

City of Providence
Department of Sustainability

Municipal Energy Report
FY 2021

Acknowledgements

Contributors to this report from the City of Providence include:

- Emily Koo, Director of Sustainability
- Kevin, Deputy Director of Sustainability
- John Biller, Energy Manager Intern, URI Energy Fellow
- Elder Gonzalez Trejo, Sustainability Policy Associate
- Julia Dearden, Sustainability Coordinator
- Dino Larson, Previous Energy Manager
- Emily Snow, Graphic Design
- Department of Public Property
- Controller's Office
- Providence Public Schools

The following external partners provided data for this report:

- National Grid
- Aramark Education
- Gilbane
- Direct Energy
- Santa Buckley Energy
- National Efficiency Supply
- Competitive Energy Services
- Southern Sky Renewable Energy RI
- Captona
- Constellation

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 (CO₂e): 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 timeframe (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.

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.

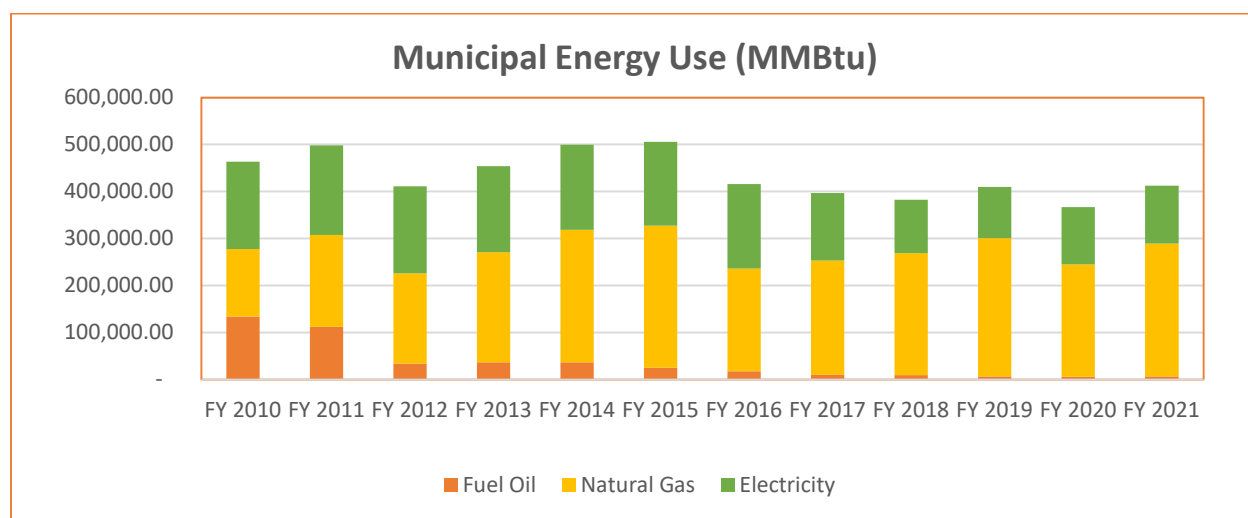


Figure 1a: City of Providence's electricity, natural gas, and fuel oil consumption, FY 2010 - FY 2021.

The City of Providence has been benchmarking and monitoring its energy consumption as part of its fiscal and environmental agenda since 2010. Due to Covid-19 and capacity issues within the department over the last year, the Municipal Energy Report FY 2021 was analyzed later than expected. On the bright side this does mark the 7th 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 the electric, natural gas, and oil 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 412,015 MMBtu of energy in FY 2021 in the form of electricity, natural gas, and oil. Most of the City's facilities, including school buildings operated by Providence Public Schools, have increased their energy consumption in comparison to FY 20, most likely due to the Municipality trying to combat COVID-19. As a result, the increase in consumption may be attributable to things going back to normal.

Key Findings:

- The City used 412,015 MMBtus of energy in FY 2021, a 11% reduction from our baseline year of FY 2010. Consumption was up from 2020, mostly due to an increase in natural gas associated with a colder winter and COVID protocols.
- The City's expenditures on energy have declined by about 30% since FY 2010.
- Greenhouse gas emissions from municipal facilities have decreased by 27% since FY 2010, the result of using cleaner fuels, LED lighting conversions, and heating system upgrades.
- The City's electricity use stayed almost exactly the same in comparison to FY 2020, continued its overall downward trend at about 36 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.
- 34 out of 82 buildings have decreased their Weather Normalized Site EUI in comparison to FY 2020.

Contents

ACKNOWLEDGEMENTS	.....ERROR! BOOKMARK NOT DEFINED.
GLOSSARY	.....3
EXECUTIVE SUMMARY	.....5
INTRODUCTION	.....8
CITY ENERGY USE	.....9
OVERVIEW	.....9
ELECTRICITY	.....10
THERMAL	.....11
ENERGY SUPPLY: RENEWABLES & PROCUREMENT STRATEGY	.....12
VIRTUAL NET METERING	.....14
BUILDING PORTFOLIO	.....14
BENCHMARKING BUILDINGS	.....17
STRATEGIC ENERGY MANAGEMENT	.....18
MUNICIPAL SCHOOL BUILDINGS	.....19
ELEMENTARY SCHOOLS	.....22
MIDDLE SCHOOLS	.....25
HIGH SCHOOLS	.....28
PUBLIC SAFETY	.....32
ADMINISTRATIVE OFFICES	.....34
NEIGHBORHOOD RECREATION CENTERS	.....36
DEPARTMENT OF PUBLIC WORKS AND OTHER BUILDINGS	.....37
OUTDOOR LIGHTING	.....38
PARK LIGHTING	.....40
TRAFFIC LIGHTS	.....40
GREENHOUSE GAS EMISSIONS	.....41

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 2020 for its Electric Vehicle charging station project at the Public Safety Garage. Unfortunately, due to the lingering effects of COVID-19 the 2021 Lead by Example Award was placed on pause.

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 2021 used for the report is available via the Sustainability Dashboard on the City website.

City Energy Use

Overview

The City's facilities, including buildings and outdoor lighting, used 412,015 MMBtu of energy in FY 2021 in the form of electricity, natural gas, and oil (see [Figure 1b](#)). 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 2021, natural gas accounted for roughly 69% of City facility energy consumption at 282,449 MMBtu. Electricity accounted for 30% of the City's total energy use at 122,946 MMBtu, while #2 heating oil accounted for only 1% at 6,619 MMBtu.

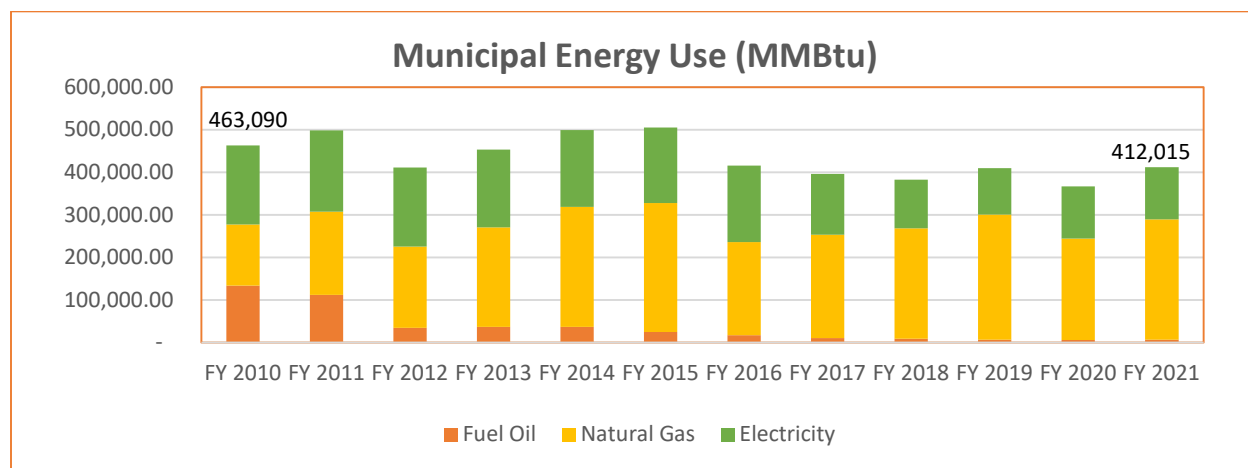


Figure 1b: City of Providence's electricity, natural gas, and fuel oil consumption, FY 2010 - FY 2021.

Relative to the City's baseline year of 2010, energy consumption has declined by 11%, 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 (COVID-19), weather is typically the primary factor in energy use fluctuations.

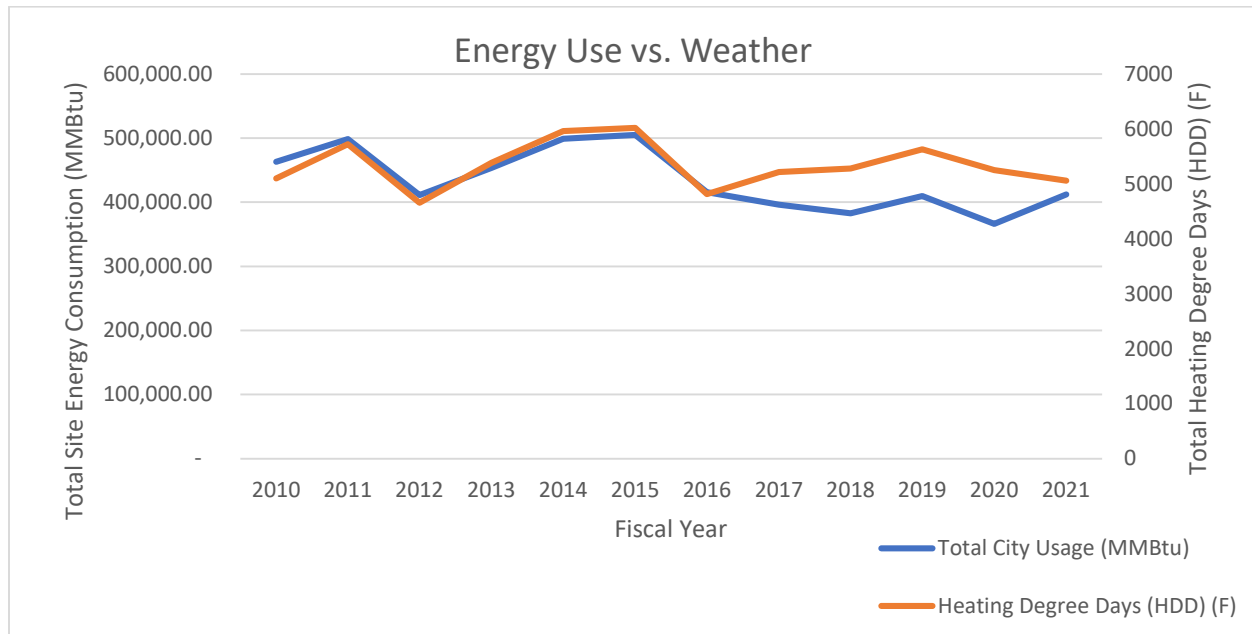


Figure 2: Because a significant amount of energy is needed for heating municipal buildings, weather is a driving factor in overall energy consumption.

Electricity

In FY 2021, the City of Providence used roughly 36,033,594 kWh of electricity; a 34% reduction from its 2010 baseline and 1% increase from FY 2020 (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, rec centers, and municipal buildings, along with transitions to more energy efficient electronics and appliances.

