WILLDAN

City of Lawrence

Measurement & Verification Report

Year 1 Savings

March 2018 through February 2019

City of Lawrence

WILLDAN

EXECUTIVE SUMMARY REPORT

ENERGY PERFORMANCE CONTRACT 1-YEAR SUMMARY: THE CITY OF LAWRENCE

In 2018, the City of Lawrence completed an Energy Performance Contract with Willdan Group Inc. (Willdan). The City of Lawrence was able to complete over $12 million in capital upgrades, funded by Green Bonds. By leveraging energy savings, this project funded deferred maintenance needs in a cash-neutral manner.

PROJECT HIGHLIGHTS OF THE WORK IMPLEMENTED BY WILLDAN INCLUDED:

- Upgraded lighting to LED in 40 City buildings
- Upgraded sports field lighting to LED at high-profile sports complexes and athletic fields
- Upgraded outdoor lighting in all City parks
- Installed 100kW solar PV array at Fire Station No. 5
- Replaced Indoor Aquatic Center equipment to resolve humidity and indoor air quality issues
- Replaced boilers and chillers at multiple City facilities
- Replaced packaged rooftop units and split systems across numerous city facilities
- Replaced windows at City Hall
- Replaced roofs on three City buildings
- Upgraded antiquated controls city-wide
- Installed web-based thermostats in city offices and buildings
- Installed fresh air ventilation with ionic air cleaning at the Prairie Park Nature Center
- Performed weatherization sealing in 25 City buildings.

As a part of the energy savings contract, Willdan is responsible for measuring and verifying the project's energy savings over the next several years. Recently, the City of Lawrence was given the Year 1 Measurement and Verification (M&V) Report for the energy project.

As the report demonstrated, significant energy and maintenance cost savings were achieved throughout the City of Lawrence facilities in Year 1 of the M&V period. In Year 1, the City of Lawrence exceeded the savings guarantee, saving over $550,000 annually. The total of all savings during the Year 1 reporting period was $551,864 which was comprised of $424,159 in electric and fuel savings and $127,704 in maintenance savings.

The savings in Year 1 included almost 4,000 MWh (Mega-Watt Hours) of electrical consumption, and over 50,000 therms of natural gas. The electric and fuel savings in Year 1 from the City of Lawrence's project are equivalent to:

The Greenhouse Gas Emission from:
Miles driven by an average passenger vehicle

7,462,103

Co2 Emissions From:
Pounds of coal burned

3,336,526

Carbon Sequestered By:
An Acre of U.S. forests in one year

3,592

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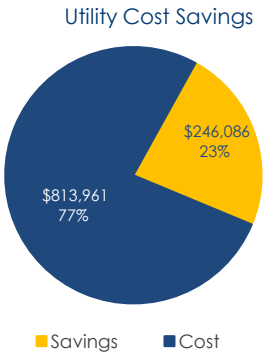
Project Summary

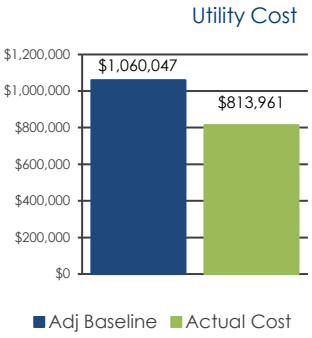
Willdan Peformance Engineering is pleased to provide you with this report demonstrating the level of savings achieved during the Measurement and Verification Phase from March 2018 through February 2019 as a result of the energy conservation upgrades project. As this report demonstrates, significant energy and maintenance cost savings were achieved throughout your facilities. The total of all savings during the reporting period was $551,864 which was comprised of $205,577 in Option C Electric Savings, $40,508 in Option C Fuel Savings, $166,406 in Option A Electric Savings, $11,668 in Stipulated Electric/Fuel Savings, and $127,704 in Stipulated Maintenance Savings; the total was $3,845 more than the guarantee savings of $548,019. 'Facilty Improvements' are provided in the margins for each building; noting that 'Bonus Improvements' were implemented at Willdan's expense (i.e. no cost to the City).



Sincerely,

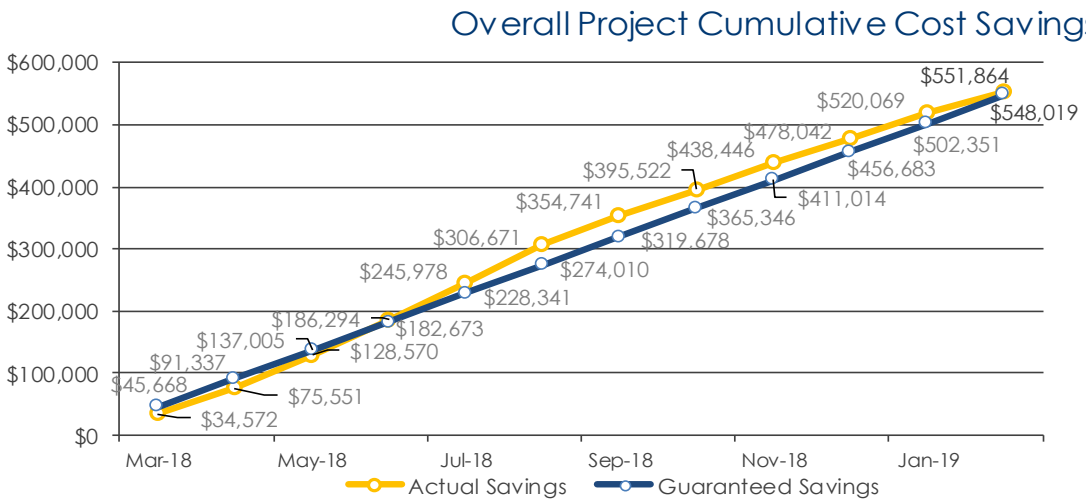
Kevin Player

Measurement & Verification Professional



Project Savings Performance Summary

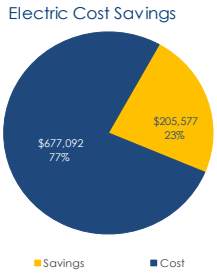
The chart below tracks project savings over time. The blue line represents the guaranteed contract savings while the yellow line represents the actual savings achieved.

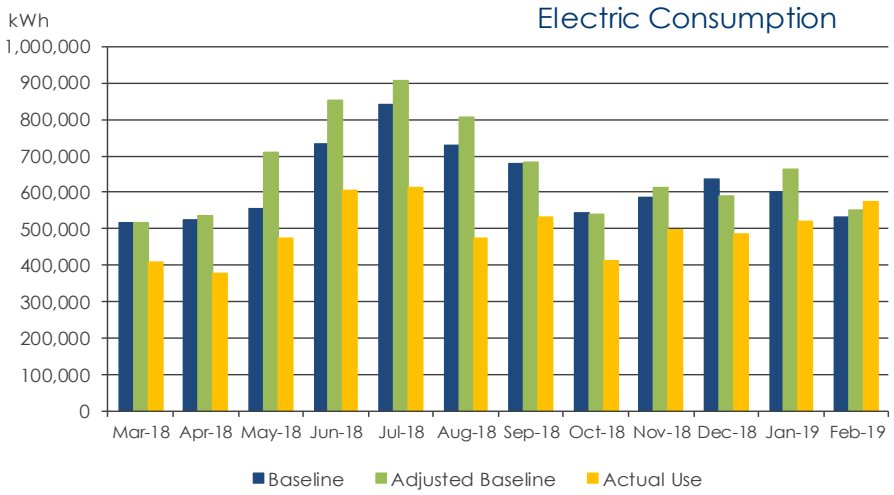


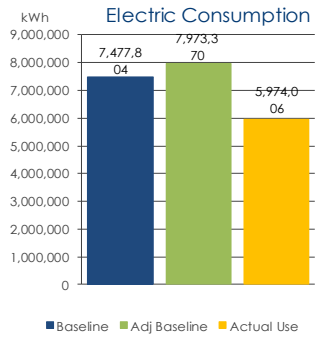
Savings Details

Overall Electrical Performance

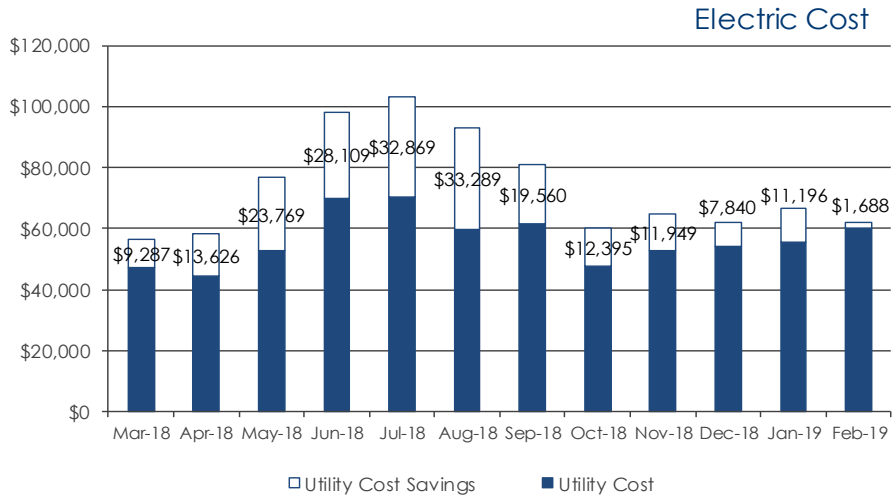
The following graphs illustrate the electrical performance for all facilities during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in electrical usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated electric savings.

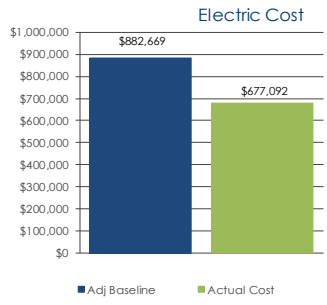




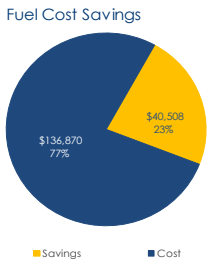


The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.





Overall Fuel Performance



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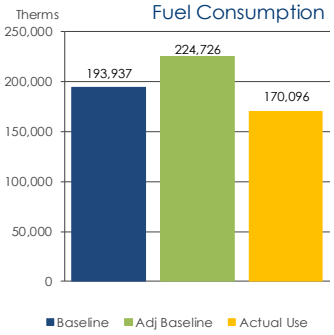

