CITY OF PROVIDENCE

MUNICIPAL ENERGY REPORT

ACKNOWLEDGEMENTS

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GLOSSARY

Benchmarking: a means of comparing a building's energy use to the average of similar buildings or to an established baseline.

Building Management System (BMS): a computer-based control system installed in buildings that controls and monitors the building's mechanical and electrical equipment such as boilers and other heating and ventilation equipment.

Carbon Dioxide Equivalent (CO_2e): a measurement that is a simple way to normalize different greenhouse gases and other climate influences in standard units based on the radiative forcing of a unit of carbon dioxide over a specified time frame (generally set at 100 years).

Commercial Building Energy Consumption Survey (CBECS): a national sample survey that collects information on the stock of U.S. commercial buildings, including their energy-related building characteristics and energy usage data.

Heating Degree Days (HDD): indicators of energy consumption for space heating. HDD are calculated by taking the average of a day's high and low temperatures and subtracting from 65°. For example: If the day's average temperature is 50° F, its HDD is 15. If every day in a 30-day month had an average temperature of 50°, the month's HDD value would be 450 (15 x 30). HDD data comes from Weather Data Depot, an online weather data hub powered by AccuWeather©

Building Management System (BMS): a computer-based system that controls and monitors a building's mechanical and electrical equipment such as HVAC, lighting, power systems, fire systems, and/or security systems. Often used for energy efficiency, real-time views into facility operations and trend analysis can provide data to optimize energy management and minimize operational costs.

British thermal unit (Btu): a unit of heat defined as the amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit. A kBtu equals 1,000 Btu. An MBtu, or MMBtu, equals 1,000,000 Btu.

ENERGY STAR Score: a measure of a building's energy performance relative to similar properties, when normalized for weather and operational characteristics.

Energy Use Intensity (EUI): measures the energy use per square foot of a building. It is calculated by dividing the total energy consumed by the building in one year by the total gross floor area of the building. Weather-Normalized energy use intensity is the energy a property would have used if it had experienced 30 year average temperatures.

Kilowatt Hour (kWh): a unit of energy equal to 3.6 mega joules commonly used as a billing unit for energy delivered to consumers by electric utilities.

GLOSSARY

Renewable Energy Credit (REC): A Renewable Energy Credit, also known as a Renewable Energy Certificate, is a tradable non-tangible energy commodity equivalent to 1 megawatt-hour (MWh) of electricity generated from a renewable energy source such as solar energy, that has been fed into a power grid.

Site Energy: the amount of energy consumed at a specified location. It can be a mix of fossil fuel such as natural gas, and electricity that is transmitted to the facility. It can be measured at the campus, building, or sub-building level and is the basis for energy charges on utility bills.

Shoulder Months: The months of the year when it is between 45 and 65 degrees outside, generally applying to the spring and autumn months, April through June and September through October.

Source Energy: Unlike site energy use, source energy use includes losses that take place during the generation, transmission and distribution of energy.

Steam Trap: A steam trap valve allows for the discharge of condensate and non-condensable gases with a negligible loss of steam.

Variable Frequency Drive (VFD): 25% of all the world's electricity is consumed by electric motors in industrial applications. Applying a variable frequency drive (VFD) to a pump allows control of the pump's speed electronically, while using only the energy needed to produce a given flow.

Watt: a unit of power defined in the International System of Units as a derived unit of 1 joule per second, and is used to quantify the rate of energy transfer. A kilowatt (kW) equals 1000 watts, and a megawatt (MW) equals 1,000,000 watts.

Zero Energy Buildings: buildings that produce at least as much energy as they consume over the course of a year.

EXECUTIVE SUMMARY

The Providence Municipal Energy Report discloses the City's facility energy data in an effort to track progress towards the City's energy goals, increase transparency, and lead by example. The City's 2014 Sustainable Providence plan set a goal to reduce energy consumption 30 percent by 2030. Measuring and monitoring energy municipal consumption by benchmarking buildings and other facilities is critical to ensuring we are achieving this goal.

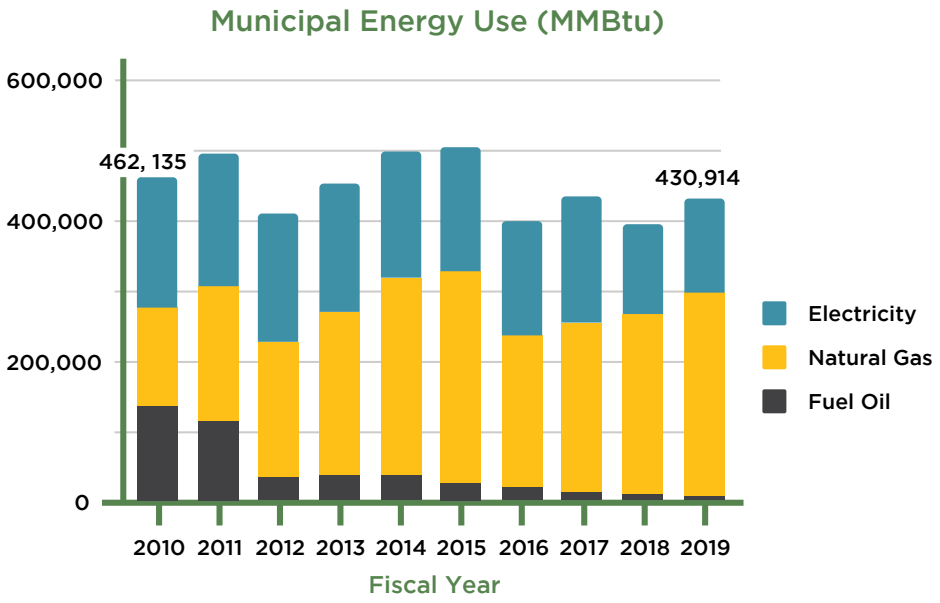

Figure 1: City of Providence's electricity, natural gas, and fuel oil consumption, FY 2010 - FY 2019.

The City of Providence has been benchmarking and monitoring its energy consumption as part of its fiscal and environmental agenda since 2010. This FY 2019 report marks the fifth annual municipal energy report released by the Office of Sustainability. The Office of Sustainability uses the U.S. Environmental Protection Agency's Energy Star Portfolio Manager to track all of the electric, natural gas, oil, and water used by City facilities. This data helps the City manage its energy consumption and identify opportunities for investment and savings. The information in this report summarizes the full dataset, which is available on the City's Open Data Portal.

The City's facilities, including buildings and outdoor lighting, used 430,914 MMBtu of energy in FY 2019 in the form of electricity, natural gas, and oil.

KEY FINDINGS

- The City used 430,914 MMBtus of energy in FY2019, a 7% reduction from our baseline year of FY 2010. Consumption was up slightly from 2018, mostly due to an increase in natural gas associated with a colder winter.
- For the third year in a row, the State's Office of Energy Resources recognized Providence with its Lead By Example award. The City was recognized in 2019 for its part in the development and hosting of the 23.1 MW Gold Medal Farm solar array in Cranston, RI.
- The City's expenditures on energy have declined by 28% since FY 2010.

- Greenhouse gas emissions from municipal facilities have decreased by 24% since FY 2010, the result of cleaner fuels, LED lighting conversions, and heating system upgrades.
- The City's electricity use, although slightly higher in FY 2019, continued its overall downward trend at about 38.9 million kWh, down from 54.5 million kWh in 2010.
- The City has reduced #2 fuel oil consumption 95% since 2010. As of December 2016, heating oil was eliminated from all City school buildings.
- The City's LED retrofit of its streetlights has saved over 31.3 million kWh since 2016, preventing 22,140 metric tons of CO_2e from entering the atmosphere. This project has saved the City about $4.8 million after project loan payments.
- 14 buildings increased their Energy Star scores between FY 2018 and FY 2019.

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INTRODUCTION

The City of Providence has been monitoring its energy consumption as part of its fiscal and environmental agenda since 2010. The Providence Municipal Energy Report presents the City's energy data publicly to showcase this work and increase transparency and accountability. It also highlights the City's leadership in making investments in energy efficiency and renewable energy over the past several years. For example, Providence's LED streetlight retrofit was recognized by the Rhode Island Office of Energy Resources (RIOER) in 2017 with their Lead by Example Award for municipalities making significant contributions toward the promotion and implementation of comprehensive clean energy measures. The City was recognized again with this award in 2019 for its part in the development and hosting of the 23.1 MW Gold Medal Farm solar array in Cranston, RI.

The 2014 sustainability plan, Sustainable Providence, set a goal for the City to "achieve a minimum of 30 percent energy use reduction by 2030 on all City-owned property." To meet this goal, the plan calls for investments in clean and renewable energy and energy efficiency projects. In 2015, Mayor Elorza called for the plan to be expanded to also include a greenhouse gas reduction goal. This was marked by his joining the Global Covenant of Mayors for Climate & Energy (GCOM), a global coalition of mayors pledging to reduce greenhouse gas emissions and enhance climate resilience. On Earth Day of 2016, Mayor Elorza reinforced his commitment to climate action by signing an executive order, committing Providence to becoming a carbon neutral city by 2050. The City reports annually to GCOM through the Carbon Disclosure Project (CDP), who tracks the City's progress on mitigating emissions, and ensuring adaptive, resilient communities and infrastructure.

Measuring and disclosing energy use is the first step in meeting the City's energy and greenhouse gas reduction goals. Under Mayor Elorza's continued leadership on fiscal and environmental responsibility, the City of Providence is following in the footsteps of many other U.S. municipalities by benchmarking its buildings and publicizing annual energy reports. Benchmarking is the practice of comparing building energy use to either other similar buildings, or historical data in an effort to manage energy consumption. Other cities that have produced similar reports in recent years include San Francisco, Boston, New York, and Seattle.

The City uses two primary energy management software applications to track all of the City's electric, gas, oil and water usage: the U.S. Environmental Protection Agency's Energy Star Portfolio Manager and Peregrine Focus. These programs allow the City to track performance on past energy efficiency projects, target buildings for new energy conservation measures, and manage energy spending.

These annual reports provide a transparent, easy to understand narrative that informs the public on City energy use. The monthly building electric, natural gas, and fuel oil consumption data from FY 2010 through 2019 used for the report is available via the Sustainability Dashboard on the City website.[1]

1: https://www.providenceri.gov/sustainability/sustainability-providence-data-dashboard/

CITY ENERGY USE

OVERVIEW

The City's facilities, including buildings and outdoor lighting, used 430,914 MMBtu of energy in FY 2019 in the form of electricity, natural gas, and oil (see Figure 1). The City has converted most of its oil-fired furnaces to natural gas, which has nearly eliminated the use of fuel oil but increased the use of natural gas. In 2019, natural gas accounted for roughly 68% of City facility energy consumption at 291,931 MMBtu. Electricity accounted for 31% of the City's total energy use at 132,732 MMBtu, while #2 heating oil accounted for only 1% at 6,251 MMBtu.

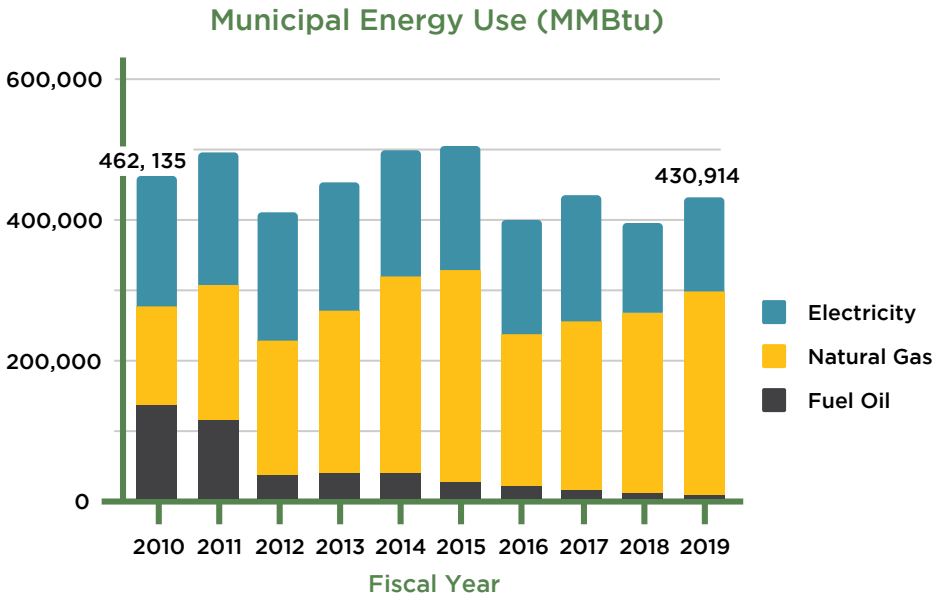


Figure 1: City of Providence's electricity, natural gas, and fuel oil consumption, FY 2010 - FY 2019.

Relative to the City's baseline year of 2010, energy consumption has declined by 7%, with some year-to-year fluctuations that are mostly attributed to weather patterns. Figure 2 shows the correlation between the City's energy consumption and weather. Weather patterns are tracked by Heating Degree Days (HDD), a standard means of normalizing energy data to weather. For example, 2012 HDD data showed an extremely mild winter; therefore the City's energy use dropped significantly. Though other factors contribute to variations in energy consumption, such as energy efficiency measures and changes in use and/or operation of the building, weather is typically the primary factor in energy use fluctuations.

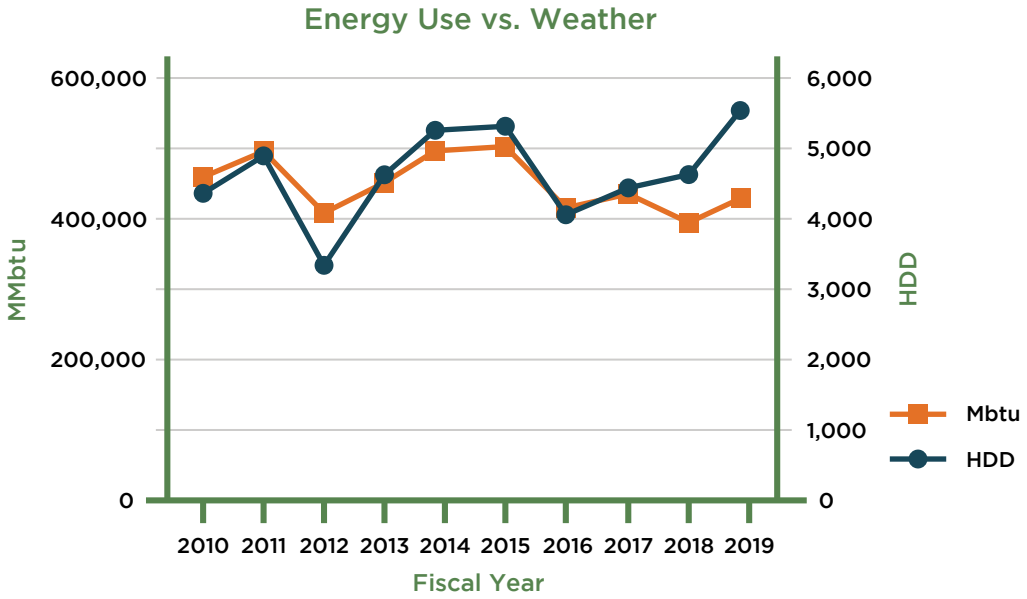


Figure 2: Because a significant amount of energy is needed for heating municipal buildings, weather is a driving factor in overall energy consumption.

ELECTRICITY

In FY 2019, the City of Providence used roughly 38,904,402 kWh of electricity; a 29% reduction from its 2010 baseline and 3% increase from FY 2018 (see Figure 3). The primary driver for electricity reduction was the conversion of the City's streetlight to LEDs, which occurred in FY 2018. Other factors over the years include lighting retrofits at Providence's schools and municipal buildings, along with transitions to more energy efficient electronics and appliances.

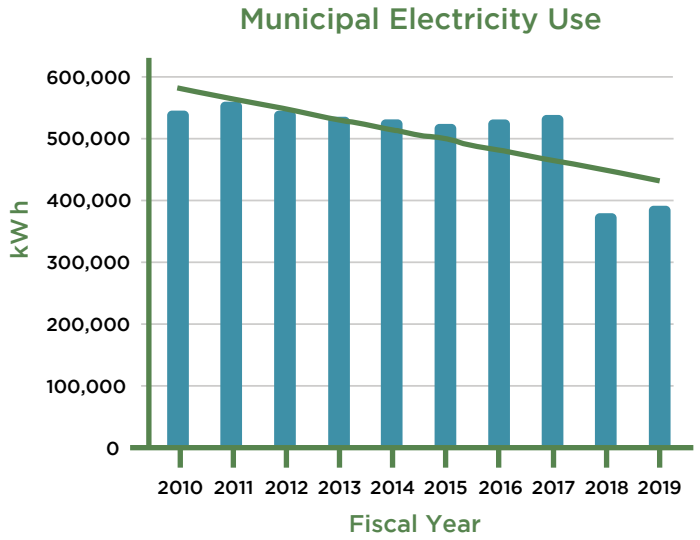


Figure 3: City of Providence's electricity use shown in kWh, FY 2010 – FY 2019. Electricity consumption has declined by 29% since FY 2010.