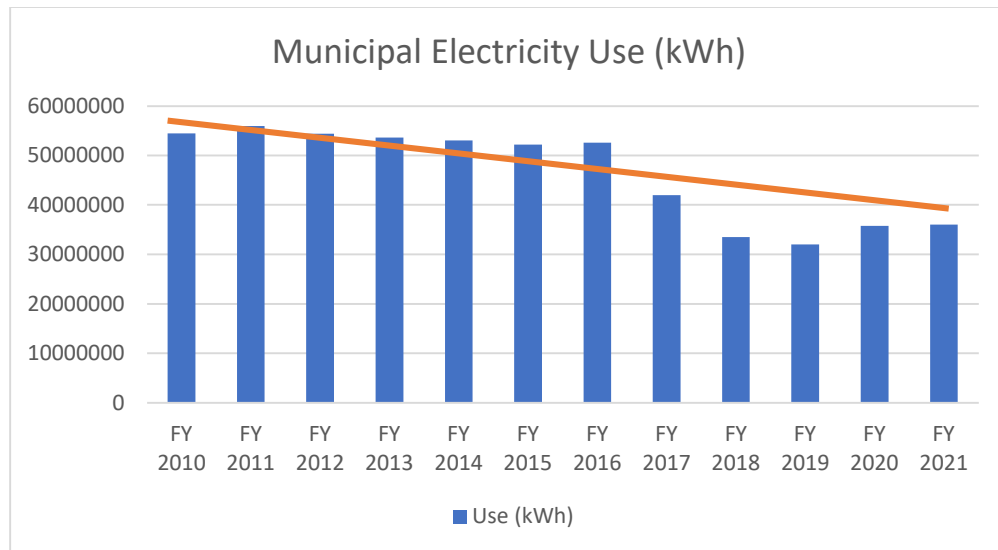


Figure 3: City of Providence's electricity use shown in kWh, FY 2010 – FY 2021. Electricity consumption has declined by 34% since FY 2010.

Thermal

The City of Providence uses two primary fuel types 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 (see [Figures 4 & 5](#)). 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 (electricity). The [Climate Justice Plan](#), which was released in 2019 calls for 100% of municipal buildings' heating to be renewable by 2040. By converting HVAC appliances to electricity will help us achieve this goal.

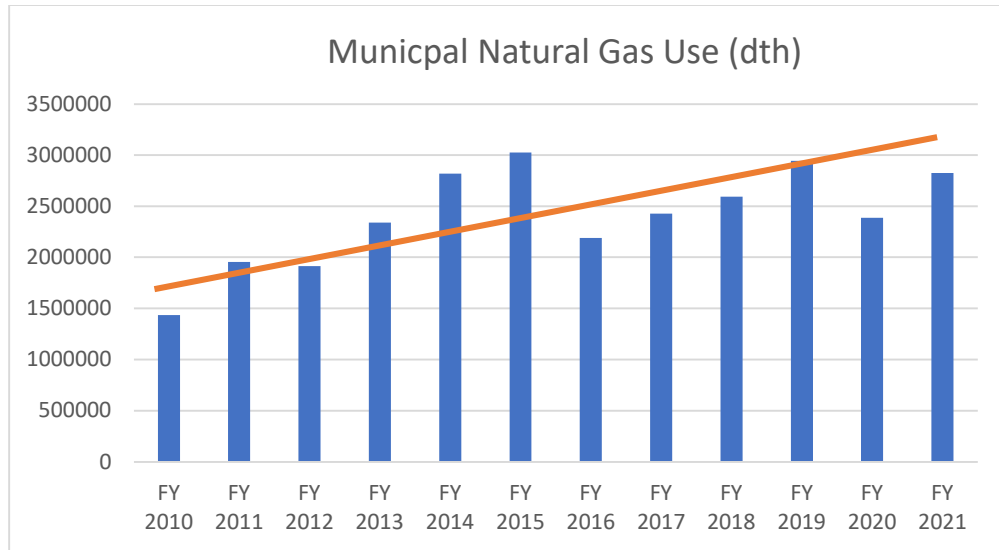


Figure 4: City of Providence's natural gas use, shown in dekatherms, FY 2010 – FY 2021.

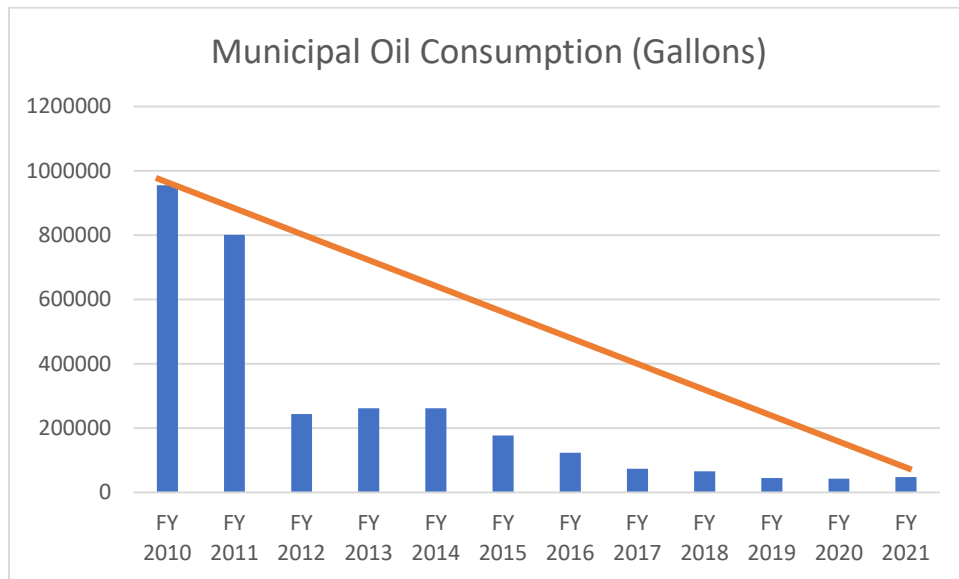


Figure 5: City of Providence's fuel oil consumption has declined by 96% since FY 2010 due to converting to natural gas systems.

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 31% since FY 2010 (see **Figure 6**).

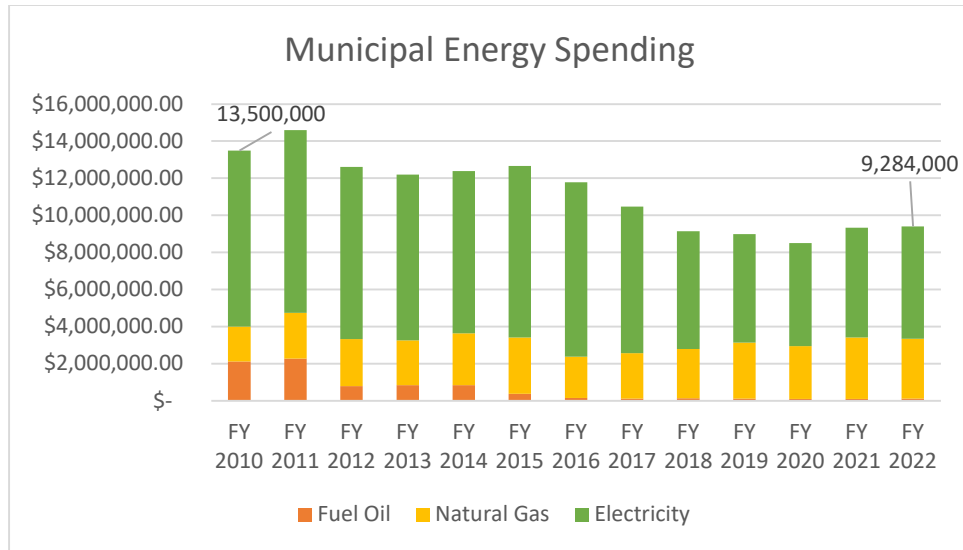


Figure 6: Despite rising energy costs, municipal spending on energy has decreased by 31% since 2010.

Energy procurement strategies have played a significant role in reducing the City energy costs while also providing stability for budgeting. The City works with a third-party energy supplier, Constellation, to secure long-term, fixed prices for its electricity supply. These contracts saved the City over \$6 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.

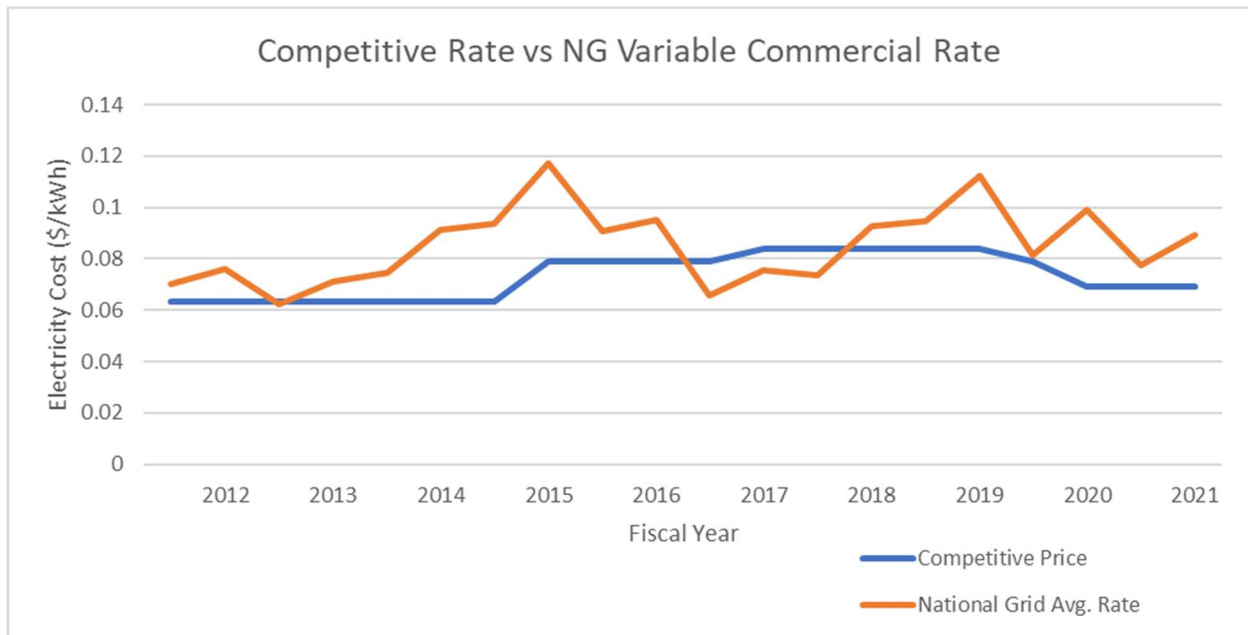


Figure 7: The graph provides a comparison of the City's actual electricity cost based on its third-party supplier rate versus estimated cost of National Grid's average rate.

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 most 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 (CO₂e) from the atmosphere, and will provide roughly \$1.66 million in annual electricity savings to the City. 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.

ADD PHOTO

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,¹ one central public safety complex, nine district police sub-stations, 12 fire stations (the Humboldt Fire Station closed in 2017), eleven recreation centers,² three maintenance buildings, 35 park buildings, one multi-level parking garage, one police academy training facility, 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.

¹ Some buildings house more than one school.

² 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.

