Charlottesville City Schools Annual Energy and Water 2019 Performance Report- *Executive Summary*

July 2020

The City of Charlottesville's Energy and Water Management Program (EWMP), which monitors and manages energy and water usage at over 70 municipal and school sites, has partnered with the Charlottesville City School (CCS) Administration to support actions that speak to the priorities stated in the CCS Energy and Water Performance Resolution passed in April 2019. This Resolution includes efforts to track and reduce energy and water usage, improve building operations, and increase education and awareness. This report provides an overview of the actions performed that helped to further the priorities of the CCS resolution and improve the energy and water performance of CCS facilities throughout the 2019 calendar year. The EWMP has set a general guide of a 2% reduction in utility consumption at each school to help provide an attainable goal and means of comparison from a school's previous year performance.

Key 2019 Performance Findings

CCS's utility spending has seen a steady increase over the past 5 years. This trend is the result of increasing utility rates and changes in building operational schedules with the largest increase in spending coming from electricity costs. Natural gas has seen a declining trend in usage over the past five years with the help of warmer weather but also improved operations of facilities' heating systems. This is particularly highlighted at Buford Middle School and Walker Upper Elementary, where there was a 37% and 24% reduction respectively in natural gas usage between 2018 and 2019. Water usage has also seen a decline in usage over the past 4 years as a result of improved operational equipment and response times to water leaks particularly at Charlottesville High School and Venable Elementary which saw decreases of 26% and 23% respectively when comparing 2018 to 2019 water usage.

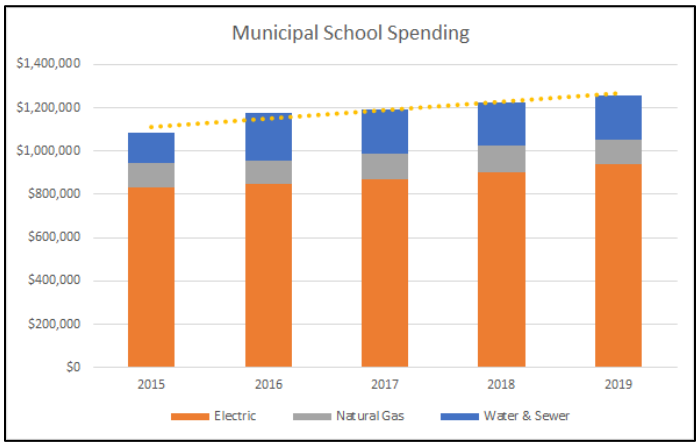


Figure 1: *Charlottesville City School's utility spending for the past 5 years for each commodity type across all school facilities.*

When reviewing the performance of CSS facilities, using energy use intensity (EUI) and ENERGY STAR scores, which provides values that are comparable regardless of building size, most CCS facilities perform better than the region's average for EUI and median score for ENERGY STAR. This further validates that the performances of CCS buildings are moving in the correct direction, and still have room to improve.

Ultimately, improved performance of CCS facilities will reduce greenhouse gas (GHG) emissions and help with the City's community-wide GHG reduction goals. Currently, CCS facilities make up approximately 40% of the municipal GHG contribution and there has been a leveling off over the past 5-years in emission levels. Efforts to reduce our utility usage and implement clean energy strategies like switching to lower-emissions fuel sources will help reduce CCS's GHG footprint and help meet Charlottesville's 45% reduction goal (below 2011 inventory emissions) by 2030 and carbon-neutrality by 2050.

2019 CCS Performance Report Dashboard
A Dashboard of all the data included in the 2019 Annual Performance Report with interactive options and more detailed data can be viewed at EnergyCAP 2019 CCS Performance Report Dashboard.

2019 Program Actions and Highlights

Operational Actions

- Establishment of the **Energy and Water Management Team,** which brings City staff together from various divisions to provide a comprehensive approach to energy and water management.
- Monthly **utility tracking** of CCS facilities to help identify and address abnormal or inconsistent trends in utility usage.
- Reviews of and improved communication around **HVAC schedules** to ensure CCS facilities have HVAC support when needed.

Technological Actions

- **Installation of LED lighting** in CCS facilities and their inclusion in classroom modernization projects.
- **Upgrades to the Building Automation Systems** (BAS) at CCS schools each year, which has allowed for more energy management strategies to be implemented and monitored.

Behavioral Actions

- **Energy and Water Management Campaign** launched at CCS with quarterly educational outreach efforts through announcements and posters. Quarterly topics included:
  - Fall: The Value of Energy and Water
  - Winter: Understanding our Energy and Water Use
  - Spring: Reduce our Energy and Water Waste
  - Summer: Keep Going- Summertime Savings!
- **Classroom engagement** around the topic of energy and water efficiency using utility data provided to iSTEM teachers and outreach to a class looking at effective messaging and engagement around this topic.

Image 1: *EWMT members with CCS High School Principal with Fall Quarter Poster.*

Charlottesville City Schools 2019 Annual Energy and Water Performance Report

May 2020

Energy & Water Management Program
City of Charlottesville

Table of Contents

Introduction

In April 2019, the Charlottesville School Board passed the *Resolution for Charlottesville City Schools Energy and Water Performance* (Appendix 1), committing to working with the City of Charlottesville to implement actions that improve energy and water performance of Charlottesville City Schools (CCS). These included prioritizing strategies that reduce the energy and water usage of existing facilities, adhering to high performance building standards for any new construction or renovations, and expanding the amount of energy derived from clean energy sources. The importance of this commitment cannot be overstated as these efforts contribute to the City's community-wide goal of achieving a 45% reduction in greenhouse gas emissions by 2030 and carbon neutrality by 2050. Although the municipal and school portion of the total Charlottesville community greenhouse gas (GHG) emissions footprint is 2.9%, the City and CCS demonstrate leadership by taking necessary actions that improve efficiency, reduce the reliance on fossil fuels, and decrease greenhouse gas emissions (City of Charlottesville 2016 Greenhouse Gas Inventory, pg. 11).

The City of Charlottesville's Energy and Water Management Program (EWMP), which monitors and manages energy and water usage at over 70 municipal and school sites, has partnered with the CCS Administration to support actions that speak to the priorities stated in the CCS resolution. These include tracking the energy and water usage at school facilities to gauge performance, coordinating with the City's Facilities Maintenance and Facilities Development teams on building operations and improvement projects, working with City staff to develop strategies that expand the renewable energy footprint of the schools, and engaging with students and faculty to help lessen their impact on energy and water usage.

This report provides a baseline of the actions performed that helped to further the priorities of the CCS resolution and the energy and water performance of the schools throughout the 2019 calendar year.

Glossary

Building Automation System (BAS): A control system in buildings that allows monitoring and control of heating, ventilation, and air conditioning (HVAC) systems, lighting, and other building equipment through a common interface.

Benchmarking: The practice of comparing the measured utility performance of a building overtime to itself or relative to other similar buildings.

Better Business Challenge (BBC): Local challenge being hosted by the Community Climate Collaborative to bring businesses together to work toward reducing their overall greenhouse gas impact and improve efficiency in their buildings.

Metric Tons of Carbon Dioxide Equivalent ($MTCO_2e$): Unit used for aggregating different greenhouse gases (e.g., carbon dioxide, methane, nitrous oxide) into one common unit. This takes the global warming potential for each greenhouse gas (how much heat each gas traps in the atmosphere, relative to carbon dioxide) and uses that to convert the emissions of that gas to carbon dioxide equivalent measured in metric tons.

Cubic Feet (cf): Unit of measurement used for natural gas and water utility.

Calendar Year (CY): Unit of time looking at measurements made from January 1st through December 31st of that year.

Capital Improvement Project (CIP): Project requiring capital expenditure and specified approval annually for City and School budgets.

Charlottesville City Schools (CCS): Charlottesville City Schools are the City of Charlottesville's public school division.

Department of Mines, Minerals, and Energy (DMME): State agency established to facilitate energy, geology, and mining programs within Virginia.

Energy and Water Management Program (EWMP): A program run by the Energy and Water Management Team that manages utility usage for all City facilities.

Energy and Water Management Team (EWMT): A group of Public Works Department City staff with representation from the Facilities Maintenance, Facilities Development, and Environmental Sustainability Divisions.

Energy Performance Contract (EPC): An agreement between an entity and a contractor (typically an ESCO) to perform building upgrade services that provide guaranteed energy savings.

Energy Services Company (ESCO): A contractor that provides the services agreed to in an energy performance contract.

EnergyCAP: Software platform used by the City to monitor utility usage and costs.

ENERGY STAR Score: A performance indicator ranging from 1 to 100 established by the Environmental Protection Agency's (EPA) ENERGY STAR program. This performance indicator compares a building's

utility performance to other similar building types with normalization of weather and operational differences (e.g., occupancy, plug load, and operating hours). A higher ENERGY STAR score indicates a better building performance where a score of 50 represents a building with a median energy performance compared to its peers.

Energy Use Intensity (EUI): The EUI is a measure of how much energy a building uses per square foot. To get the EUI, the total energy usage (e.g., electricity and natural gas) is converted to a common unit known as kilo-British thermal units (kBtu) and this is divided by the total square footage of the building. Typical EUIs can range from 40 – 70 kBtu/sq.ft. depending on the property type and the lower EUI value, the less energy intensive the facility.

Greenhouse Gas (GHG): Gases that absorb infrared radiation and contribute to the greenhouse effect (warming) of the Earth. The primary greenhouse gases include water vapor, carbon dioxide, methane, nitrous oxide, and ozone.

Heating, Ventilation, and Air Conditioning (HVAC): Equipment or system that controls thermal comfort within a built environment. Includes equipment such as air handlers, chillers, cooling towers, and boilers.

Kilo British Thermal Units (kBtu): Unit of measurement for energy. One Btu (British Thermal Unit) is defined as the amount of heat required to raise the temperature of one pound of water by one-degree Fahrenheit. 1 kBtu is equal to 1,000 Btus.