THERMAL

The City of Providence uses two primary sources of thermal energy for heating its facilities: natural gas and #2 fuel oil. Relative to fuel oil, natural gas is a cleaner-burning fuel. Switching from oil to natural gas provides a considerable greenhouse gas reduction, but it is still a fossil fuel. Furthermore, switching fuels is only considered an energy efficiency measure when performed in concert with energy efficient upgrades such as installing condensing boilers or advanced monitoring systems.

Natural gas remains a cheaper alternative to #2 fuel oil, and natural gas-fired boilers require less maintenance, which also helps save the City money. Fuel-switching efforts at City schools began in 2009, and by the end of 2016, #2 fuel oil was no longer in use in any of the district's buildings. Subsequently, the City has focused efforts on HVAC controls and retro-commissioning for maximum energy savings. The City is currently exploring cleaner alternatives to natural gas such as air source heat pumps. The Climate Justice Plan, which was released in 2019 calls for 100% of municipal buildings' heating to be renewable by 2040.

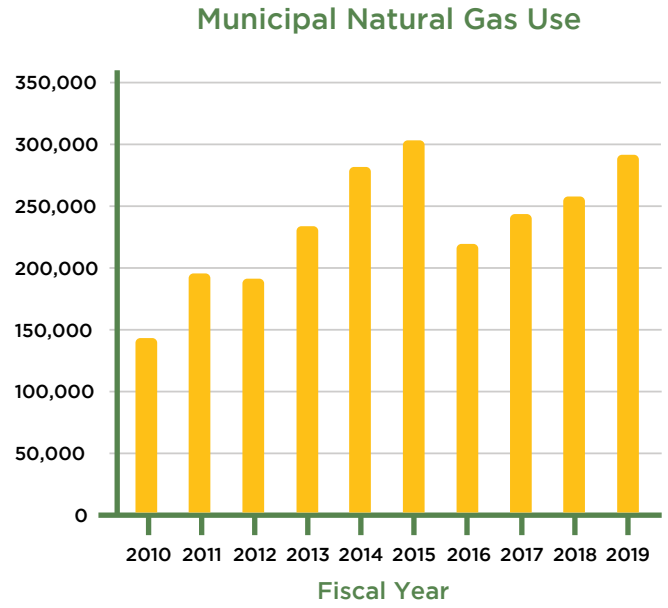


Figure 4: City of Providence's natural gas use, shown in dekatherms, FY 2010 – FY 2019.

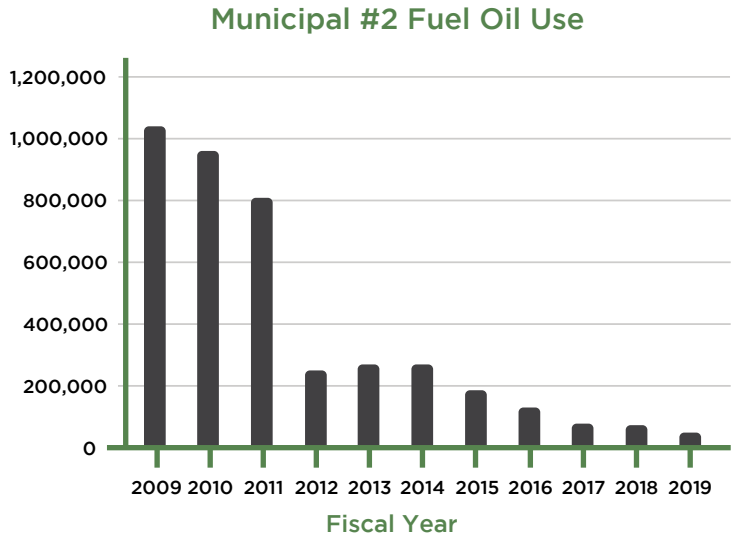


Figure 5: City of Providence's fuel oil consumption has declined by 95% since FY 2010 due to converting to natural gas systems.

ENERGY SUPPLY: RENEWABLES & PROCUREMENT STRATEGY

The Department of Public Property and the Office of Sustainability continue to identify energy conservation measures to maximize its operating budget and combat increasing energy costs. Despite rising energy prices, the City has reduced its operating costs for energy by nearly 28% since FY 2010 (see Figure 6).

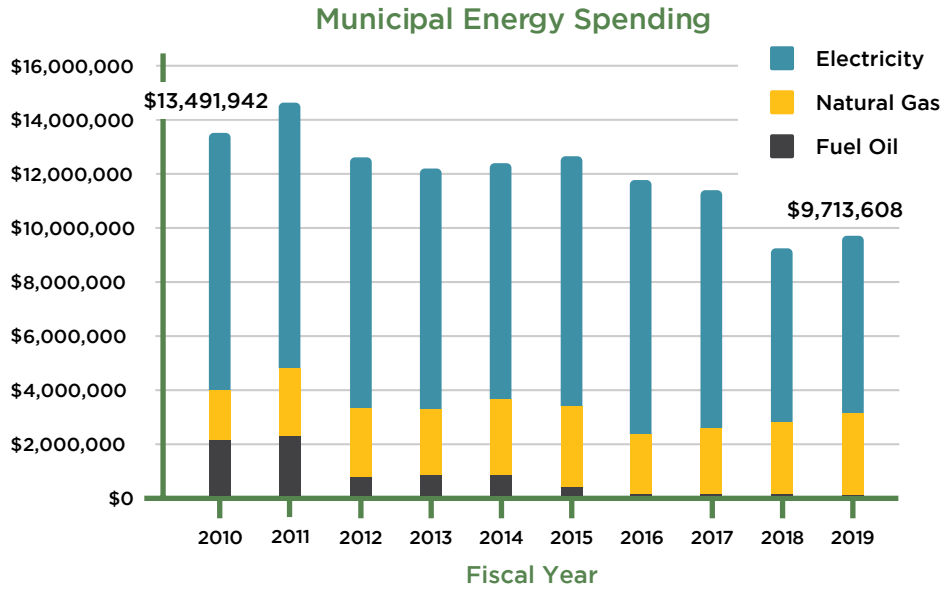


Figure 6: Despite rising energy costs, municipal spending on energy has decreased by 28% since 2010.

Energy procurement strategies have played a significant role in reducing the City energy costs while also providing stability for budgeting. The City continues to work with a third party energy supplier, Direct Energy, to secure long-term, fixed prices for its electricity supply. These contracts, covering FY 2012

through FY 2016, saved the City over $3.5 million compared to what it would have paid for electricity supplied by National Grid for that same time period (see Figure 7). Such contracts are enabled by the Energy Policy Act of 1992, which decoupled electricity distribution (retained by the utilities) from suppliers.

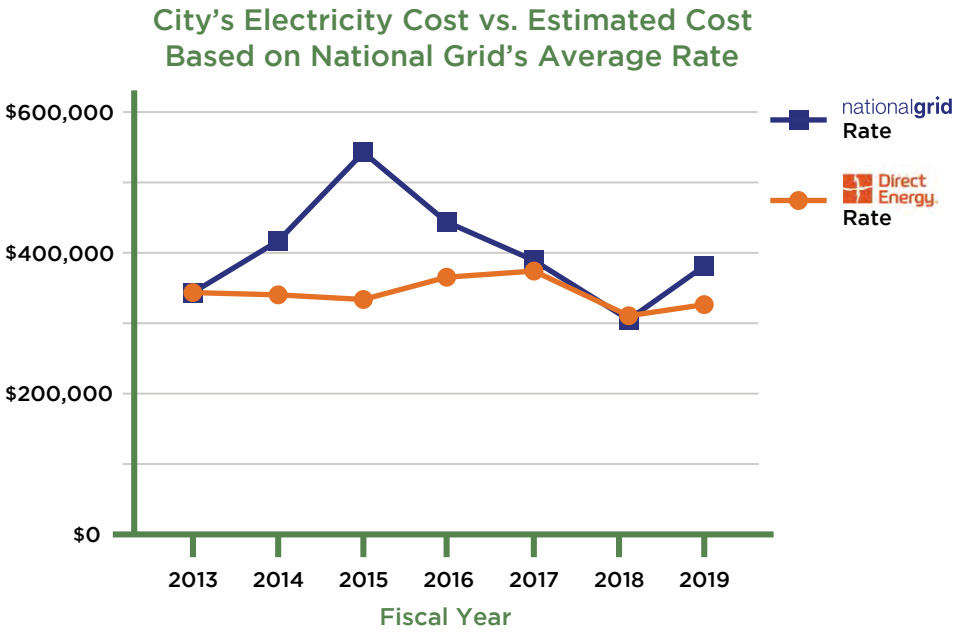


Figure 7: The graph provides a comparison of the City's actual electricity cost based on its third-party supplier rate versus estimated cost of National Grid's average rate.

SOLAR PROCUREMENT - VIRTUAL NET METERING

In April 2019, the City's 23 MW virtual net metering project came online. A small part of the system (3.9 MW) is located on a former landfill site in the Town of Johnston and the rest of the system is generated from a site in Cranston, RI. Energy from the photovoltaic array generates electricity equivalent to approximately 60% of Providence's municipal electricity needs. The project was developed by Southern Sky Renewables and designed and built by Conti Solar and members of the International Brotherhood of Electrical Workers, IBEW Local 99.The 30.5 million kilowatt hours of renewable energy produced by the nearly 58,000 panels will eliminate 22,670 metric tonnes of carbon dioxide equivalent (CO_2e) from the atmosphere, and will provide roughly $1.66 million in annual electricity savings to the City. The City should see the full result of these savings in FY20. After the first ten years of the contract, the City will be able to retain the Renewable Energy Credits (RECs), meaning the City can claim the carbon reduction benefits of the solar production.

BUILDING PORTFOLIO

The City's Department of Public Property manages and maintains approximately 130 buildings totaling 5.4 million square feet of floor space. This includes 38 school buildings,[2] one central public safety complex, nine district police sub-stations, 12 fire stations (the Humboldt Fire Station closed in 2017), eleven recreation centers,[3] three maintenance buildings, 35 park buildings, one multi-level parking garage, and seven administration buildings. The schools' roughly 4.2 million square feet of space account for 79% of the City's portfolio (see Figure 8). Of the remaining 21% of building space (figure 9), public safety buildings account for 28%. Buildings for public assembly such as The Casino at Roger Williams Park, and those at the North Burial Ground account for 25%. Administration buildings like City Hall account for 24%, and recreation centers and DPW buildings total 21%. The remaining two percent of properties include buildings such as the City's animal shelter and historic buildings including the Esek Hopkins House, on Admiral Street, and the Garvin House on Mashapaug Pond.

2: Some buildings house more than one school.

3: Several of the City's schools double as neighborhood rec centers such as the B. Jae Clanton Educational Complex that serves as the John H. Rollins Rec Center, and Pleasant View Elementary School that now doubles as the new Armand E. Batastini Jr. Rec Center. Robert F. Kennedy and Sackett Street Elementary Schools also opened their new rec centers in 2017.

City Buildings Gross Floor Area (Including Schools)

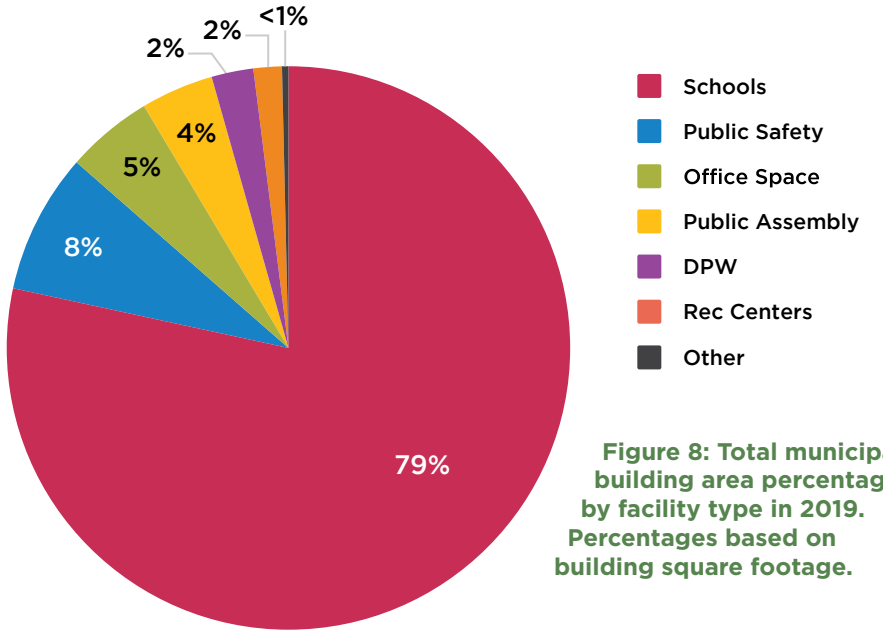


Figure 8: Total municipal building area percentage by facility type in 2019. Percentages based on building square footage.

City Buildings Gross Floor Area (Excluding Schools)

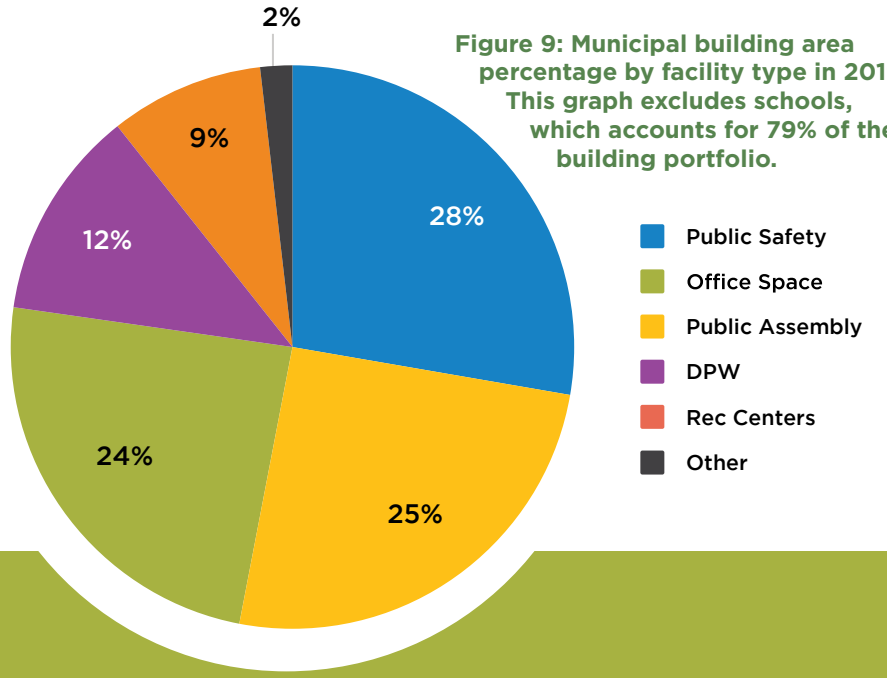


Figure 9: Municipal building area percentage by facility type in 2019. This graph excludes schools, which accounts for 79% of the building portfolio.

The buildings in the City's portfolio were constructed within a span of over one hundred fifty years(see Figure 10). Built in 1855, Providence City Hall is one of the oldest. The newest City-owned building is the Providence Career and Technical Academy, built in 2009. The state-of-the-art technical education facility was built in conjunction with the Rhode Island Department of Education and their partners, the Collaborative for High Performance Schools. The latter provided guidelines on design and best construction practices for saving energy. Due to advancements in the Rhode Island State building codes and the passage of the Rhode Island Green Buildings Act (RIGL §37-24) in 2009, newer City-owned buildings have incorporated more advanced lighting, HVAC technologies and efficiency guidelines.

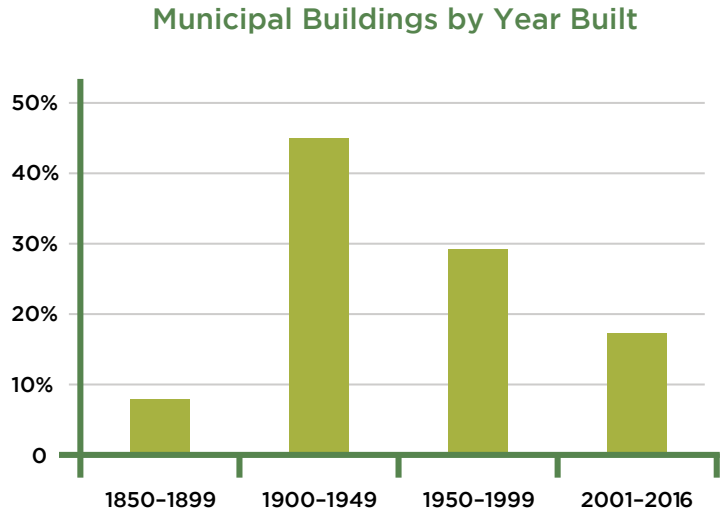


Figure 10: Municipal buildings by year built shown as a percentage. Most of the City's building portfolio was built in the early 20th century.

Identifying building use-types and age in this way helps in understanding the energy needs. For instance, fire station garage doors are opened often during shifts, so the building may use more energy for heating and cooling compared to an office building of similar size. Fire and police stations are also generally occupied around-the-clock, unlike offices or recreation centers.

Building age is also a factor. It is often perceived that older buildings are less efficient; however, buildings constructed before the advent of HVAC systems and cheap, accessible energy were designed to be comfortable without these technologies. As a result, older buildings are often low consumers of energy when compared to more modern facilities. As you can see in Figure 11, buildings built in the mid-century are actually some of the least efficient buildings in our portfolio. These buildings were designed and constructed during a time when energy was cheap and building codes were not focused on energy efficiency measures.