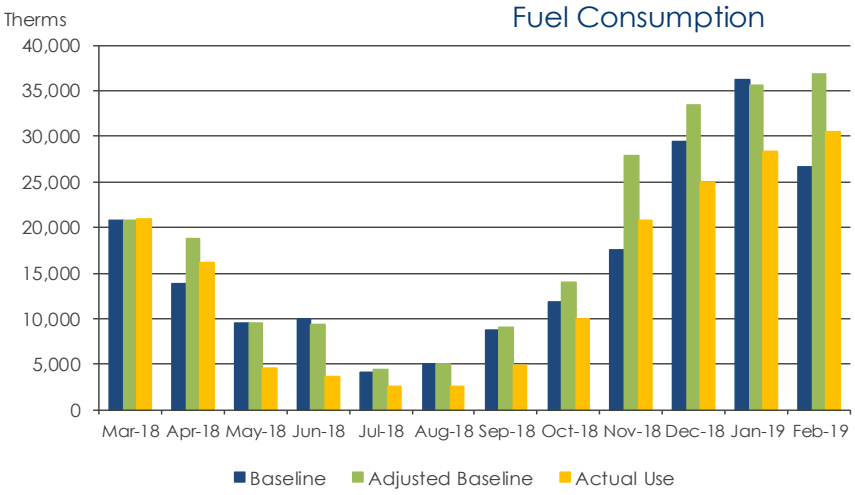

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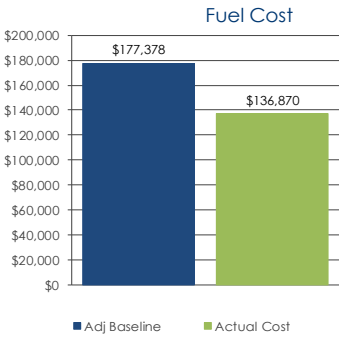
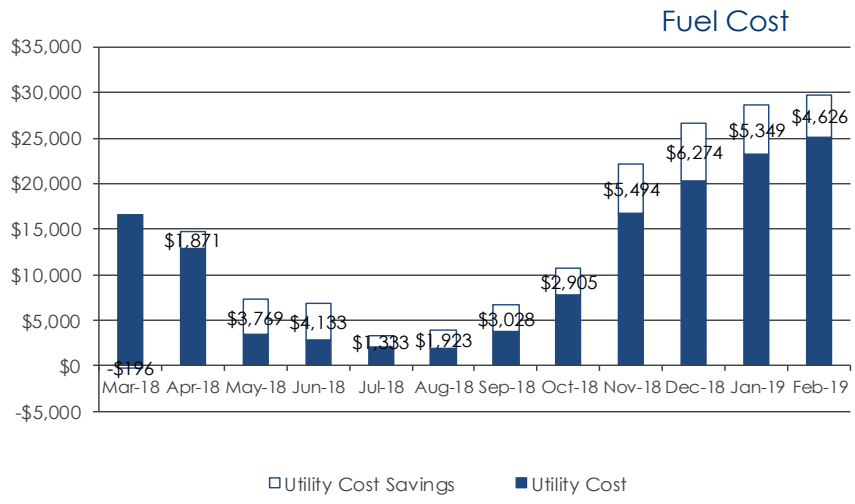
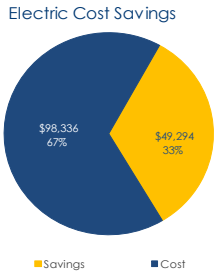
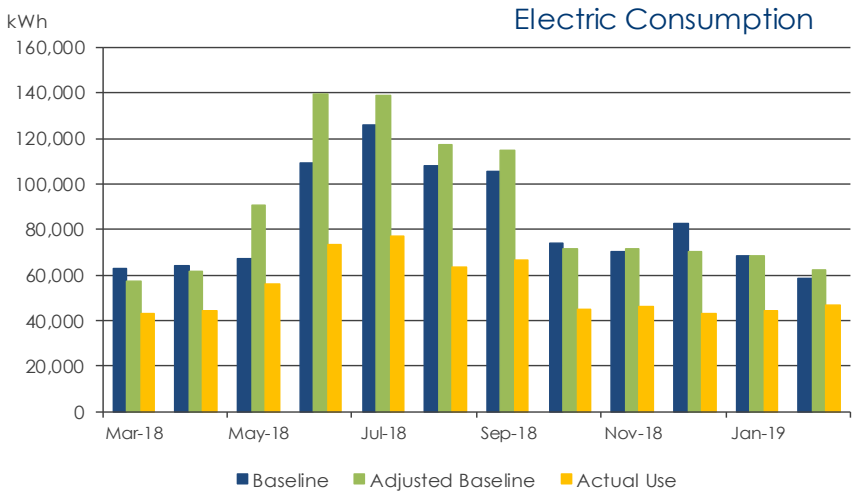


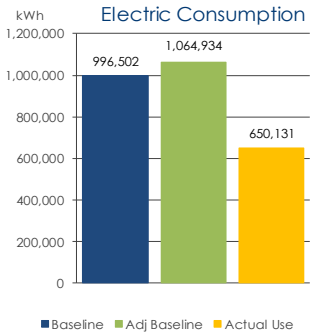


Community Health Building Electrical Performance

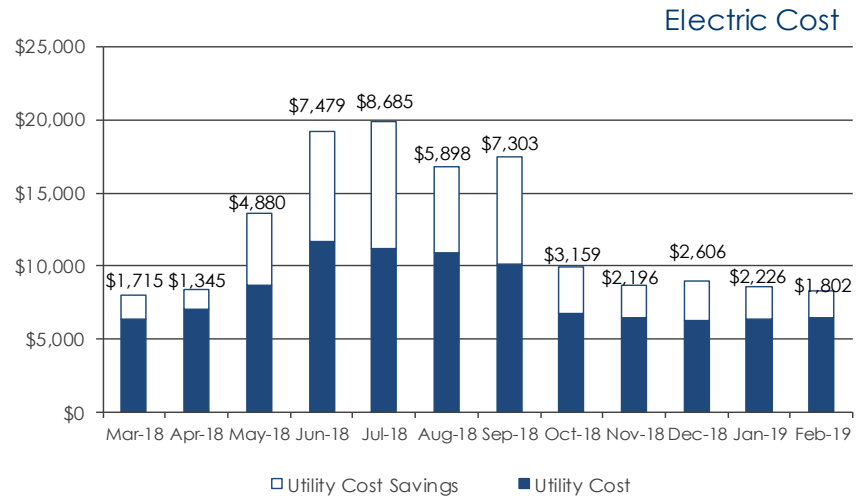
The following graphs illustrate the electrical performance for the Community Health Building during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in electrical usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated electric savings.

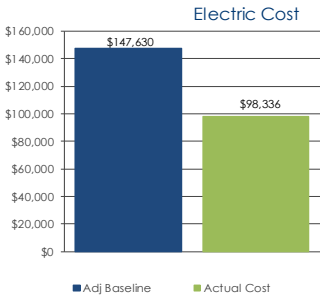






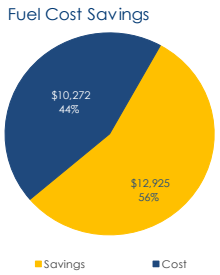
The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.



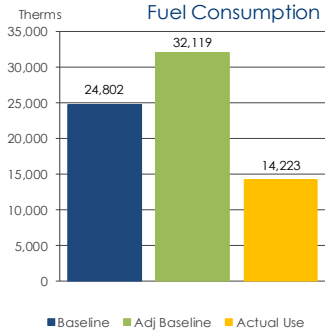


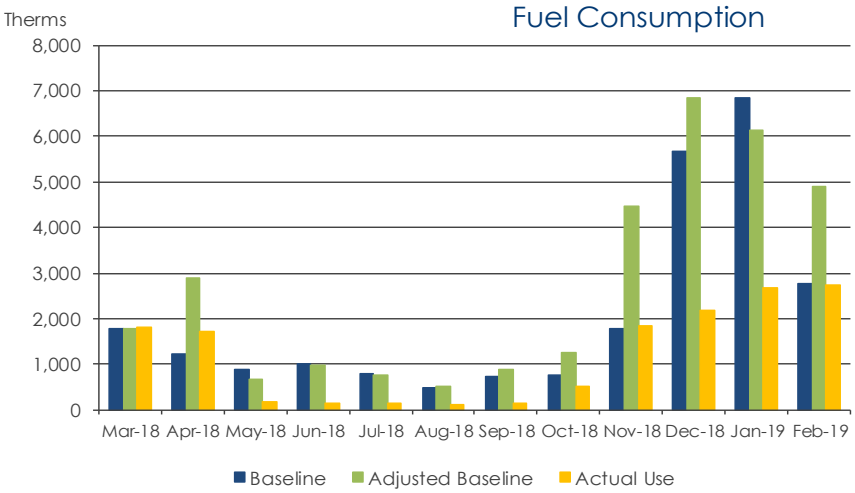
Facility Improvements:
* New Air-cooled chiller,
* New Air handler filtration,
* New DDC controls with updated sequences,
* New roof,
* New LED lighting

Community Health Building Fuel Performance

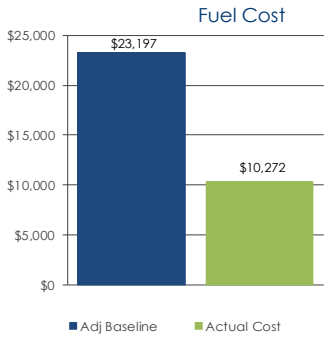


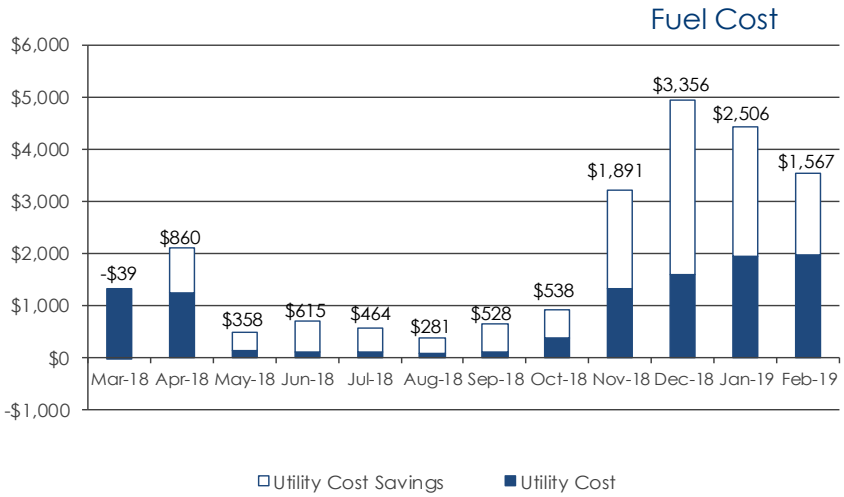
The following graphs illustrate the fuel performance for the Community Health Building during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in fuel usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated fuel savings.





The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.

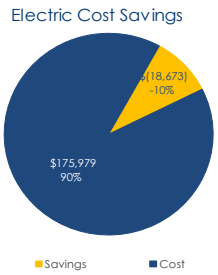


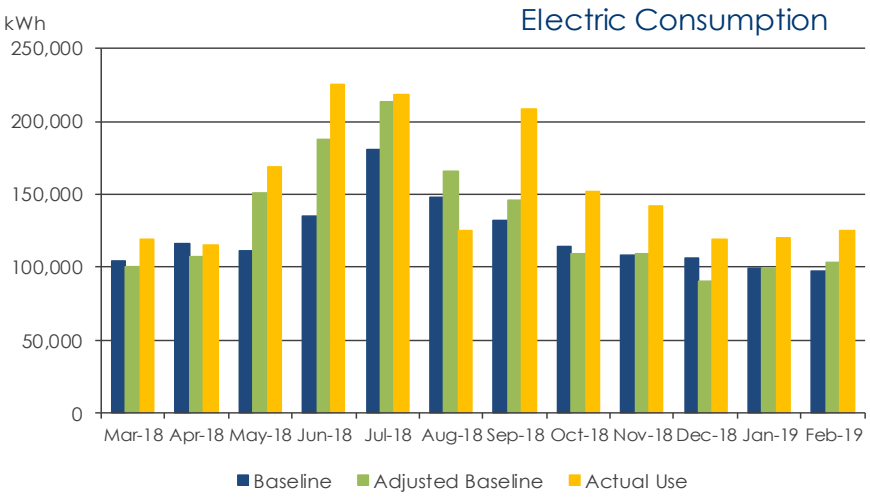


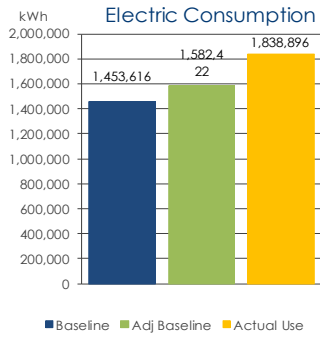
Facility Improvements:
* New heating water boilers,
* New Air handler filtration,
* New DDC controls with updated sequences,
* New roof

Indoor Aquatic Center Electrical Performance

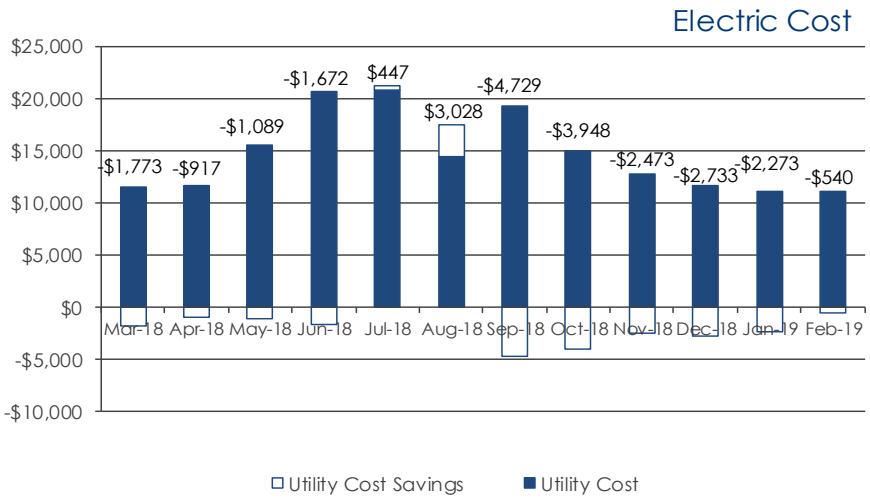
The following graphs illustrate the electrical performance for the Indoor Aquatic Center during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in electrical usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated electric savings.

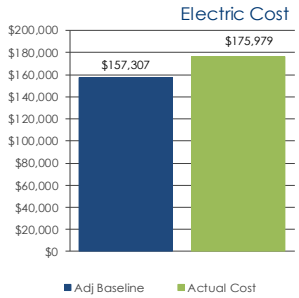






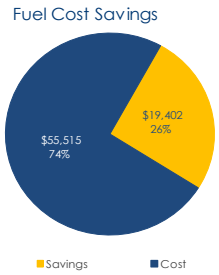
The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.