Kilowatt-hour (kWh): Unit of measurement for power, the rate at which energy is generated or consumed. Used to measure electricity consumption.

Light-Emitting Diode (LED): A semiconductor that emits light when a current passes through it. LEDs typically use less energy and last longer than traditional light sources (e.g., incandescent, fluorescent, halogen).

Leadership in Energy and Environmental Design (LEED): An internationally accepted green building rating system developed by the US Green Building Council.

Photo Voltaic (PV) System: A system that generates electric power by using solar cells to convert sunlight into direct current electricity.

Solar Power Purchase Agreement (PPA): A financial agreement with a developer where the developer facilitates the design and installation of a solar system and charges the customer a fixed electricity rate for the power generated, typically below the current market electricity rate. The developer maintains the system through the end of the contract term and at the end, the customer may choose to extend the contract, purchase the system, or have the developer remove it.

STEM (Science, Technology, Engineering, and Mathematics): Grade school subject that brings in concepts of science, technology, engineering, and mathematicises together in one academic discipline. At CCS, this subject is called “iSTEM” which stands for Instructional STEM.

United States Department of Energy (DOE): A department of the United States government that focuses on energy and the safety of handling nuclear materials.

Weather Normalization: A method of estimating the impact of weather on energy consumption and adjusting consumption to remove weather variance from year to year. Typically uses degree days (the number of days that exceed or go below a balance point temperature multiplied by the extent to which the daily average deviates from the balance point temperature). If the average temperature is above the balance point, that day would be considered a cooling degree day (CDD). If the average temperature is below the balance point, that day would be considered a heating degree day (HDD).

Actions

The Energy and Water Management Program (EWMP) have identified three focus areas for organizing actions related to improving energy and water performance: operations, technology, and people. This three-prong approach ensures that the program comprehensively addresses the most influential factors that affect energy and water usage in facilities by evaluating building operations, building equipment, and occupant use (Image 1). In July 2019, the Charlottesville City Manager signed the City's first *Energy and Water Management Policy* setting new operational, technological, and behavioral standards for all City buildings and employees around energy and water efficiency. Many of the operational standards were already being implemented by City staff and now have a dedicated policy to support these actions and efforts. The EWMP oversees that this policy is implemented across all City facilities and provides support when necessary.

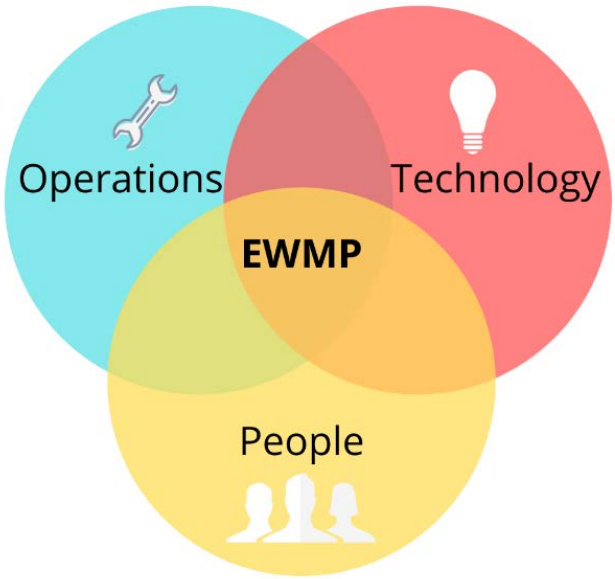


Image 1: *The Energy and Water Management Program involves the interactions of all three focus areas to implement energy and water efficiency across City facilities.*

Operations

The efficient operations of the City's facilities represent the lowest cost but potentially the highest impact opportunities for achieving energy and water reductions. These include examining the control and maintenance of heating, ventilation, and air conditioning (HVAC) systems and lighting in facilities, then aligning this with the current needs of building occupants. The goal is to run equipment optimally and efficiently and eliminate unnecessary operations. Many times, shifting occupant needs (ad hoc events or meetings) present difficulties in consistently maintaining comfort and minimizing unneeded operations, but they also provide opportunities to fine-tune equipment schedules and enhance current communication and scheduling processes. These are typical actions that have no additional cost that can produce real savings (energy, water, and dollars).

Strategies Implemented

- Establishing an Energy and Water Management Team (EWMT)

To properly manage efficiency in City buildings, various perspectives must be brought together to manage and implement strategies cohesively and consistently including stages of construction, renovation, maintenance, and operations. To ensure such a comprehensive approach, the City formed the Energy and Water Management Team (EWMT). The Team is comprised of staff from Facilities Maintenance (responsible for managing the operations and maintenance of facilities), Facilities Development (responsible for constructing and renovating facilities), and Environment Sustainability (responsible for evaluating efficiency opportunities and aligning with larger environmental goals) Divisions. With these three divisions represented, energy and water strategies can be vetted from not only the building operations perspective (existing equipment that is in the building), but from the development perspective (future renovations and new equipment). One of the primary goals of this Team is to deliver the EWMP.

- Utility Tracking and Investigation

Each month the EWMT reviews the utility usage (electricity, natural gas, and water and sewer) of all City facilities including CCS. The EWMT is looking for abnormal or inconsistent trends that may indicate an operational issue like a toilet running or an air handling unit running constantly. Utility usage is compared to previous years as well as the previous month and include normalization for variation in weather. Through this tracking, the EWMT has been able to identify potential issues with building operations, investigate these issues by talking to appropriate staff, and facilitate work orders to address problems when necessary. As a result, several instances of CCS building equipment issues have been corrected and water leaks have been fixed preventing the unchecked waste of that utility. The EWMT uses EnergyCAP software to monitor utility usage and costs effectively and efficiently.

- Reviewing HVAC schedules and communication processes

As a best practice, it is important to periodically review the HVAC scheduling process to ensure that school staff are communicating HVAC needs that fall outside normal school hours through the appropriate channels and that the schedules accurately align with actual facility use. The EWMT was able to discuss the scheduling process with each school's administration to confirm the process being used and make any necessary adjustments across all schools. Through reviews of these schedules, instances when the HVAC was scheduled to run for a reserved event that had been cancelled or changed resulting in unnecessary HVAC usage were identified and corrected. As a helpful reminder, a note will be sent out to all schools seasonally to check calendars and ensure that requests for HVAC align with actual events taking place.

In addition to HVAC schedules matching the needs of the occupants, at times, schedules can conflict with the building's ability to reach satisfactory indoor air temperatures based on the changing outside temperature. Schedules are periodically adjusted because of a specific need during a colder or warmer time of year (starting up earlier to make sure the building is at occupied temperature set points when occupants arrive) but these are not always adjusted back to normal settings. For example, if a year has a colder winter and the heating system is set to come on earlier to reach occupied temperatures, that same schedule could remain in place after outside temperatures become milder, although this longer operation is not necessary. It is important to review these schedules and adjust as needed to keep up

with changing conditions. The EWMT works with school Facilities Maintenance teams to review and confirm appropriate schedules.

Strategies Planned/2020 Outlook

Looking further into 2020, the EWMT will continue to monitor utilities and school operations to ensure that systems are only running when necessary. HVAC schedule reviews will be a priority, which is especially dependent on effective communication of HVAC needs for events held at schools and consistent reminders to keep calendars up to date. The Facilities Maintenance teams at each school have been on the "front lines" of making efficiency adjustments in real time and will continue to be the most important actors in maintaining and improving operational efficiency. As schools have been largely vacant or low occupancy due to closures for the Coronavirus (COVID-19) pandemic, Facilities Maintenance teams have performed measures to save energy and water including putting building systems in set-back mode, performing remote monitoring of system operations through building automation systems, and responding to emergency calls on-site as needed.

Technology

Building equipment (e.g., HVAC, BAS/control systems, lighting, plumbing fixtures) continues to increase in efficiency and offers greater abilities to reduce energy and water usage at school facilities. Although opportunities exist to upgrade building equipment within the school portfolio, cost tends to be the limiting factor. However, the City has been able to annually implement projects that cycle in more efficient systems that will ultimately improve the efficiency of school facilities. The lowest cost upgrades tend to be lighting while HVAC systems and building envelope (includes roof, windows, building façade/curtain wall) improvements are at the higher end. The existing funding mechanisms have allowed for gradual upgrades of equipment over time that address equipment efficiency. These may not always be visible, as for example, HVAC equipment replacement projects are usually not noticeable to the public, but the improvements on the energy and water side can be seen in the utility usage.

Strategies Implemented

- Installation of LED lighting

Last year, the City was able to implement lighting upgrades at two schools, switching from fluorescent to LED lighting fixtures. A Jackson-Via Elementary modernization project included an LED upgrade component with enhanced lighting controls (occupancy sensors with dimming capabilities) for the lower level classrooms and commons of the school. In addition, older Smartboards were replaced with LED touchscreen Smartboards that use less energy. At Greenbrier Elementary, hallway fluorescent lighting was converted to LEDs, with dimming control and solar tubes being considered as a future addition. Although these projects did not address all lighting in the facilities, it did lower the lighting energy footprint of the schools and made incremental progress toward high efficiency lighting and lighting controls.

- Upgrades to Building Automation Systems

Building automation systems (BAS) located at each school control the HVAC system and lighting in most of Charlottesville City Schools. The BAS provides the ability to monitor HVAC settings and schedules that have a direct impact on operation's energy usage. Newer systems tend to have more advanced capabilities to monitor specific settings, trend performance data, and generally a more intuitive

interface that better equips Facilities Maintenance staff to control the building. An advanced BAS also aids in the ability to implement energy management strategies through programming algorithms to auto-adjust for changing building conditions or getting real-time data to the maintenance team to make operational adjustments quickly.