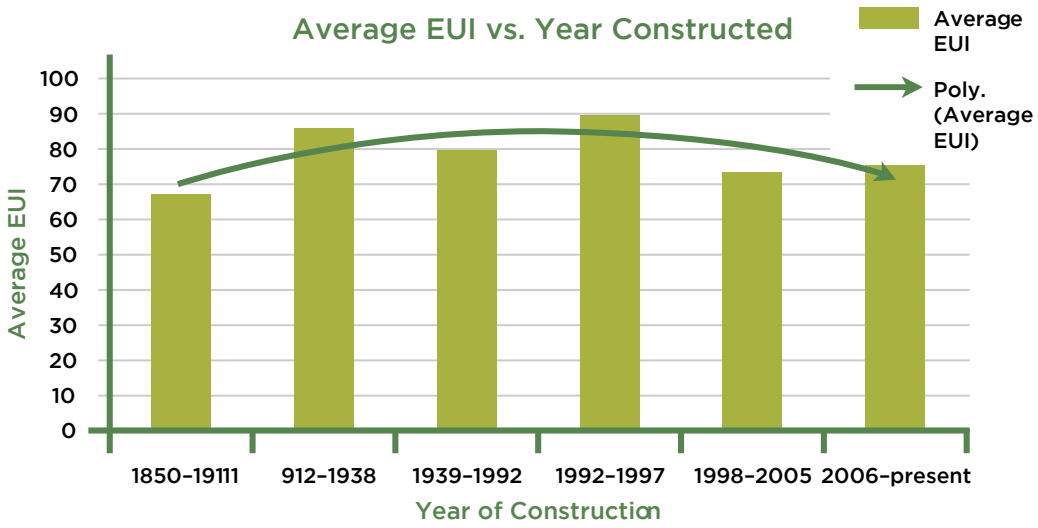


Figure 11: This graph compares year of construction with building's energy use intensity (EUI). Older municipal buildings, built before the advent of energy-intensive heating, cooling and lighting systems, are some of the City's lowest energy consumers per square foot. New policies such as the International building code of 1997 and energy policy act of 2005 have also influenced energy performance in modern buildings.

BENCHMARKING BUILDINGS

Benchmarking allows for the review of a building's energy performance despite variables such as its size, age, type of use, level of occupancy, and weather. Benchmarking is a critical practice that enables the City to identify opportunities for energy efficiency savings, track building performance, and measure the effectiveness of energy efficiency measures. The City has benchmarked nearly 100 percent of all City-owned buildings. Only a small handful of buildings, including a number with no utility use, have been omitted. To benchmark its buildings, the City uses Energy Star Portfolio Manager, a free online building benchmarking tool developed by the United States Environmental Protection Agency. It enables users to create building profiles by entering basic site information, such as year built and total square footage, and provides an Energy Star score, which is a 1-100 standardized metric of energy efficiency.

ENERGY STAR PORTFOLIO MANAGER uses utility billing data, along with details about the facility itself including gross floor area (sq. ft.), year built, and occupancy, to benchmark buildings against a national median of buildings with the same characteristics. The software also tracks how buildings perform over time. Users enter a minimum of one year's worth of energy bills for each fuel type. Portfolio Manager then calculates a building's Energy Use Intensity (EUI), a metric that represents the amount of Btu's (British thermal units) that a building uses per square feet. The higher the EUI, the more inefficient the building is. Portfolio Manager also calculates scores for buildings in certain categories, so that they can be recognized with Energy Star certification. To score a building, Portfolio Manager takes the building's source energy use intensity (EUI) then uses a regression equation specific to each property type that reflects data from the US Energy Information Administration's (EIA) Commercial Building Energy Consumption Survey (CBECS) to calculate predicted EUI. The resulting actual/predicted EUI ratio is what determines the building's 1-100 Energy Star score. Buildings with a score of 50 perform better than fifty percent of peer buildings, while buildings scoring 75 or above are in the top 75th percentile, making them eligible for Energy Star certification.

An Energy Star score is dependent on a nationally representative data set and robust analysis. Because of this technical foundation, many of the City's municipal buildings, such as fire stations, recreation centers, and service buildings cannot be benchmarked with an Energy Star score. Alternatively, these buildings are benchmarked on the basis of site EUI. The FY 2019 Municipal Energy Report includes

weather-normalized building EUIs. This metric allows the City to track year-to-year energy fluctuations outside of changes in weather. The weather-normalized EUI for each facility can then be compared to that of other City municipal buildings of a similar type. This helps the City benchmark buildings that cannot get Portfolio Manager scores.[4]

In August of 2018, the EPA updated its scoring models to reflect 2012 Commercial Buildings Energy Consumption Survey (CBECS) data supplied by the U.S. Energy Information Administration. The new data, published in 2016, is a 29% larger sampling, with a 14% increase in the total number of buildings, and a 22% increase in total building floor space. Though the change has resulted in lower City building scores for FY18 and FY19's fiscal report, the new calculations have been applied to historical scores as well, so that the ability to compare performance over time will be maintained.

STRATEGIC ENERGY MANAGEMENT

In 2017, an outside team of consultants funded by the U.S. Department of Energy engaged with the City of Providence to develop a strategic approach to energy management. The team, which included New Buildings Institute (NBI), Eco Edge and Maalka, has worked with several other cities to embrace a data-driven approach to conserving energy as well as a people-oriented process.

The consultants used Providence's strong foundation of benchmarking energy data in NBI's FirstView software to analyze energy usage trends, much like a virtual energy audit, of all feasible buildings in the portfolio. This led to a process of prioritizing buildings for deeper facility assessments in a more targeted approach based on relative energy use, total energy consumption, and peer building comparisons. The end use disaggregation of energy identified top performers vs. those buildings with an opportunity for improvement in heating, thermal baseload or electric baseload.

This team is continuing to work on developing more interim targets towards Providence's existing goals, as well as supporting the development of additional standards and policies that support Providence's efforts to save energy in municipal buildings and engage the community. In the fall of 2019, the City released it's Climate Justice Plan which set the following targets for municipal energy use:

- 100% of municipal buildings' electricity will be renewable by 2030.
- 100% of municipal buildings' heating will be renewable by 2040.
- 100% of the City's fleet and school buses will be renewable by 2040.

MUNICIPAL SCHOOL BUILDINGS

The City of Providence has 42 K-12 schools operating in 38 municipal school buildings. The buildings are owned by the City, and maintained by Aramark™ with oversight by the Providence Public School District and the City's Department of Public Property. Five of the buildings house more than one school, such as the Charles N. Fortes and Alfred Lima, Sr. Elementary Schools, which are housed in different wings of The Leviton Complex building, and the Evolutions (now closed) and 360 High Schools, which are located in Mt. Pleasant High School.

4: Although Portfolio Manager is capable of measuring energy use for all types of buildings, some building types are not eligible for scoring such as public safety buildings, DPW buildings and rec centers. The Providence Career and Technical Academy, unlike other City schools, is also not eligible to receive an Energy Star score.

Representing the majority of the City's building space, and with a student, teacher, and staff population of nearly 28,000, City schools account for most of Providence's municipal energy use. In FY 2019, Providence's schools used 287,686 MMBtu, or 67% of the City's energy consumption (see figure 12). After seeing a substantial drop in 2016, the energy used by the City's school buildings has increased the past three years, coinciding with a dramatic up-tick in after-school and summer programs that began being offered by the City in FY 2017, including the Mayor Elorza's Summer Learning Program, and Summer Day Camp.

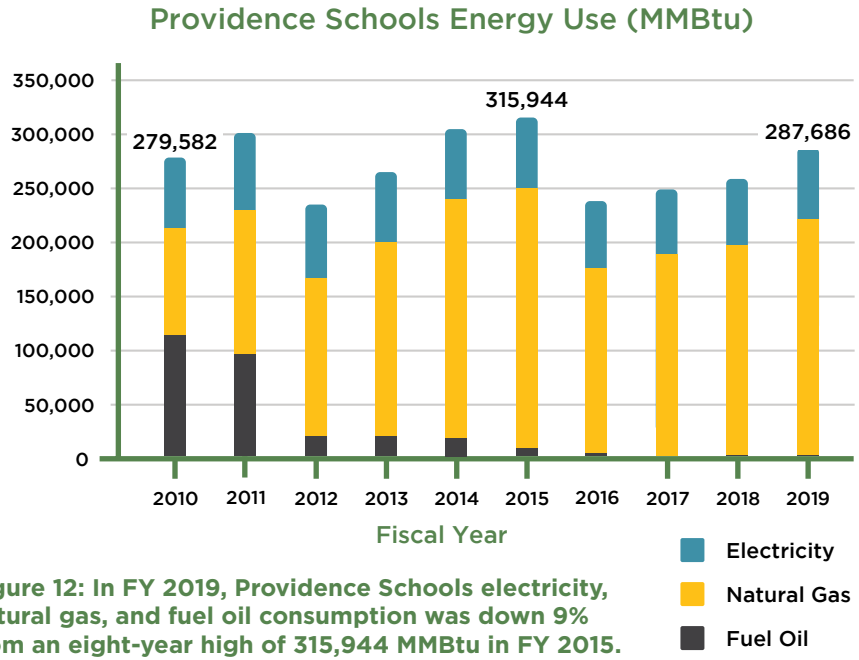


Figure 12: In FY 2019, Providence Schools electricity, natural gas, and fuel oil consumption was down 9% from an eight-year high of 315,944 MMBtu in FY 2015.

While there are many unavoidable factors that can impact energy use in schools (i.e. extended hours of use, increased use of electronics, and increasing student and teacher population), the City continues to make on-going investments in energy efficiency. The reductions have been largely driven by HVAC upgrades, controls retro-commissioning and building weatherization completed by Aramark and the Department of Public Property. Under the direction of the Providence Public School District with guidance from the Department of Public Property, Aramark monitors and maintains all of the equipment associated with heating and cooling the school buildings. They also are an important partner in coordinating all energy efficiency projects in the City's schools and working with National Grid to leverage financial incentives from the utility. For example, in 2016, this strategy resulted in weather-stripping replacement in school buildings district-wide, a project that netted $42,148 in National Grid incentives and is projected to reduce the district's natural gas use by 32,074 therms and save about $45,000 a year. Aramark's HVAC control technicians have also recommissioned outdated building management systems (BMS) at schools district-wide, in addition to fine tuning boilers and controls.

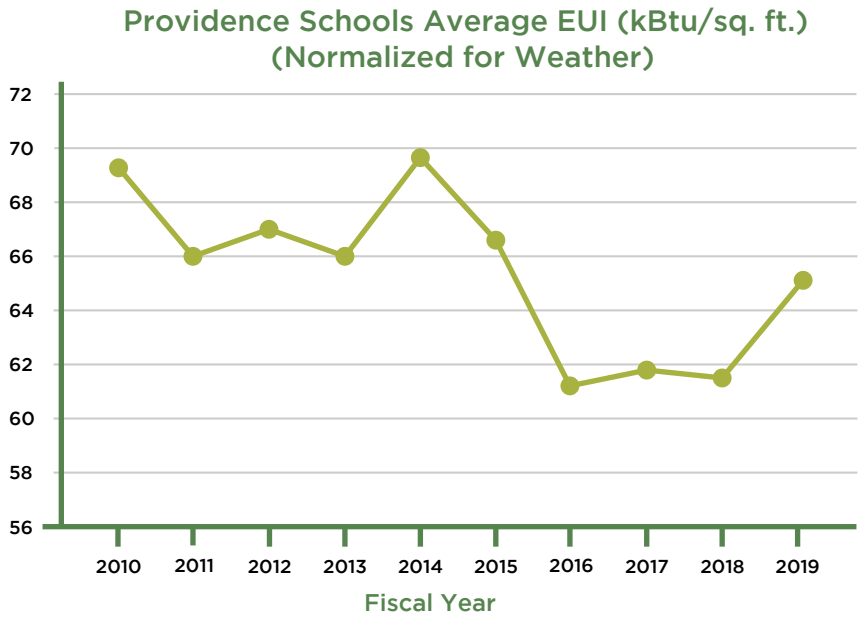


Figure 12b: Weather-normalized average energy use intensity (EUI) for all City school buildings.

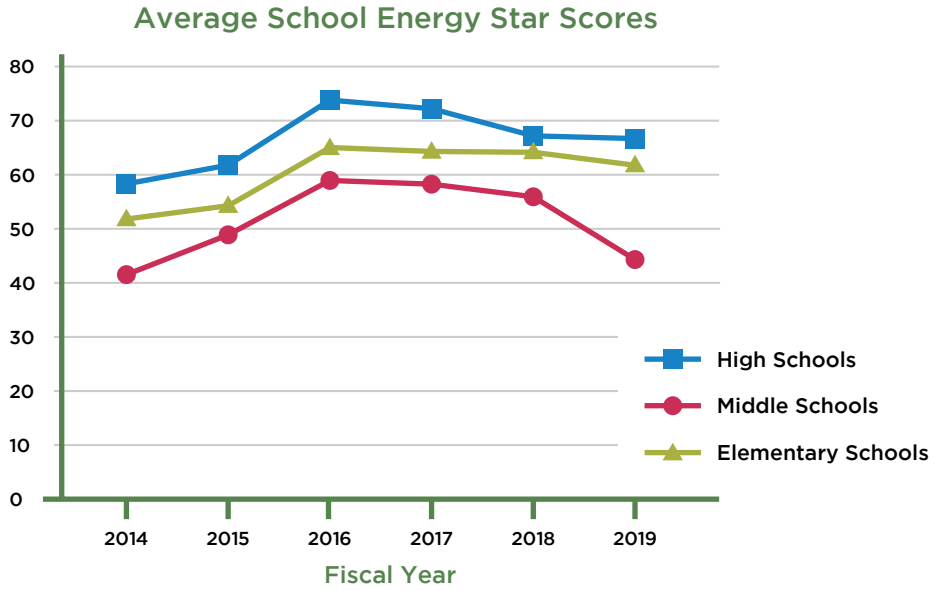


Figure 13: Though some middle school Energy Star scores dipped during 2019, average scores for all school buildings have increased substantially since 2014.

While much of the work for maintaining and upgrading HVAC systems is included in Aramark's operating budget, large-scale projects depend on financing from the City, which relies heavily on Rhode Island Department of Education (RIDE) School Building Authority (SBA) school housing aid reimbursements and the SBA Capital Fund. To qualify for the funding, projects need to comply with all current Northeast Collaborative for High Performance Schools Protocol (Northeast-CHPS) requirements "so that approved projects provide high quality learning environments, conserve natural resources, consume less energy, are easier to maintain, and provide an enhanced school facility". Large-scale projects are normally included in the Providence Schools Capital Plan, which is updated every five years. Some recommendations for the master plan come from the SBA, who provides facility condition assessments to the City so it can effectively use its limited resources to provide the best outcomes. Data collected during the facility condition assessments are the basis for the SBA Recommended Action Plan that provides guidance throughout the master planning process. The facility condition assessments contain "detailed information associated with each building component, including the overall condition of school facilities, as well as life cycle forecasting information that attempts to identify future building and system needs."

ELEMENTARY SCHOOLS

In FY 2019, the Leviton Dual Language School improved its Energy Star Score by 7% to 75, bringing the total number of the City's 22 City elementary schools qualifying for Energy Star certification to 8. Robert L. Bailey, IV Elementary School's score of 93 was the highest Energy Star score of all the City's schools in FY 2019. The current data, in addition to showing better performance amongst the newer buildings, also demonstrates that older schools are capable of achieving high scores. For example, Allan Shawn Feinstein and Frank D. Spaziano elementary schools were constructed in 1908 and 1895, respectively, yet both were both eligible for Energy Star certification in 2019 with scores of 80 and 88. In addition to the scoring realignment, increased building activity is responsible for scores at some schools dipping in FY 2017 and FY 2018, such as at Lillian Feinstein and Robert F. Kennedy where the City opened two of three new recreation centers. The third new recreation center was opened at Pleasant View Elementary School.

ENERGY EFFICIENCY IMPROVEMENTS

Working closely with Gilbane, Aramark and National Grid, the City has implemented numerous energy efficiency measures throughout the City's elementary schools including heating and cooling systems, building management systems (BMS), lighting upgrades, and building envelope improvements.

Building Management System Upgrades

In FY 2019, Aramark continued its ongoing maintenance and monitoring of Building Management Systems (BMS) district-wide.

Heating and Cooling System Upgrades

HVAC and BMS upgrades in the Gym and Swimming Pool area at Pleasant View Elementary School/Armand E. Batastini Jr. Rec Center have saved over 18,000 therms of natural gas since FY 2016, preventing 64 metric tons of CO_2e from entering the atmosphere. The building's two main boilers have been replaced with condensing boilers, and a 750 gallon hot water storage tank was replaced with a 200 gallon tank. A separate boiler for the swimming pool was also commissioned that year. Since the building's construction in 1971, the pool had relied on hot water from the main boiler to heat the pool through a heat-transfer system, facilitating the need to run school boilers during the warmer, shoulder months. The upgrades have saved Providence Schools over $12,000 on natural gas since 2017.