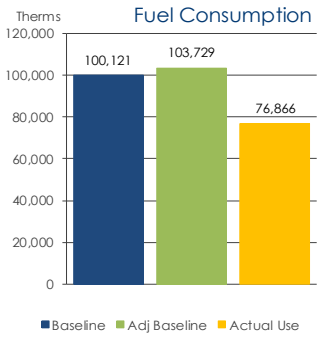


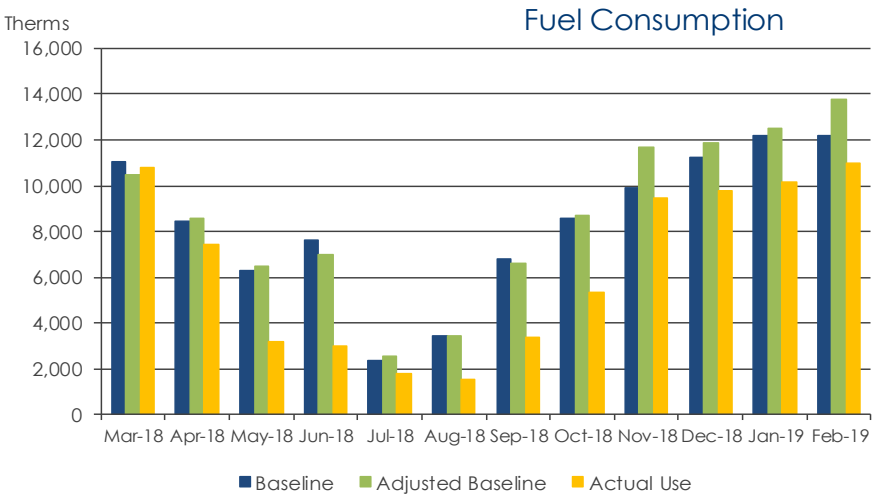
Facility Improvements:
* 2 New dehumidification units,
* New low-capture exhaust systems,
* New pool pump variable frequency drives,
* New VAV air handler condensing unit,
* New supplemental electric heat,
* Updated sequences,
* LED lighting

Indoor Aquatic Center Fuel Performance

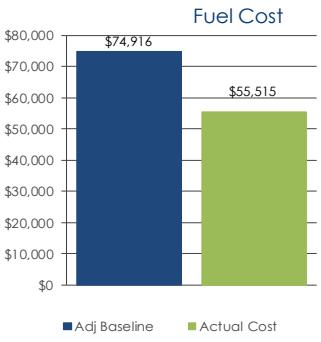


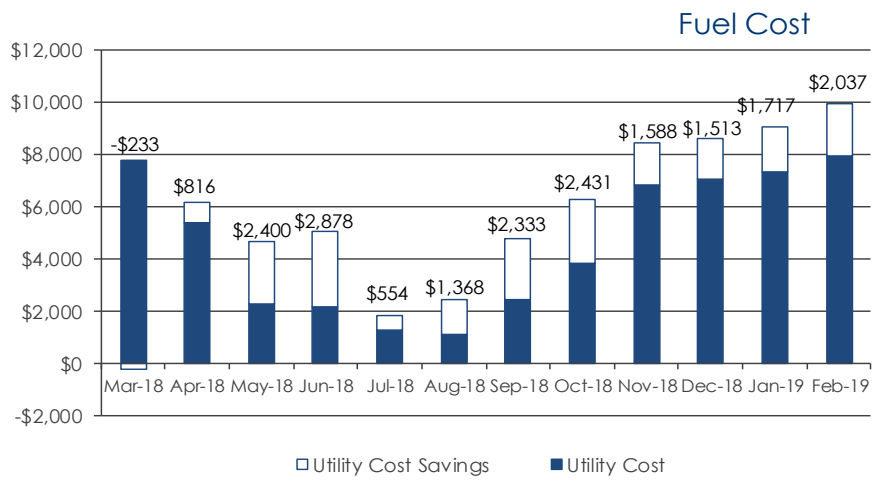
The following graphs illustrate the fuel performance for the Indoor Aquatic Center during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in fuel usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated fuel savings.





The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.

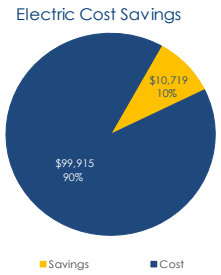


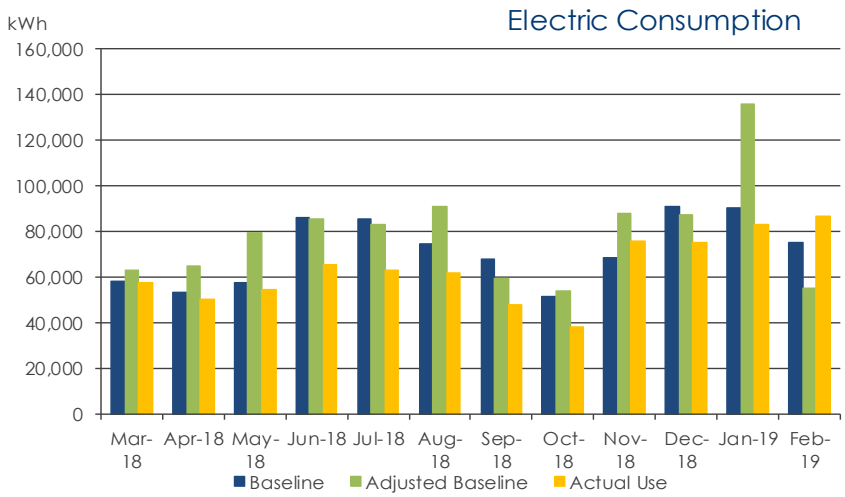


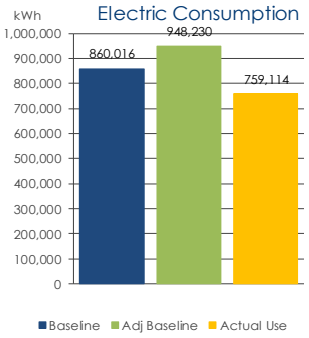
Facility Improvements:
* 2 New dehumidification units,
* New pool heating boilers,
* New pool pump variable frequency drives,
* Updated sequences

Library Electrical Performance

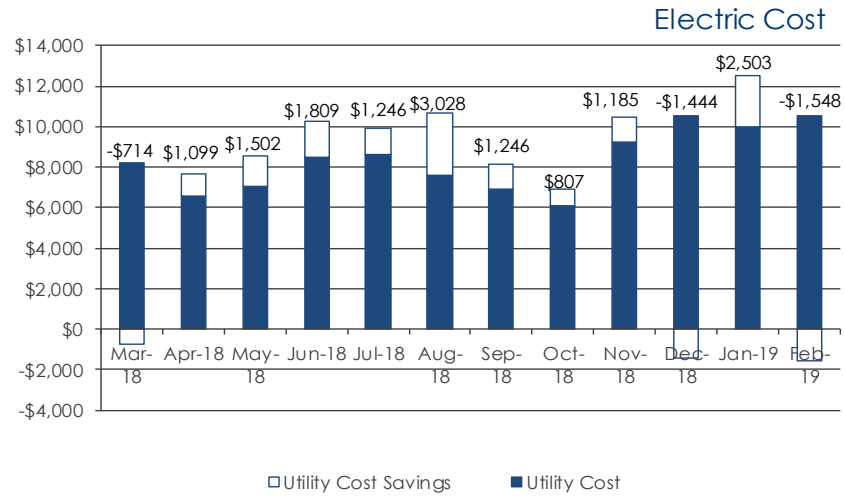
The following graphs illustrate the electrical performance for the Library during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in electrical usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated electric savings.

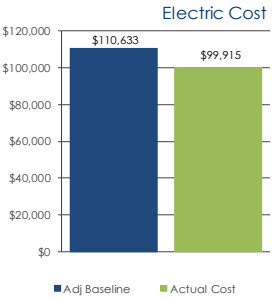






The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.

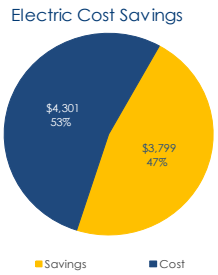


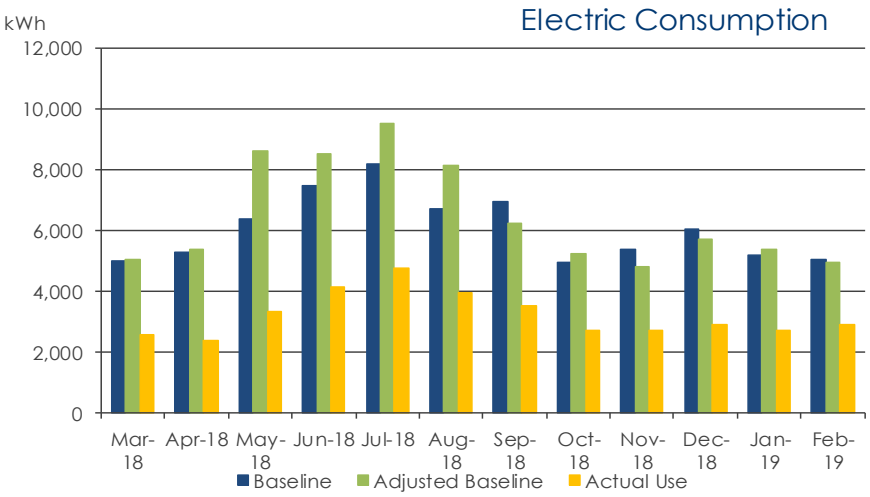


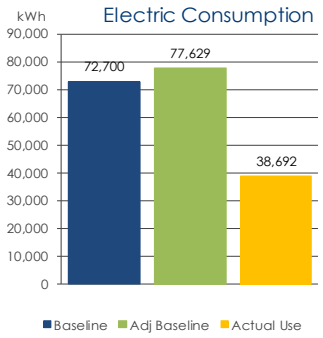
Facility Improvements:
* New CO2 sensors & updated sequences for demand controlled ventilation,
* LED lighting

Airport Terminal Electrical Performance

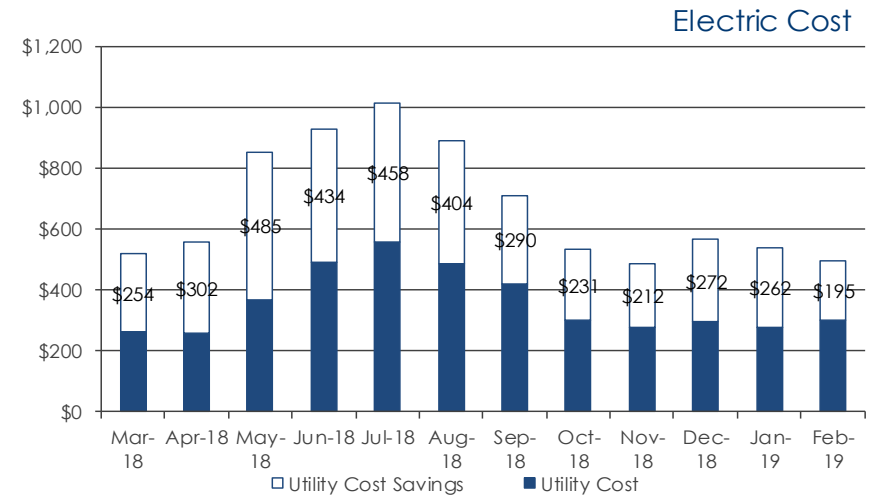
The following graphs illustrate the electrical performance for the Airport Terminal during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in electrical usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated electric savings.

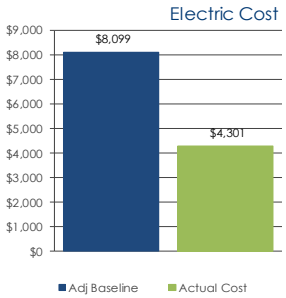






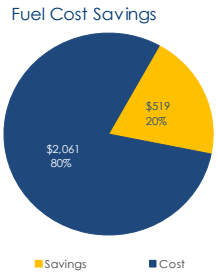
The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.