BAS's have been upgraded at Greenbrier Elementary (2015), Burnley-Moran Elementary (2016), Walker Upper Elementary (2017), Jackson-Via Elementary (2018), and Johnson Elementary (2019), with a typical schedule of upgrading one school per year. After the BAS was installed at Johnson Elementary last year, the Facilities Maintenance team continued to coordinate with the contractor to ensure that programing within the system was accurate and included necessary schedules and settings. The system installation was completed in August 2019 with a few programming changes occurring in October 2019 that corrected some errors. The new system included upgraded thermostats, and after installation, the Facilities Maintenance team provided an overview of how to operate the thermostats to the principal. The EWMT is going to be providing additional educational materials about thermostat settings to staff at each school.

- Project Rebate Programs Through the PJM Regional Transmission Organization

In 2018, the City entered into an agreement to participate in the Energy Efficiency program offered by the Pennsylvania, Jersey, Maryland (PJM) Regional Transmission Organization, the organization that manages the electric grid across portions of the Mid-Atlantic and Mid-West regions of the United States. The Energy Efficiency program offers financial incentives to organizations to implement projects that improve energy efficiency and reduce the energy usage at a location. These can include lighting upgrade projects, HVAC equipment replacement projects, and building envelope improvement projects. CPOWER, a curtailment service provider, helps facilitate the program and is the third-party that the City works with to verify projects that are submitted for this program. Projects have the opportunity to receive a quarterly financial incentive for up to four years after the projects are completed.

The EWMT submitted a chiller replacement project that was implemented at Charlottesville High School in 2016 along with an air handling unit replacement at City Hall from 2017. These were approved and starting in Fall 2019, PJM provided a payment of approximately $500 that will continue to be paid each quarter throughout 2020. Since the chiller replacement at Charlottesville High School was completed in 2016 and 2017 was the first full year of savings, 2020 marks the fourth year after installation and will be the last year the project is eligible for payment. However, the EWMT will continue to submit new (eligible) projects for this program to continue to capture additional funding. The City has designated a fund that is earmarked for energy and water efficiency to allocate these payments.

Strategies Planned/2020 Outlook

Traditionally most projects go through the capital improvement project (CIP) process for funding, which means that projects may be deferred due to other priority projects up for the same funding. This can cause equipment upgrades to take place at a gradual pace. However, in 2020, projects are planned to be implemented through the CIP process including upgrades to HVAC equipment at Clark Elementary, Johnson Elementary, MLK Performing Arts Center at Charlottesville High School, and Walker Upper Elementary. All of these projects will provide a marked improvement in equipment efficiency and will improve overall operations of the facilities

The EWMT is investigating an alternative method for financing and implementing projects called an energy performance contract. This is a budget-neutral approach whereby an energy savings company (ESCO) identifies and implements energy and water savings projects with a guaranteed annual utility savings that covers the cost of the projects each year. This means that if projects are implemented and the City/CCS does not see the projected utility savings, the ESCO is required to pay back the difference.

Through discussions with the Department of Mines, Minerals, and Energy (DMME) - the state agency that assists public entities in going through the energy performance contract process – the EWMT is developing a plan to begin the first stage, which is soliciting a back of envelope audit from state-qualified ESCOs to help with selecting a potential contractor for the energy performance contract. Due to precautions taken during the Coronavirus (COVID-19) pandemic, this process has been delayed but will resume when feasible.

Expanding the amount of energy derived from renewable sources continues to be a priority and the City is developing plans on how best to do this. Solar is the primary technology being considered, and multiple avenues for adding more capacity (see Table 1 for current capacity) are being reviewed. These include funding through power purchase agreement (PPA) and installing systems onsite at schools or potentially accessing offsite solar (or combination of the two). Solar systems installed at school sites provide the ability to educate students about renewable energy and can provide the opportunity to offset grid-purchased electricity, but system size and capacity are limited by each school's roof and ground space. Offsite solar provides the opportunity to invest in higher capacity systems that will produce larger amounts of solar energy (although these systems will not tie directly to schools), expanding the ability to reduce greenhouse gas emissions. The City is evaluating how best to achieve the largest greenhouse gas reductions while achieving the direct benefits of onsite solar. Currently, the City is reviewing the solar potential of school roofs and comparing to roof replacement schedules so that any onsite systems are not slated for installation on roofs being replaced in the near future.

Table 1: *Solar photovoltaic systems installed to date at CCS schools.*

School	Installed Capacity (kW)	Year Installed	Location
Charlottesville High School	111.8	2012/2013	Roof and ground mount
Lugo McGinness Academy	9.4	2015	Roof

People (Behavior)

Strategies Implemented

- Energy and Water Management Campaign

With the signing of the *Resolution for Charlottesville City Schools Energy and Water Performance*, the City and CCS were able to develop a new partnership to help implement energy and water efficiency into our schools and create a consistent and engaging message around saving water and energy to staff and students. Through this new partnership the EWMT has had quarterly meetings with each school's principal to discuss school performance and a new educational initiative that will be rolled out to the school. In addition, school-specific opportunities to collaborate with teachers on projects that would align well with CCS and the EWMT's education goals are discussed. With the engagement of the school

principal around educational messages, the principal helped provide their school's unique connection through school announcements or newsletters (with text provided by the EWMT) around the quarterly educational message and a few energy and water saving tips that could be applied at school.

For the 2019/2020 school year, the EWMT identified the following themes for their first introduction to schools and educational outreach to students and staff:

- **Fall: The Value of Energy and Water**
  - Included an introduction to the Energy and Water Management Program and why what we are doing is important.
  - Tips: Only use what we need- turn water and lights off when not in use.
- **Winter: Understanding our Energy and Water Use**
  - Included information on identifying what uses water and energy in schools.
  - Tips: Reduce energy and water use by turning lights off when leave a room, unplug personal electronics, turn the water off when not in use, and reporting water leaks.
- **Spring: Reduce our Energy and Water Waste**
  - Included information on how to reduce unnecessary energy and water use at school and what to do if you see something that might be causing this.
  - Tips: Reduce your energy and water waste by keeping outside doors closed, using and filling a reusable water bottle with tap water instead of single-use plastic, and to report a water leak or propped-open outside door.
- **Summer: Keep Going- Summertime Savings!**
  - Included information on how to take what staff and students learned at school and apply these tips at home.
  - Tips: Review of all the tips discussed over the school year and what that means at home.

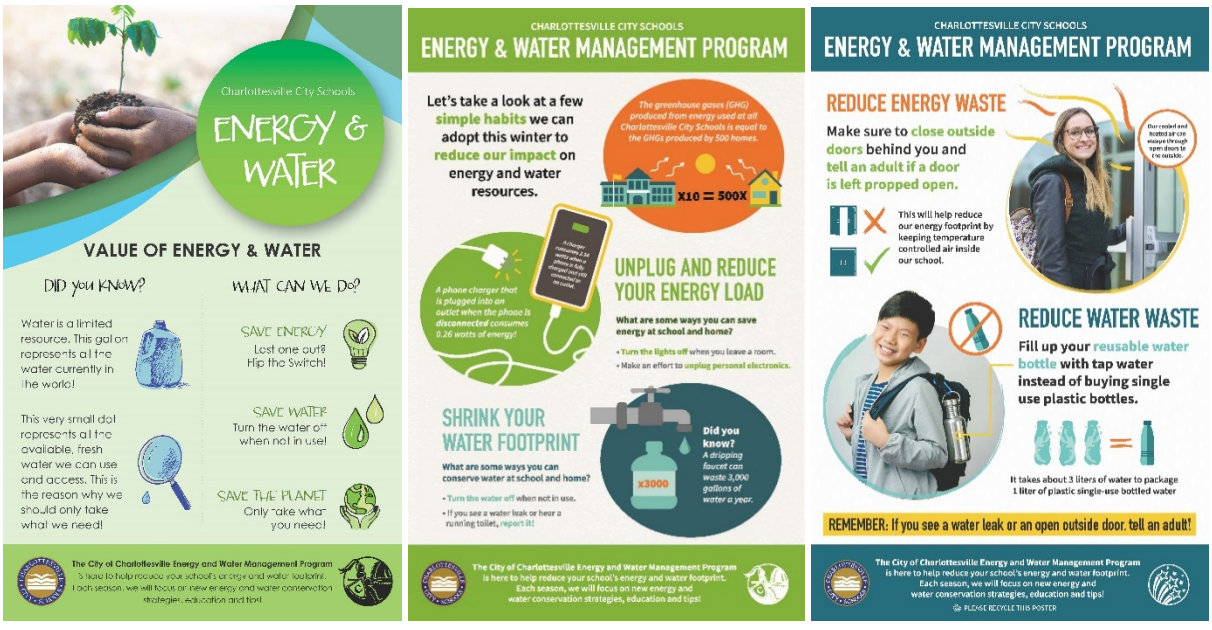


Image 2 – 4: *EWMP quartly themed posters starting with Fall, Winter, and Spring focus from left to right.*

For Fall through Spring quarters, educational posters were developed in addition to announcement text to reinforce these messages (Image 2 – 4). Posters were tailored to appropriate ages by making posters specific for elementary schools and for middle and upper schools. Posters were professionally done to ensure kids would find them engaging and would interact with them more. Each school was given a stack of posters to put in high traffic areas around their schools (Image 5). Announcement text was provided to each school principal and included several messages around the educational focus and tips that narrowed into a specific energy or water topic. These messages were also further pushed out to students and their parents through social media by highlighting a few important messages each quarter and sharing the quarter's focus poster. This information was also available to be viewed on the CCS website highlighting each quarter's message and poster when available.

