
  - Time management
  - Warranty
  - Tiered pricing
  - Insight into site make-ready
  - Trusted in-network contractors
  - Experience with multi-family dwellings

## Results

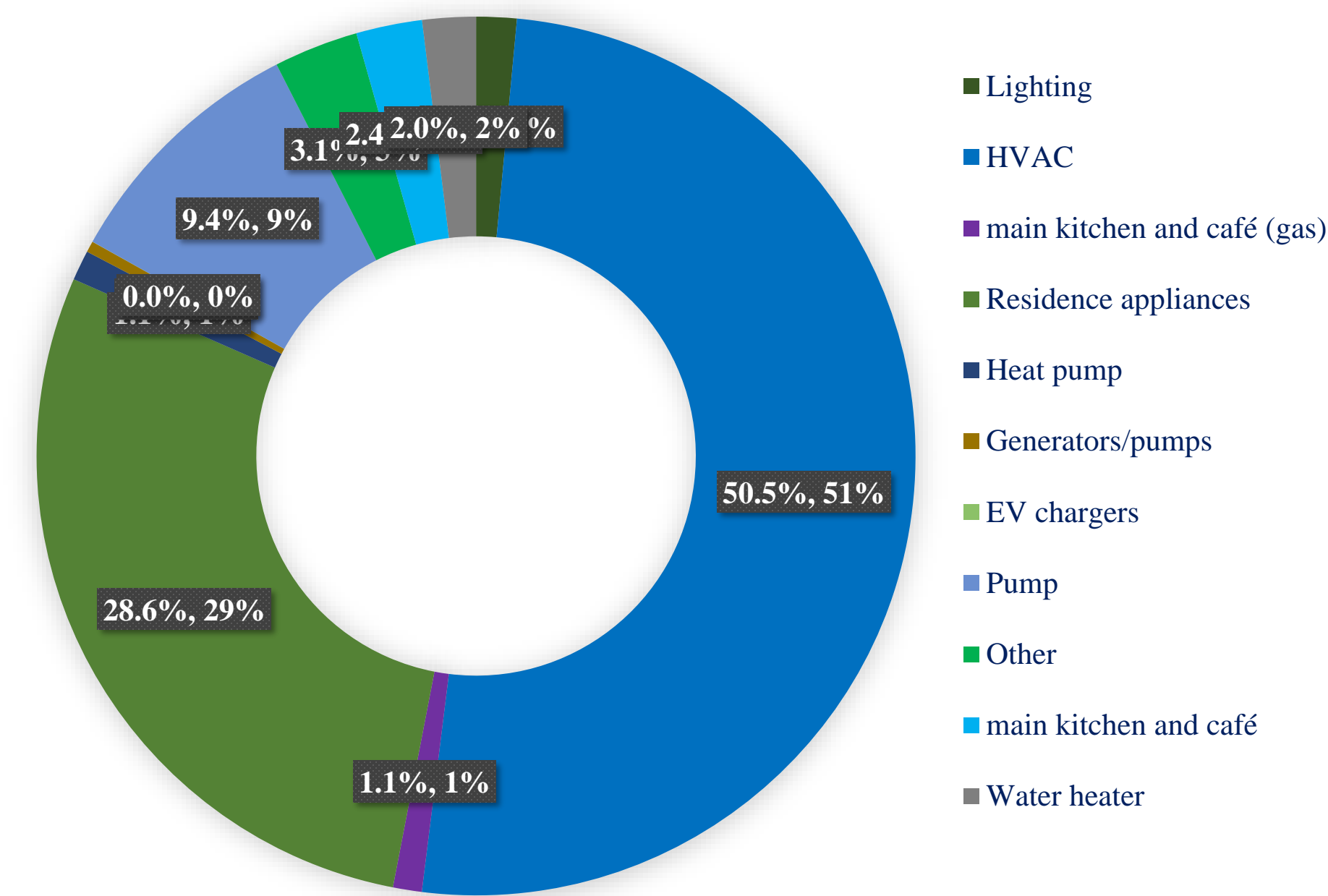


Figure: Audit Residential Energy Usage Breakdown

### HVAC

- The apartments use water source heat pumps for heating and cooling fed by 3 Crest condensing boilers installed in 2018.
  - These systems carry the potential to be most efficient when programmed correctly.
  - The heat pumps are over 20 years old
- Electrifying the whole system has a high investment cost of ~\$30,000
  - However, is 25% more efficient and can save up to \$390 per user.
  - Operating life of about 15 years (same as other system) and will not affect the existing equipment like radiators. (Lang et. al., 2021)
- The garden units and cottages use split systems which consists of an indoor unit and ducts carrying the refrigerants that run to the outdoor unit or the compressor.
  - Different control strategies can be used to enhance these systems and make them more efficient.
  - Air curtain installations and use of solar air heating systems can also help save a significant amount of energy and tremendously reduce the associated energy costs. (Teke & Timur, 2014)