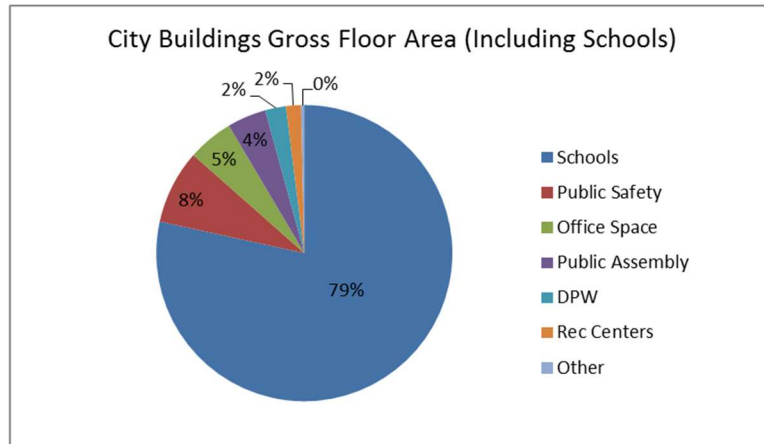


Figure 8: Total municipal building area percentage by facility type. Percentages based on building square footage.

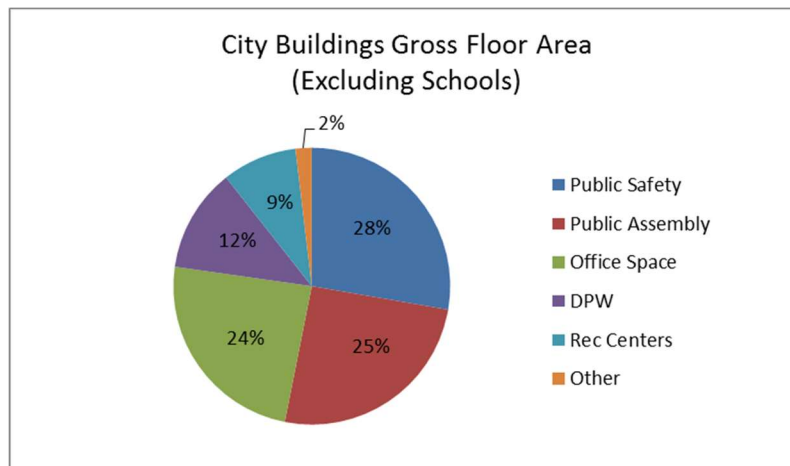


Figure 9: Municipal building area percentage by facility type. This graph excludes schools, which accounts for 79% of the building portfolio.

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.

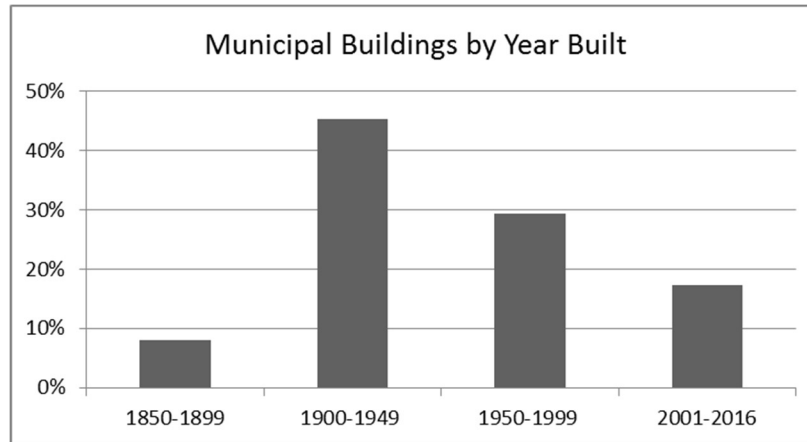


Figure 10: Municipal buildings by year built shown as a percentage. Most of the City's building portfolio was built in the early 20th century.

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.

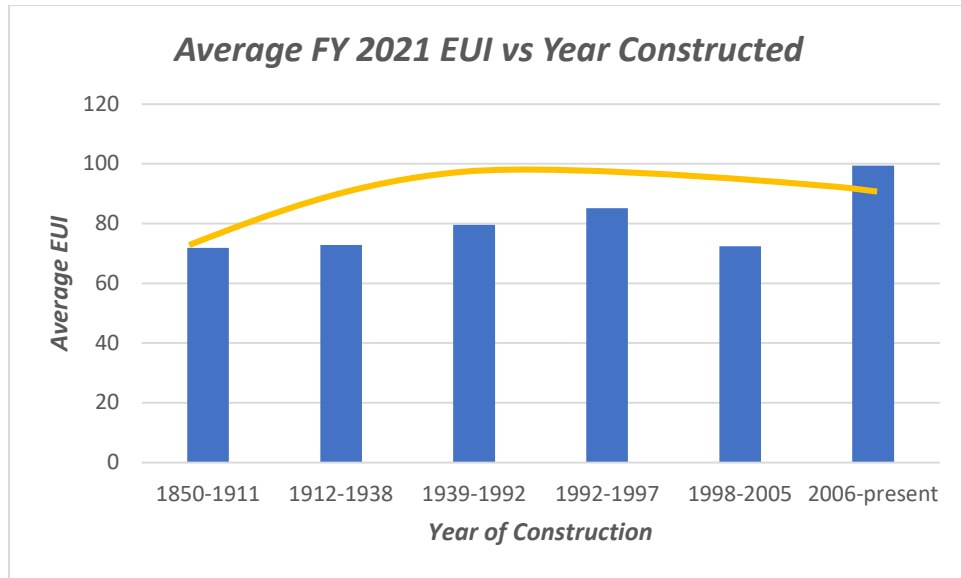


Figure 11: This graph compares year of construction with building's energy use intensity (EUI). Older municipal buildings, built before the advent of energy-intensive heating, cooling and lighting systems, are some of the City's lowest energy consumers per square foot. New policies such as the International 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 2021 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.³

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. 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

³ 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.

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 its 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 Schools Department 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.

Representing most of the City's building space, and with a student, teacher, and staff population of nearly **24,000**, City schools account for most of Providence's municipal energy use. In FY 2021, Providence's schools used 278,925 MMBtu, or 68% 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 slightly trended up over the last few 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

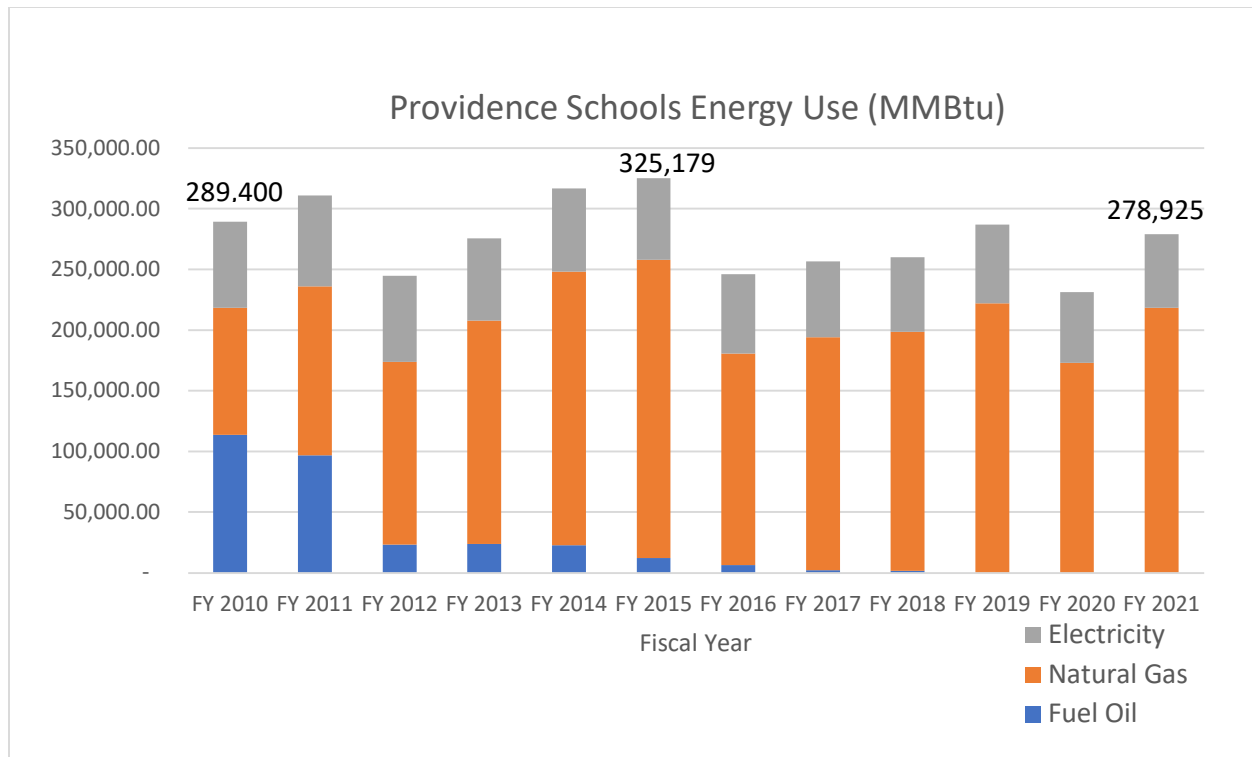


Figure 12: In FY 2021, Providence Schools electricity, natural gas, and fuel oil consumption was down 14% from an eight-year high of 325,179 MMBtu in FY 2015.

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 Department of Public Property, Aramark monitors and maintains all 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 (now RI Energy) 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.

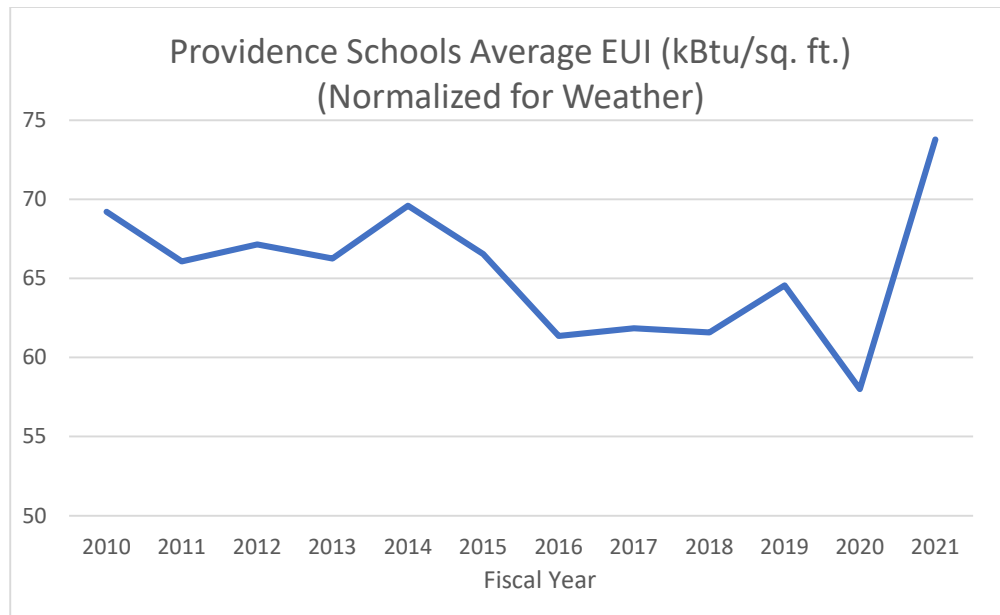


Figure 12b: Weather-normalized average energy use intensity (EUI) for all City school buildings.