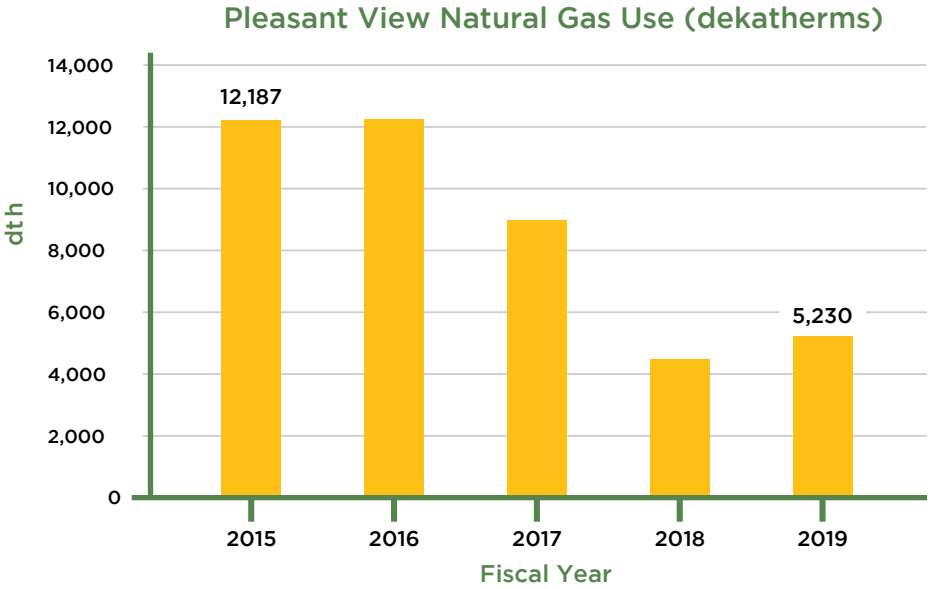


Figure 14: The evolution of heating system upgrades at Pleasant View is reflected in the buildings natural gas use.

5: RIDE School Construction Regulations (5/24/07)

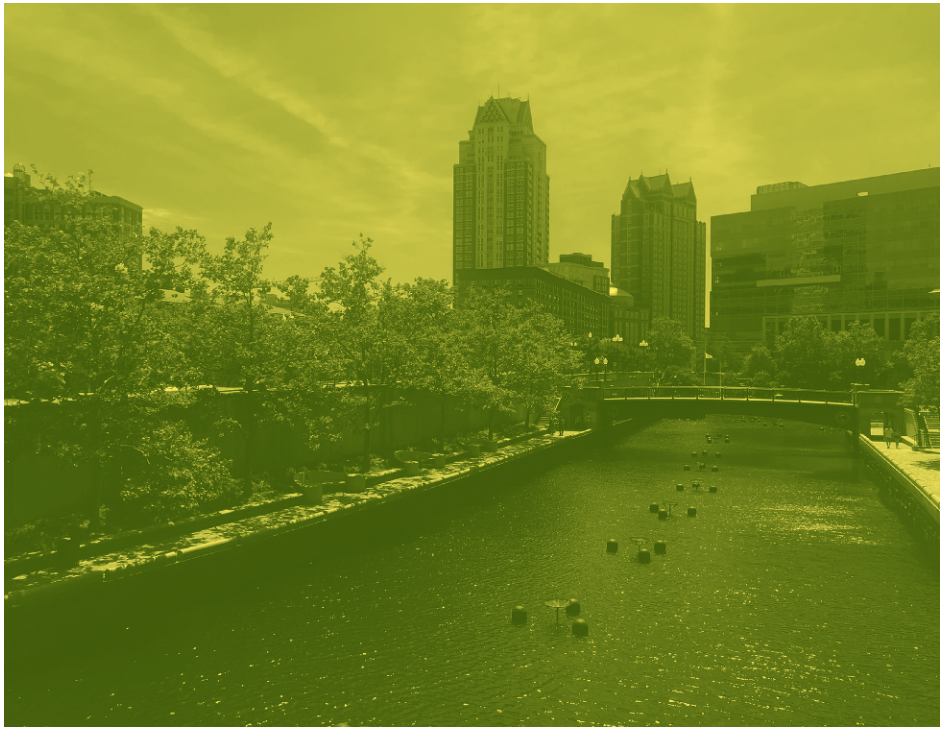
6: http://www.ride.ri.gov/FundingFinance/SchoolBuildingAuthority/FacilityDataInformation.aspx#37541392-condition-assessments

Regular maintenance of heating system steam traps is essential to preventing leaks that can waste thousands of dollars each year. Through incentives from National Grid, the City receives $3 for every therm saved, up to 50% of the repair costs. The City is also reimbursed for 100% of the cost of the steam trap surveys, needed to identify traps in need of repair. Large buildings with steam heat can have hundreds of steam traps such as Mount Pleasant High School, which has 602 steam traps located throughout the school. Other schools where traps are regularly surveyed and maintained include Hope High School, Nathanael Greene, Gilbert Stuart, and Roger Williams Middle Schools. The Harry Kizirian, Robert F. Kennedy, Carl G. Lauro, Mary E. Fogarty, George J. West, and Allan Shawn Feinstein Elementary Schools also have their steam traps regularly maintained through the National Grid program. Together, these projects are helping save about 300,000 therms of natural gas annually, and are keeping about 1,591 metric tons of CO_2e from entering the atmosphere every year.

The Providence Schools Capital Plan for heating and cooling system projects in the City's elementary schools completed in 2019 included unit heater replacement and improvements at Harry Kizirian, and installation of Cozy® thermostatic steam radiator covers at Alan Shawn Feinstein (ASF) Elementary School @ Broad Street. Steam trap repairs and replacements were also completed at ASF in 2019. Work also began in late 2019 on roof replacements at Vartan Gregorian and Veazie Elementary schools, which will significantly improve building envelope and overall heating and cooling efficiency at the sites.

LED Lighting Retrofits

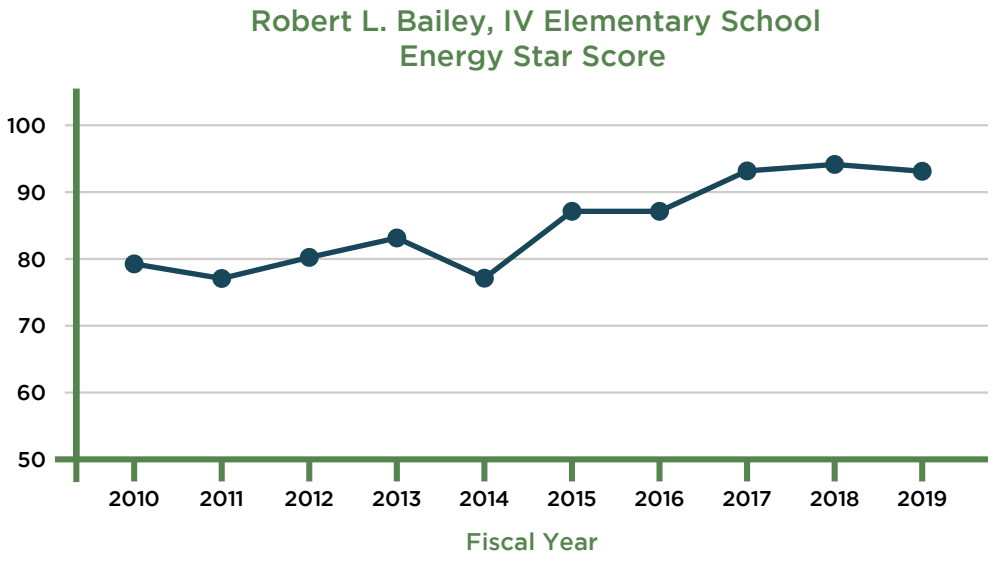
As of 2019, nine out of 22 elementary schools have been retrofitted with new interior LED lighting. Despite increased activity at the City's elementary schools, both before and after school, total cumulative electricity savings at the retrofitted schools in FY 2019 was about 1,443,311 kWh, saving Providence Schools about $245,000 over the last four years. The increased life span of the new LED lamps (up to 70,000 hours) is also significantly reducing maintenance costs.

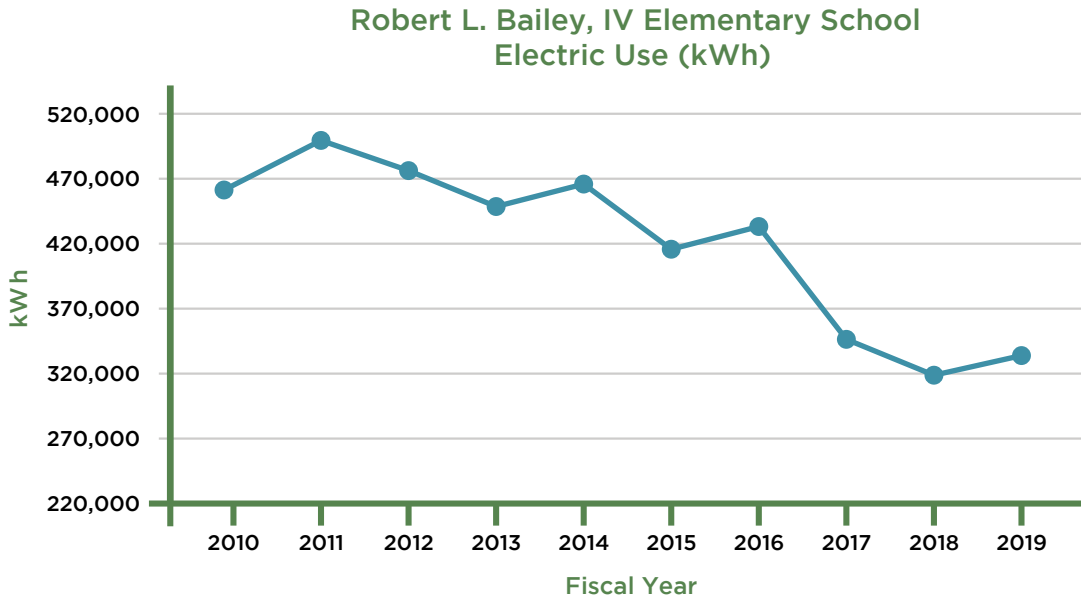


FACILITY	YEAR BUILT	GROSS FLOOR AREA (SQ. FT.)	FY 2019 ELECTRICITY USE (KWH)	FY 2019 NATURAL GAS USE (THERMS)	FY 2018 FUEL OIL #2 (KBTU)	FY 2019 TOTAL SITE ENERGY USE (KBTU)	FY 2019 DIRECT GHG EMISSIONS (METRIC TONS CO_2E)	FY 2010 WEATHER-NORMALIZED SITE EUI (KBTU/FT²)	FY 2019 WEATHER-NORMALIZED SITE EUI (KBTU/FT²)	FY 2010 ENERGY STAR SCORE	FY 2019 ENERGY STAR SCORE
ELEMENTARY SCHOOLS							***190.5***	***71.9***	***63.0***	***52.7***	***61.9***
Allan Shawn Feinstein Elementary School @ Broad Street	1895	77,899	136,962	52,347		5,702,011	278	74.9	73.5	80	80
Anthony Carnevale Elementary School	1999	78,000	513,189	18,473		3,598,327	98.1	56.7	45.4	47	69
Asa Messer Elementary School @ Samuel W. Bridgham	1972	109,255	426,541	33,752		4,830,578	179.3	70.8	44	39	77
B. Jae Clanton Complex	2004	103,000	464,913	27,638		4,350,097	146.8	89.4	41.6	41	90
Carl G. Lauro Elementary School	1921	117,482	191,804	69,415		7,595,956	368.7	62.6	63.8	71	69
Dr. Martin Luther King Elementary School	1959	71,724	236,383	33,296		4,136,170	176.9	59.4	57.1	71	77
Frank D. Spaziano Elementary School	1908	58,015	102,428	21,957		2,545,143	116.6	73	43.3	56	88
Frank D. Spaziano Elementary School Annex	1910	19,585	94,327	12,328		1,554,629	65.5	73.5	79	42	25
George J. West Elementary School	1959	112,030	217,033	75,567		8,297,199	401.4	70.2	73.8	64	56
Harry Kizirian Elementary School	1959	73,950	255,982	44,167		5,290,071	234.6	68.3	70.7	57	50
Leviton Dual Language School	2002	40,000	285,725	9,488		1,923,685	50.4	49.6	47.9	73	75
Lillian Feinstein Elementary School @ Sackett Street	1921	68,400	233,709	30,272		3,824,585	160.8	59.3	55.3	71	79
Mary E. Fogarty Elementary School	1959	51,400	160,010	26,717		3,217,698	141.9	61.8	62.6	60	60
Reservoir Avenue Elementary School	1924	22,000	82,771	11,570		1,439,445	61.5	81.7	64.6	28	44
Robert F. Kennedy Elementary School	1921	49,840	151,741	37,111		4,228,837	197.1	84.6	83.8	38	38
Robert. L Bailey, IV Elementary School	2000	78,000	333,500	16,876		2,825,492	89.6	46.7	36.1	79	93
The Leviton Complex	1908	178,654	923,298	54,057		8,556,007	287.1	56.6	47.5	52	63
Vartan Gregorian Elementary School	1954	63,000	328,447	47,879		5,908,576	254.3	108.6	92.6	16	20
Veazie Street Elementary School	1909	110,000	302,847	56,042		6,637,481	297.7	90.2	60.3	31	65
Webster Avenue Elementary School	1904	44,290	120,501	22,931		2,704,250	121.8	56.7	60.3	65	64
William D'Abate Elementary School	1959	44,174	182,157	34,741		4,095,621	184.5	115.3	91.8	25	40
Pleasant View Elementary School	1971	74,800	456,880	52,210		6,779,925	277.3		90.3		40

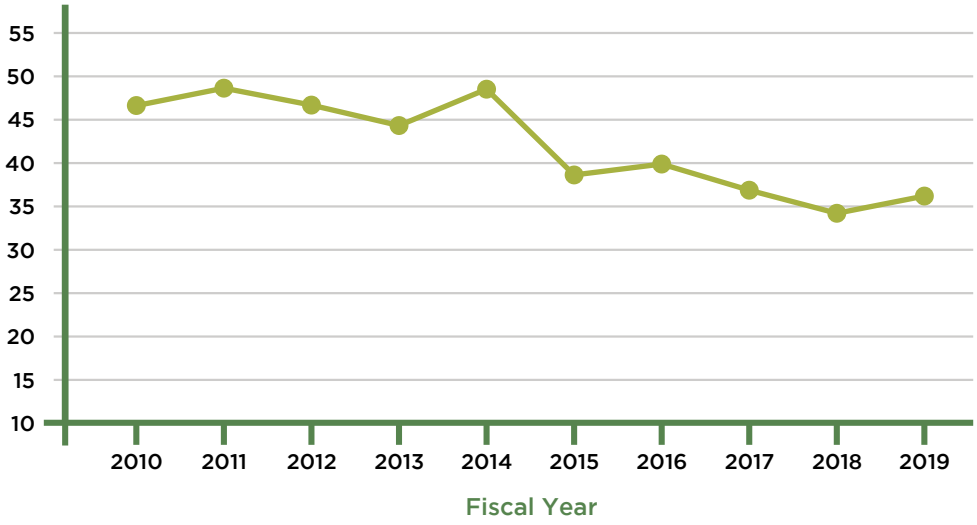
HIGHLIGHT: ROBERT L. BAILEY, IV ELEMENTARY SCHOOL

Energy efficiency measures at the Robert L. Bailey Elementary School including weather-stripping, LED retrofitting and Building Management System (BMS) upgrades have all contributed the building's Energy Star score improvement, lower electricity use, and lower EUI. Carbon emissions at the site are 20% below FY 2010 levels.

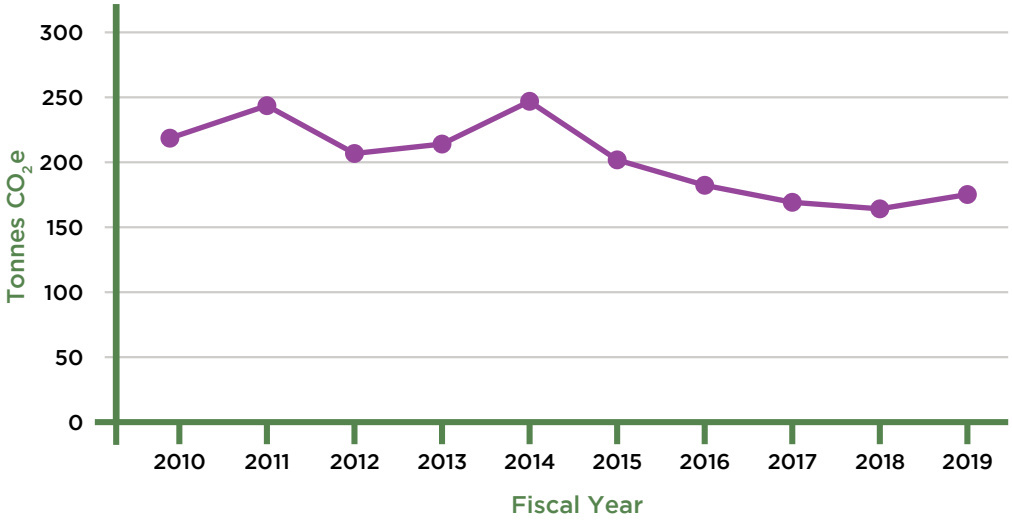




Robert L. Bailey, IV Elementary School EUI
(kBtu/sq. ft.) (Normalized for Weather)



Robert L. Bailey, IV Elementary School
Total GHG Emissions ($MTCO_2e$) (Direct and Indirect)



MIDDLE SCHOOLS

Five of the City's six middle school buildings are some of the oldest buildings in the City's portfolio. Constructed in 1916, Esek Hopkins is the oldest of the City's middle schools, yet based on its score, has maintained eligible Energy Star certification since 2012.This has been the result of targeted energy efficiency improvements such as HVAC controls upgrades, steam trap replacement, and LED lighting. For 2019, DelSesto Middle School's Energy Star score again came in just below the eligibility mark at 73, down from a 74 last year.