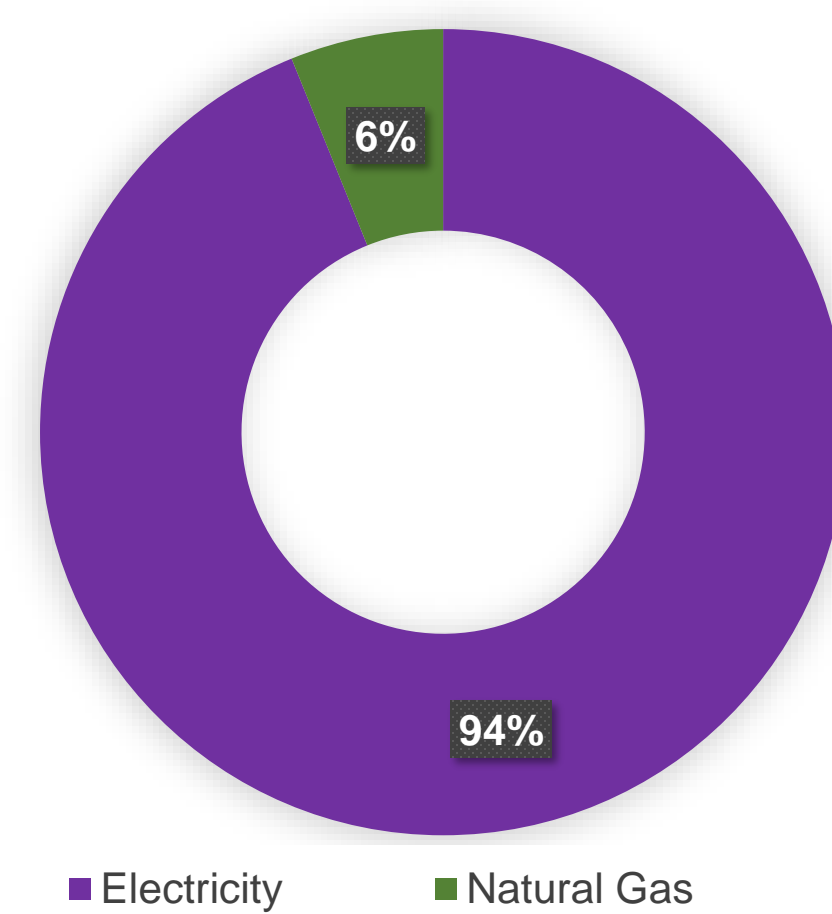


Figure: Energy Sources

### Hot water system

- Current system: Direct-vent instantaneous water heater
  - Consumes approximately 292,000 kBtu annually
  - Operating life of about 15 years
  - Efficiency: ~81%
- The current cooling tower is already as efficient as possible and there is no need for energy efficiency upgrades