Image 5: *EWMT members with CCS High School Principal with Fall Quarter Poster.*

For the Summer educational message, the EWMT is in the process of developing an activity sheet for students and their families to work on at home to better understand their energy and water use and start to implement saving behaviors at home. The EWMT hopes these activities paired with messaging around these efforts in newsletters sent out by CCS will keep students engaged around this topic and ready to continue learning efforts in the next school year. Teachers will also be engaged by providing information around next year's educational focuses ahead of time to allow for time and potential collaboration opportunities to occur.

Specific class engagement was developed through principal meetings and discussions with the CCS iSTEM Coordinator. The EWMT met with all CCS iSTEM teachers at the beginning of the school year to discuss their education goals and initiatives and offer resources for any interested teachers. Several iSTEM teachers from Charlottesville High School and Buford Middle School reached out for data around their specific schools' energy and water usage including some interval (30 minute) electricity data for students to interpret and graph.

Lastly, initial outreach focused on CCS staff occurred this winter through direct messaging about stopping the use of space heaters in schools. This was also paired with information about hot and cold room issues and a recommendation to use the work order process to notify Facilities Maintenance staff to help identify the problem rather than try and mask it with a space heater, ultimately causing more heating and cooling issues for the space.

Strategies Planned/2020 Outlook

For the 2020/2021 school year, the EWMT plans to continue education and outreach efforts at each school including quarterly educational focuses and outreach efforts through announcements and

posters during the school year. Further classroom engagement opportunities will be explored with each school to find appropriate ways to engage students when learning about similar topics. Also, potentially at the start of the school year, there will be mirror clings in all school bathrooms that encourage students to turn the water off when not in use and report water leaks. The outreach about these were postponed during Spring 2020 due to COVID-19 impacts to the school year.

Case Studies

❖ Think Global, Act Local Classroom Engagement

The assistant principal at Clark Elementary helped connect the EWMT with one of their teachers, Ms. Ashley Riley, working on communication with fourth-grade classes. Ms. Riley had her students work on marketing pitches around the idea of "Think Global, Act Local" and their task was to apply this idea by marketing to their fellow students about the EWMP and how to engage them to save water. The EWMT presented at each fourth-grade class about the EWMP and provided context around the larger goal of this initiative as well as provided lots of marketing examples from the Water Conservation Program's extensive community outreach campaigns. Unfortunately, the final pitch from students was cancelled due to COVID-19 impacts on the school year, but the students enjoyed working on a project that would have had a direct impact on their school.

❖ Better Behaviors Helping Building Performance

In 2018 the gym at Walker Upper Elementary School was having problems holding temperatures within the appropriate range and putting a large stress on the HVAC unit, causing increased energy usage for the school. As a response to the gym not keeping comfortable temperatures, the doors were often kept open while students were occupying it. This continued to put additional strain on the HVAC unit, especially when temperatures were warm. The EWMT evaluated the temperatures and performance of the building, making some operational adjustments to help keep comfortable temperature ranges. However, the EWMT also discussed these changes with gym staff and how doors and windows needed to be kept closed for the HVAC unit to stay in these temperature ranges. Gym and EWMT staff agreed that if doors were kept closed, these changes could be implemented, and if temperature issues continued to occur to let the EWMT know. Since this discussion, there have not been any reported issues with this space with keeping temperature set points and no reports of the doors being left open in 2019. In addition, one of the two rooftop HVAC units on the gym was replaced in 2019 helping with the conditioning of this space. The EWMT has monitored the Walker Upper Elementary gym in 2019, and the team has observed more efficient performance of the HVAC system in terms of energy loads and temperature readings. This instance was a great example of combining operational changes with education to help make an effective and long-term change that benefited the building and users.

Performance

Energy and water performance can be influenced by several factors including those that are within our control, such as building equipment efficiency, building operations, and occupant behavior, and those that are outside our control, such as weather. Replacing inefficient equipment may seem like the highest priority but managing operations to maximize efficiency and educating occupants on best practices can have a major impact on performance. Since weather varies from year to year, it's necessary to normalize (adjust data to account for weather changes) so that a warmer winter one year (requiring less natural gas usage) will not artificially seem like an improvement in building energy performance.

Changes in occupancy can also have an effect on both energy and water usage. Building occupancy tends to have a more direct effect on water usage, due to domestic water usage for restrooms. Occupancy's effect on energy usage only comes through if operations of those spaces changes to adjust for the low occupancy. For example, if a space becomes unoccupied but the HVAC is still running on the normal schedule for that area, nothing has changed with the energy usage. Therefore, it is important to track when and where spaces within our schools are being used so that unoccupied areas can have reduced HVAC and lighting operations.

After-school activities and summer camps can change energy and water performance from year to year as these tend to be outside of normal operating hours and may be unique compared to previous months or years. If summer camps shift to a school that did not have them the year before, that will increase the overall energy and water usage for that year, but not necessarily the result of inefficient energy and water practices. Changes in building use because of events can happen periodically throughout the year but summer tends to be the period that varies the most from year to year. Therefore, it's important to account for any changes in use during the school year and summer when tracking performance. The EWMT has been working with school staff to understand changes in activities at each school throughout the year and how that can affect energy and water performance.

The Charlottesville City School portfolio is comprised of ten schools: Buford Middle School, Burnley Moran Elementary, Charlottesville High School, Clark Elementary, Greenbrier Elementary, Jackson-Via Elementary, Johnson Elementary, Lugo McGinness Academy, Venable Elementary, and Walker Upper Elementary. Within the portfolio, there is a mix of ages, sizes, design, and layout, all which influence the amount of energy and water usage at each school (Table 2). Due to similar layouts and functions, a few schools are paired as sister schools in terms of performance: Buford Middle School and Walker Upper Elementary, Burnley-Moran Elementary and Johnson Elementary, and Clark Elementary and Venable Elementary.

Table 2: *Charlottesville City School's general descriptions and important portfolio performance metrics of all CCS 10 schools. Venable Elementary School Annex is separated from Venable Elementary School metrics as its use is very different to a school.*

Schools	Year Built	Gross Floor Area (sq. ft.)	Energy Use Intensity (kBtu/sq.ft.)	ENERGY STAR Score (1-100)	2019 Energy Change (compared to 2018)	2019 Water Change (compared to 2018)
Buford Middle School	1965	110,650	51.3	44	-6.7%	-4.41%
Burnley-Moran Elementary School	1955	51,158	54.2	64	-9.8%	-20.19%
Charlottesville High School	1974	285,700	55.6	58	-0.09%	-25.75%
Clark Elementary School	1930	54,021	63.4	41	-8.8%	8.72%
Greenbrier Elementary School	1930/59	46,750	56.8	60	-0.1%	16.34%
Jackson-Via Elementary School	1951	66,600	52.9	56	0.0%	0.35%
Johnson Elementary School	1955	54,655	52.5	65	7.6%	-5.59%
Lugo-McGinness Academy	2014	6,830	42.6	89	-5.2%	24.04%
Venable Elementary School	1925/51	61,720	53.1	55	-2.9%	-23.41%
Venable Elementary School Annex	1925/51	1,200	180.1	3	-4.2%	-69.51%
Walker Upper Elementary School	1965	106,700	55.8	34	-1.7%	5.85%

EUI and ENERGY STAR Scores

To measure performance, we compare each school to itself overtime to see how energy and water usage has changed over the years. For energy, we also compare schools to each other using metrics known as Energy Use Intensity (EUI) and ENERGY STAR scores. The EUI is a measure of how much energy (electricity and natural gas) a school uses per square foot and the lower the EUI, the better. EUI allows an organization to compare smaller buildings to larger buildings even though the larger building will likely use more energy. Based on data from the Energy Information Administration (CBECS 2012), the average EUI for education facilities in our region is 62.6 kBtu/sq.ft., and the average across the CCS portfolio is 65.3 kBtu/sq.ft. Although it is appropriate to compare the EUI of schools to the EUI of other schools, the EUI should not be used to compare schools to other types of buildings, such as office buildings and multifamily housing. The differing use cases make these inaccurate comparisons of performance.

Another measure of performance is the ENERGY STAR score. All Charlottesville City Schools are benchmarked using ENERGY STAR Portfolio Manager, an online tool that allows buildings to receive a score based on the level of energy efficiency compared to similar facilities across the nation. Schools are compared to other schools to give a 1-100 score, where the higher the score the more efficient the building is. An ENERGY STAR score of 50 means that the school is performing at the 50th percentile of schools nationwide while a score of 75 means that the school is performing in the top 25%. Buildings need to have a score of 75 or higher before pursuing ENERGY STAR certification. ENERGY STAR for buildings is a measure of operational performance at that point in time and is meant to be reviewed and applied for annually. Although there is a cost for the review and certification, achieving consistent multi-year certifications is seen as a goal for many organizations.