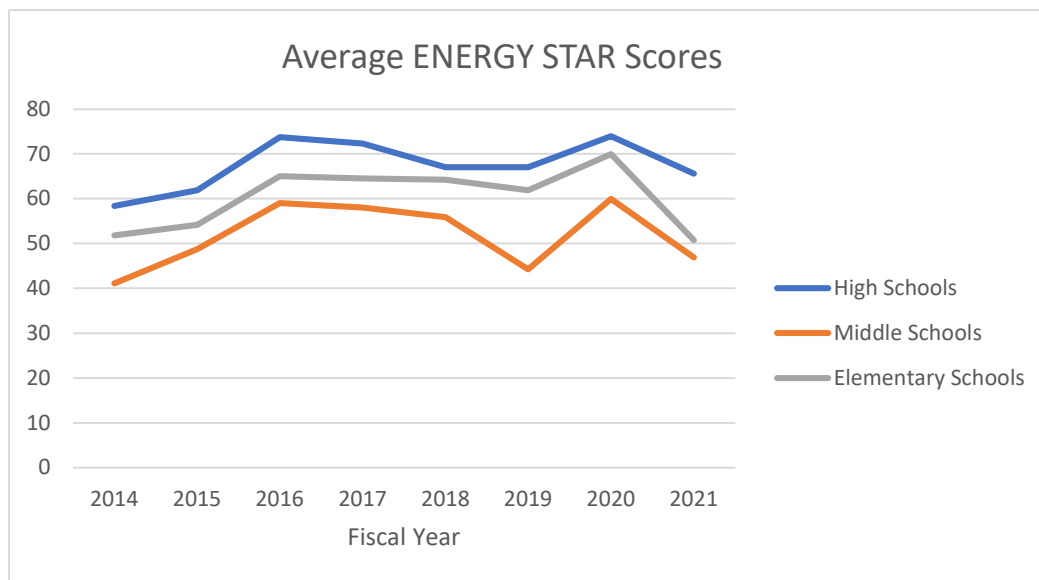


Figure 13: Though some middle school ENERGY STAR scores dipped during 2019, average scores for all school buildings have increased substantially since 2014.

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”.

⁴ Large-scale projects are normally included in Providence Schools' master 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.”⁵

It is important to highlight that funding was put on hold for FY 2021, due to the lingering effects of COVID-19. Spending did not occur in any of the school buildings; therefore no energy efficiency upgrades were present during this fiscal year.

Elementary Schools

In FY 2021, Providence Public Elementary Schools saw a decrease in ENERGY STAR score within each property. In comparison to the Avg. ENERGY STAR Scores in 2020, Elementary Schools dropped a considerable 26%. Only 3 Elementary Schools managed to qualify for the ENERGY STAR Certification (score higher than 75), bringing the total number of the City's public schools qualifying for ENERGY STAR certification to 6. As previously mentioned, COVID protocols greatly impacted the normal operation of K-12 school buildings which resulted in the changes in ENERGY STAR scores. However, Robert L. Bailey, IV Elementary School's scored 88 which was the highest ENERGY STAR score of all the City's schools in FY 2021. The current data, in addition to showing better performance amongst the newer buildings, also demonstrates that older schools can achieve high scores. For example, Frank D. Spaziano elementary schools was constructed in 1895, yet was eligible for ENERGY STAR certification in 2021 with a score of 76. Older buildings typically have fewer energy intensive system which help them score better. Unfortunately, they lack many 21 century educational amenities – computer labs and air conditioning being prime examples.

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. However, in FY 2021, due to COVID-

⁴ RIDE School Construction Regulations (5/24/07)

⁵<http://www.ride.ri.gov/FundingFinance/SchoolBuildingAuthority/FacilityDataInformation.aspx#37541392-condition-assessments>

19, funding was put on pause, therefore there was no spending on energy efficiency upgrades.

Building Management System Upgrades

In FY 2020, Aramark continued its ongoing maintenance and monitoring of Building Management Systems (BMS) district wide. However, in FY 2021, due to COVID-19, this type of operations was put on hold and the expected energy savings from these upgrades were not realized. Aramark and PPSD fully expect this work to resume in FY 2022.

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 CO₂e 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 more that \$20,000 on natural gas since 2017.

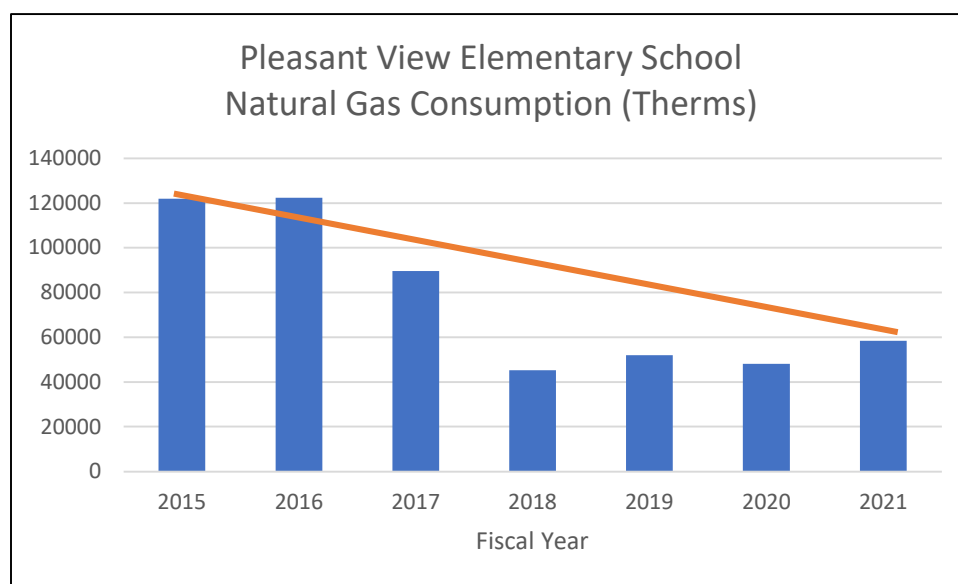


Figure 14: The evolution of heating system upgrades at Pleasant View is reflected in the buildings natural gas use.

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.

LED Lighting Retrofits

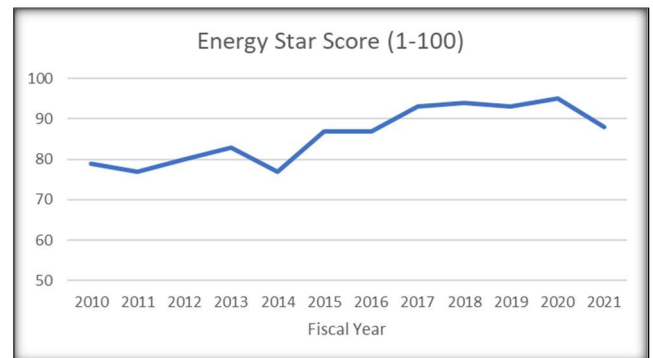
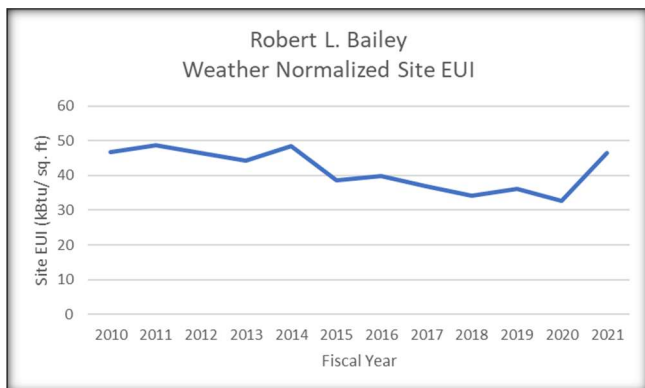
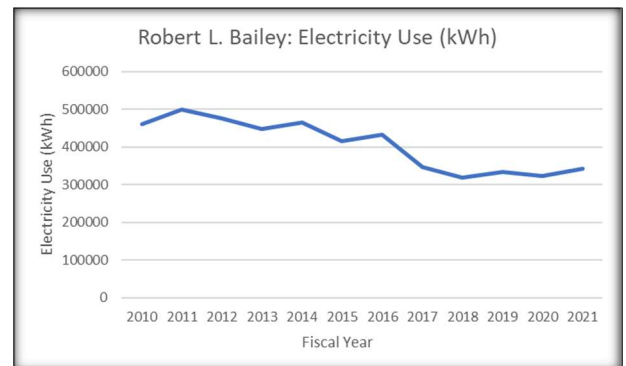
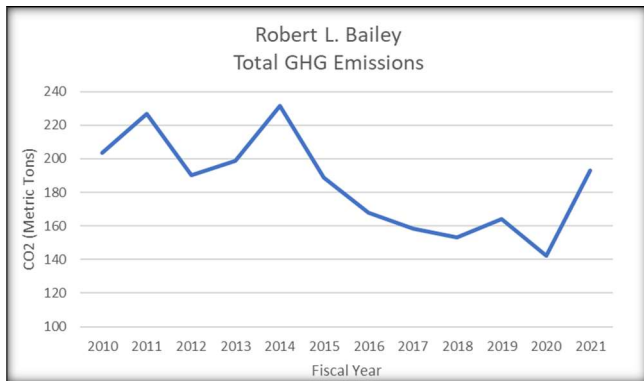
As of 2021, ten out of 22 elementary schools have been retrofitted with new interior LED lighting. Despite increased activity at the City's elementary schools, both before school and after school activities, total cumulative electricity savings at the retrofitted schools in FY 2021 approached 2,750,000 kWh, saving Providence Schools approximately \$450,000 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.

Property Information			FY 2021 Fuel Consumption			Energy Use Intensity			ENERGY STAR Score			Green House Gas Emissions		
Property Name	Property GFA - Self-Reported (ft ²)	Year Built	FY 2021 Electricity Use - Grid Purchase (kWh)	FY 2021 Natural Gas Use (therms)	Site Energy Use (kBtu)	FY 2020 Weather Normalized Site EUI (kBtu/ft ²)	FY 2021 Weather Normalized Site EUI (kBtu/ft ²)	Percentage Improvement	FY 2020 ENERGY STAR Score	FY 2021 ENERGY STAR Score	Percentage Improvement	FY 2020 Direct GHG Emissions (Metric Tons CO _{2e})	FY 2021 Direct GHG Emissions (Metric Tons CO _{2e})	Percentage Improvement
Elementary Schools						70	81	-15%	55	51	-8%	246	231	6%
Allan Shawn Feinstein Elementary School @ Broad Street	77,899	1895	134,998	67,142	7,174,817	74.9	99.7	-33%	80	62	-23%	375.5	356.6	5%
Anthony Carnevale Elementary School	78,000	1999	456,706	27,403	4,298,584	56.7	59.3	-5%	47	62	32%	113.4	145.6	-28%
Asa Messer Elementary School @ Samuel W. Bridgman	109,255	1972	518,825	62,923	8,062,497	70.8	80.4	-14%	39	35	-10%	395.7	334.2	16%
B. Jae Clanton Complex	103,000	2004	487,158	40,943	5,756,522	89.4	NA	NA	41	78	90%	352.9	217.5	38%
Carl G. Lauro Elementary School	117,482	1921	250,365	88,210	9,675,242	62.6	90.6	-45%	71	41	-42%	311.8	468.5	-50%
Dr. Martin Luther King Elementary School	71,724	1959	235,393	39,019	4,705,055	59.4	71.2	-20%	71	67	-6%	234.3	207.2	12%
Frank D. Spaziano Elementary School	58,015	1908	97,267	27,609	3,092,747	73.0	59.0	19%	56	76	36%	256.2	146.6	43%
George J. West Elementary School	112,030	1959	210,607	81,164	8,834,964	70.2	85.8	-22%	64	46	-28%	488	431.1	12%
Harry Kizirian Elementary School	73,950	1959	236,723	45,361	5,343,754	68.4	77.6	-13%	57	46	-19%	279.8	240.9	14%
Leviton Dual Language School	40,000	2002	284,295	14,827	2,452,665	49.6	65.7	-32%	73	61	-16%	52.7	78.8	-50%
Lillian Feinstein Elementary School @ Sackett Street	68,400	1921	249,168	34,386	4,288,782	58.5	68.9	-18%	71	68	-4%	190.6	182.6	4%
Mary E. Fogarty Elementary School	51,400	1959	142,060	31,408	3,625,518	NA	76.7	NA	60	48	-20%	180.5	166.8	8%
Pleasant View Elementary School	74,800	1971	491,315	58,510	7,527,315	22.3	107.7	-383%	100	24	NA	31.4	310.8	-890%
Reservoir Avenue Elementary School	22,000	1924	102,850	13,463	1,697,236	81.7	84.0	-3%	28	22	-21%	72.3	71.5	1%
Robert F. Kennedy Elementary School	49,840	1921	139,273	45,336	5,008,781	84.6	110.4	-30%	38	22	-42%	279.6	240.8	14%
Robert. L Bailey, IV Elementary School	78,000	2000	342,660	21,866	3,355,726	46.7	46.4	1%	79	88	11%	99.9	116.1	-16%
The Leviton Complex	178,654	1908	1,012,037	47,159	8,168,946	56.6	NA	NA	52	58	12%	331.9	250.5	25%
Vartan Gregorian Elementary School	63,000	1954	228,426	47,705	5,549,899	108.6	97.9	10%	16	26	63%	280.7	253.4	10%
Veazie Street Elementary School	110,000	1909	337,708	55,915	6,743,767	90.2	66.6	26%	31	57	84%	410	297.0	28%
Webster Avenue Elementary School	44,290	1904	136,360	24,078	2,873,061	56.8	71.4	-26%	65	53	-18%	151.6	127.9	16%
William D'Abate Elementary School	44,174	1959	218,002	37,345	4,478,299	115.3	111.3	3%	25	26	4%	286.5	198.4	31%