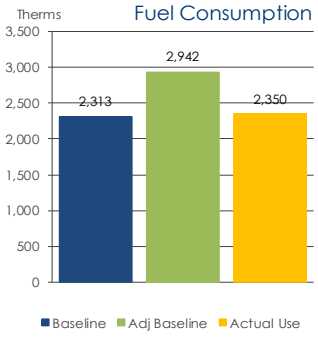


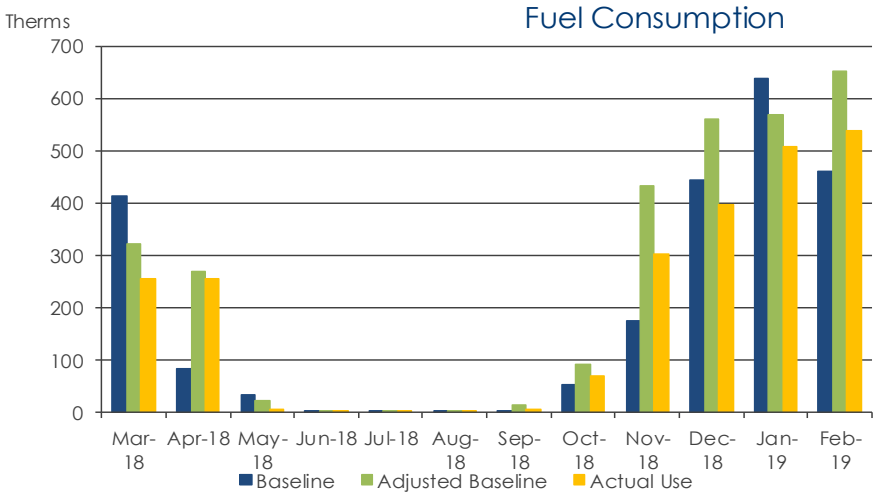
Facility Improvements:
* New AC split systems,
* New internet-based thermostats,
* LED lighting

Airport Terminal Fuel Performance

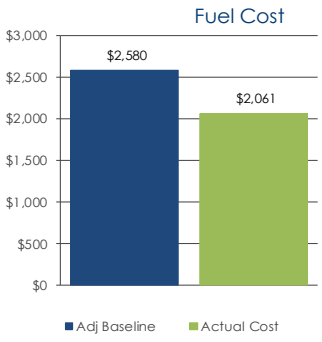


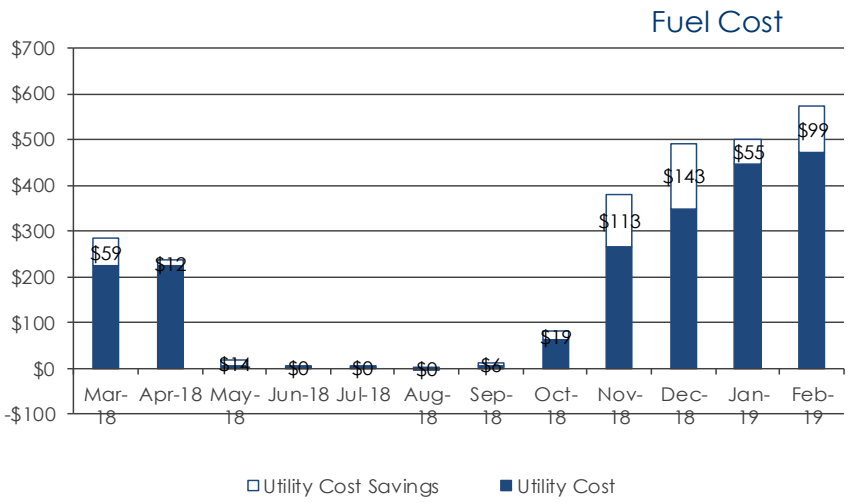
The following graphs illustrate the fuel performance for the Airport Terminal during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in fuel usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated fuel savings.





The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.

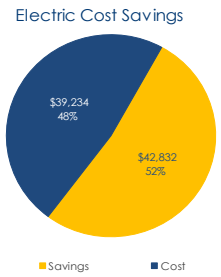


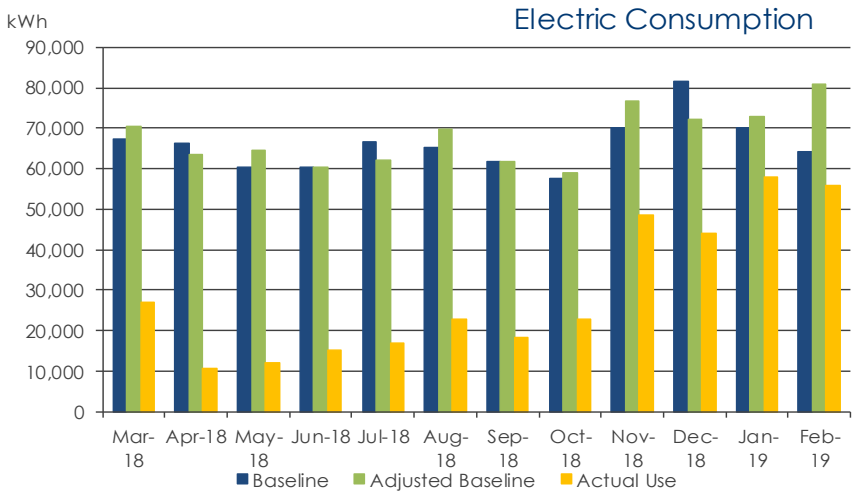


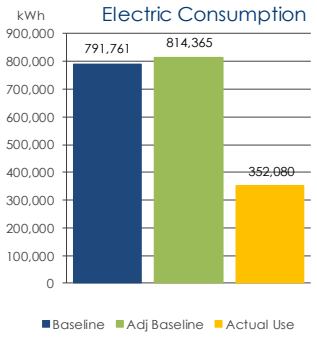
Facility Improvements:
* New gas furnaces,
* New internet-based thermostats

Fire/Med #5 Electrical Performance

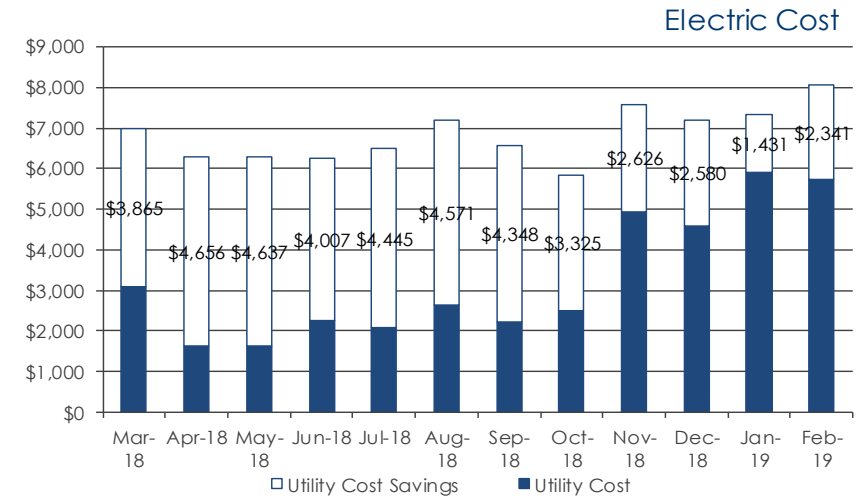
The following graphs illustrate the electrical performance for the Fire/Med #5 during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in electrical usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated electric savings.

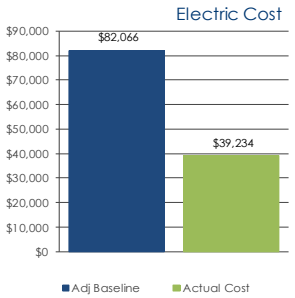






The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.

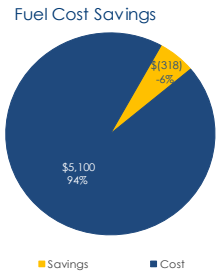




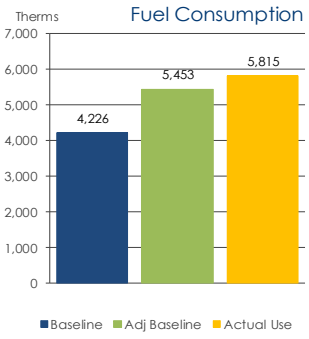
Facility Improvements:
* New 100 kW solar PV array,
* New DDC control system with updated sequences,
* LED lighting

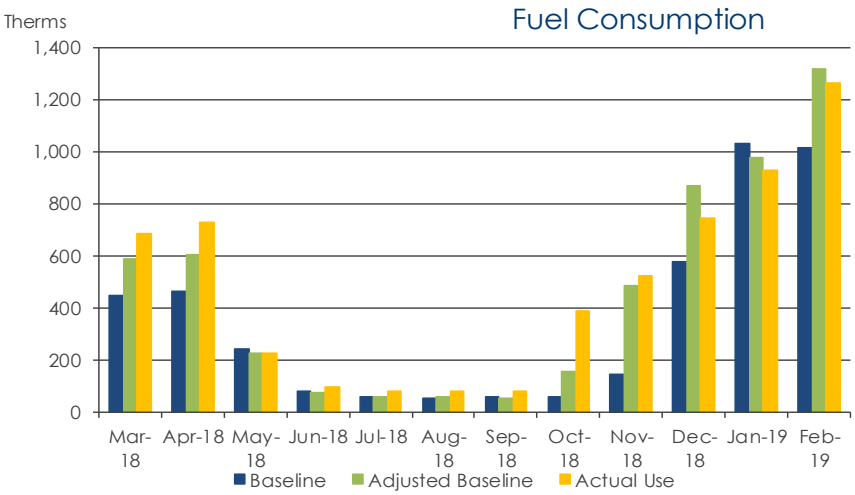
Bonus Improvements:
* Rebalance register airflows to improve comfort

Fire/Med #5 Fuel Performance

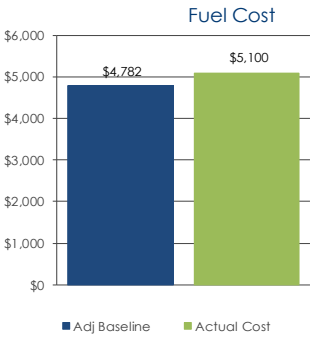


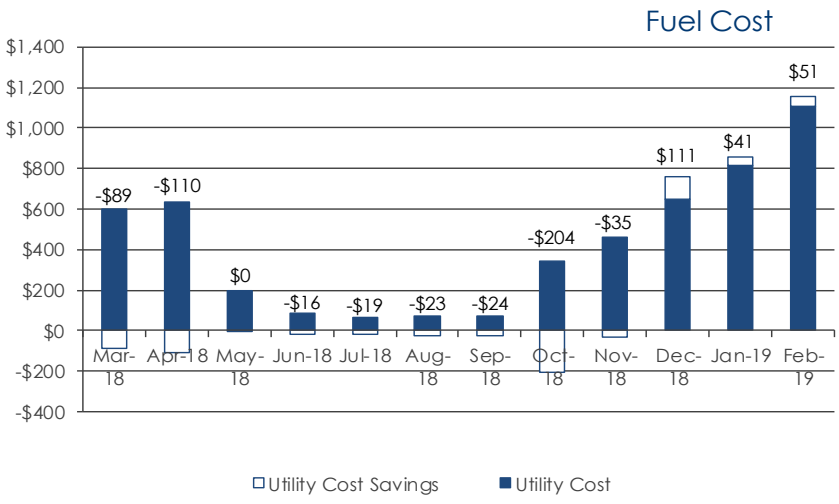
The following graphs illustrate the fuel performance for the Fire/Med #5 during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in fuel usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated fuel savings.





The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.



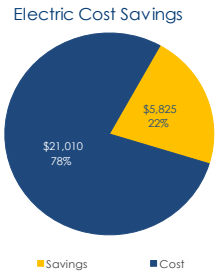


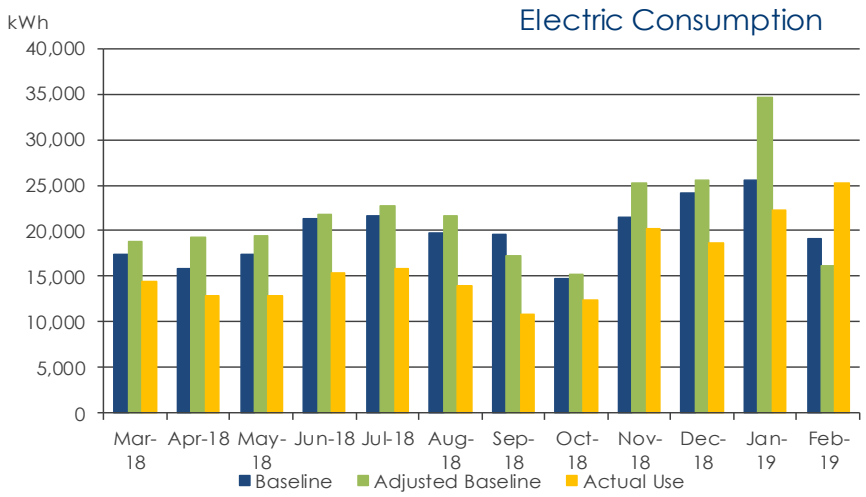
Facility Improvements:
* New DDC control system with updated sequences

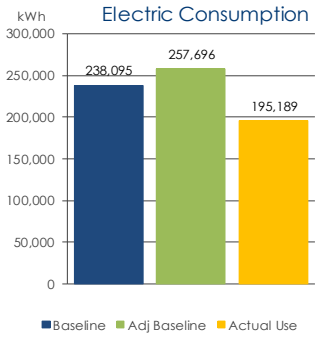
Bonus Improvements:
* Rebalance airflows to improve comfort

Fire/Med #4 Electrical Performance

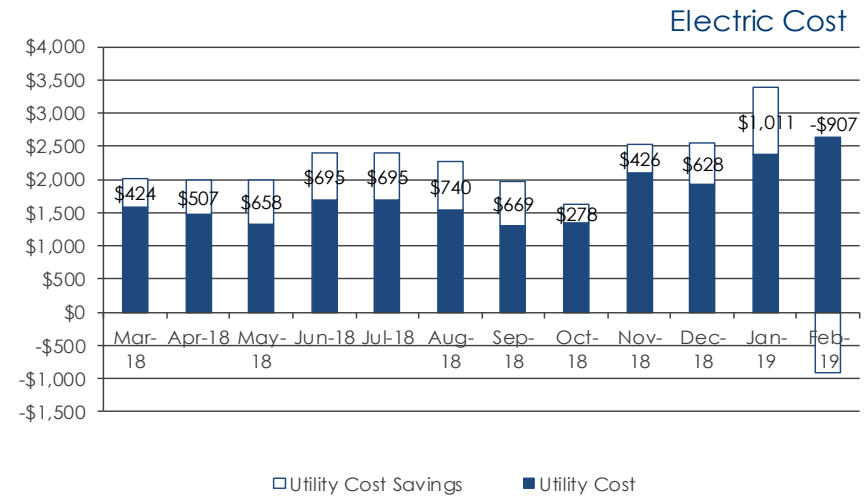
The following graphs illustrate the electrical performance for the Fire/Med #4 during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in electrical usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated electric savings.