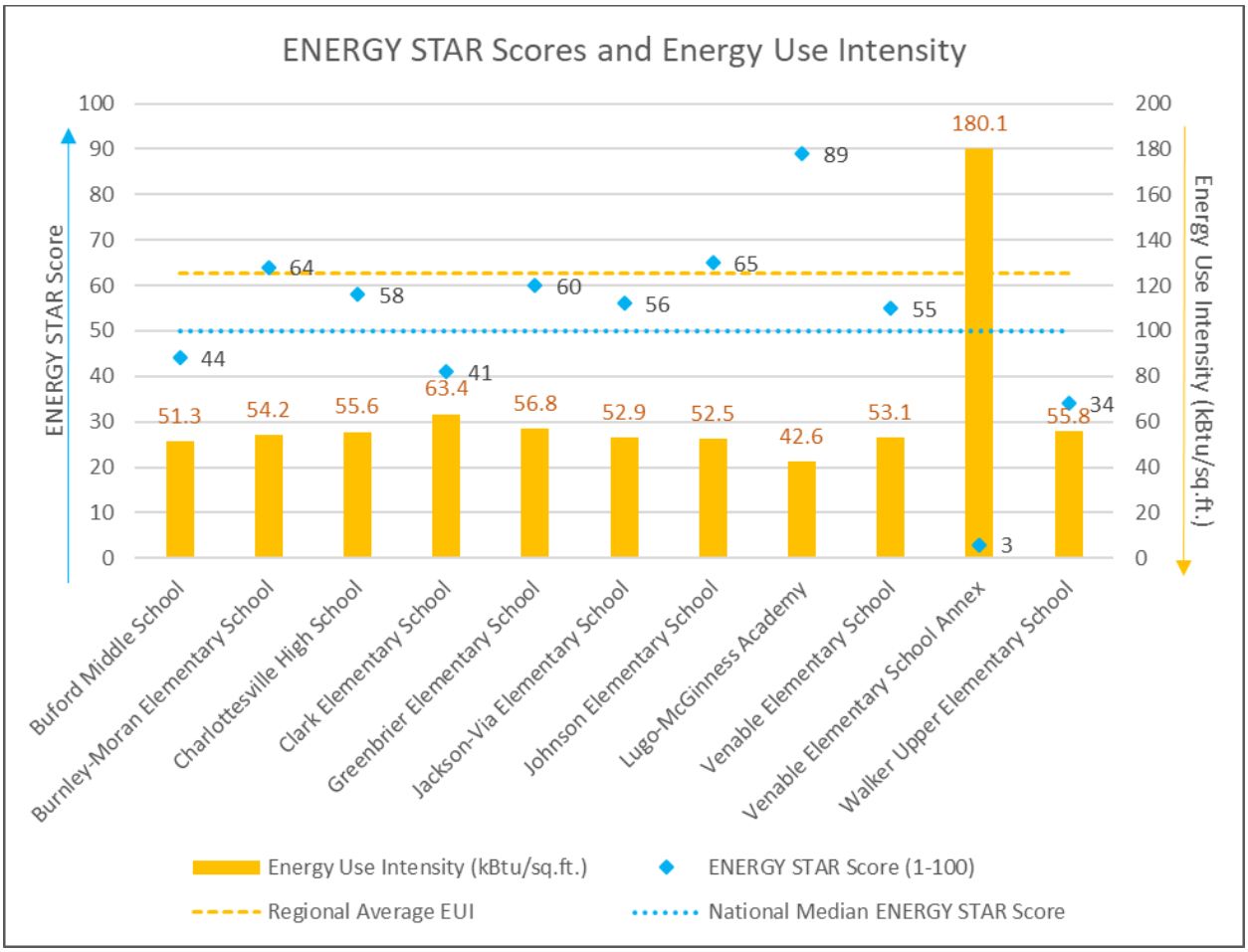


Figure 1: *ENERGY STAR Scores and Energy Use Intensity (EUI) comparison by school (as of Dec. 2019). High ENERGY STAR scores and low EUI values are better and mean a facility is more energy efficient.*

Most Charlottesville City Schools reached the prerequisite ENERGY STAR Score of 75 and received the ENERGY STAR certification in 2009. Since then, the schools have not reapplied for any years since. As buildings across the nation have gotten more efficient, ENERGY STAR has adjusted the Portfolio Manager tool to account for this, which raises the bar for achieving higher ENERGY STAR scores. This means it is harder to achieve an ENERGY STAR score of 75 in 2020 than it was in 2009 if schools have not kept up with the nation's pace of efficiency improvements, which is not easy for many school districts.

A helpful way to approach this is to evaluate what is considered feasible given the potential for energy savings at each school, and then determine what ENERGY STAR score will be achieved with a given energy reduction. This can then be adjusted as needed to reflect current and proposed strategies and a target ENERGY STAR score can be determined, even if not 75. No and low-cost energy reduction strategies (such as HVAC operations changes and occupant behavior changes) can have large impacts on a lower ENERGY STAR score (below 50) that can push the building towards the 75 level. Once a building gets above 75, incremental changes in the score become harder to achieve, so a lower ENERGY STAR score can mean easier opportunities to make big improvements.

Seven out of the ten schools are currently above a 50 ENERGY STAR score, placing them above the average performance of schools in the country (Table 2 and Figure 1). Burnley-Moran Elementary and Johnson Elementary, with scores in the mid-60s, are in favorable positions to achieve a 75 score and ENERGY STAR certification. Johnson Elementary, having received an upgraded BAS this year, and Burnley-Moran Elementary, being considered for an upgrade next year, will likely see noticeable increases in their scores over the next couple years. Burnley-Moran Elementary achieved a 9.8% reduction in energy usage from 2018, jumping from a 58 to a 64 ENERGY STAR score over the course of 2019. Johnson Elementary experienced an increase in energy usage in 2019, mainly due to energy losses during the BAS installation construction process and from testing and fine-tuning programing within the BAS to make sure systems operated properly. Burnley-Moran Elementary may see similar increases in energy usage during the construction process but the City will work to keep this to a minimum.

Lugo McGinness Academy is the smallest school in the portfolio and although it does not have a BAS to aid in controlling systems, it has consistently used the lowest amount of energy per square foot and has the highest ENERGY STAR score of the portfolio at 89. This is attributed in part to upgrades that were made to the building in 2014 improving the HVAC system, plumbing, and insulation. The EWMT is confirming the benchmarking details of the Lugo McGinness Academy ENERGY STAR profile to verify eligibility for certification. If eligible, the next step will be to identify the funding needed to begin the certification process.

One outlier in the portfolio is the Venable Annex Building. It is a separate facility that is benchmarked on its own as its use is different than Venable's main building and it has its own utility metering in place. It is split between CLASS program office space and iSTEM classroom space. The EWMT is working with staff to better understand what is causing the high EUI compared to other facilities.

Portfolio Performance

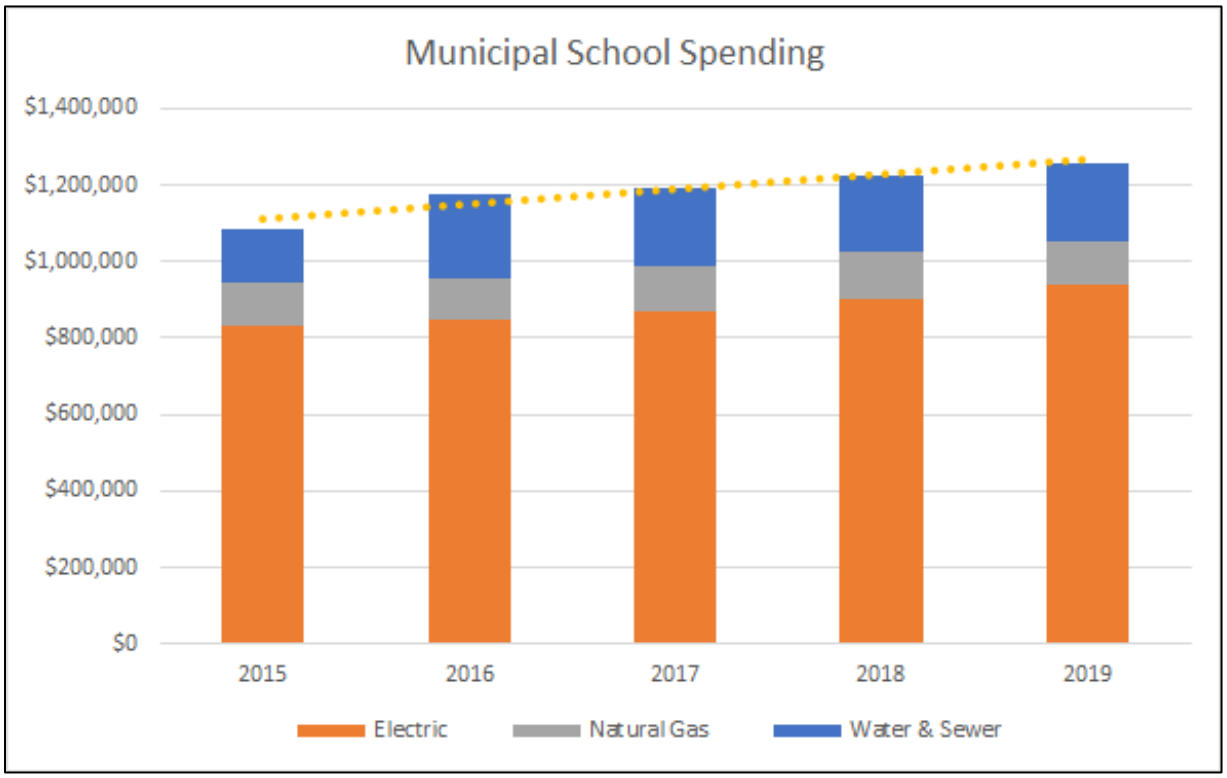


Figure 2: *Charlottesville City School's utility spending for the past 5 years for each commodity type across all school facilities.*

Overall, the school portfolio spends just over $1.2 Million for energy and water utilities annually, which has been on an upward trend over the past five years (Figure 2). This is due in part to increasing utility rates but also changing operations year to year to account for after-school and summer activities. Electricity makes up the majority (75%) of CCS's utility costs and although there is a slight increase in cost from electricity over the past five years, there are still opportunities to reduce these costs (Figure 2 and 3).