Highlight: Robert L. Bailey, IV Elementary School

In 2019, investment in energy efficiency measures at the Robert L. Bailey Elementary School included 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 to date. Carbon emissions at the site are below FY 2010 levels.



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.

In 2021, similarly to the Elementary Schools, every building except for Nathan Bishop Middle decreased in ENERGY STAR score. Del Sesto Middle School and Nathanael Greene Middle School fell short of ENERGY STAR certification, in which they obtained the year before. This again is largely attributed to the hold on funding and spending due to COVID-19.

Energy Efficiency Improvements

Building Management System Upgrades

A new BMS at DelSesto Middle School installed in 2017 helped the building to perform well in FY 2020. Yet, due to COVID-19, in FY 2021 Aramark was unable to assist in maintenance and monitoring for middle schools.

Due to the same reasons as the elementary schools, no energy efficiency improvements took place in FY 2021.

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.

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

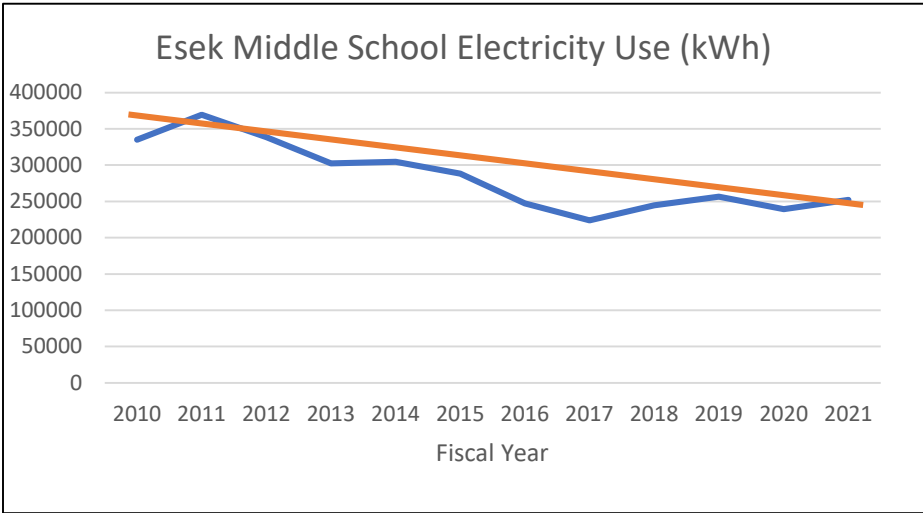
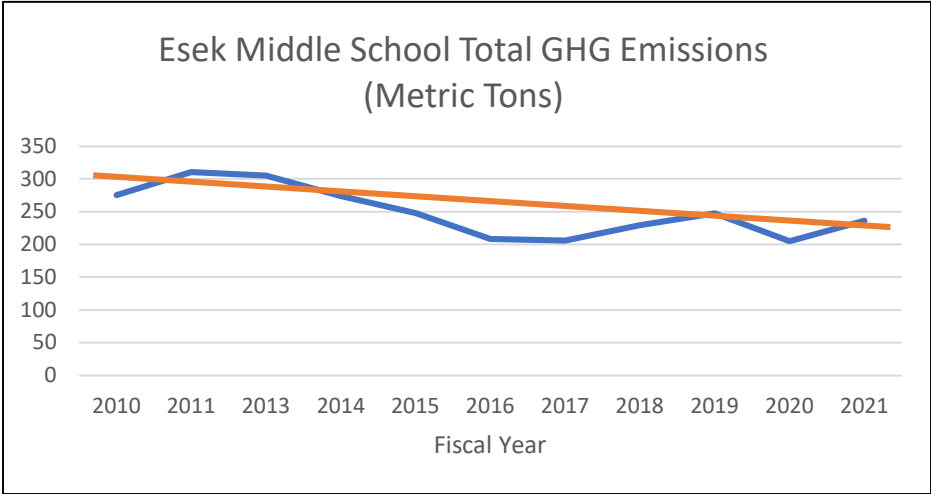
To date, LED lighting has been installed in all the classrooms and common spaces at Esek Hopkins, Nathanael Greene, Roger Williams, Gilbert Stuart, and DelSesto middle schools. In 2016, exterior lighting was replaced with LEDs at Nathan Bishop, Nathanael Greene, and West Broadway. In August of 2017, 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 2020, these LED retrofits have resulted in more than 1,250,000 kWh of energy saved and \$200,000 in avoided utility costs.

Property Information			FY 2021 Fuel Consumption			Energy Use Intensity			ENERGY STAR Score			Green House Gas Emissions		
Property Name	Property GFA - Self-Reported (ft ²)	Year Built	FY 2021 Electricity Use - Grid Purchase (kWh)	FY 2021 Natural Gas Use (therms)	Site Energy Use (kBtu)	FY 2010 Weather Normalized Site EUI (kBtu/ft ²)	FY 2021 Weather Normalized Site EUI (kBtu/ft ²)	Percentage Improvement	FY 2010 ENERGY STAR Score	FY 2021 ENERGY STAR Score	Percentage Improvement	FY 2010 Direct GHG Emissions (Metric Tons CO ₂ e)	FY 2021 Direct GHG Emissions (Metric Tons CO ₂ e)	Percentage Improvement
Middle Schools						63.7	75.8	-19%	54	47	-13%	465	371	20%
DelSesto Middle School	146,000	1998	812,067	52,632	8,033,939	57	59	-4%	52	63	21%	238.4	279.6	-17%
Esek Hopkins Middle School	87,560	1916	252,271	33,785	4,239,275	49.1	53.1	-8%	73	75	3%	200.3	179.4	10%
Gilbert Stuart Middle School	154,450	1929	310,058	92,171	10,274,977	56.1	73.3	-31%	70	52	-26%	502.8	489.6	3%
Nathan Bishop Middle School	136,000	1929	1,202,613	45,808	8,684,116	68.9	68.1	1%	50	38	-24%	NA	243.3	NA
Nathanael Greene Middle School	168,500	1930	255,232	138,376	14,708,404	61.9	95.5	-54%	66	36	-45%	606.2	735	-21%
Roger Williams Middle School	135,228	1929	289,454	94,154	10,403,048	89.1	84.5	5%	36	45	25%	778.7	500.1	36%
West Broadway Middle School	46,000	1966	236,461	32,326	4,039,406	NA	96.9	NA	29	19	NA	NA	171.7	NA

Highlight: Esek Hopkins Middle School



Esek Hopkins Middle School has maintained ENERGY STAR certification for 8 years in 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 now 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 two of the City's high school buildings again qualifying for ENERGY STAR certification in FY 2021.

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 heating plant. This results in a single ENERGY STAR score for the two schools. In 2017, National Grid rebates covered more than 60% of the cost of a new building management system (BMS) and the variable frequency drives (VFDs) for pump motors for the Classical Auditorium and Café hot water service.

Property Information			FY 2021 Fuel Consumption			Energy Use Intensity			ENERGY STAR Score			Green House Gas Emissions		
Property Name	Property GFA - Self-Reported (ft ²)	Year Built	FY 2021 Electricity Use - Grid Purchase (kWh)	FY 2021 Natural Gas Use (therms)	Site Energy Use (kBtu)	FY 2020 Weather Normalized Site EUI (kBtu/ft ²)	FY 2021 Weather Normalized Site EUI (kBtu/ft ²)	Percentage Improvement	FY 2020 ENERGY STAR Score	FY 2021 ENERGY STAR Score	Percentage Improvement	FY 2020 Direct GHG Emissions (Metric Tons CO ₂ e)	FY 2021 Direct GHG Emissions (Metric Tons CO ₂ e)	Percentage Improvement
High Schools						63	66	-5%	67	65	-2%	551	466	16%
Central High - Classical High Schools	454,059	1962	2,026,803	168,428	23,758,209	NA	56.8	NA	61	75	23%	1180.6	894.6	24%
Dr. Jorge Alvarez High School	88,000	2007	652,933	35,291	5,756,939	55.6	68.4	-23%	61	54	-11%	130.3	187.4	-44%
E-Cubed Academy	44,600	2004	282,452	20,022	2,965,917	52.8	72.9	-38%	67	69	3%	45.8	106.3	-132%
Hope High School	257,089	1938	573,378	181,640	20,120,385	73.1	86.8	-19%	76	70	-8%	781.6	964.8	-23%
Juanita Sanchez Educational Complex	110,000	2004	792,876	36,595	6,364,834	69.6	61.8	11%	53	73	38%	206	194.4	6%
Mount Pleasant High School	320,000	1938	874,583	182,462	21,230,312	74.9	73.1	2%	75	78	4%	1458.6	969.1	34%
Providence Career and Technical Academy	300,000	2009	1,649,025	65,318	12,158,235	NA	42.4	NA	NA	NA	NA	NA	346.9	NA
Windmill Annex (A Venture)	25,060	1930	85,637	11,880	1,480,141	51.7	65.6	-27%	73	39	-47%	56.4	63.1	-12%

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 have continued to be maintained and monitored by Aramark, who performs repairs, upgrades, and recommissioning when needed.