ENERGY EFFICIENCY IMPROVEMENTS

Building Management System Upgrades

A new BMS at DelSesto Middle School installed in 2017 helped the building continue to perform well in FY 2019. Aramark continued its on-going maintenance and monitoring of all middle school BMS through FY 2019. BMS are also updated and retro-commissioned as part of new boiler replacements such as those completed in 2015 and 2016 at Gilbert Stuart and Roger Williams middle schools.

Heating and Cooling System Upgrades

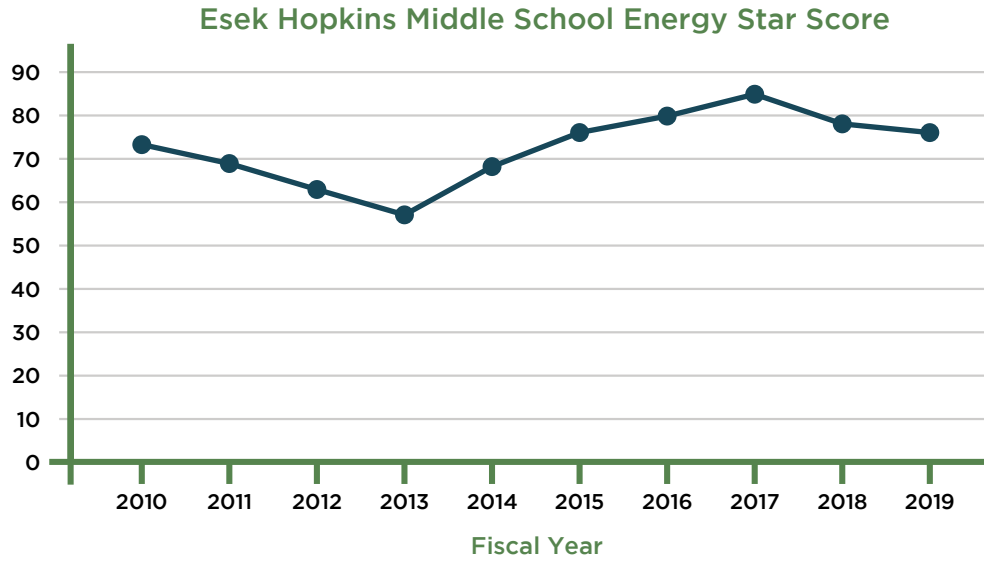
A new #1 boiler and vacuum condensate receiver were installed in 2018 at the Nathanael Greene Middle School, significantly enhancing heating efficiency at the facility. Condensate is the liquid formed when steam passes from the vapor to the liquid state. A vacuum condensate receiver recovers the water and residual heat contained in the discharged condensate for the purposes of reusing it for

the boiler. Recovering condensate, instead of discharging it completely, can lead to significant savings of energy. Though the school's Energy Star Score dropped significantly in FY19 largely due to an increase in natural gas use, we expect this to level off in FY20. The #2 boiler at Gilbert Stuart Middle School was replaced in 2016, along with a new vacuum return system, and a properly-sized condensate tank to provide better efficiency. Roger Williams Middle School's replacement boiler was installed in 2016.

LED Lighting Retrofits

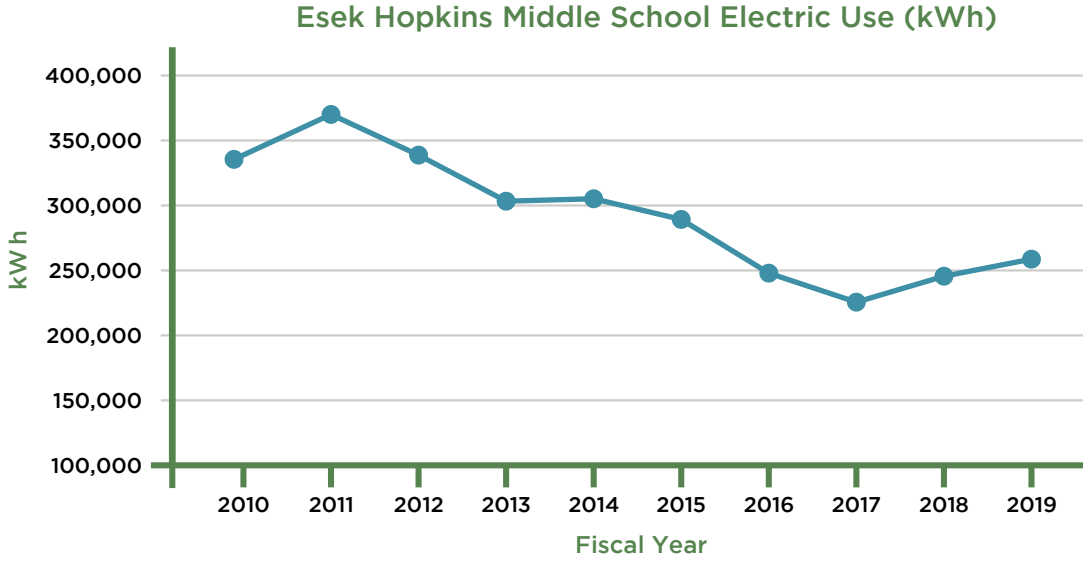
To date, LED lighting has been installed in all of the classrooms and common spaces at Esek Hopkins, Nathanael Greene, Roger Williams, Gilbert Stuart, and DelSesto middle schools. In 2016, exterior lighting was replaced with LEDs at Nathan Bishop, Nathanael Greene, and West Broadway. In August 2017, Aramark also replaced 250 watt metal halide lamps with 50 watt LED lamps in the auditoriums at Nathanael Greene and Roger Williams Middle School. As of FY 2019, these LED retrofits have saved roughly 1,108,720 kWh, and about $188,000.

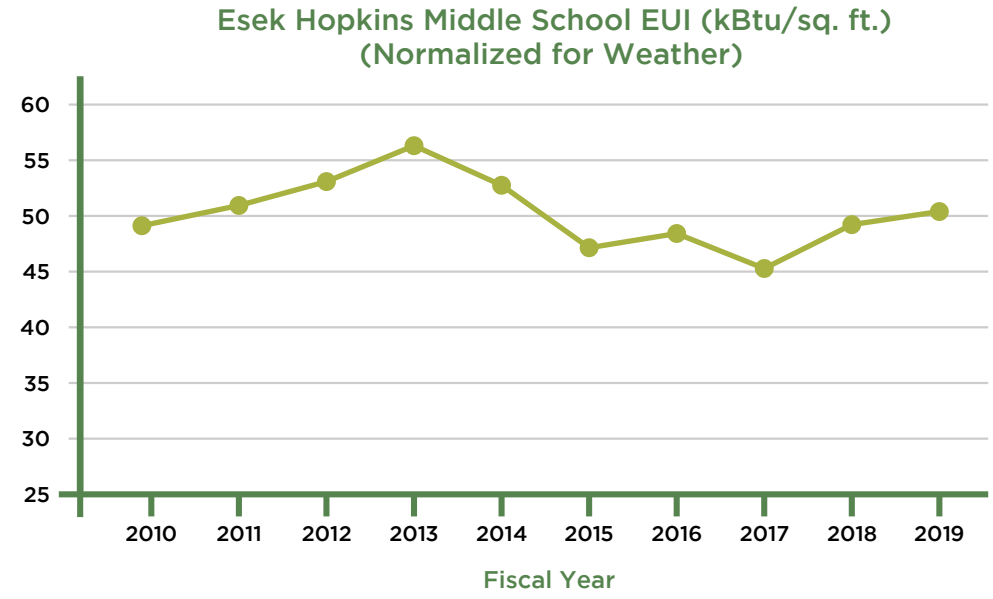
FACILITY	YEAR BUILT	GROSS FLOOR AREA (SQ. FT.)	FY 2019 ELECTRICITY USE (KWH)	FY 2019 NATURAL GAS USE (THERMS)	FY 2017 FUEL OIL #2 (KBTU)	FY 2018 TOTAL SITE ENERGY USE (KBTU)	FY 2019 DIRECT GHG EMISSIONS (METRIC TONS CO_2E)	FY 2010 WEATHER-NORMALIZED SITE EUI (KBTU/FT²)	FY 2019 WEATHER-NORMALIZED SITE EUI (KBTU/FT²)	FY 2010 ENERGY STAR SCORE	FY 2019 ENERGY STAR SCORE
MIDDLE SCHOOLS								***63.3***	***76.3***	***57.8***	***44.3***
DelSesto Middle School	1998	146,000	783,127	45,625		7,234,528	242.3	57	49.1	52	73
Esek Hopkins Middle School	1916	87,560	256,652	35,714		4,447,051	189.7	49.1	50.3	73	76
Gilbert Stuart Middle school	1929	154,450	306,767	96,463		10,692,970	512.4	56.1	68.4	70	54
Nathan Bishop Middle School	1929	136,000	1,617,283	71,081		12,626,284	377.5	68.9	92.2	50	13
Nathanael Greene Middle School	1930	159,070	268,065	142,146		15,129,270	755	61.9	88.7	66	38
Roger Williams Middle School	1929	135,228	292,653	101,856		11,184,132	541	86.7	81.6	36	43
West Broadway Middle School	1966	46,000	235,344	40,187		4,821,692	213.5		103.7		13

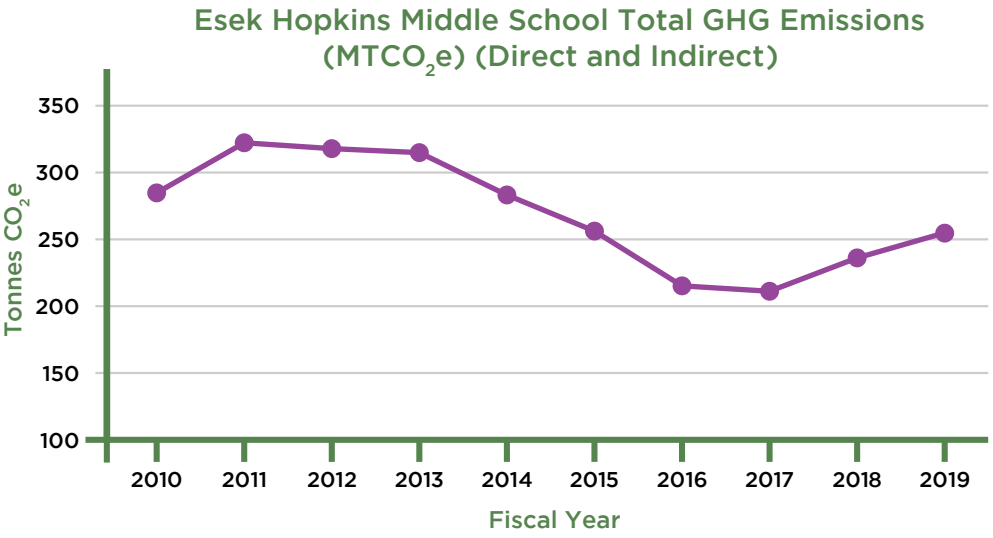


HIGHLIGHT: ESEK HOPKINS MIDDLE SCHOOL

Energy efficiency measures at the Robert L. Bailey Esek Hopkins Middle School has maintained Energy Star certification for five years is a row. In addition to building-wide LED conversions and occupancy sensor installations, the school's BMS equipment has also been upgraded. Energy conservation efforts by students and staff have also played a major part in saving energy and reducing emissions at the site.







HIGH SCHOOLS

The City owns nine high school buildings with a few of the buildings housing two or more different schools. For example the Juanita Sanchez Educational Complex, houses both William B. Cooley, Sr. High School, and The Providence Academy of International Studies. Similarly, Mount Pleasant and Hope High Schools house two of the City's "Opportunity by Design" high schools, Evolutions (now closed) and 360, respectively.

Providence's high schools support a wide variety of on-going academic, athletic, and cultural programs. They are bustling centers of activity where lighting, computers, and heating and cooling systems are relied on by students, faculty, and the community even after the end of the normal school day. Despite this fact, aggressive approaches by the City to target energy efficiency in its high schools have resulted in three of the City's high school buildings again qualifying for Energy Star certification in FY 2019.

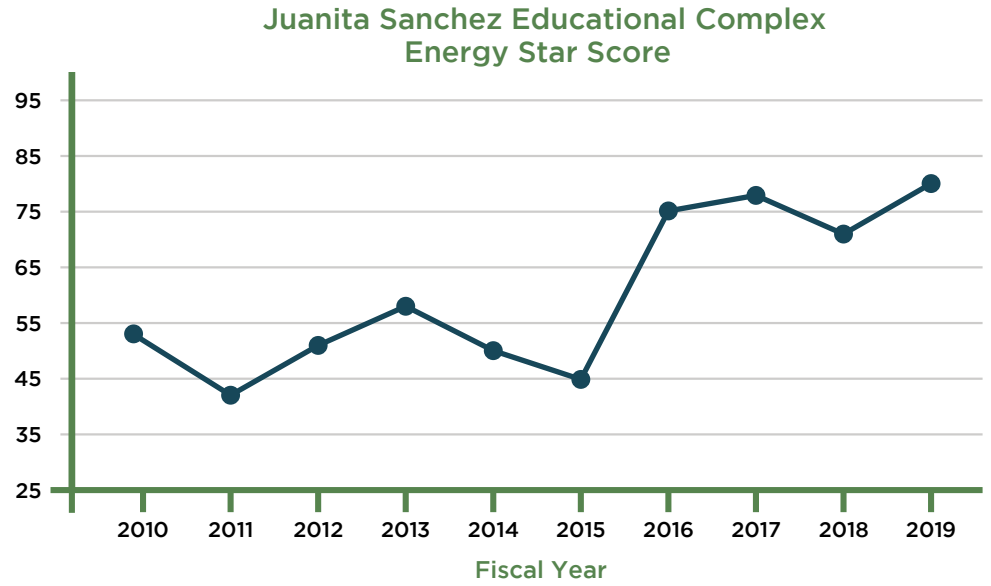
It is important to note that for the purposes of this report, Central and Classical High Schools are grouped together for measuring heating energy used due to the fact that the two facilities share a common, centrally-located heating plant. This results in a single Energy Star score for the two schools. In 2017, National Grid rebates covered over 60% of the cost of a new building management system (BMS) and hot water pump variable frequency drives (VFDs) for the Classical Auditorium and Café.

ENERGY EFFICIENCY IMPROVEMENTS

Heating and Cooling System Upgrades

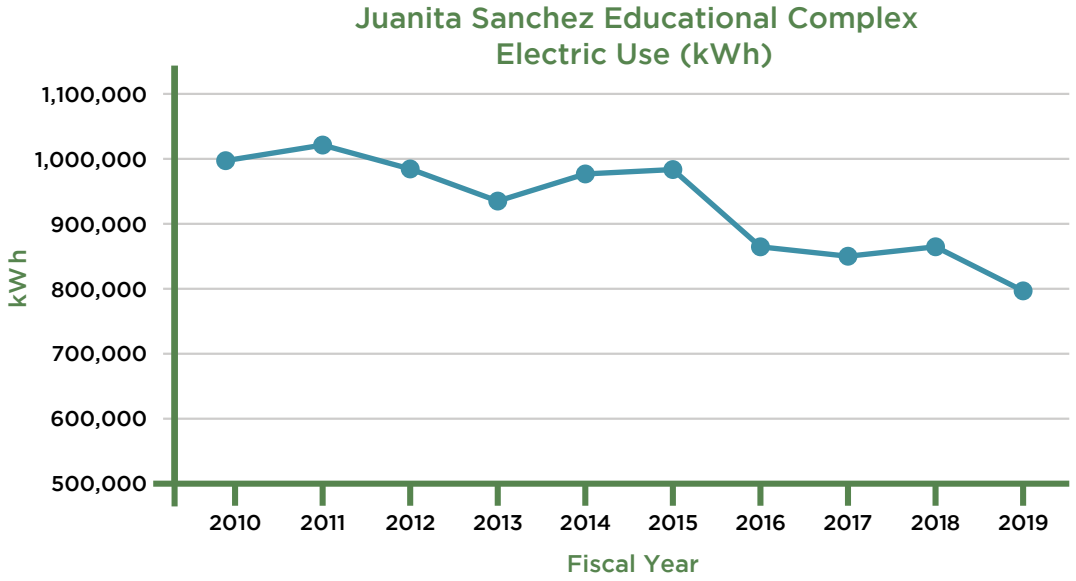
In 2017, the City leveraged utility rebates to help pay for two new condensing boilers at the Juanita Sanchez Educational Complex. The project also included a new BMS for the building's mechanical room that will monitor boilers, chiller, chiller pumps, and primary pumps. BMS systems at all of the high schools continue to be maintained and monitored by Aramark, who performs repairs, upgrades, and recommissioning when needed.