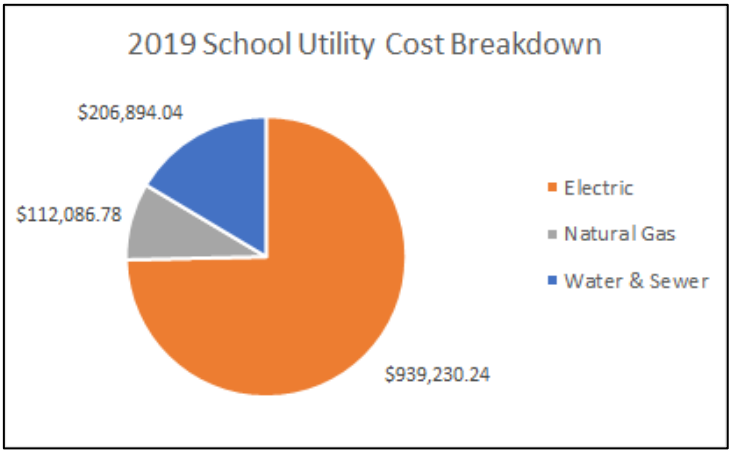


Figure 3: *Charlottesville City School's utility spending broken down by commodity for 2019 across all school facilities.*

The year 2015 was used as a performance baseline for utility tracking as it is the earliest full year of utility usage that includes all the current facilities in use by the City. The EWMP uses 2015 when determining long term trends and changes. The year 2016 is used as the City's weather normalization standard (all energy data is adjusted according to deviation from 2016 heating and cooling degree days) as it represents a typical and expected weather trend for Charlottesville, Virginia. Normalizing for weather removes the effects from varying outside temperature from year to year (colder or warmer

years) and allows utility performance to be evaluated based on non-weather events, such as efficiency projects or adjustments to operations.

When reviewing the performance of each school, a general goal of a 2% reduction in utility consumption has been discussed. This goal was provided by the EWMT as a point of comparison for the school's performance and is not an official goal established by the EWMP; however, it is an attainable goal in most settings that would help keep utility spending from increasing year to year. Overall, the goal of the EWMP and CCS is to reduce our utility consumption and utility costs through efficient management of those utilities and improved behaviors.

The figures and data from this report can be viewed through an interactive dashboard on EnergyCAP. See the appendix for further instructions regarding how to access this information (Appendix 2).

Electricity

Electricity makes up the bulk of spending for utilities at 75% of total utility cost (Figure 3). CCS electricity use is mainly tied to the cooling and ventilation systems, indoor/outdoor lighting (excluding street lighting), and equipment plug load throughout all facility areas (e.g., classrooms, offices, kitchen, gym, etc.). Although the portfolio has seen some minor dips in electricity use in the past five years, the prevailing trend has been upward. This is mostly related to two factors: recent construction and renovation projects and expanded after-hours/summer activities.

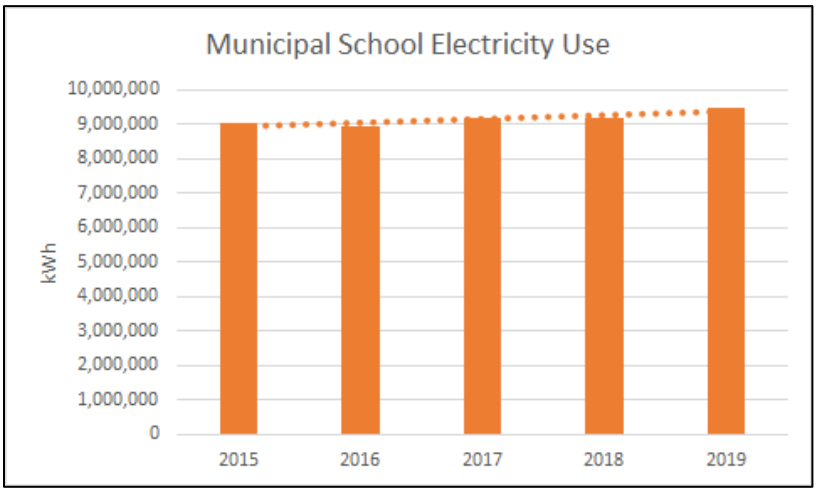


Figure 4: *Charlottesville City School's electricity usage (weather normalized) for the past 5 years across all school facilities.*

Construction and renovation projects are typically performed during the summer in schools, minimizing any disruption during the school year. Summer is also the most electricity-intensive time period as this is the peak of the cooling season when HVAC systems are trying to keep up with warmer temperatures and higher humidity. Most construction projects require significant back and forth foot traffic and activity that sometimes requires doors to be left open longer, allowing conditioned air to escape. Best practices for minimizing open door duration can be recommended to contractors (even required) but are difficult to enforce consistently. The result is that increased electricity use can be incurred during the construction period. In 2018 and 2019, both Jackson-Via Elementary and Johnson Elementary had BAS installations, and additionally in 2019, Jackson-Via had a modernization project. This can be seen in the electricity use where Jackson-Via Elementary experienced increases of 7.5% in 2018 and 9.4% in 2019, and Johnson Elementary had an increase of 15.7% in 2019 (Appendix 3). BAS installations require fine-tuning program settings after installation to get the HVAC system running properly, so a portion of the increases have to do with HVAC losses during this process. However, much of the losses are seen during

the construction period and the EWMT is consulting industry best practices and successful methods for working with contractors more effectively to manage energy use during projects

After-school and weekend activities (athletic practices, clubs, church service) and summer activities (camps, athletic practices) tend to vary year to year at each school. These activities require HVAC and lighting systems to run in many areas (sometimes the whole school). This can cause fluctuations in the electricity that is seen year to year at each school. When larger schools start operating for longer hours, the portfolio tends to see an overall shift in electricity use. In 2019, Charlottesville High School had an increase in summer camps that required greater daily HVAC and lighting operations throughout July and August compared to 2018. This was a significant cause of its 7.6% increase in electricity usage (Appendix 3). Charlottesville High School electricity typically makes up 30% of the entire portfolio's electricity usage, so a small shift here can cause large shifts at the portfolio-level. Although electricity use for after-hours and summertime activities is seemingly a necessity rather than something that can be managed and reduced, the EWMT worked with Charlottesville High School staff in January 2020 to determine when HVAC and lighting in portions of the school could be shut-off if not being used during these activity periods and educated staff on the appropriate method for scheduling.

Natural Gas

Fueling the space heating and water heating equipment for schools, natural gas makes up close to 9% of utility spending for the portfolio (Figure 3). In 2019, all schools saw a drop in natural gas compared to 2018, partly because of warmer weather but also because of efficient operating of heating systems. Buford Middle School and Walker Upper Elementary saw the highest reductions at 37% and 24% respectively (Appendix 4). The Facilities Maintenance teams at every school investigated areas to reduce unnecessary heating by adjusting schedules and equipment settings to trim up operations while working with school staff to ensure that comfort is being maintained. The teams have made this a standard practice to perform during the heating season each year.

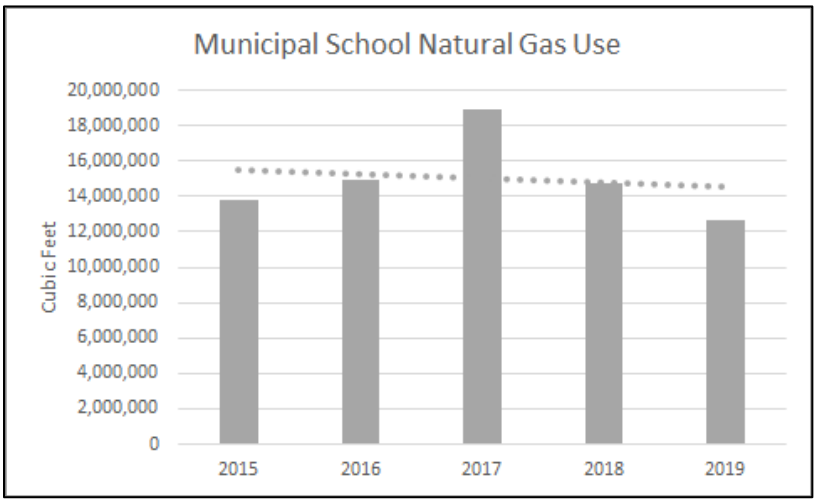


Figure 5: *Charlottesville City School's natural gas usage (weather normalized) for the past 5 years across all school facilities.*

It is worth noting that in 2017, Charlottesville High School experienced a natural gas leak during the summer which caused a major spike in natural gas usage (Figure 5). The issue was addressed and fixed but not before a considerable amount of natural gas loss had occurred.

Water and Sewer

In 2019, just over 16% of total utility costs were for water and sewer at CCS facilities. Water and sewer costs and water consumption have fluctuated over the past five years showing a slight upward trend (Figure 6). The increase and fluctuation associated with water and sewer costs and usage for water can be associated with the addition of a few new water accounts over the past five years particularly for irrigation accounts as well as a few large water leaks that have occurred over the past five years.

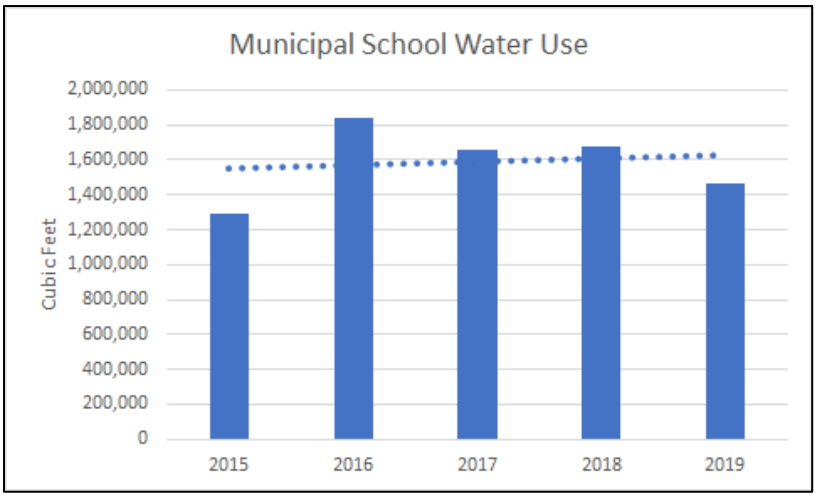


Figure 6: *Charlottesville City School's water usage (weather normalized) for the past 5 years across all school facilities.*

Domestic daily water usage is heavily impacted by the number of people in a building particularly from the use of toilets. For the past four years, we are seeing a significant decline in water usage with a large decline occurring in 2017 and then again in 2019 (Figure 6). There was a drought warning declared for the City of Charlottesville during the Fall of 2017 which prevented any water usage toward irrigation which could have helped contribute to the large decline in water usage from 2016 to 2017 (Figure 6).