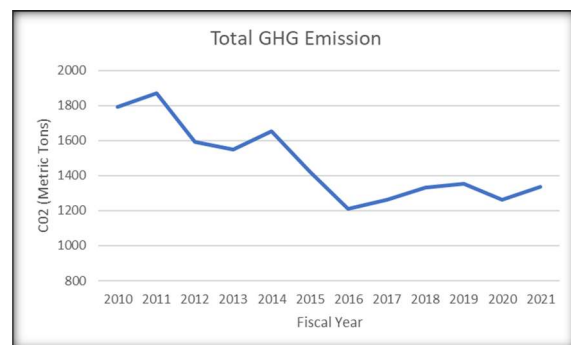
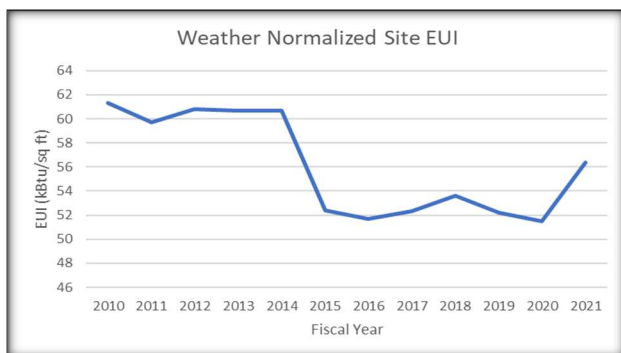
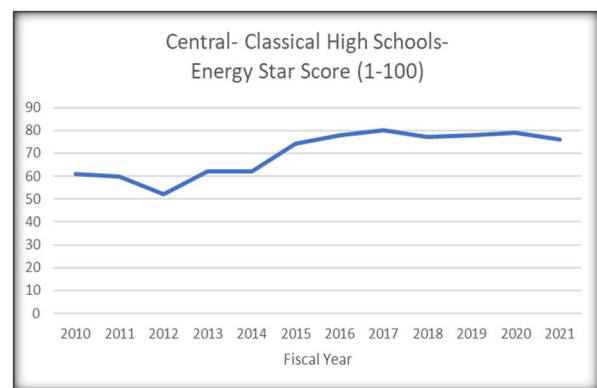
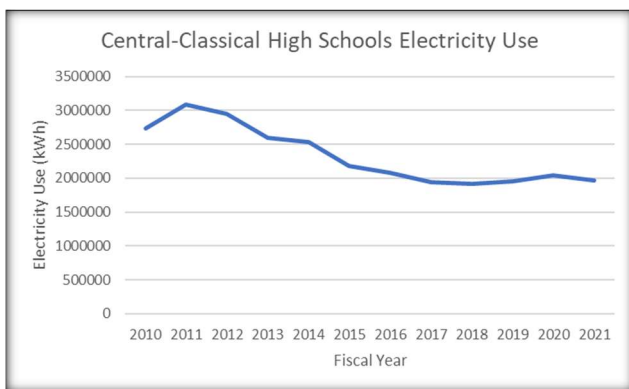
Included in PPSP's master facilities HVAC projects list is the replacement of the boiler feedwater system at Hope High School. The plan also entails the replacement of Roof

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: Central and Classical High Schools

Central and Classical High School's ENERGY STAR score continued to decrease slightly in FY 2021, still, 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.



Public Safety and Fire Department

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 Providence Fire Department, 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. Using 2010 as a baseline year, these collective measures have helped reduce electricity use at the site by 12,039,520 kWhs. In FY 2021, the public safety complex (including garage) saved 1,665,124 kWhs in comparison to FY 2010.

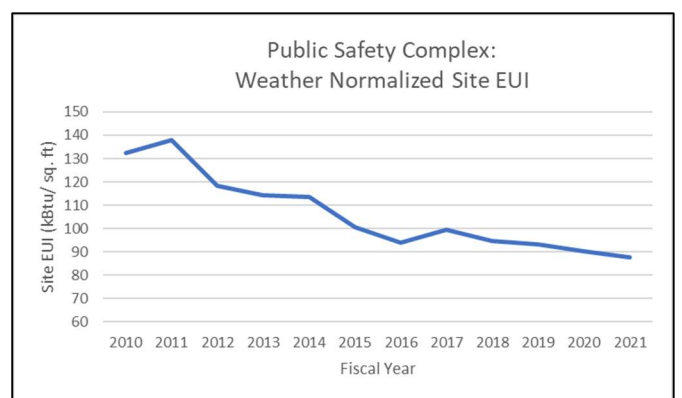
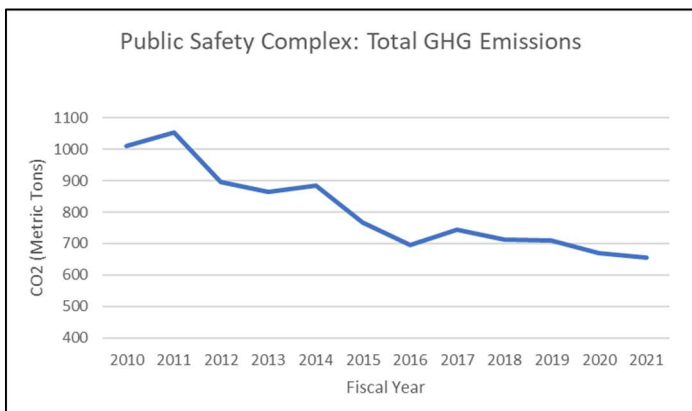
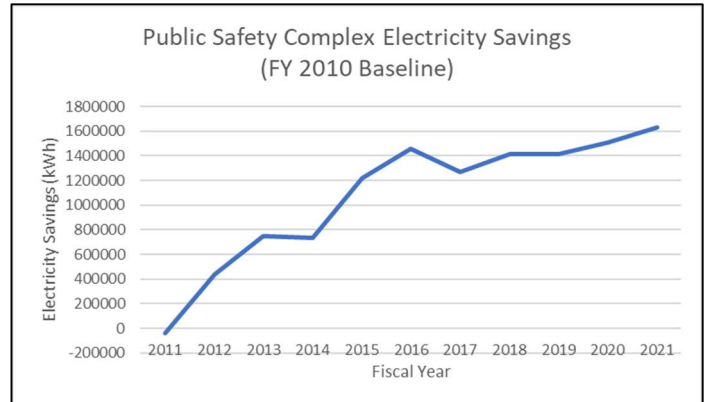
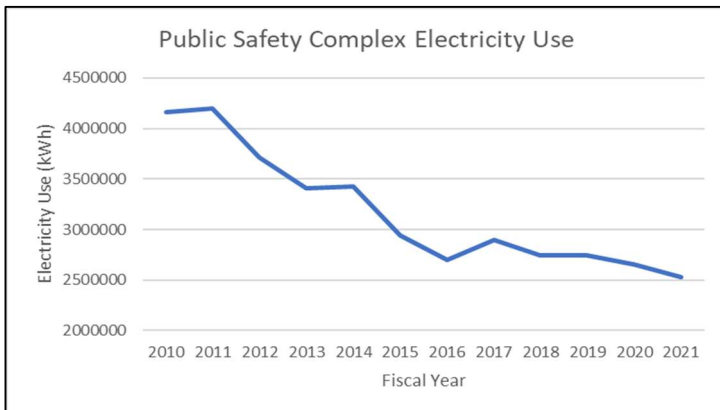
Property Information			FY 2021 Fuel Consumption				Energy Use Intensity			ENERGY STAR Score			Green House Gas Emissions		
Property Name	Property GFA - Self-Reported (ft²)	Year Built	FY 2021 Electricity Use - Grid Purchase (kWh)	FY 2021 Natural Gas Use (therms)	FY 2021 Fuel Oil #2 Use (kbtu)	Site Energy Use (kbtu)	FY 2010 Weather Normalized Site EUI (kbtu/ft²)	FY 2021 Weather Normalized Site EUI (kbtu/ft²)	Percentage Improvement	FY 2010 ENERGY STAR Score	FY 2021 ENERGY STAR Score	Percentage Improvement	FY 2010 Direct GHG Emissions (Metric Tons CO2e)	FY 2021 Direct GHG Emissions (Metric Tons CO2e)	Percentage Improvement
Public Safety Complex							108.1	105.4	2%	NA	NA	NA	52	68	-30%
Department of Communications	13,608	1985	216,182	7,694	NA	1,507,002	157.5	117.8	25%	NA	NA	NA	40.8	40.9	0%
Peter A. Rochio Substation	914	2006	27,527	NA	NA	93,924	84.1	109.8	-31%	NA	NA	NA	NA	NA	NA
Providence Emergency Management Agency	12,776	1991	144,276	3,044	332,304	1,128,537	42.8	88.3	-106%	NA	NA	NA	15.3	40.8	-167%
Providence Police Academy	20,175	1928	16,112	14,361	NA	1,491,079	97.4	81.6	16%	NA	NA	NA	124.1	76.3	39%
Providence Water Authority Building	46,416	1960	147,117	29,652	NA	3,467,120	NA	81.2	NA	NA	NA	NA	NA	157.5	NA
Public Safety Complex	119,002	2002	2,527,685	16,588	NA	10,283,260	132.5	87.7	34%	NA	NA	NA	78.6	88.1	-12%
Steven M. Shaw District 5 Substation	546	1996	5,096	686	NA	85,987	134.2	171.7	-28%	NA	NA	NA	2.4	3.6	-50%

Property Information			FY 2021 Fuel Consumption				Energy Use Intensity			ENERGY STAR Score			Green House Gas Emissions		
Property Name	Property GFA - Self-Reported (ft²)	Year Built	FY 2021 Electricity Use - Grid Purchase (kWh)	FY 2021 Natural Gas Use (therms)	FY 2021 Fuel Oil #2 Use (kbtu)	Site Energy Use (kbtu)	FY 2010 Weather Normalized Site EUI (kbtu/ft²)	FY 2021 Weather Normalized Site EUI (kbtu/ft²)	Percentage Improvement	FY 2010 ENERGY STAR Score	FY 2021 ENERGY STAR Score	Percentage Improvement	FY 2010 Direct GHG Emissions (Metric Tons CO2e)	FY 2021 Direct GHG Emissions (Metric Tons CO2e)	Percentage Improvement
Fire Stations							91.6	102.0	-11%	NA	NA	NA	49	43	11%
Admiral Street Fire Station	12,850	1924	63,518	7,036	72,864	993,190	107.9	85.3	21%	NA	NA	NA	78.2	42.8	45%
Allens Avenue Fire Station	9,440	1948	55,267	5,774	NA	765,929	103.2	85.6	17%	NA	NA	NA	53.2	30.7	42%
Atwells Avenue Fire Station	10,022	1948	89,176	11,088	NA	1,413,054	80.8	151.0	-87%	NA	NA	NA	42.8	58.9	-38%
Branch Avenue Fire Station	14,616	1948	89,171	9,826	NA	1,286,851	78.0	93.5	-20%	NA	NA	NA	52.4	52.2	0%
Broad Street Fire Station	9,426	1942	73,225	7,388	NA	988,662	92.1	111.0	-21%	NA	NA	NA	45.1	39.2	13%
Brook Street Fire Station	7,580	1950	47,041	5,147	NA	675,181	90.4	94.3	-4%	NA	NA	NA	23.6	27.3	-16%
Hartford Avenue Fire Station	9,150	1948	62,702	NA	715,530	930,256	88.9	93.6	-5%	NA	NA	NA	45.2	53.1	-17%
Humboldt Avenue Fire Station	7,460	1905	22,841	NA	674,820	752,752	114.3	108.6	5%	NA	NA	NA	54.1	50.1	7%
Messer Street Fire Station	9,150	1948	68,065	793	441,462	753,044	80.1	82.3	-3%	NA	NA	NA	37.4	37	1%
Mount Pleasant Avenue Fire Station	5,332	1903	24,159	4,581	NA	540,481	126.8	109.3	14%	NA	NA	NA	35.1	24.3	31%
North Main Street Fire Station	14,760	1951	92,507	4,518	NA	767,432	65.5	54.2	17%	NA	NA	NA	46.9	24	49%
Reservoir Avenue Fire Station	7,360	1932	42,066	689	514,878	727,301	84.8	104.4	-23%	NA	NA	NA	29.5	41.9	-42%
Rochambeau Avenue Fire Station	7,400	1928	20,515	5,586	NA	628,599	126.3	93.6	26%	NA	NA	NA	38.6	29.7	23%



Highlight: Providence Public Safety Complex

Energy use at the Providence Public Safety Complex (not including the garage), the headquarters and central station for the Providence Police and Providence Fire Department, has been reduced at the site by 39% since FY 2010. Emissions at the facility have been reduced by 355.5 metric tons (35%) 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.