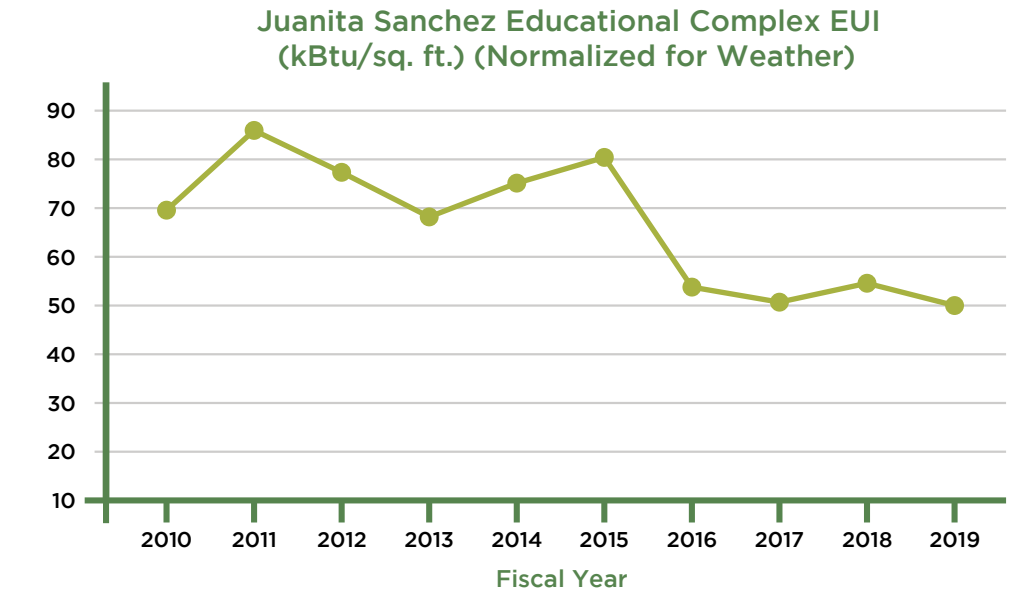
Included in the Providence Schools Capital Plan heating system projects is the replacement of the boiler feedwater system at Hope High School. The plan also entails the replacement of Roof Top units (RTUs) at Central High School. Though the main purpose of both projects is to replace antiquated, failing equipment, the projects will augment efficiency and provide considerable maintenance cost savings.

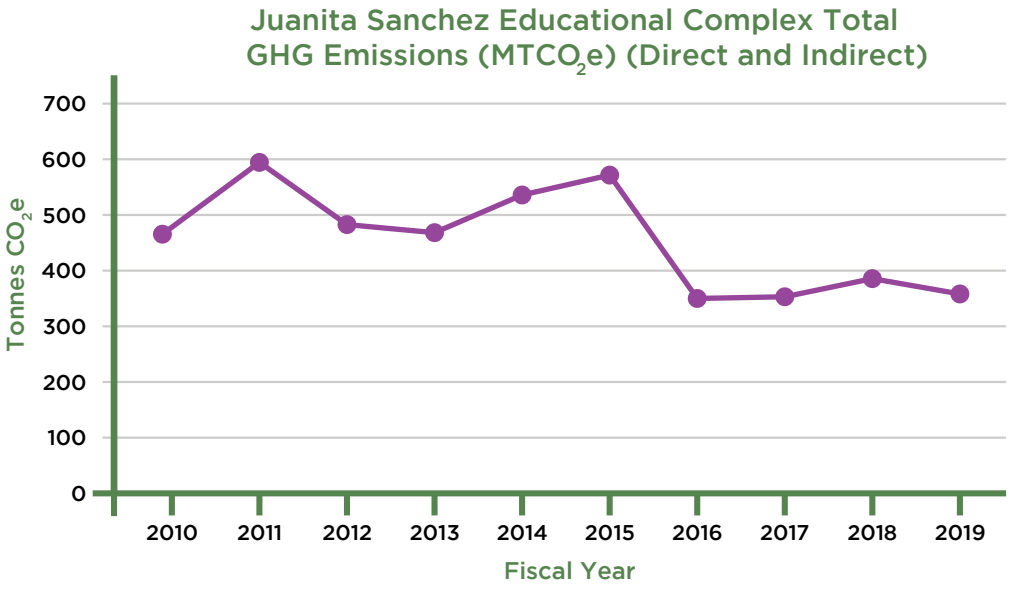


HIGHLIGHT: JUANITA SANCHEZ EDUCATIONAL COMPLEX

The Juanita Sanchez Educational Complex, home to the William B. Cooley, Sr. High School, and The Providence Academy of International Studies, qualified for Energy Star certification in FY 2019 by improving its score from a 71 in FY 2018 to an 80. The gymnasium roof was replaced in 2019 for a total project cost of $355,733.00. Boilers at the site were replaced with energy efficient condensing boilers in 2017, with a new energy management system and pump replacements. Energy conservation efforts by students and staff have also played a major part in saving energy and reducing emissions at the site.



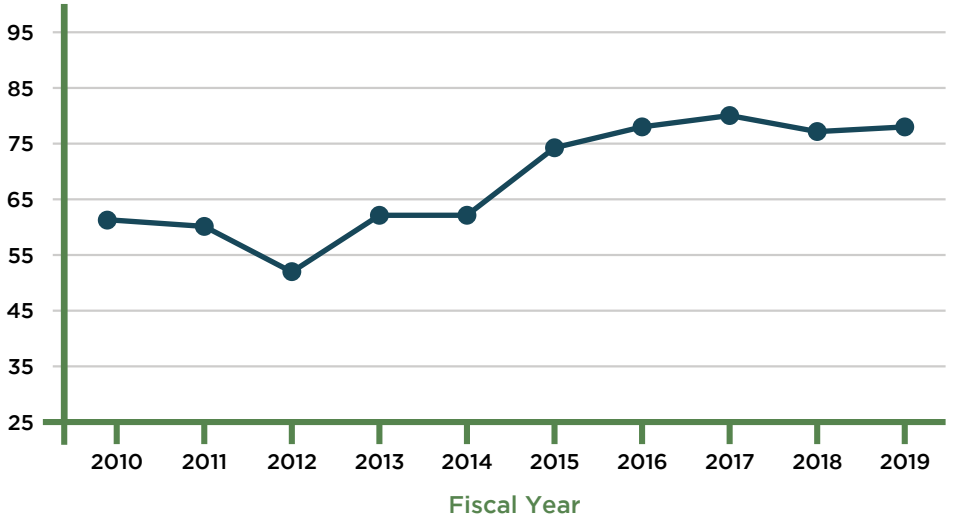




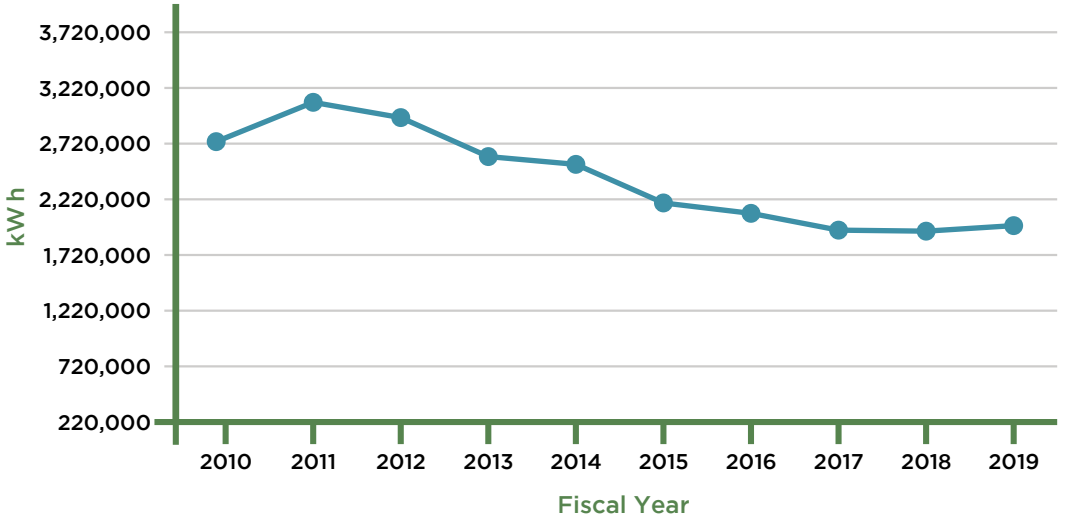
HIGHLIGHT: CENTRAL AND CLASSICAL HIGH SCHOOLS

Central and Classical High School's Energy Star score continued to improved slightly in 2019, maintaining the schools certification eligibility. In order to benchmark thermal energy use and emissions, both school buildings are grouped together due to the fact that the two facilities share a common, centrally-located heating plant. Boilers heating the buildings were retrofitted from #2 heating oil to natural gas in 2011. Additional energy efficiency measures completed include LED retrofits, hot water VFDs, weather-stripping replacement and BMS upgrades. Energy conservation efforts by students and staff have also played a major part in saving energy and reducing emissions at the site.

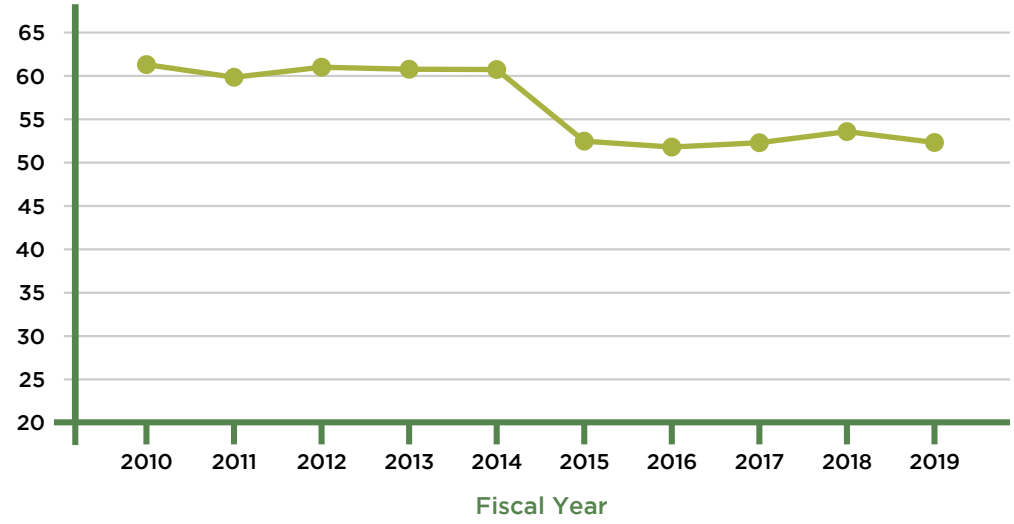
Central-Classical High Schools Energy Star Score (1-100)



Central-Classical High Schools Electric Use (kWh)



Central-Classical High Schools EUI (kBtu/sq. ft.) (Normalized for Weather)



Central-Classical High Schools Total GHG Emissions ($MTCO_2e$) (Direct and Indirect)

PUBLIC SAFETY

Public Safety buildings present considerable energy efficiency challenges due to the intense nature of their use. All of the City's fire stations, as well as the Public Safety Complex, are occupied twenty-four hours a day, seven days a week by emergency responders. The Providence Public Safety Complex, the headquarters and central station for the Providence Police and Fire Departments, serves the City around the clock, 365 days a year. Though the building uses more electricity than any other single building in the City's portfolio, energy use has been reduced at the site by 29% since FY 2010. Measures reducing electricity used at the site have included the 2014 installation of a new rooftop package unit for heating and cooling, and interior and exterior LED lighting upgrades. In 2017, LED retrofits were completed in the seven-floor Public Safety Garage, and lighting for the main parking lot was also upgraded to LED lighting. These collective measures have helped reduce annual electricity use at the site by 1,415,530 kWh since 2010.

ENERGY EFFICIENCY IMPROVEMENTS

Heating and Cooling System Upgrades

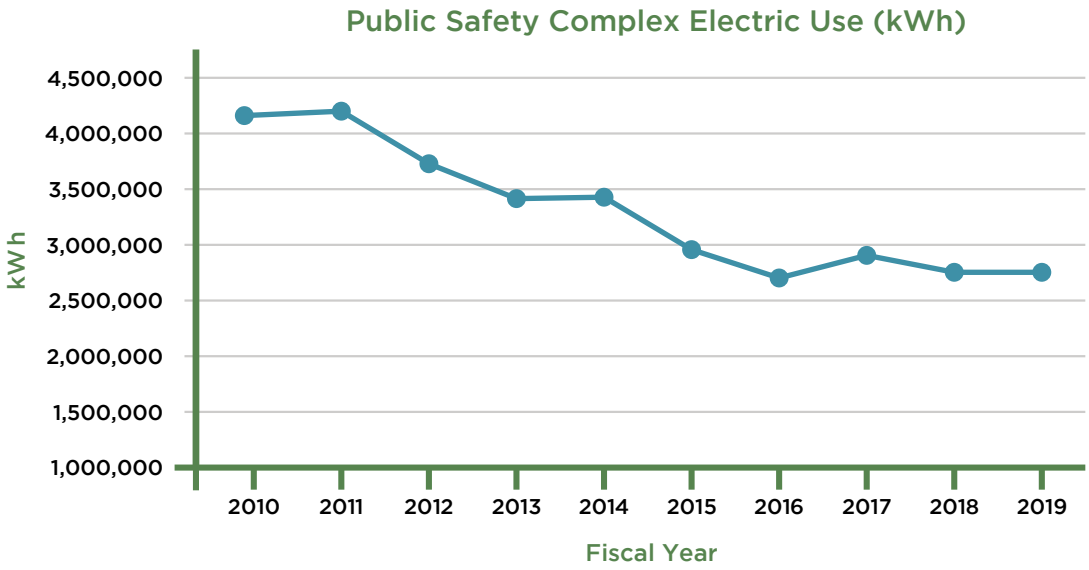
The Mount Pleasant Avenue, Hartford Avenue, Reservoir Avenue, and Messer Street Fire Stations are the latest buildings to be targeted for fuel switching and heating system upgrades. The measures, along with the measures at the Department of Telecommunications building (home to the City's 911 call center) were identified during energy audits by the Antares Group, courtesy of National Grid, for consideration in future funding opportunities.

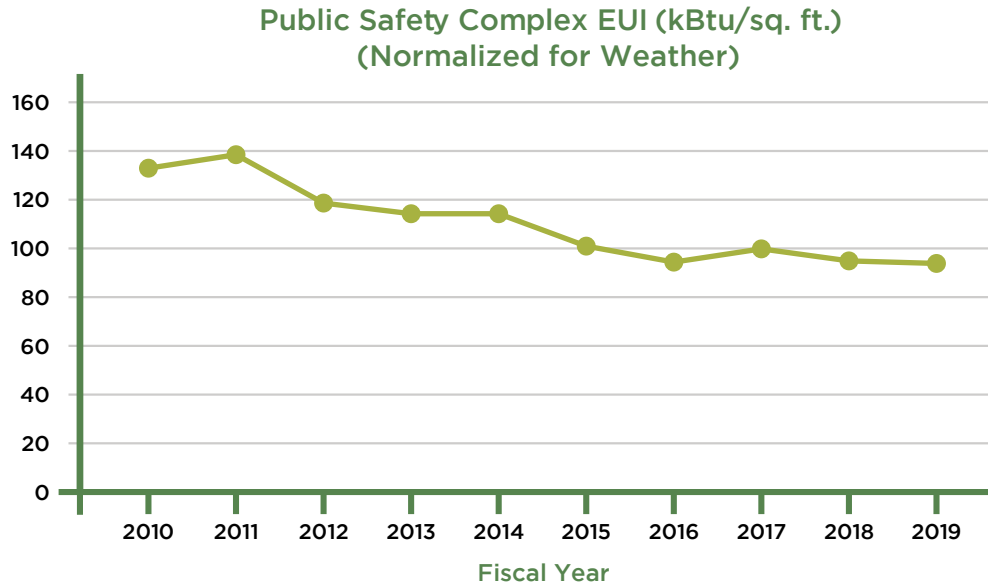
FACILITY	YEAR BUILT	GROSS FLOOR AREA (SQ. FT.)	FY 2019 ELECTRICITY USE (KWH)	FY 2019 NATURAL GAS USE (THERMS)	FY 2019 FUEL OIL #2 (KBTU)	FY 2019 TOTAL SITE ENERGY USE (KBTU)	FY 2019 DIRECT GHG EMISSIONS (METRIC TONS CO_2E)	FY 2010 WEATHER-NORMALIZED SITE EUI (KBTU/FT²)	FY 2019 WEATHER-NORMALIZED SITE EUI (KBTU/FT²)
PUBLIC SAFETY BUILDINGS								***115.4***	***121.5***
Department of Communications	1987	11,752	260,464	8,693		1,757,997	46.2	151	126.9
Peter A. Rochio Substation	2006	914	31,898			108,836		78.2	117.8
Providence Police Academy	1928	20,175	22,208	19,160		1,991,776	101.8	90.6	97.6
Public Safety Complex	2002	119,002	2,741,815	18,168		11,171,923	96.5	131.6	93.3
Steven M. Shaw District 5 Substation	1996	546	8,220	665		94,547	3.5	125.5	171.8
Providence Emergency Management Agency	1991	12,776	158,165	3,313	245,226	1,116,200	35.8		