When comparing 2018 to 2019, we see a 12.6% decline in water usage and a 3.5% increase in water and sewer costs (Appendix 5). The increase of cost can be linked to the approximate 1% increase in water utility rates and 2% increase sewer utility rates references in the *City of Charlottesville Utility Rate Report*. When looking across each school and comparing 2018 to 2019 water usage: six schools showed a decrease in utility usage over 2%, one school showed minimal change, and four schools saw increase in utility usage (Appendix 5). A few of these large decreases in water usage were caused by large water leaks that occurred in 2018 (Charlottesville High School, Venable Elementary School, and Venable School Annex), and increases in water usage were also the result of water leaks or increased irrigation needs (Lugo-McGinness Academy). Even a few running toilets can cause water usage to spike during a particular year. The EWMT has been able to closely monitor water usage at each school and has been very quick to report abnormal spikes or trends in water usage for further investigation by the Facilities Maintenance team.

Greenhouse Gas Emissions

On July 1, 2019, the City of Charlottesville committed to a community-wide greenhouse gas (GHG) reduction goal of 45% below the 2011 inventory year by 2030 and carbon-neutrality by 2050. Schools make up approximately 40% of the municipal greenhouse gas portion, equivalent to greenhouse gases from approximately 500 homes (Image 6).

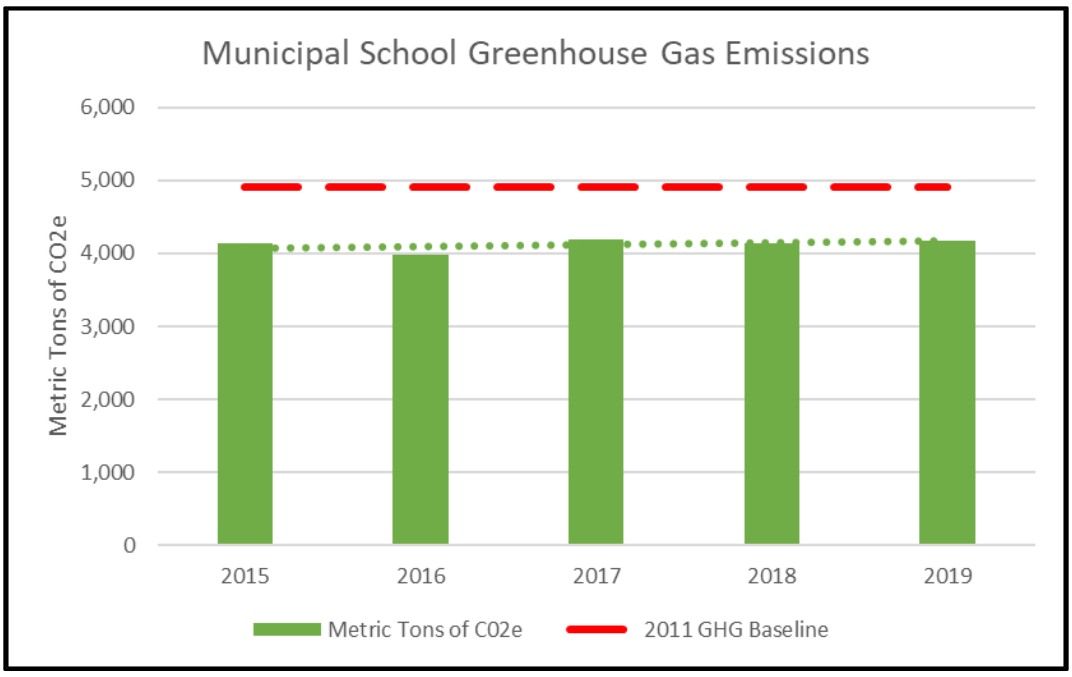


Figure 7: *Greenhouse gas emissions for the past 5 years across all school facilities.*

Since 2011, the portfolio saw a downward trend and then has seen a leveling off over the past five years (Figure 7). This reduction is in part due to the electric grid becoming cleaner (generating energy from cleaner sources), so although we have had a slight increase in electricity, the electricity used is producing less emissions. Electricity is the source of the majority of greenhouse gas emissions from school buildings so strategies that reduce electricity have the potential to have the greatest impact on emissions (Figure 8). Electricity can also get cleaner overtime as renewable sources, such as solar and wind, continue to be installed at the grid-level and onsite. Although advancements are being made in cleaner natural gas (e.g., renewable natural gas), it is still a fossil fuel and use of this will likely continue to produce greenhouse gas emissions for the foreseeable future. As stated in the "City of Charlottesville 2016 Greenhouse Gas Inventory", the two options for reducing greenhouse gas emissions are from

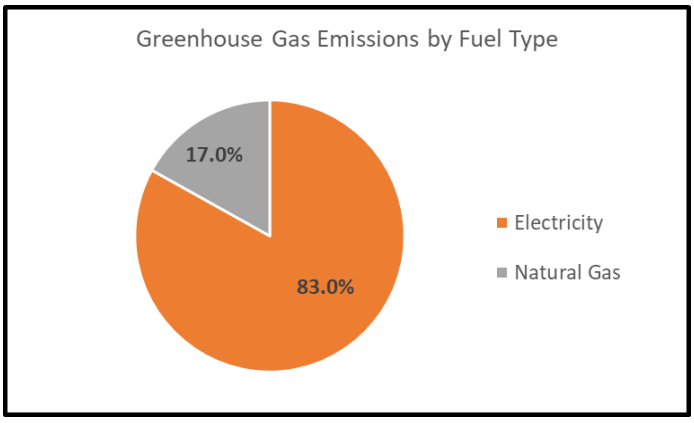


Figure 8: *Greenhouse gas emissions by fuel type (percentage).*

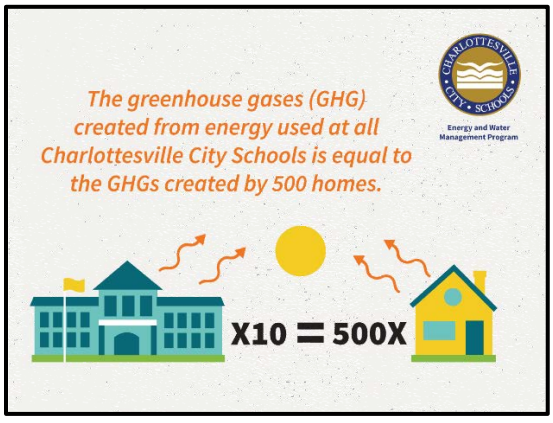


Image 6: *Approximate greenhouse gas equivalent of the amount of energy CCS used in 2019. This image was used in CCS's Winter Quarterly Education Poster and outreach.*

switching to a fuel source that produces less emissions and from reducing energy use through efficiency and conservation measures. Both of these approaches will continue to be utilized to reduce the CCS greenhouse gas footprint.

2020 Outlook

The EWMP is expecting, with the programs continual review of utilities and involvement in identifying opportunities to help save, that there will be reductions seen across all utilities' consumption in 2020. The EWMP plans to establish clear reduction goals for CCS facilities for each utility that are in line with meeting the City of Charlottesville's Climate Action Plan and greenhouse gas emission reduction goals. The EWMP will continue to review utility performances monthly and investigate opportunities to improve efficiency through operations, technology, and behavior strategies. Through the EPC, the program hopes to identify a myriad of opportunities to improve efficiency at most of CCS's facilities and to be able to estimate approximate cost savings from these improvements. The partnership between the City and CCS has allowed for considerable progress to be made on energy and water efficiency, and the EWMP is looking forward to building on this momentum.

Appendix

Appendix 1*: Resolution for Charlottesville City Schools Energy and Water Performance*

Resolution for Charlottesville City Schools Energy and Water Performance

Whereas, Charlottesville City Schools are committed to personal and academic excellence and preparing all current and future students to be engaged citizens who make contributions to the well-being of their community, including the natural environment; and

Whereas, building energy use is a major expense and emitter of greenhouse gases contributing to air pollution and climate change; and

Whereas, actions that reduce negative climate and air quality impacts and increase energy efficiencies will also lead to a cleaner environment and a better quality of life for both students and community members; and

Whereas, renewable power installations, energy savings initiatives, and fuel-efficient transportation provide an educational opportunity for students and employees for everyday teaching and learning; and

Whereas, through practices and partnerships, Charlottesville City Schools strives for optimized energy and water efficiency while balancing equity, economic, and environmental impacts; and

Whereas, Charlottesville City Schools has been deliberate and proactive in implementing environmental improvement measures in school operations and taking actions that reduce resource consumption and associated greenhouse gas emissions, including:

- Implementation of a Guaranteed Energy Savings Performance Contract in 2007 to provide energy efficiency and infrastructure upgrades to three schools
- Certification by U.S. Environmental Protection Agency as ENERGY STAR® for seven of nine schools in 2009
- Installation of solar photovoltaic systems on Charlottesville High School and Lugo-McGinness Academy
- Honored by U.S. Department of Education in 2016 with Green Ribbon Schools District Sustainability Award; and

Whereas, pursuing energy improvements and cleaner sources of energy is in line with City goals, values, and commitments on climate protection that acknowledge local and global implications; and Whereas, Charlottesville City Schools aims to reflect and support the goals of the community it serves.