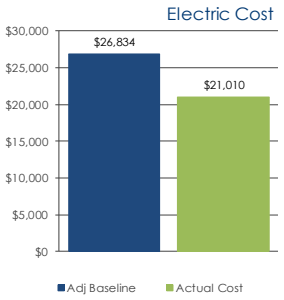






The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.

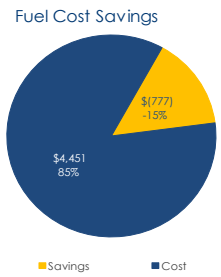




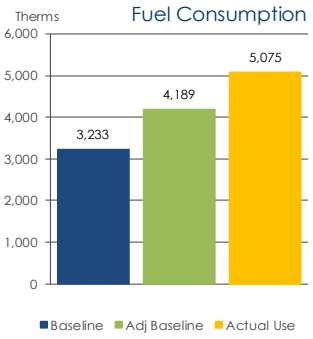
Facility Improvements:
* New DDC control system with updated sequences,
* LED lighting

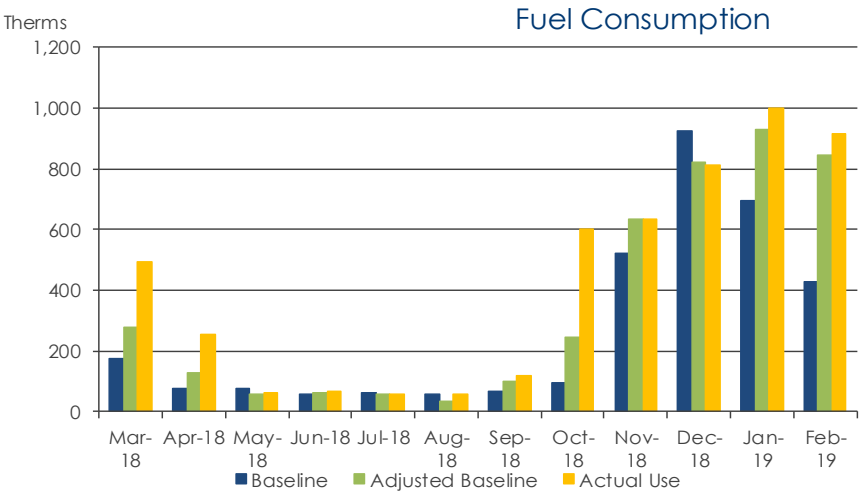
Bonus Improvements:
* Rebalance airflows to improve comfort

Fire/Med #4 Fuel Performance

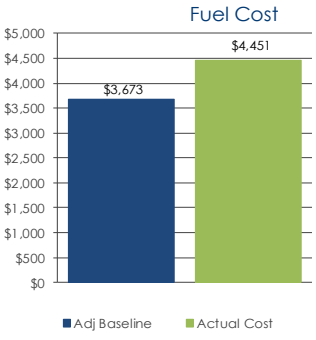


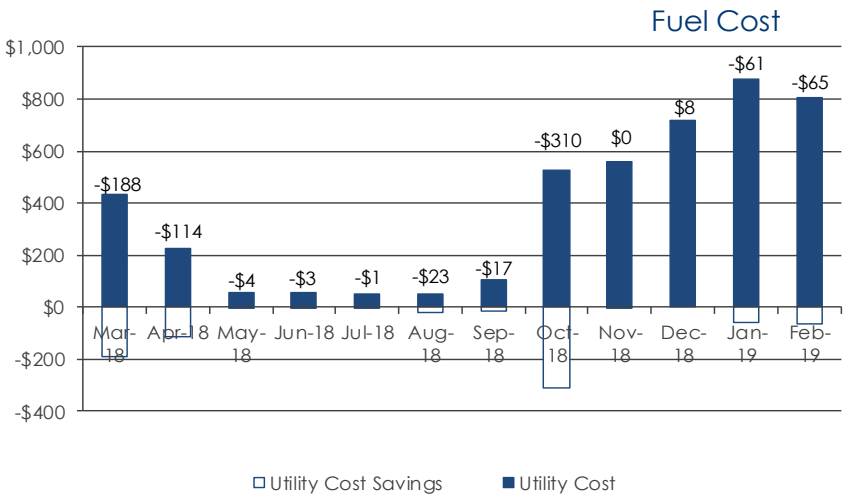
The following graphs illustrate the fuel performance for the Fire/Med #4 during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in fuel usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated fuel savings.





The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.



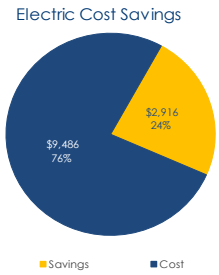


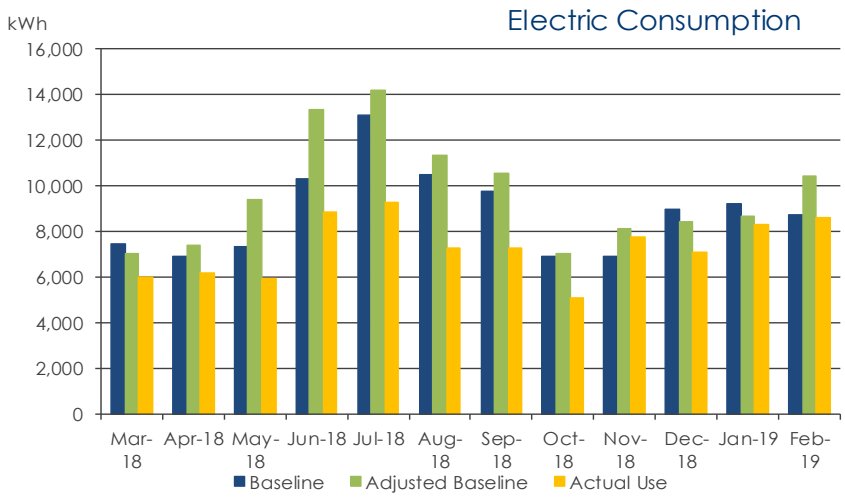
Facility Improvements:
* New DDC control system with updated sequences

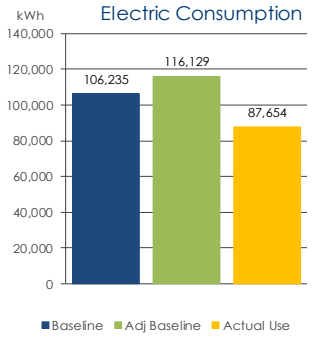
Bonus Improvements:
* Rebalance airflows to improve comfort

Fire/Med #3 Electrical Performance

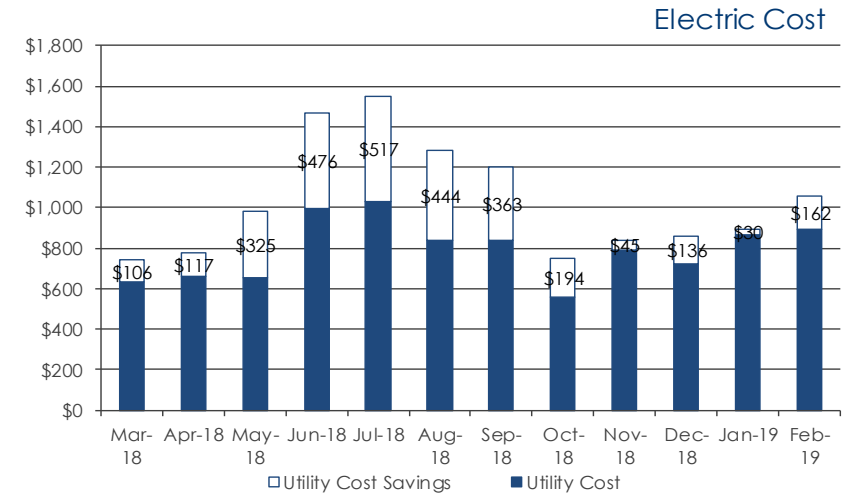
The following graphs illustrate the electrical performance for the Fire/Med #3 during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in electrical usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated electric savings.

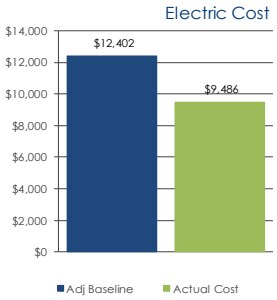






The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.

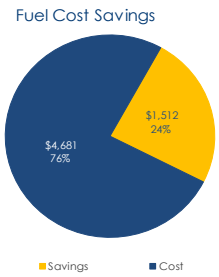




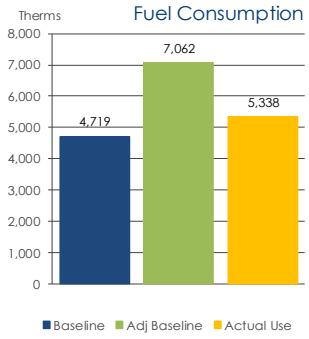
Facility Improvements:
* New packaged heating & cooling roof-top units,
* New DDC control system with updated sequences,
* New roof,
* LED lighting

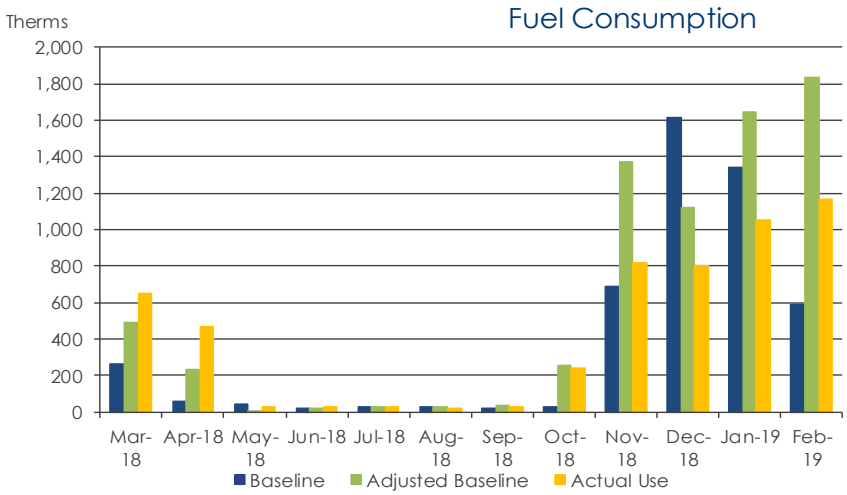
Bonus Improvements:
* Rebalance airflows to improve comfort

Fire/Med #3 Fuel Performance

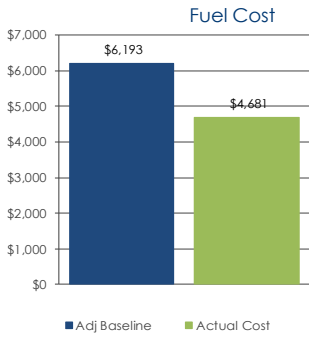


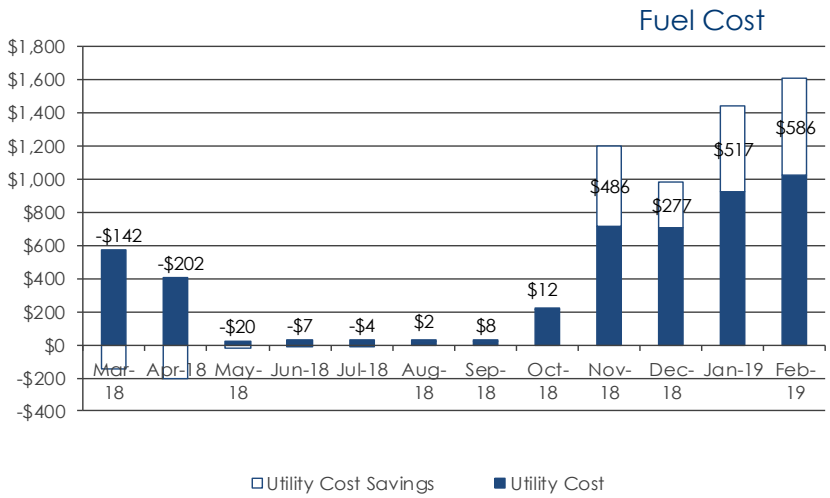
The following graphs illustrate the fuel performance for the Fire/Med #3 during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in fuel usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated fuel savings.





The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.