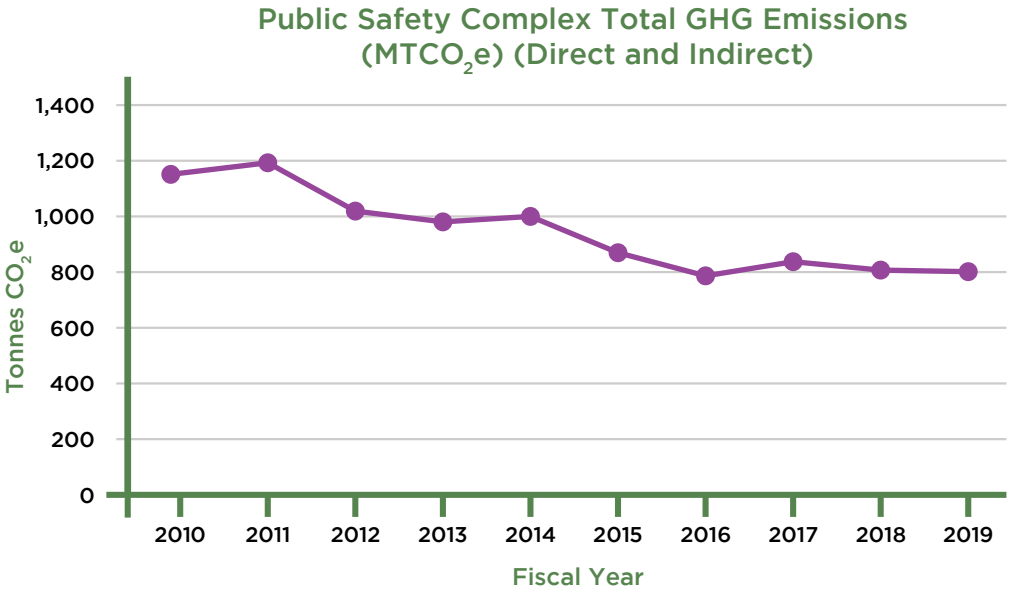
FACILITY	YEAR BUILT	GROSS FLOOR AREA (SQ. FT.)	FY 2019 ELECTRICITY USE (KWH)	FY 2019 NATURAL GAS USE (THERMS)	FY 2019 FUEL OIL #2 (KBTU)	FY 2019 TOTAL SITE ENERGY USE (KBTU)	FY 2019 DIRECT GHG EMISSIONS (METRIC TONS CO_2E)	FY 2010 WEATHER-NORMALIZED SITE EUI (KBTU/FT²)	FY 2019 WEATHER-NORMALIZED SITE EUI (KBTU/FT²)
FIRE STATIONS								***93.9***	***89.6***
Admiral Street Fire Station	1924	12,850	71,869	7,411	101,706	1,088,021	46.9		83.3
Allens Avenue Fire Station	1948	9,440	50,185	6,548		826,074	34.8	103.2	85.4
Atwells Avenue Fire Station	1948	10,022	65,123	11,580		1,380,208	61.5	80.7	138
Branch Avenue Fire Station	1948	14,616	80,129	10,269		1,300,343	54.5	74.8	88.5
Broad Street Fire Station	1942	9,426	71,611	6,850		929,374	36.4	92.2	97
Brook Street Fire Station	1950	7,580	55,499	4,603		649,686	24.5	90.4	85.2
Hartford Avenue Fire Station	1948	9,150	63,379		574,632	790,882	42.6	88.7	86.2
Humboldt Avenue Fire Station	1905	7,460	19,427		643,632	709,917	47.8	114.3	94.8
Messer Street Fire Station	1948	9,150	68,223	722	451,536	756,536	37.3	79.9	82
Mount Pleasant Avenue Fire Station	1903	5,332	32,834	369	338,790	487,740	27.1	126.5	91.4
North Main Street Fire Station	1951	14,760	85,250	5,761		867,012	30.6	65.5	58.1
Reservoir Avenue Fire Station	1932	7,360	39,541	748	416,898	626,657	34.9	84.8	85.5
Rochambeau Avenue Fire Station	1928	7,400	4,936	6,023		619,166	32	126.3	83.3

HIGHLIGHT: PROVIDENCE PUBLIC SAFETY COMPLEX

Energy use at the Providence Public Safety Complex, the headquarters and central station for the Providence Police and Providence Fire Department, has been reduced at the site by 29% since FY 2010. Emissions at the facility have been reduced by 334 metric tons (30%) since 2010. Energy conservation efforts by first responders and support staff have also played a major part in saving energy and reducing emissions at the site.







ADMINISTRATIVE OFFICES

Providence City Hall and the Joseph Doorley, Jr. Municipal Building[7] are the two primary administrative offices of the City. The Mayor's Office, Public Property, Human Resources, Retirement Office, Tax Assessor, and The Office of Sustainability, are just a small sampling of the numerous City departments housed at Providence City Hall. The building, recognized in 2016 for having achieved an Energy Star score of 94, continued to perform well in FY 2019. (The building's FY 2019 score of 84 reflects the EPA's Energy Star score 2018 realignment. The building continues to perform at a high level).Providence City Hall is a great example of how properly performed energy-efficiency retrofitting measures can reduce building emissions and provide energy and cost savings.

Joseph Doorley, Jr. Municipal Building, named for Providence's 31st mayor, and leased from Paolino Properties, houses the City's Department of Inspections and Standards, and the Department of Planning and Development, along with several other City departments. The building's annual weather-normalized energy use has been reduced by 36% since FY 2013. Given that this building is one of Providence's larger energy consumers, the City continues to explore ways to advance energy efficiency as tenants of the space. A no-cost investment-grade energy audit was performed at the facility in 2016 that identified a number of investments that the City is considering to reduce operational costs of the building through energy conservation.

Other City buildings in this category include the Department of Recreation building, the Department of Public Works Administration Building, and Providence Schools' Dr. Robert F. Roberti Administration and Family and Community Engagement Center.

LED LIGHTING RETROFITS

In the beginning of FY 2017, 22 exterior 400-watt metal halide flood lights illuminating Providence City Hall were replaced with 129 watt LED fixtures. This, in addition to the replacement of 10 500 watt halogen floodlights in the building's atrium, resulted in a 19% reduction in the building's electricity use between FY 2017 and FY 2018. These recent measures, combined with past LED tube retrofits in the building's offices, conference rooms and corridors have reduced annual electricity consumption at City Hall by 45% since FY 2010.

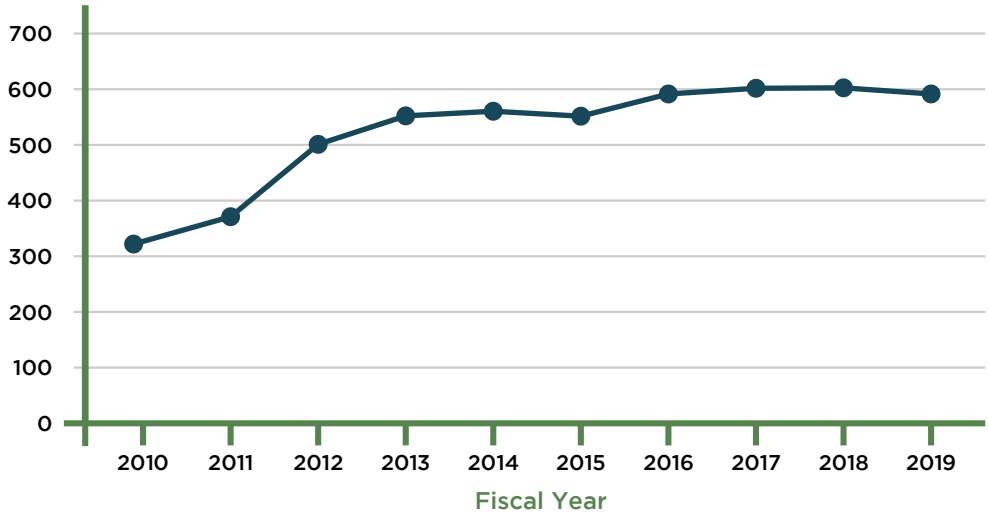
7: The Joseph A. Doorley Municipal Building was first leased at the end of 2011, and therefore saw no energy used by the City in FY 2010.

FACILITY	YEAR BUILT	GROSS FLOOR AREA (SQ. FT.)	FY 2019 ELECTRICITY USE (KWH)	FY 2019 NATURAL GAS USE (THERMS)	FY 2019 FUEL OIL #2 (KBTU)	FY 2019 TOTAL SITE ENERGY USE (KBTU)	FY 2019 DIRECT GHG EMISSIONS (METRIC TONS CO_2E)	FY 2010 WEATHER-NORMALIZED SITE EUI (KBTU/FT²)	FY 2019 WEATHER-NORMALIZED SITE EUI (KBTU/FT²)	FY 2010 ENERGY STAR SCORE	FY 2019 ENERGY STAR SCORE
ADMINISTRATION BUILDINGS								***105.9***	***81.6***	***26.5***	***47.8***
City Hall	1855	99,675	452,796	45,276		6,072,497	240.5	86.1	60.6	47	84
Department of Recreation	2001	4,186	54,807		1,242	188,243	0.1			4	22
DPW Administration Building	1925	20,511	80,966	17,175		1,993,792	91.2	99.9	95.9	66	32
Dr. Robert F. Roberti Administration Building	1945	56,744	772,266	29,284		5,563,330	155.5	122.8	96.9	28	58
Joseph A. Doorley, Jr. Building	1966	72,000	905,682	31,030		6,193,225	164.8	121.1	77.5	8	53
The Family and Community Engagement Center	1960	8,700	46,915	5,192		679,234	27.6	99.5	77.2	6	38

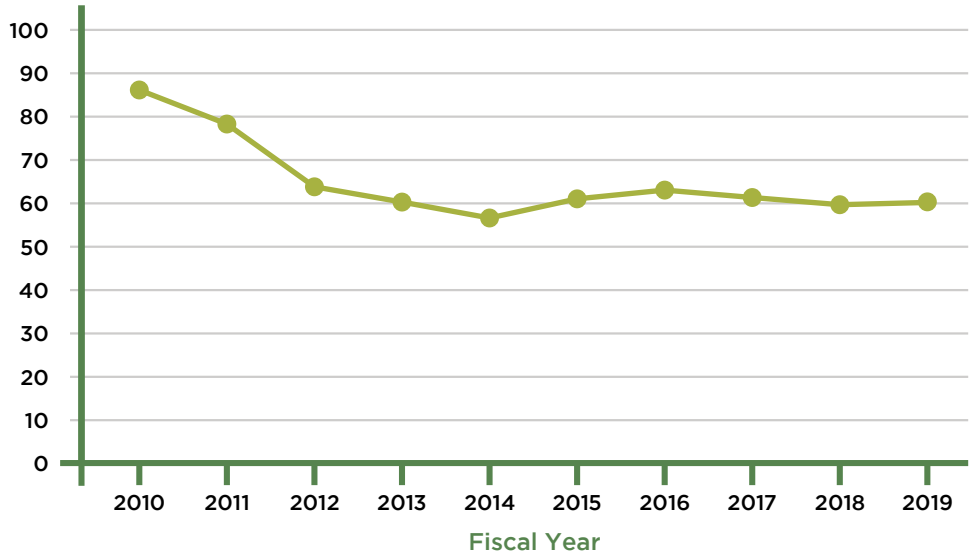
HIGHLIGHT: PROVIDENCE CITY HALL

Interior and exterior LED retrofits, BMS controls, and other energy efficiency upgrades have all played a part in having reduced the energy use intensity (EUI) at City Hall from 86.1 in FY 2010 to 60.6 in FY 2019, an energy use reduction of 30%.

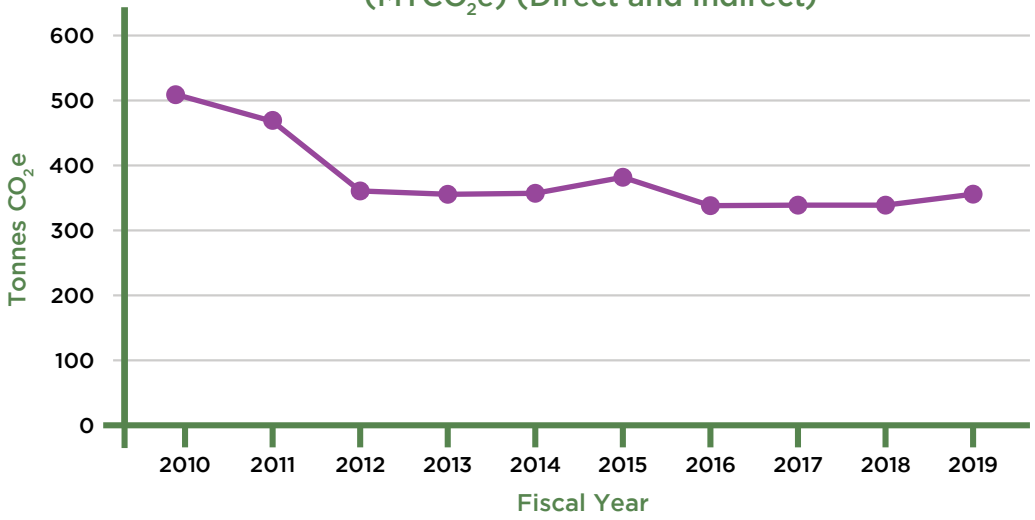
Providence City Hall Energy Star Score



Providence City Hall EUI (kBtu/sq. ft.) (Normalized for Weather)



Providence City Hall Total GHG Emissions ($MTCO_2e$) (Direct and Indirect)



NEIGHBORHOOD RECREATION CENTERS

Each of the City's eleven recreation centers are open, free of charge, to all Providence residents. In addition to athletics, the City's recreation centers house a wide range of youth and family programs. In 2017, three new recreation centers were opened at elementary schools in Providence, increasing the total number of rec centers owned by the City to eleven, and the number of schools doubling as recreation centers to six. The Armand E. Batastini Jr., Robert F. Kennedy, and Sackett Street Recreation Centers were newly opened at Pleasant View, Kennedy, and Lillian Feinstein, respectively. Since the energy consumed by the six recreation centers headquartered in school buildings is only a portion of the total use, their EUIs do not appear in Table 7. Despite FY 2017 LED retrofits in recreation centers City-wide, the average weather-normalized EUI of all the non-school centers combined has increased by about 16% in FY 2019 largely due to the City's new summer day camp and expanded athletic programs. Industrial refrigeration equipment was also added to these sites in 2017 for meals and snacks included as part of the program(s).

ENERGY EFFICIENCY IMPROVEMENTS

LED Lighting Retrofits

In 2017, with the help of rebates from National Grid, the Department of Property oversaw LED lighting retrofits at the City's recreation centers that are saving over 95,000 kWh annually, and about $16,000 a year in City electricity costs.

Multiple investment-grade energy audits have been completed at the Davey Lopes Recreation Center in the past several years as part of a variety of potential funding programs. Though funding for deep efficiency and resiliency remain elusive, the Office of Sustainability and Department of Public Property have nonetheless been working to identify the best solutions for conserving energy at the facility, and to identify external funding sources that could potentially allow for a zero energy approach to updating the aging facility to also meet the challenges of climate change adaptation.

FACILITY	YEAR BUILT	GROSS FLOOR AREA (SQ. FT.)	FY 2019 ELECTRICITY USE (KWH)	FY 2019 NATURAL GAS USE (THERMS)	FY 2019 FUEL OIL #2 (KBTU)	FY 2019 TOTAL SITE ENERGY USE (KBTU)	FY 2019 DIRECT GHG EMISSIONS (METRIC TONS CO_2E)	FY 2010 WEATHER-NORMALIZED SITE EUI (KBTU/FT²)	FY 2019 WEATHER-NORMALIZED SITE EUI (KBTU/FT²)
RECREATION CENTERS								***87.6***	***99.7***
Davey Lopes Recreation Center	1948	11,860	107,589	12,540		1,621,065	66.6	146.5	133.9
Neutaconkanut Recreation Center	1997	15,345	54,147	9,260		1,110,703	49.2	89.4	71.6
Selim Madelin Rogers Recreation Center	2000	9,350	51,770	14,602		1,636,809	77.6	92.8	173.3
Vincent Brown Recreation Center	1997	18,111	30,577	16,708		1,775,133	88.7	57.4	96.9
West End Recreation Center	1997	25,760	198,177	8,859		1,562,072	47.1	56.1	59.2
Zuccolo Recreation Center	1949	11,592	41,476	6,085		750,000	32.3	83.5	63.1

DEPARTMENT OF PUBLIC WORKS AND OTHER BUILDINGS

City buildings in this category include the Lillian Feinstein Senior Center, Department of Public Works (DPW), and school buildings owned by the City, but not currently under PPSD administration. Also being benchmarked is the Public Safety Maintenance Garage on Dexter Street where all City-owned police and fire vehicles are sent for repairs. Buildings at Roger Williams Park included in this category are the Dalrymple Boathouse, the Casino, and the newly renovated Museum of Natural History and Planetarium. Two buildings showing some notable improvement in FY 2018 in this category were the City's DPW buildings which lowered their collective weather-normalized EUI by 7% from FY 2017, and the Casino which reduced its EUI by 5%.

OUTDOOR LIGHTING

Outdoor lighting, which includes the City's streetlights, accounted for 15% of the City's total electricity use in FY 2019, compared to 34% in FY 2015. The City provides lighting for City roadways, sidewalks, parks, athletic fields, playgrounds, school yards and municipal parking lots. The Department of Public Property continues to identify opportunities for low-cost outdoor LED replacement, so that outdated lighting can be replaced at all of its facilities.