## Results Continued

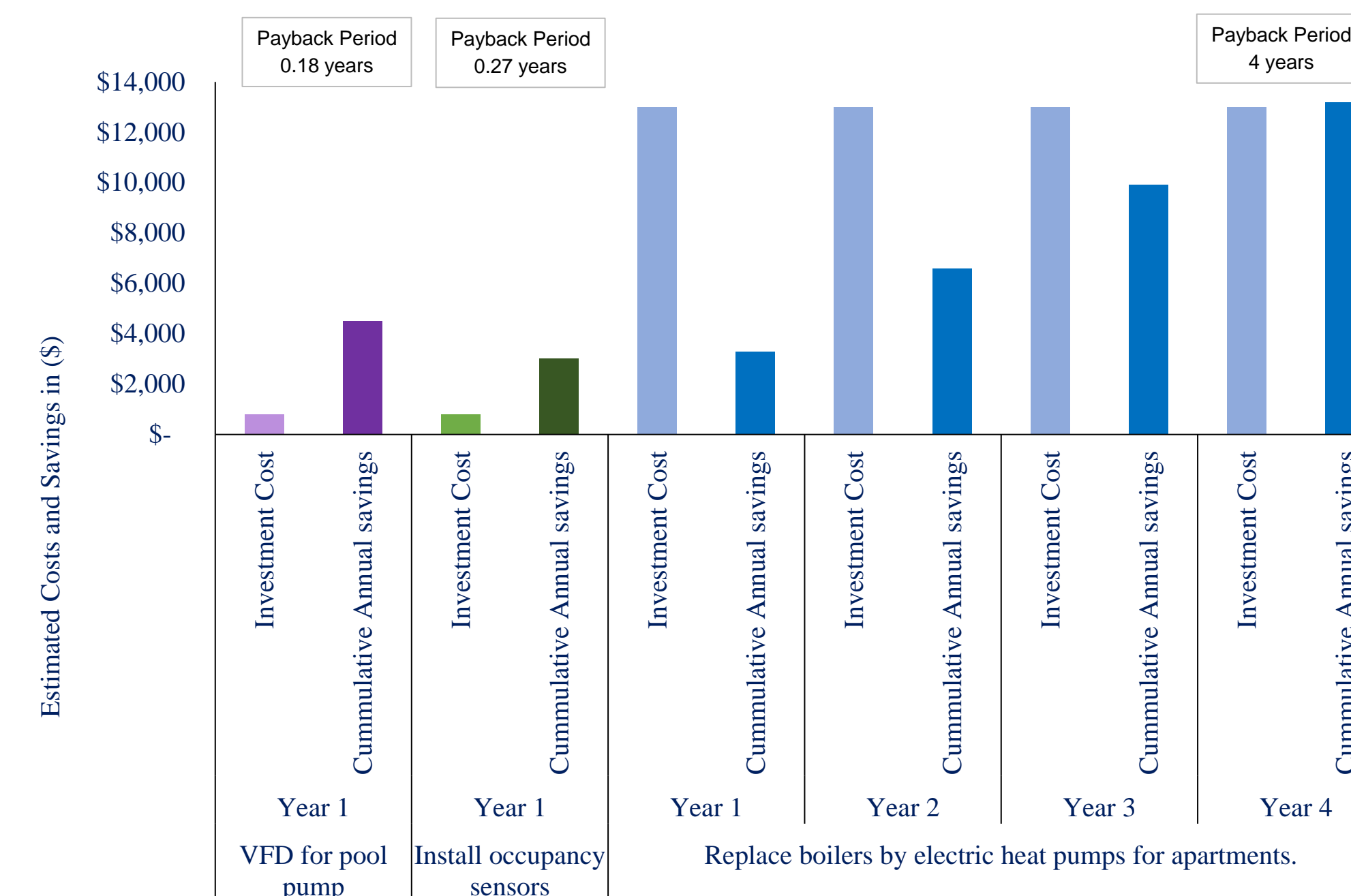


Figure: Recommended areas for Energy Savings

## Final Recommendations

### HVAC

- The water source heat pump system is better than the split systems in terms of efficiency. Most of the equipment has been recently replaced with highly efficient equipment and have a long life still. Any unit that fails can be replaced at end of life.
- **Replace boilers in the apartments and indoor units (natural gas furnaces) in the garden units and cottages with air source electric heat pumps.**
  - They can provide three times more heat energy than they consume.
  - They may incur a high installation cost of \$13,000 on an average with a simple payback period of around 4 years.
- **Low cost control strategies**
  - Investigate whether the current controls for the water loop are maintaining it at 80 F based on heating or cooling mode.
  - Heating and cooling at the same time take up extra energy. The boilers and cooling towers need to be programmed correctly and avoid running them at the same time. An investigation can be recommended to see if their sequence and setpoints need to be optimized for further efficiencies. Adjusting setpoints can help save upto 30% energy on an average.

### Hot water system

- **Replace the direct vent instantaneous water heater** with an air-cooled heat pump when it reaches the end of life.
  - 3:1 ratio of energy provided to energy consumed
  - Fewer maintenance events
  - Saves an average ~\$412 dollars annually
- **Source energy from the grid.** When microgenerators are at their end of life, the URC should instead source energy from the grid.
  - Can keep their original split system
  - Reduce energy footprint with the continued addition of renewable energy
- **Install a VFD for pool pump**
  - Reduce energy consumption during non-occupancy
  - Reduce energy by up to 50%
- **Replace boilers with electric boilers.**
  - Potential to reduce their CO2 emissions up to 21% as seen in other studies (Jibran, M., 2021).