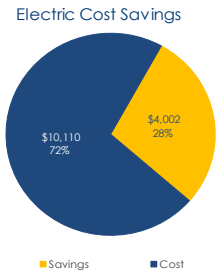


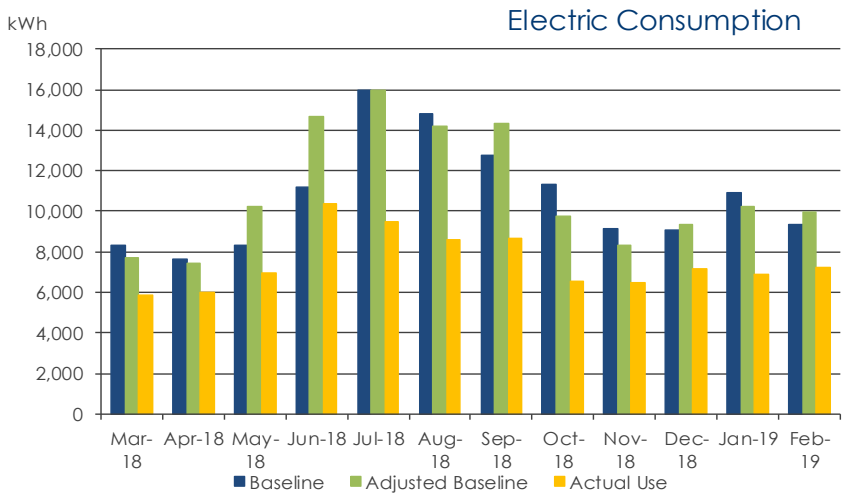
Facility Improvements:
* New packaged heating & cooling roof-top units,
* New DDC control system with updated sequences,
* New roof

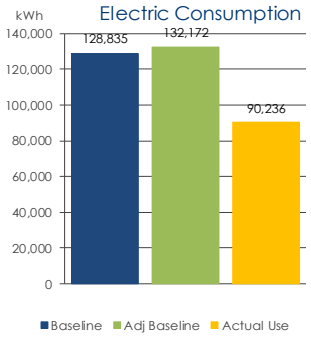
Bonus Improvements:
* Rebalance airflows to improve comfort

Fire/Med #2 Electrical Performance

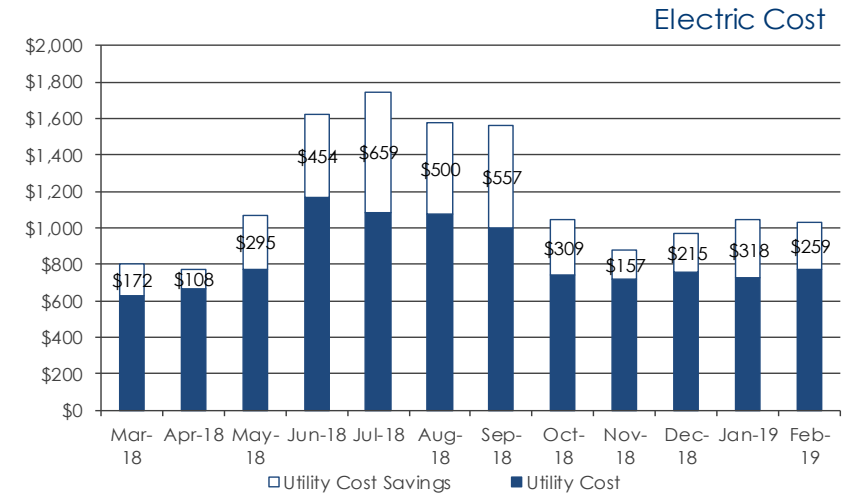
The following graphs illustrate the electrical performance for the Fire/Med #2 during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in electrical usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated electric savings.

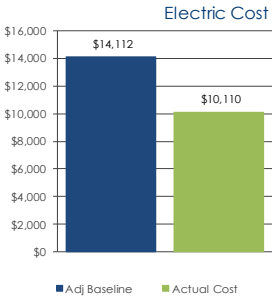






The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.

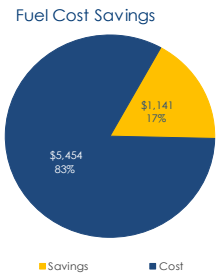




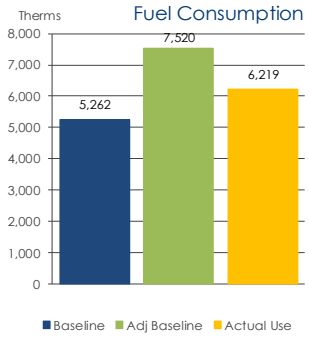
Facility Improvements:
* New packaged heating & cooling roof-top units,
* New internet-based thermostats,
* LED lighting

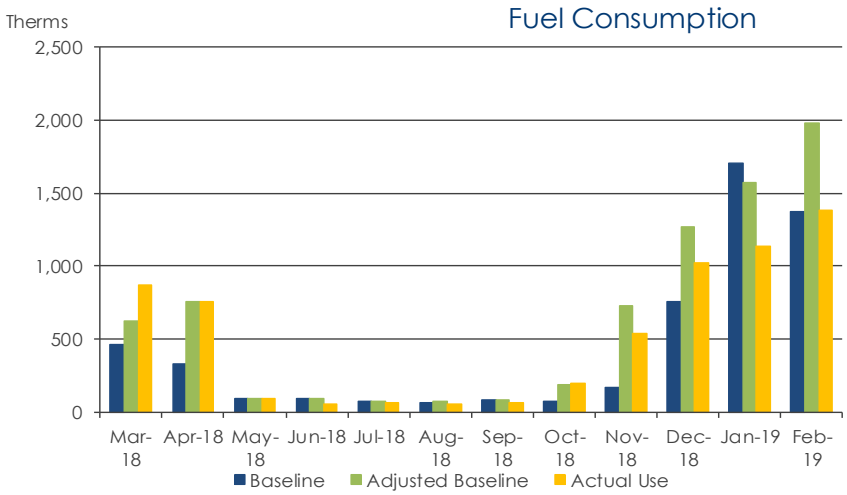
Bonus Improvements:
* Rebalance airflows to improve comfort

Fire/Med #2 Fuel Performance

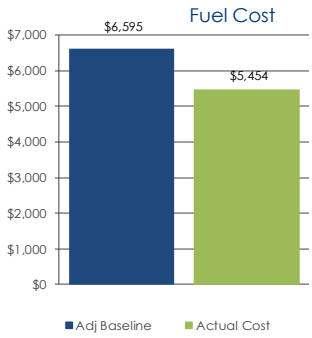


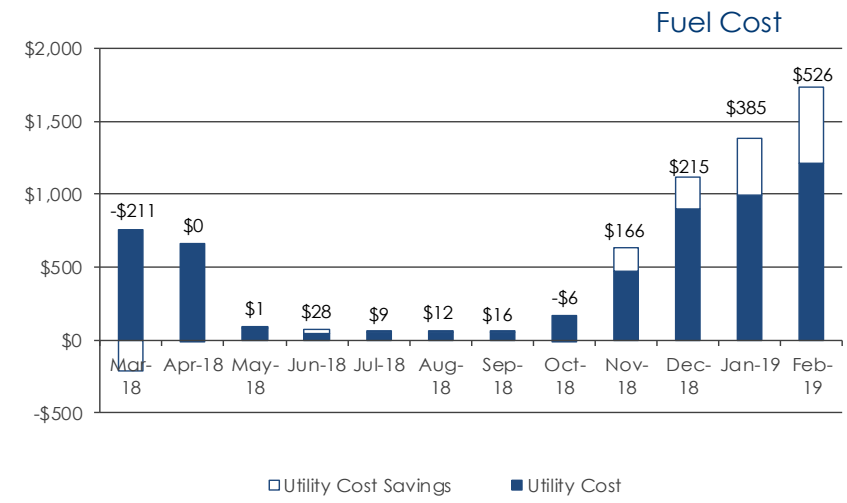
The following graphs illustrate the fuel performance for the Fire/Med #2 during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in fuel usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated fuel savings.





The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.



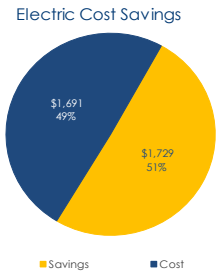


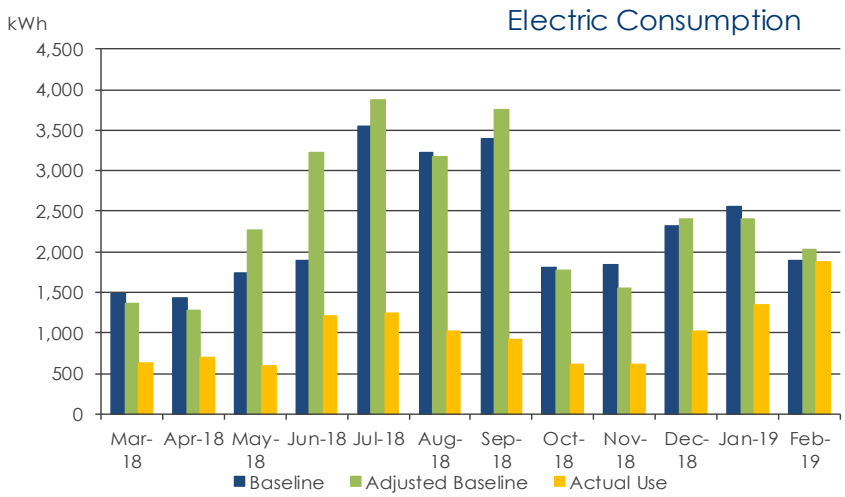
Facility Improvements:
* New packaged heating & cooling roof-top units,
* New internet-based thermostats

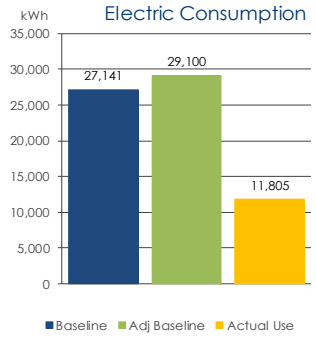
Bonus Improvements:
* Rebalance airflows to improve comfort

Fire and Rescue Training Electrical Performance

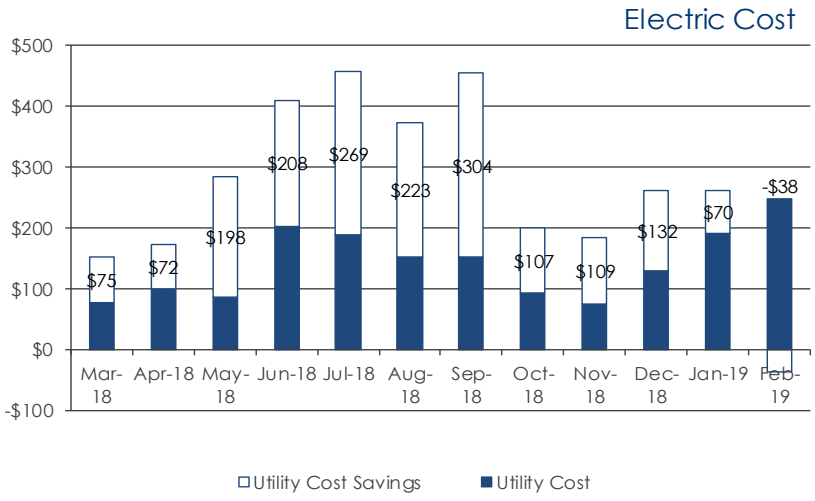
The following graphs illustrate the electrical performance for the Fire and Rescue Training during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in electrical usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated electric savings.

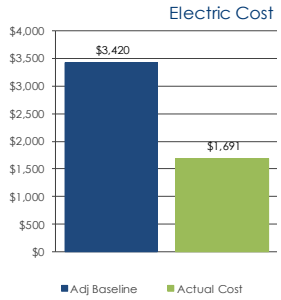






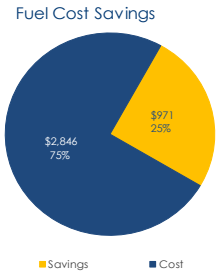
The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.