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.

Administrative Offices

Providence City Hall and the Joseph Doorley, Jr. Municipal Building⁶ 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 2021. (The building's FY 2019 score of 89 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 thirty-first 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 offices. The building's annual weather-normalized energy use has been reduced by 24% since FY 2010. 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

⁶ 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.

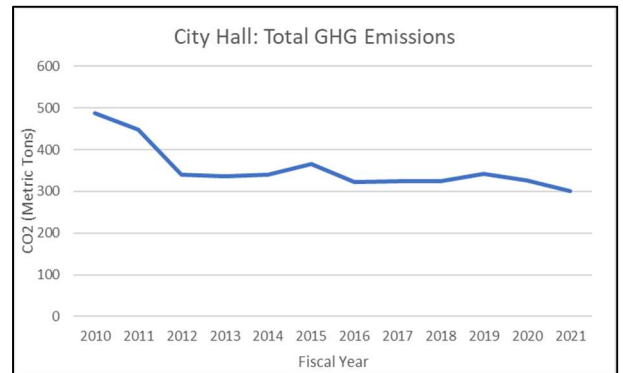
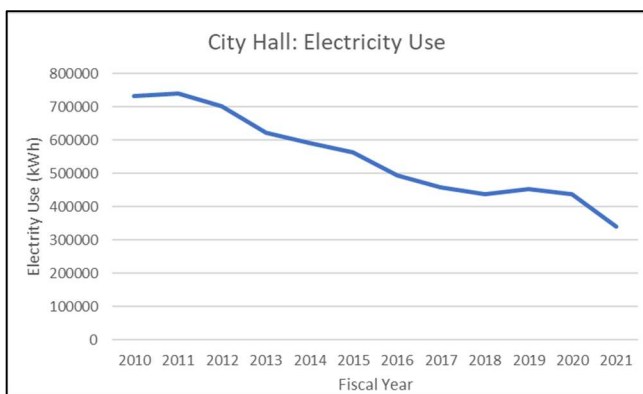
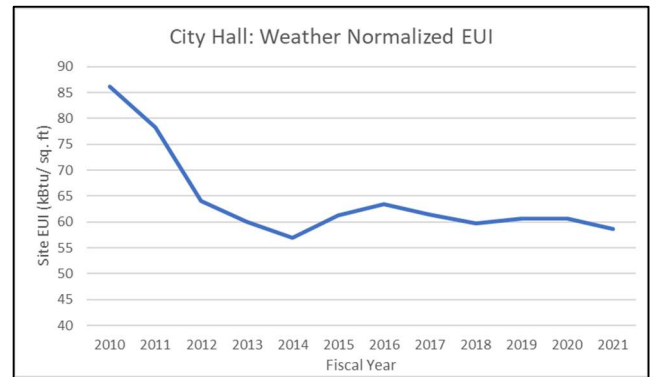
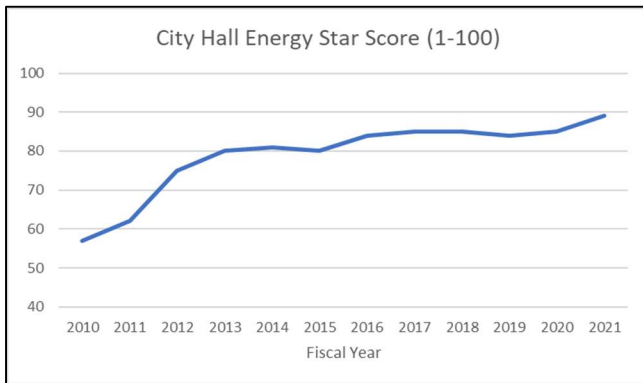
replacement of 10 500-watt halogen floodlights in the building's atrium, resulted in a 19% reduction in the building's electricity use between FY 2017 and FY 2018. These recent measures, combined with past LED tube retrofits in the building's offices, conference rooms and corridors have reduced annual electricity consumption at City Hall by 53% since FY 2010 (electricity consumption in FY 2010 was 724,400 kWhs).

Property Information			FY 2021 Fuel Consumption				Energy Use Intensity			ENERGY STAR Score			Green House Gas Emissions		
Property Name	Property GFA - Self-Reported (ft²)	Year Built	FY 2021 Electricity Use - Grid Purchase (kWh)	FY 2021 Natural Gas Use (therms)	FY 2021 Fuel Oil #2 Use (kBu)	Site Energy Use (kBu)	FY 2018 Weather Normalized Site EUI (kBtu/ft²)	FY 2021 Weather Normalized Site EUI (kBtu/ft²)	Percentage Improvement	FY 2018 ENERGY STAR Score	FY 2021 ENERGY STAR Score	Percentage Improvement	FY 2018 Direct GHG Emissions (Metric Tons CO2e)	FY 2021 Direct GHG Emissions (Metric Tons CO2e)	Percentage Improvement
Administration Buildings							105.9	78.9	26%	38	51	34%	129.6	105.8	18%
City Hall	99,675	1878	341,200	42,122	NA	5,376,404	86.1	58.5	32%	57	89	56%	322.8	223.7	31%
Department of Recreation	4,186	2001	44,646	NA	87,768	240,101	NA	NA	NA	10	22	120%	10.3	6.5	37%
DPW Administration Building	20,511	1925	90,741	13,206	NA	1,630,223	99.9	86.9	13%	77	40	-48%	NA	70.1	NA
Dr. Robert F. Roberti Administration Building	56,744	1945	646,026	28,625	NA	5,066,772	122.8	93.7	24%	34	66	94%	143.8	152.0	-6%
Joseph A. Doorley, Jr. Building	79,366	1967	865,200	30,438	NA	5,995,828	121.1	79.2	35%	NA	55	NA	NA	161.7	NA
The Family and Community Engagement Center	8,700	1960	60,914	3,926	NA	600,469	99.5	75.9	24%	13	36	177%	41.3	20.9	49%

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 58.6 in FY 2021, an energy use intensity reduction of 32%.



Neighborhood Recreation Centers

Each of the City's eleven recreation centers is 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. The average weather-normalized EUI of all rec centers combined has decreased 13% in FY 2021 in comparison to FY 2020, largely due to the City's summer day camp and athletic programs on hold. 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 remains 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.

Property Information			FY 2021 Fuel Consumption				Energy Use Intensity			ENERGY STAR Score			Green House Gas Emissions		
Property Name	Property GFA - Self-Reported (ft ²)	Year Built	FY 2021 Electricity Use Grid Purchase (kWh)	FY 2021 Natural Gas Use (therms)	FY 2021 Fuel Oil #2 Use (kBtu)	FY 2021 Site Energy Use (kBtu)	FY 2020 Weather Normalized Site EUI (kBtu/ft ²)	FY 2021 Weather Normalized Site EUI (kBtu/ft ²)	Percentage Improvement	FY 2020 ENERGY STAR Score	FY 2021 ENERGY STAR Score	Percentage Improvement	FY 2020 Direct GHG Emissions (Metric Tons CO ₂ e)	FY 2021 Direct GHG Emissions (Metric Tons CO ₂ e)	Percentage Improvement
Recreation Centers							75.8	77.9	-3%	NA	NA	NA	45.7	44.7	2%
Davey Lopes Recreation Center	11,860	1948	23,281	7,134	NA	792,799	NA	73.6	NA	NA	NA	NA	72.9	37.9	48%
Neutaconkanut Recreation Center	15,345	1997	30,650	8,684	NA	972,958	89.4	69.7	NA	NA	NA	NA	56.3	46.1	18%
Selim Madelin Rogers Recreation Center	9,350	2000	44,235	11,361	NA	1,287,043	92.8	148.5	-60%	NA	NA	NA	28.9	60.3	-109%
Vincent Brown Recreation Center	18,111	1997	17,710	12,293	NA	1,289,679	57.4	77.2	-34%	NA	NA	NA	43.3	65.3	-51%
West End Recreation Center	25,760	1997	167,922	6,770	NA	1,249,916	56.1	51.5	8%	NA	NA	NA	37.3	36.0	3%
Zuccolo Recreation Center	11,592	1949	22,255	4,221	NA	498,049	83.5	47.1	44%	NA	NA	NA	35.2	22.4	36%

Fuel oil is no longer used in this group of buildings.
ENERGY STAR Scores are not available for this building type.

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. In FY 2021, the DPW and the other buildings featured in this table, on average reduced their EUI from 2020 by 7%. Two notable buildings, the Providence Water Authority building reduced its EUI by 14% and the Dalrymple House reduced its EUI by 20%.

Property Information			FY 2021 Fuel Consumption				Energy Use Intensity			ENERGY STAR Score			Green House Gas Emissions		
Property Name	Property GFA - Self-Reported (ft ²)	Year Built	FY 2021 Electricity Use - Grid Purchase (kWh)	FY 2021 Natural Gas Use (therms)	FY 2021 Fuel Oil #2 Use (kbtu)	Site Energy Use (kbtu)	FY 2020 Weather Normalized Site EUI (kbtu/ft ²)	FY 2021 Weather Normalized Site EUI (kbtu/ft ²)	Percentage Improvement	FY 2020 ENERGY STAR Score	FY 2021 ENERGY STAR Score	Percentage Improvement	FY 2020 Direct GHG Emissions (Metric Tons CO ₂ e)	FY 2021 Direct GHG Emissions (Metric Tons CO ₂ e)	Percentage Improvement
DPW & Other Buildings							114.4	80.8	29%	NA	NA	NA	176.5	61.1	65%
Alex & Ani City Center	6,373	1999	402,700	NA	NA	1,374,012	487.4	243.7	50%	NA	NA	NA	53.5	NA	NA
Camp Cronin	4,362	1960	75	NA	NA	254	2.2	0.1	95%	NA	NA	NA	NA	NA	NA
Central Supply	15,525	2004	32,051	7,380	NA	847,357	129.3	59.5	54%	NA	45	NA	71.1	39.2	45%
Dalrymple Boat House	17,474	1894	51,282	NA	209,622	410,968	36.9	23.5	36%	NA	NA	NA	30.5	17.0	44%
Dexter Street Garage	17,000	1905	75,963	11,064	NA	1,365,610	110.4	87.2	21%	NA	NA	NA	100.1	58.8	41%
DPW Maintenance, Traffic and Roller Shed	110,450	1930	154,587	24,373	NA	2,964,750	NA	29.5	NA	NA	NA	NA	627.3	129.5	79%
Lillian Feinstein Senior Center	8,520	2001	52,915	3,605	NA	541,070	36.9	67.5	-83%	NA	NA	NA	9.9	19.1	-93%
Museum of Natural History and Planetarium	19,500	1894	255,167	NA	766,452	1,637,083	109	83.5	23%	NA	NA	NA	86.5	56.9	34%
Providence Water Authority Building	46,416	1960	147,117	29,652	NA	3,467,120	NA	81.2	NA	NA	NA	NA	NA	157.5	NA
Public Safety Garage	162,976	2002	195,590	NA	NA	667,354	4.8	4.1	15%	NA	NA	NA	NA	NA	NA
Roger Williams Park Carousel	51,600	1897	28,597	8,019	NA	899,452	26.2	18.9	28%	NA	NA	NA	47.8	42.6	11%
Roger Williams Park Maintenance Facility	27,937	1894	199,418	21,397	862,500	3,682,658	159.5	140.4	12%	NA	NA	NA	218.5	177.7	19%
RWP Botanical Center & Mounted Command	44,331	2007	204,384	76,691	NA	8,366,490	178.3	205.7	-15%	NA	NA	NA	352.3	407.3	-16%
The Casino at Roger Williams Park	16,782	1894	116,094	9,371	NA	1,333,232	92.1	86.1	7%	NA	NA	NA	46.6	49.8	-7%

ENERGY STAR Scores are not available for this building type.