Therefore be it resolved that the Charlottesville City Schools, acknowledging the ongoing partnership with the City of Charlottesville and the reliance on City support in implementing energy and water performance improvement measures, commits to

1. Support improved performance of the school building portfolio through efforts to reduce energy and water use through management, conservation, and efficiency upgrades; and
2. Work with the City to pursue new school buildings that integrate high performance standards related to energy and water; and
3. Partner with City staff to evaluate and pursue opportunities increasing the amount of clean energy used by Charlottesville City Schools, such as through increased onsite renewable energy.

Chair, Charlottesville City School Board

April 11, 2019

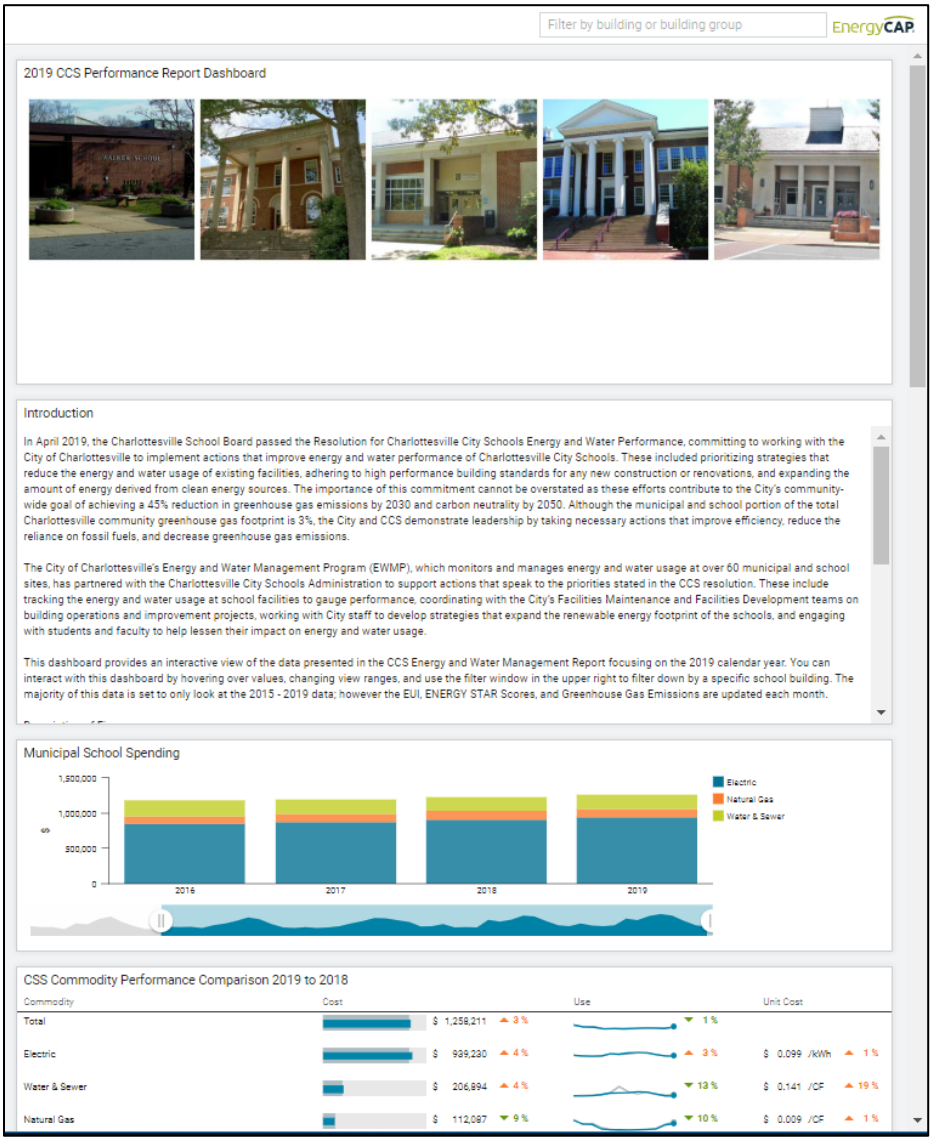
Date

Appendix 2: *EnergyCAP Dashboard Link and Instructions on how to interact with the data views.*

[EnergyCAP 2019 CCS Performance Report Dashboard Link]

This dashboard is an interactive option for viewing the data put forth in this report using the EWMT utility tracking software, EnergyCAP. The figures in this dashboard are all slight variations of the data provided in this report. The data in this dashboard are for all Charlottesville City Schools; however, you can further filter the data specific for one school using the "Filter by building or building group" feature in the upper right. Start typing the name of the school and select the correct name from the auto-generated list and the data will update with your new filtered view. Many of the figures and graphs offer the ability to interact including hovering over the figures to get detailed information and changing time views of the data using the slide bar above or below a graph. Most data presented in these figures are static and are focused on 2019; however, a few are continually updated with data over time but still include 2019 numbers.

Any questions about this data or dashboard can be directed to EnergyWaterTeam@charlottesville.gov.



Appendix 3*: Charlottesville City School's electric usage and costs for each school in 2018 and 2019 with percent comparison. Usage is weather normalized.*

Building Name	Electric Usage (kWh)			Electric Cost		
	2018	2019	% Change	2018	2019	% Change
Buford Middle School	1,415,961	1,411,955	-0.28%	$138,068.07	$140,373.84	1.67%
Burnley-Moran Elementary School	545,704	509,187	-6.69%	$53,983.95	$51,336.82	-4.90%
Charlottesville High School	2,839,382	3,056,166	7.63%	$280,151.54	$303,142.34	8.21%
Clark Elementary School	597,146	575,859	-3.56%	$58,327.88	$56,584.56	-2.99%
Greenbrier Elementary School	492,713	491,914	-0.16%	$49,137.16	$49,524.32	0.79%
Jackson-Via Elementary School	599,950	656,099	9.36%	$60,011.91	$65,158.72	8.58%
Johnson Elementary School	443,829	513,434	15.68%	$44,298.90	$51,817.36	16.97%
Lugo-McGinness Academy	36,275	33,929	-6.47%	$3,991.16	$3,699.26	-7.31%
Venable Elementary School	689,071	664,943	-3.50%	$66,961.03	$65,776.51	-1.77%
Venable School Annex	14,371	14,379	0.06%	$1,578.19	$1,589.66	0.73%
Walker Upper Elementary School	1,505,067	1,533,917	1.92%	$146,204.21	$150,226.84	2.75%
Total	**9,179,469**	**9,461,782**	**3.08%**	**$902,714.00**	**$939,230.24**	**4.05%**

Appendix 4*: Charlottesville City School's natural gas usage and costs for each school in 2018 and 2019 with percent comparison. Usage is weather normalized.*

Building Name	Natural Gas Usage (CF)			Natural Gas Cost		
	2018	2019	% Change	2018	2019	% Change
Buford Middle School	1,006,544.60	637,713.62	-36.64%	$8,705.33	$6,022.39	-30.82%
Burnley-Moran Elementary School	1,066,487.14	906,414.96	-15.01%	$8,729.64	$8,002.89	-8.33%
Charlottesville High School	5,749,209.71	4,891,554.56	-14.92%	$47,004.60	$42,605.55	-9.36%
Clark Elementary School	1,539,811.74	1,300,283.35	-15.56%	$12,468.62	$11,286.16	-9.48%
Greenbrier Elementary School	886,310.35	875,738.74	-1.19%	$7,879.91	$8,108.63	2.90%
Jackson-Via Elementary School	1,355,856.21	1,167,465.13	-13.89%	$10,864.31	$9,967.70	-8.25%
Johnson Elementary School	1,064,685.32	1,026,712.28	-3.57%	$8,852.87	$8,908.88	0.63%
Lugo-McGinness Academy	167,950.53	160,752.28	-4.29%	$1,712.11	$1,774.78	3.66%
Venable Elementary School	950,098.26	934,803.39	-1.61%	$8,313.63	$8,244.63	-0.83%
Venable School Annex	162,972.87	154,128.43	-5.43%	$1,496.82	$1,501.82	0.33%
Walker Upper Elementary School	817,230.72	624,126.46	-23.63%	$6,884.58	$5,663.36	-17.74%
Total	**14,767,157.45**	**12,679,693.20**	**-14.14%**	**$122,912.42**	**$112,086.78**	**-8.81%**

Appendix 5*: Charlottesville City School's water usage and costs (water and sewer) for each school in 2018 and 2019 with percent comparison.*

Building Name	Water Usage (CF)			Water & Sewer Cost		
	2018	2019	% Change	2018	2019	% Change
Buford Middle School	195,850.39	187,217.78	-4.41%	$25,383.92	$25,236.88	-0.58%
Burnley-Moran Elementary School	73,967.15	59,035.00	-20.19%	$10,298.49	$9,061.36	-12.01%
Charlottesville High School	707,354.15	525,198.18	-25.75%	$68,956.20	$70,149.65	1.73%
Clark Elementary School	86,669.45	94,229.72	8.72%	$12,176.69	$13,950.01	14.56%
Greenbrier Elementary School	54,935.43	63,911.52	16.34%	$8,467.63	$10,613.29	25.34%
Jackson-Via Elementary School	105,838.33	106,204.55	0.35%	$14,498.28	$15,524.69	7.08%
Johnson Elementary School	76,865.38	72,570.17	-5.59%	$9,263.37	$11,165.37	20.53%
Lugo-McGinness Academy	7,934.40	9,841.60	24.04%	$1,111.53	$1,778.52	60.01%
Venable Elementary School	131,855.88	100,992.98	-23.41%	$17,974.58	$14,696.90	-18.24%
Venable School Annex	3,841.91	1,171.35	-69.51%	$633.70	$277.16	-56.26%
Walker Upper Elementary School	233,712.67	247,389.67	5.85%	$31,066.71	$34,440.22	10.86%
Total	**1,678,825.14**	**1,467,762.53**	**-12.57%**	**$199,831.10**	**$206,894.04**	**3.53%**