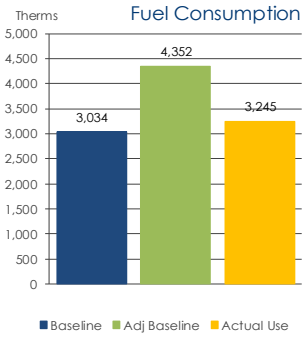


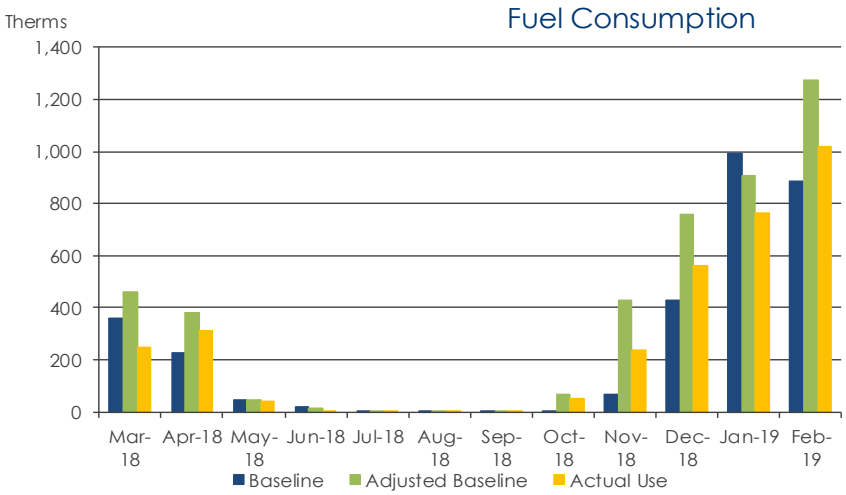
Facility Improvements:
* New internet-based thermostats
* LED lighting

Fire and Rescue Training Fuel Performance

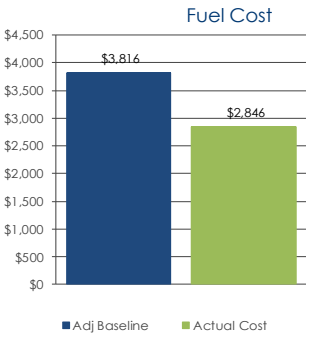


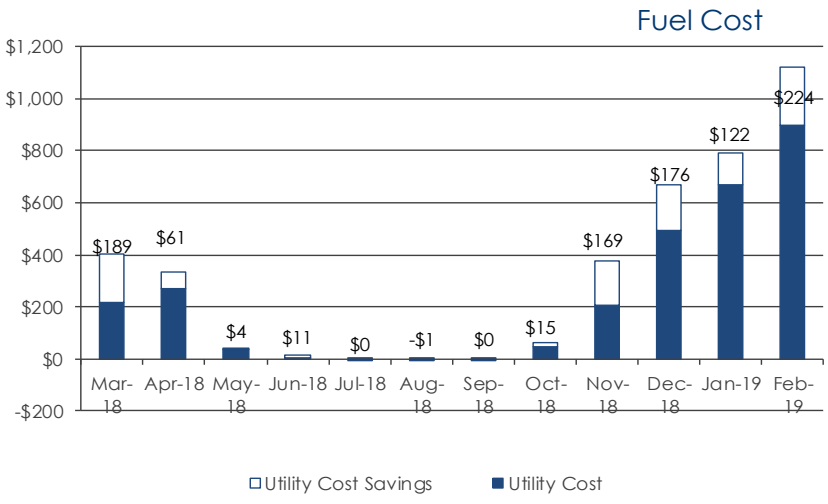
The following graphs illustrate the fuel performance for the Fire and Rescue Training during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in fuel usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated fuel savings.





The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.

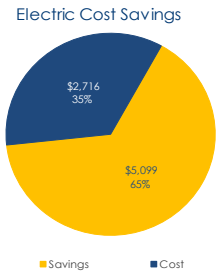


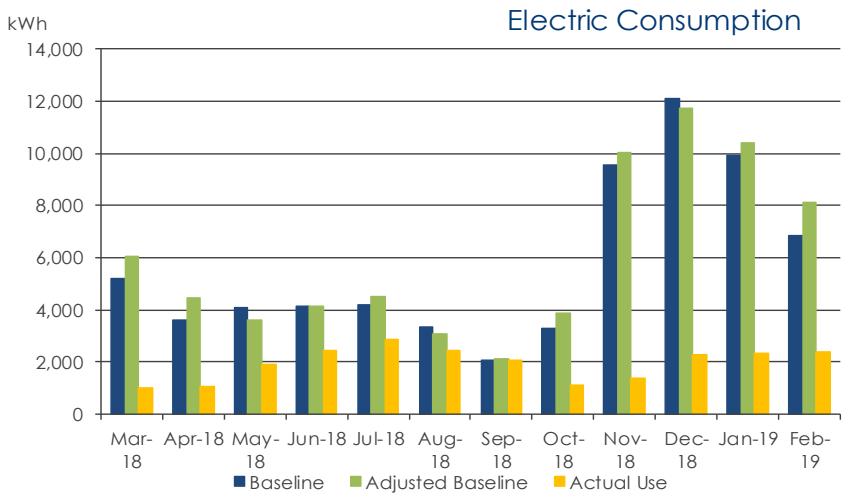


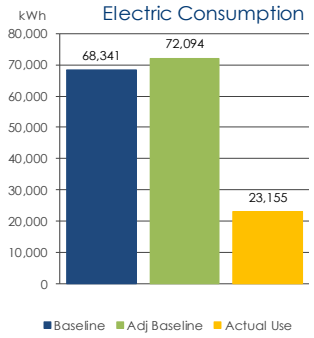
Facility Improvements:
* New internet-based thermostats

Parking/Animal Control/Transit Electrical Performance

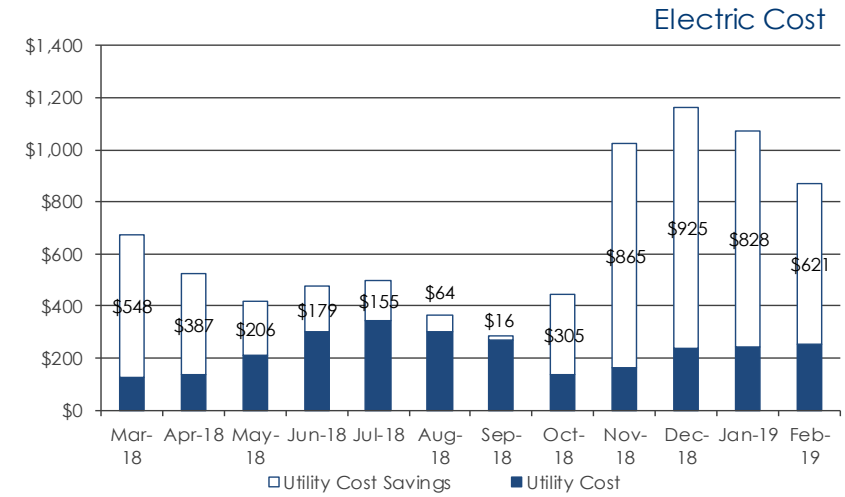
The following graphs illustrate the electrical performance for the Parking/Animal Control/Transit during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in electrical usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated electric savings.

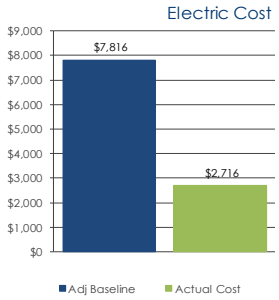






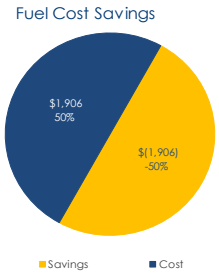
The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.



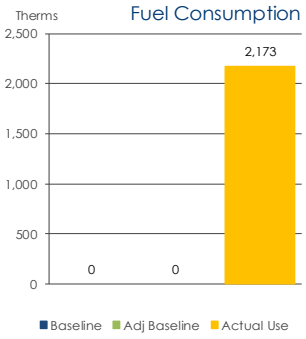


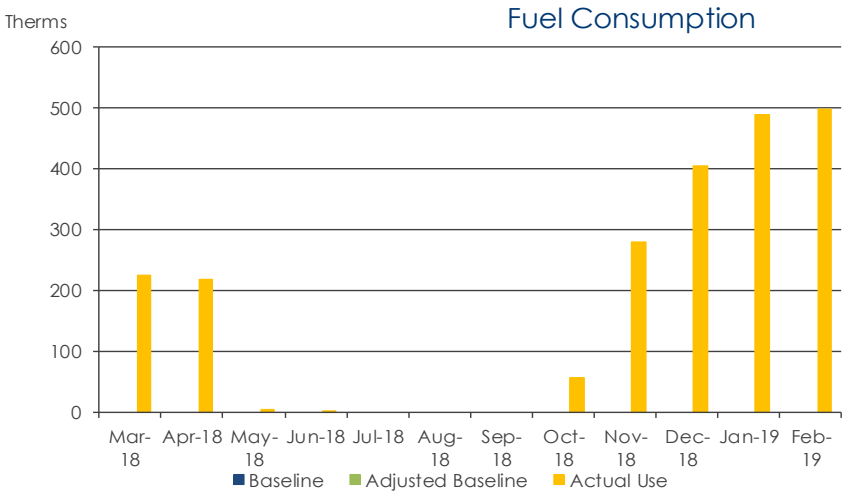
Facility Improvements:
* New packaged heating & cooling units (replaced electric heat with gas heat),
* New internet-based thermostats,
* LED lighting

Parking/Animal Control/Transit Fuel Performance

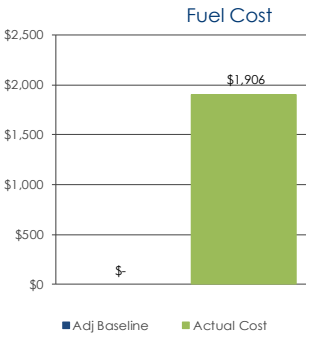


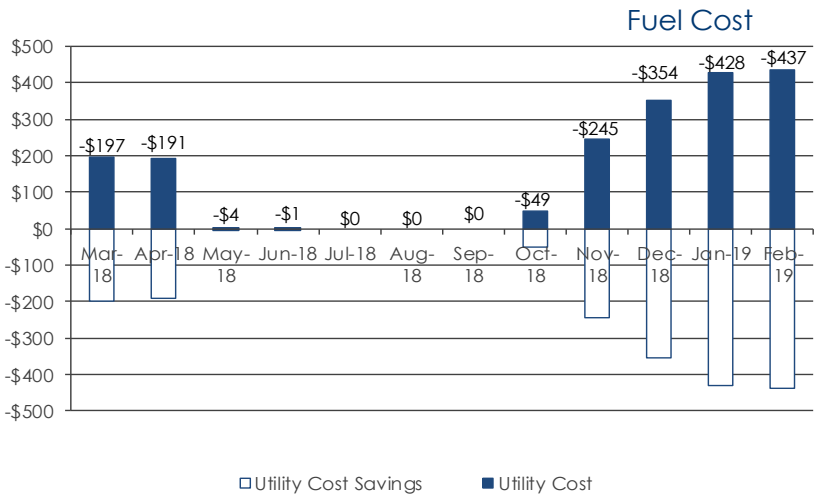
The following graphs illustrate the fuel performance for the Parking/Animal Control/Transit during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in fuel usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated fuel savings.





The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.

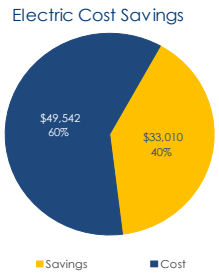


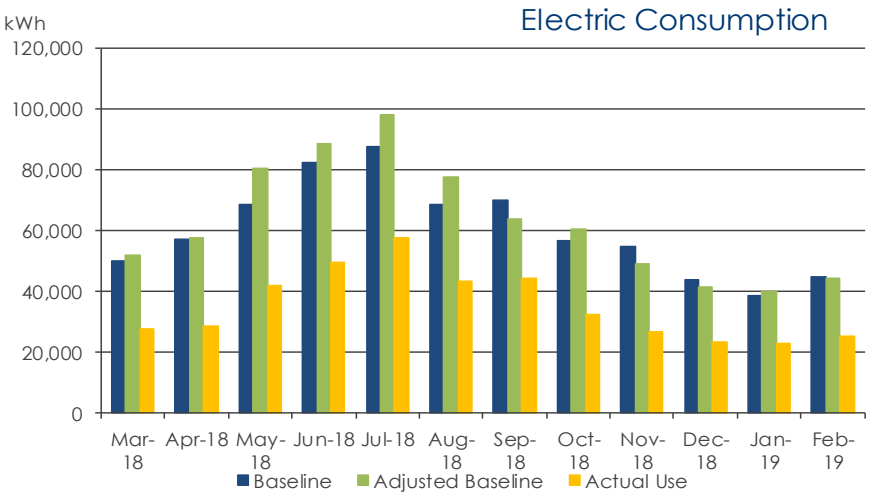


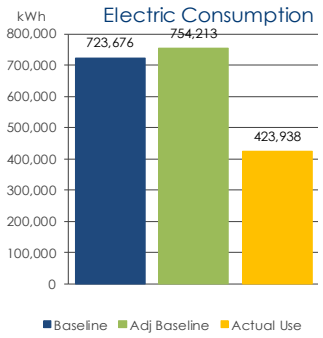
Facility Improvements:
* New packaged heating & cooling units (replaced electric heat with gas heat),
* New internet-based thermostats

Lawrence Arts Center Electrical Performance

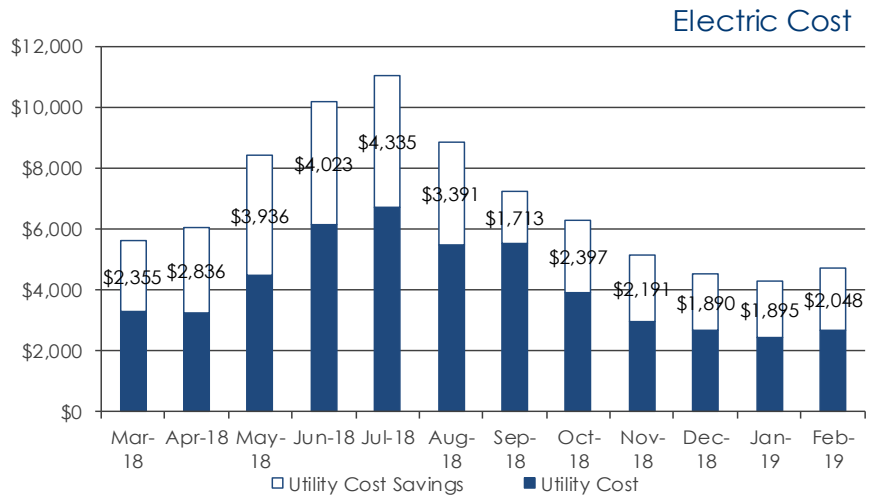
The following graphs illustrate the electrical performance for the Lawrence Arts Center during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in electrical usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated electric savings.