## EV Charging Stations

### Electric Vehicle Charging Station Options

- Dual-port level 2 charging station
- Assure maintenance and warranty - \$775 per year
- ChargePoint as a service - \$2160 per year per station
  - Personalized, tiered pricing
  - Online access for control and performance metrics
  - 24x7 proactive station monitoring with remote troubleshooting
  - The owner receives the revenue

### Electric Vehicle Charging Station Recommendations

- Install 1 to 2 dual-port level 2 charging stations in visitor parking near the front entrance
- Utilize ChargePoint as a service and Assure
- Offer low pricing to incentive charging during off-peak hours
- Offer stations as a convenience to future residents

### Cost for fully owning and operating the charging station

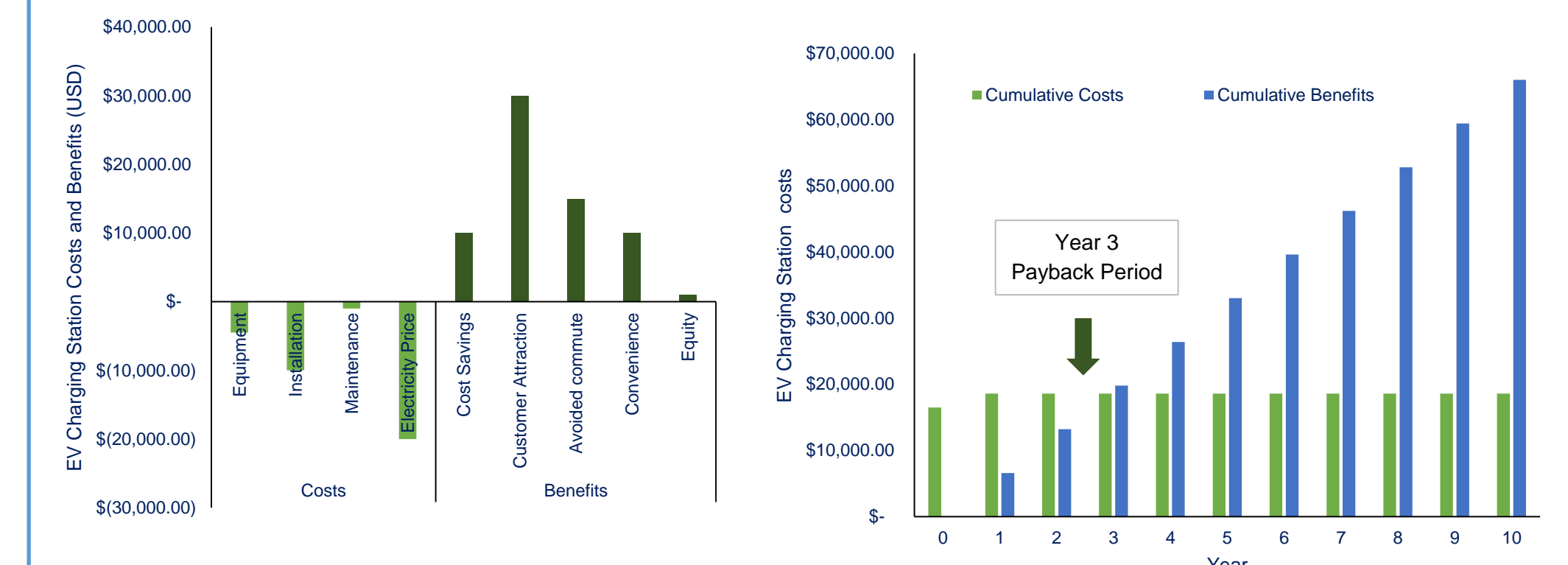


Figure: Cost Benefit analysis of EV Charging station installation at URC parking structure with a Payback period of 3 years.

### Sources of Uncertainty:

- Fluctuation in electricity prices
- The need for EV charging stations for URC community increases or decreases
- Need for maintenance
- The infrastructural change in the complex
- Change in EV vehicle or Charging equipment and installation cost.

## References

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