Outdoor Lighting

Outdoor lighting, which includes the City's streetlights, accounted for 15% of the City's total electricity use in FY 2021, 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) a year which is a 68% reduction in energy use, (figure 15). The streetlight purchase and subsequent LED retrofitting has saved the City more than \$11.0 million in streetlight electricity use and maintenance since 2015 (figure 16).

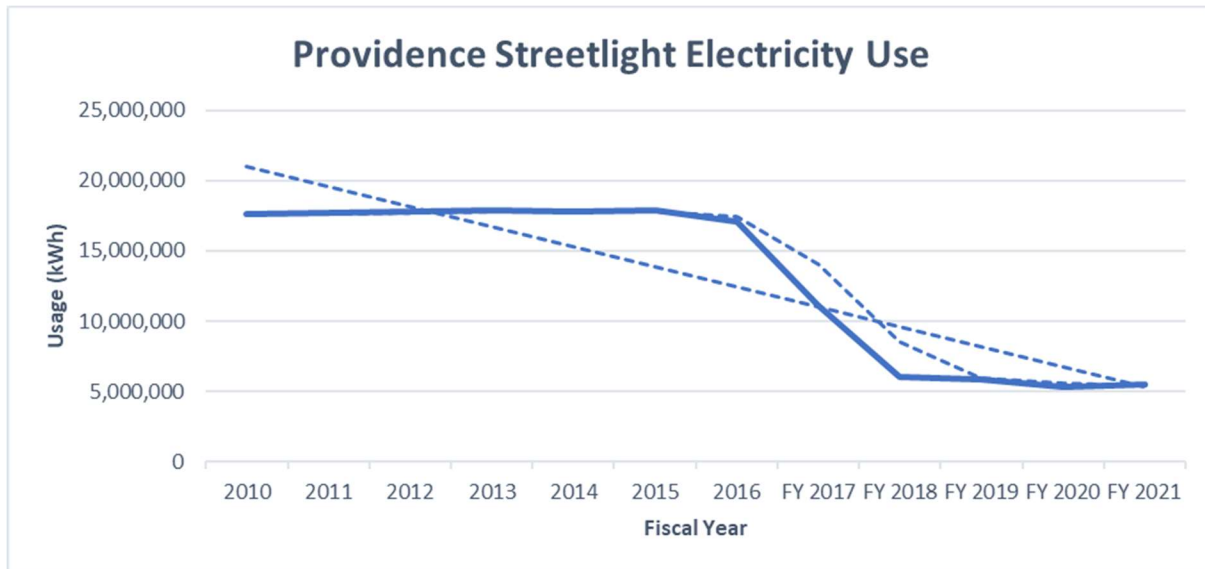


Figure 15: Providence streetlight electricity use was reduced by 12 million kWh/yr. from a 2015 pre-LED retrofit baseline.

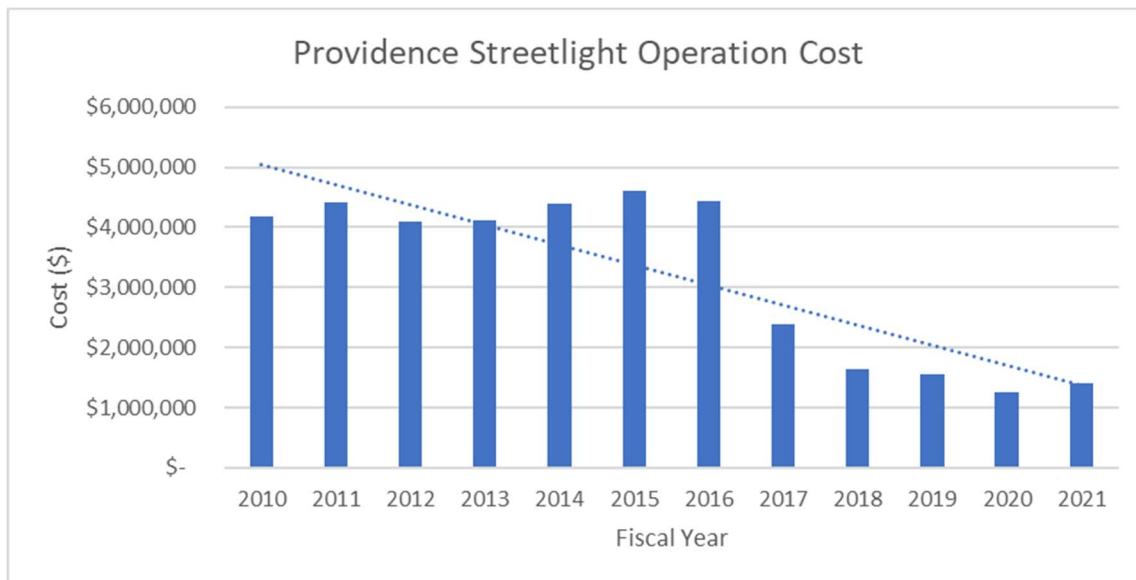


Figure 16: Providence streetlight combined electricity and operational costs have been reduced by ~\$3million per year or nearly 70%, between from a 2015 pre-LED retrofit baseline.

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 packs⁷ 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 grid purchased electricity consumption down. More work is needed to identify other measures to ensure that downward trending from FY 2010 can be maintained. Electricity consumption from traffic signals saw a 4% decrease in FY 2021 from the previous year, and a 42% decrease from the 2010 baseline year. (Figure 17).

⁷ Wall Packs are lighting fixtures usually found mounted on exterior walls of commercial buildings.

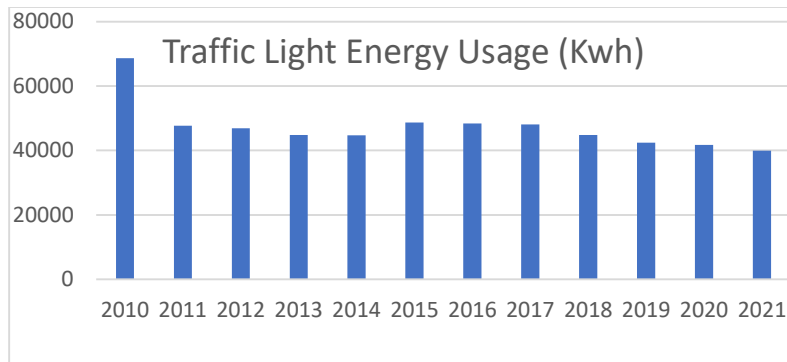


Figure 17: Figure 17: Electricity use for traffic lights in the City of Providence FY 2010-FY 2021.

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 CO₂e; **Figure 18** profiles the metric tons of CO₂e 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.

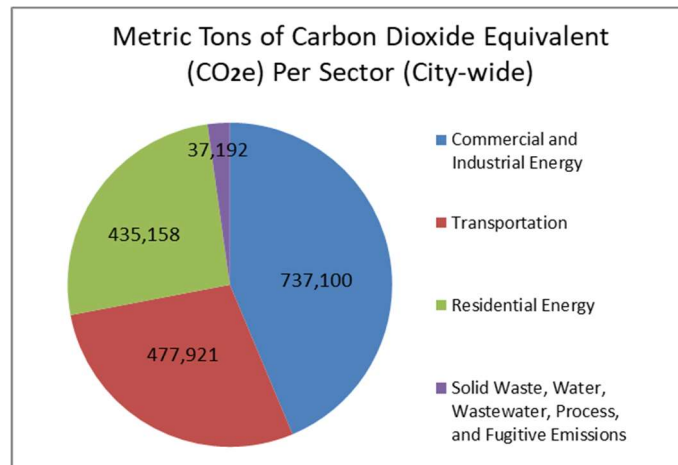


Figure 18: Providence FY 2018 greenhouse gas emissions by sector.

In 2021, 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 CO₂e. 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 assess 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. On March 2, 2020 the City signed a contract with Good Energy, L.P. to implement and manage its 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 2021 municipal GHG emissions are estimated to have been 27,415 metric tons, up 10% from FY 2020, but still 27% 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 27% reduction from the 2010 baseline is the result of strategic investments in City facilities including building upgrades, converting City streetlights to LEDs, and employee education around energy conservation.

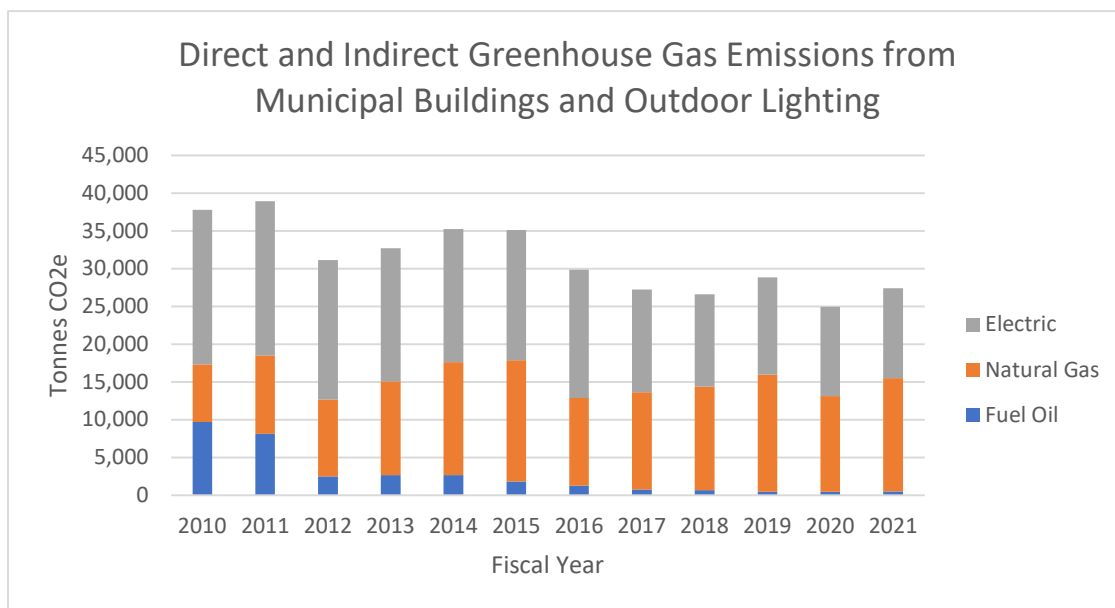


Figure19: Greenhouse gas emissions from municipal buildings and lighting, shown in metric tons of CO2 equivalents, FY 2010 - FY 2021.