In FY 2017, Providence first began seeing the energy saving impacts of its highly visible streetlight LED retrofit project. The project began in 2016 when the City purchased its 16,800 cobra-style streetlights from National Grid (formerly Narragansett Electric), who previously owned and maintained the system. By purchasing the asset, the City has been able to avoid costly maintenance charges, known as "facility" charges, which were previously billed by the utility. The City's 2016 streetlight maintenance contract with the Rhode Island Partnership for Streetlight Management (PRISM) replaced these charges, about $138 annually per fixture, and totaling about $2.3 million a year, with PRISM's all-inclusive maintenance program that costs about $463,000 annually. Rhode Island General Law (RIGL) 39-30, enacted in 2014, made the purchase and subsequent transfer of maintenance responsibility to the City possible. Additionally, Providence's purchase of the streetlight system paved the way for the City to replace the high-pressure sodium (HPS) heads with energy saving LED fixtures capable of supporting open portal control applications, such as remote dimming. The new LED lamps and dimming schedule were able to reduce City streetlight electricity use by 12 million kilowatt hours (kWh) for FY 2019 (figure 15). The streetlight purchase and subsequent LED retrofitting has saved the City roughly $8.4 million in streetlight electricity use and maintenance since 2015 (figure 16).

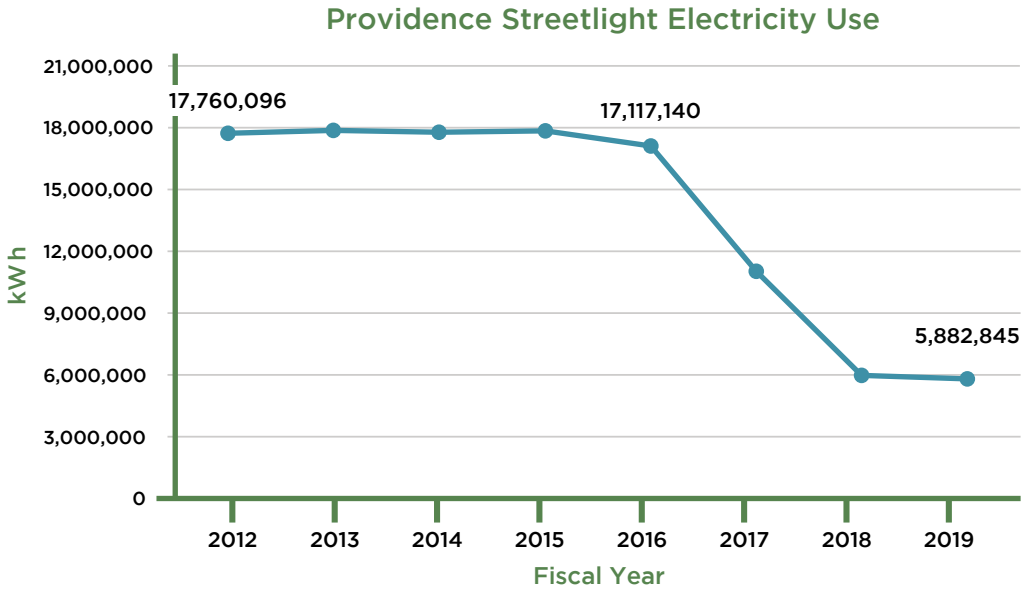


Figure 15: Providence streetlight electricity use was reduced by 12 million kilowatt hours (kWh) between FY 2015 and FY 2019.

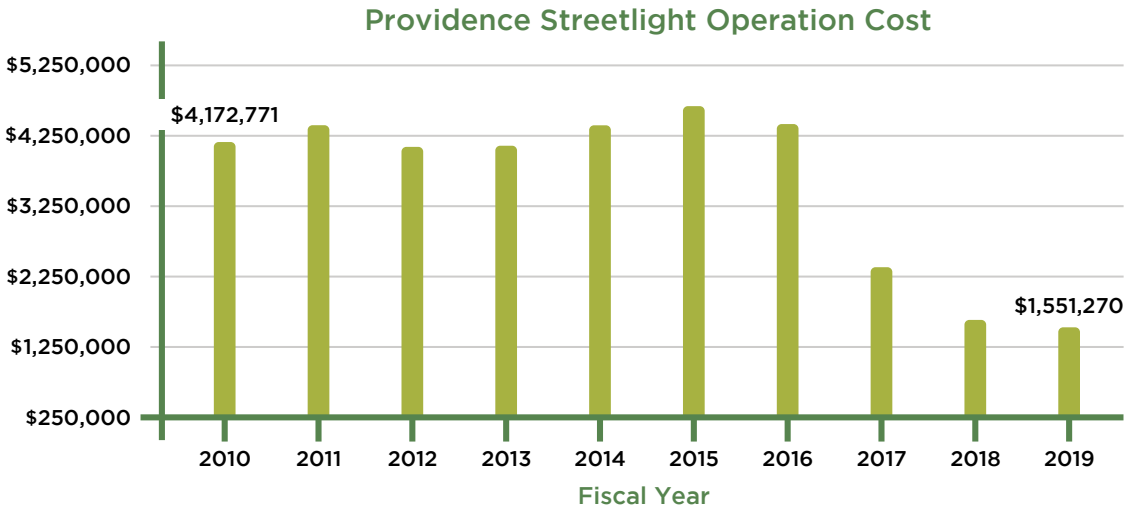


Figure 16: Providence streetlight combined electricity and operational cost was reduced by $3million or nearly 70%, between FY 2015 and FY 2019.

PARK AND DECORATIVE LIGHTING

National Grid's commercial and industrial customer rebate programs helped the City tackle LED lighting retrofits at 24 of the City's parks, playgrounds and ballfields in 2017. Northeast Energy Supply (NES), which expedited the program by the utility for the City, retrofitted floodlighting and wall packs[8] at the Ardoene, Amos Earley, Miguel Luna, Billy Taylor, and Gano Street Parks, just to name a few. Total annual electricity savings from the retrofits is expected to reach 486,272 kWh, reducing City electricity costs by about $72,000.

2015 LED lighting upgrades at the Roger Williams Park Zoo, supported by National Grid's upstream LED lighting program, and expedited by Northeast Efficiency Supply (NES) are continuing to provide an annual operational savings of about $15,000. In 2016, NES retrofitted lighting at the Casino bandstand to LEDs. 23% of the project cost was covered by National Grid incentives, and the new lighting is expected to provide $3,382 in annual operational savings. NES also expedited the replacing of 375 existing 32-watt T8 florescent tubes at the Public Safety Complex's parking garage. The bulbs were replaced with 12-watt LED tubes. National Grid provided LED upstream lighting program incentives for the project that is generating about $7,800 in annual savings.

In FY 2018, the City began retrofitting sidewalk and pathway induction lighting around the City to LED technology. The project will reduce annual City electricity consumption by over 1,000,000 kWh, and an annual savings of about $178,000.

TRAFFIC LIGHTS

The Department of Traffic Engineering is responsible for the maintenance and operation of all City traffic lights. LED technology, and in some cases renewable energy technologies are being utilized in efforts to keep electricity consumption down. More work is needed to identify other measures to insure that downward trending from FY 2010 can be maintained. Electricity consumption from traffic signals saw a 2% increase in FY 2019 (Figure 17).

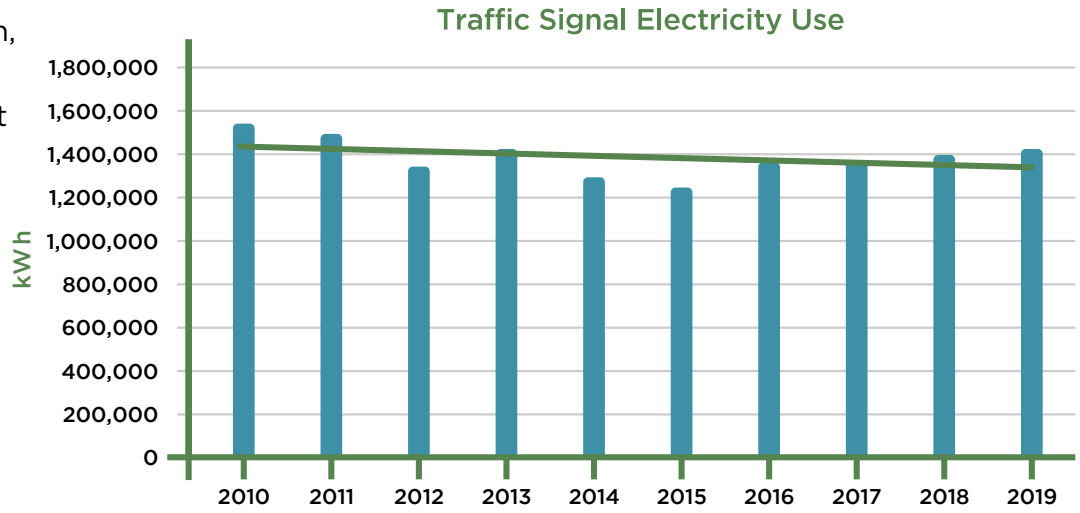


Figure 17: Electricity use for traffic lights in the City of Providence FY 2010-FY 2019.

8: Wall Packs are lighting fixtures usually found mounted on exterior walls of commercial buildings.

GREENHOUSE GAS EMISSIONS

CITYWIDE EMISSIONS

In July of 2015, Mayor Elorza joined thousands of other local government leaders around the world in signing the Compact of Mayors, which is now called the Global Covenant of Mayors, pledging the City to adopt "measurable climate and energy initiatives that lead to an inclusive, just, low-emission and climate resilient future." The agreement committed the City to developing a citywide greenhouse gas (GHG) emissions inventory consistent with the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC). The agreement also called for the City to report on climate hazards and vulnerabilities, emission reduction targets, and climate change mitigation and adaptation planning. Mayor Elorza subsequently issued an executive order on April 22, 2016 committing Providence to becoming a carbon-neutral city by 2050.

The Office of Sustainability accounted for and reported Providence's citywide baseline greenhouse gas (GHG) inventory in 2015 and completed an update in 2018. The citywide GHG inventory includes all emissions from all sectors within the physical city boundary and informs policy and programs to help Providence achieve its goal of becoming a carbon neutral city by 2050. Citywide emissions total about 1.7 million metric tons of CO_2e; Figure 18 profiles the metric tons of CO_2e by sector. Buildings are the largest GHG contributor, accounting for roughly 70% of city-wide carbon emissions. According to the 2018 inventory, citywide emissions declined by 3.04% over the three-year span from 2015 to 2018, equating to an approximate average 1.01% reduction per year.

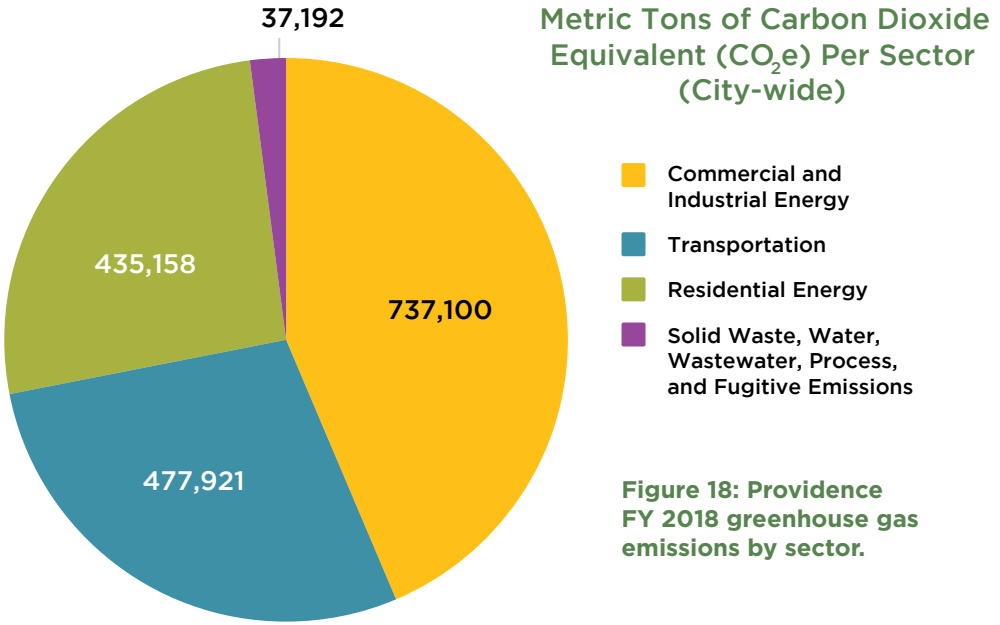


Figure 18: Providence FY 2018 greenhouse gas emissions by sector.

In 2019, the Office of Sustainability further developed programs and policies aimed at reducing citywide GHG emissions, especially from buildings. By demonstrating leadership in GHG accounting and reporting, the City aims to support and encourage emissions reductions in sectors not under our direct control, particularly in large buildings and institutions.

- Released the annual **RePowerPVD** report, highlighting the work of participants in Providence's voluntary energy challenge program, which resulted in a greenhouse gas reduction of 1042.5 Metric Tons CO_2e. Mary E. Fogarty

Elementary School became the first participating building to achieve the challenge goal, reducing its energy usage 26 percent as compared to its 2015 baseline. The report also featured the enrollment of three new projects in the RePowerPVD "Race to Zero" competition, where properties compete to become the first Zero Energy Building in Providence.

- Continued to work with City Council and stakeholders to develop a **benchmarking** or **building energy reporting ordinance**. This ordinance, if passed, would require large commercial, institutional, and multifamily building owners to use ENERGY STAR Portfolio Manager to asses their buildings' energy performance and report energy use information to the City, which then verifies and discloses that data to the public. Use of ENERGY STAR Portfolio Manager helps drive energy efficiency improvements and significant energy savings.
- The City Council authorized and the Office of Sustainability solicited bids for consulting services for the development and administration of a **Community Choice Aggregation** (CCA) Program. The CCA program will aggregate the electrical load of electricity customers in Providence and will prioritize cost savings and emissions reductions through the purchase of local, renewable energy or by another method.

EMISSIONS FROM CITY OPERATIONS

City buildings and outdoor lighting account for only 2.54% of citywide building emissions. Nonetheless, the City of Providence expects to lead by example in reducing emissions from its energy use. The 2014 Sustainable Providence Plan set out goals and strategies to reduce energy use in municipal buildings. The 2019 Climate Justice Plan further aims to eliminate all climate pollution from municipal operations by 2040, prioritizing city-owned schools and facilities most used by low income, communities of color and in cumulative pollution areas.

Greenhouse gas emissions from our City building and outdoor lighting energy consumption have been steadily decreasing since 2010. FY 2019 municipal GHG emissions are estimated to have been 28,845 metric tons, up 8% from FY 2018, but still 23.7% below the 37,792 metric ton 2010 baseline. Emissions reductions have occurred at both the building-level, for thermal energy (oil to natural gas conversions, and energy efficiency measures), and at the region's power plants, as many have replaced coal and oil with natural gas to generate electricity.

Figure 19 shows the direct and indirect greenhouse gas emissions from municipal buildings and outdoor lighting. The 23.7% reduction from the 2010 baseline is the result of strategic investments in City facilities including building upgrades, converting City street lights to LEDs, and employee education around energy conservation.

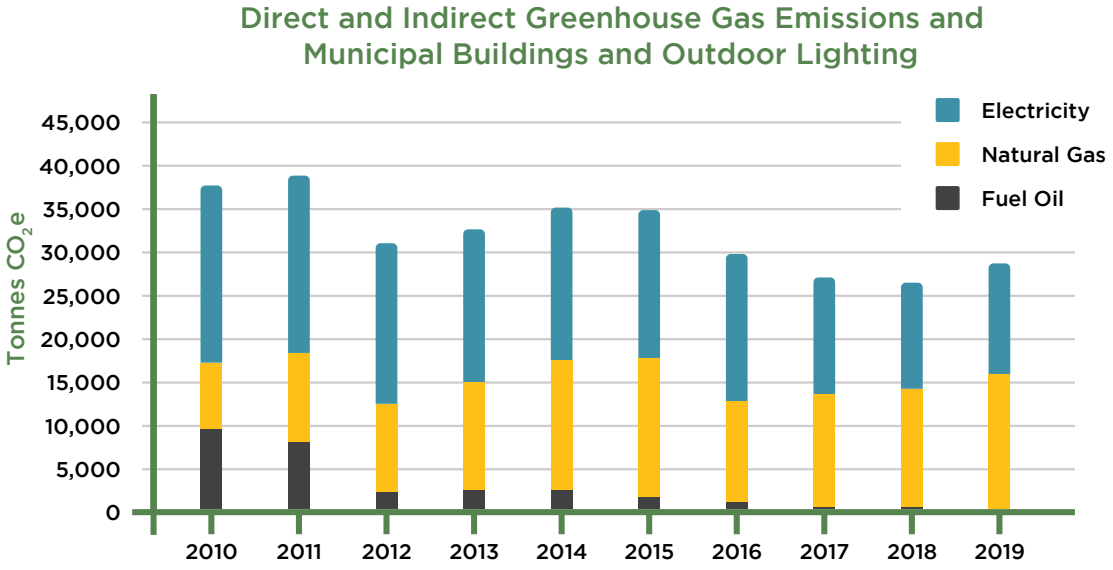


Figure 19: Greenhouse gas emissions from municipal buildings and lighting, shown in metric tons of CO_2 equivalents, FY 2010 - FY 2019.