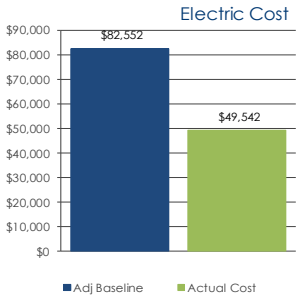






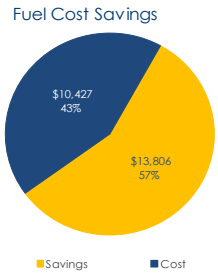
The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.



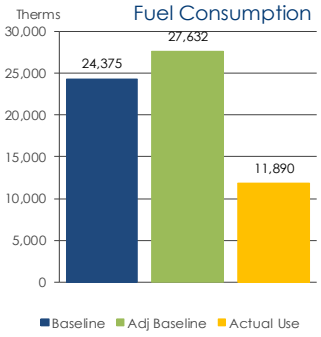


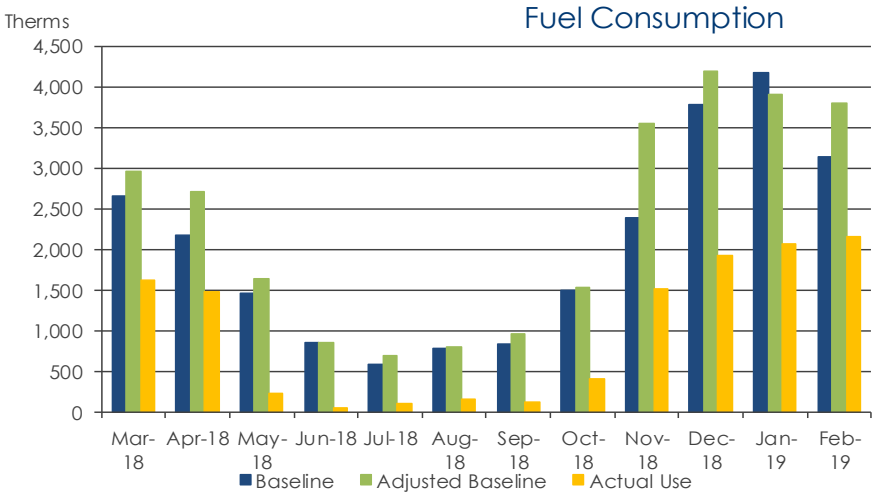
Facility Improvements:
* New air-cooled chiller,
* New DDC control system with updated sequences,
* LED lighting (except theatre performance lights)

Lawrence Arts Center Fuel Performance

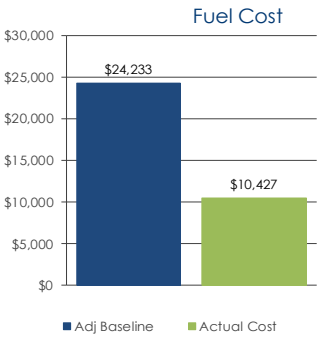


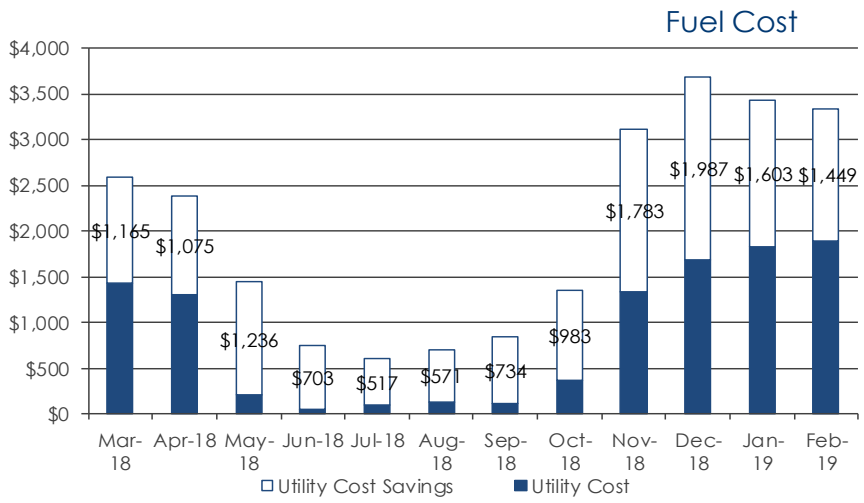
The following graphs illustrate the fuel performance for the Lawrence Arts Center during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in fuel usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated fuel savings.





The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.

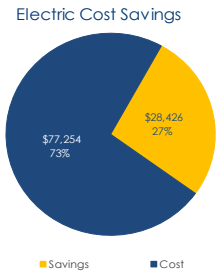


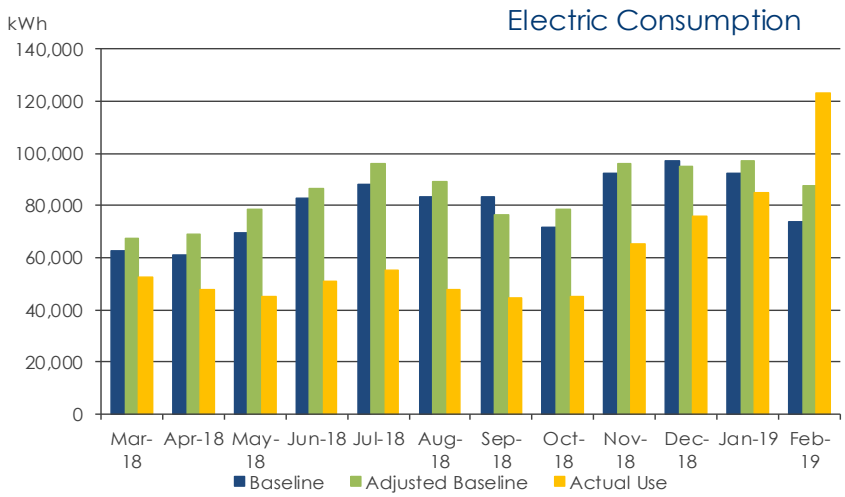


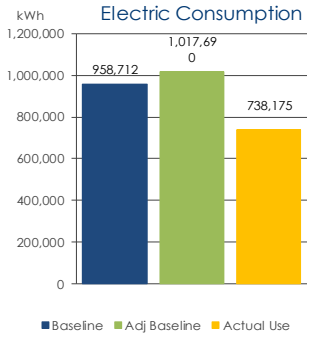
Facility Improvements:
* New DDC controls with updated sequences

City Hall Electrical Performance

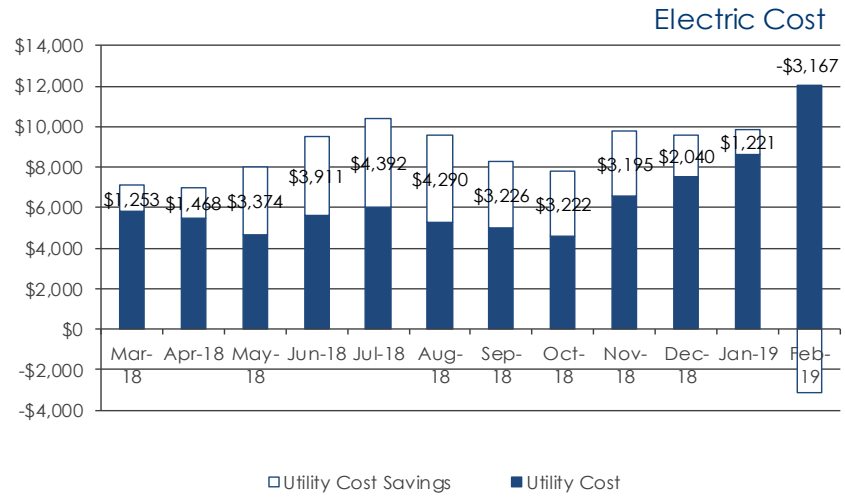
The following graphs illustrate the electrical performance for the City Hall during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in electrical usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated electric savings.

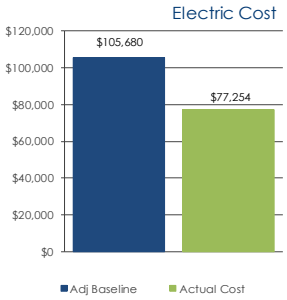






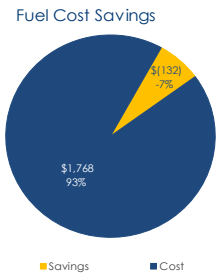
The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.



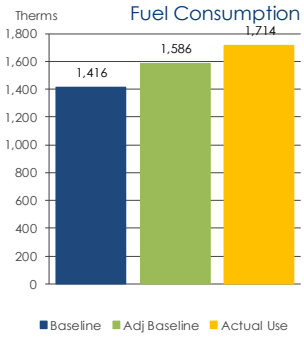


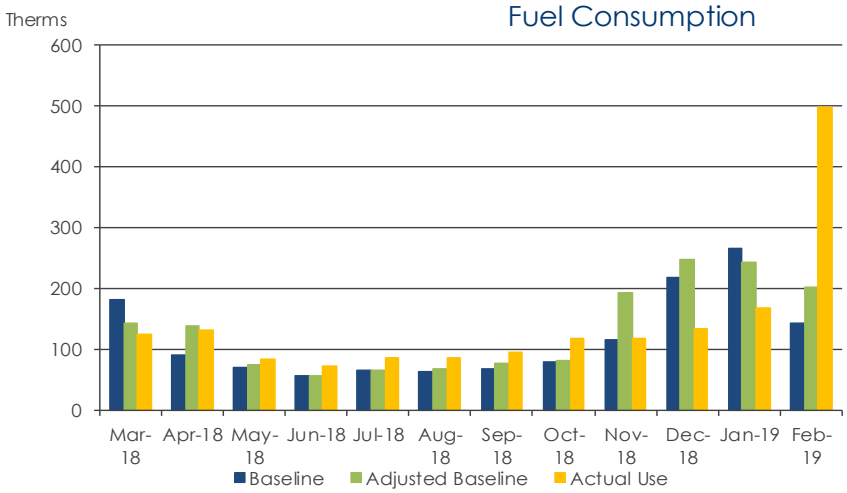
Facility Improvements:
* New supplemental electric heating in entries,
* Updated control sequences,
* New windows,
* LED lighting

City Hall Fuel Performance

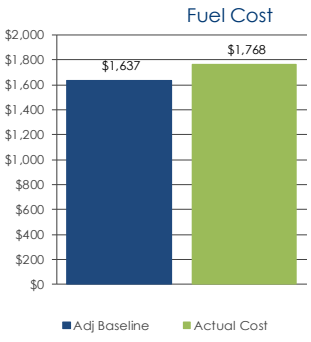


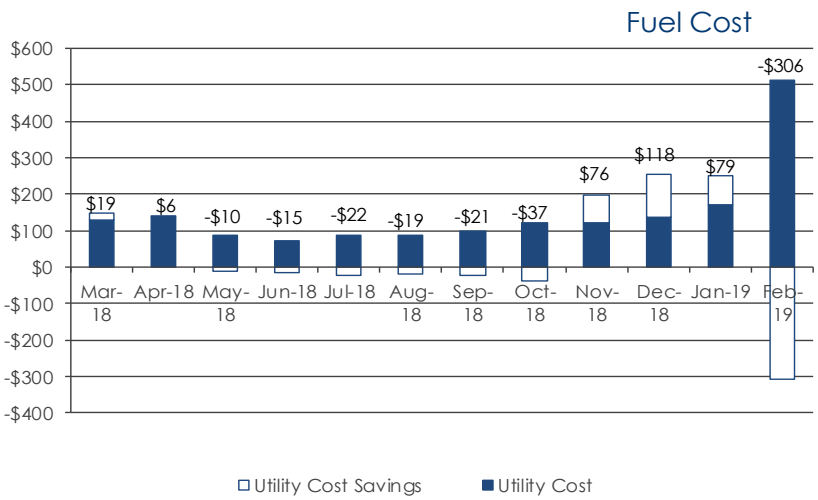
The following graphs illustrate the fuel performance for the City Hall during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in fuel usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated fuel savings.





The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.

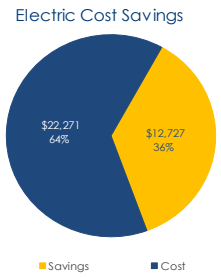


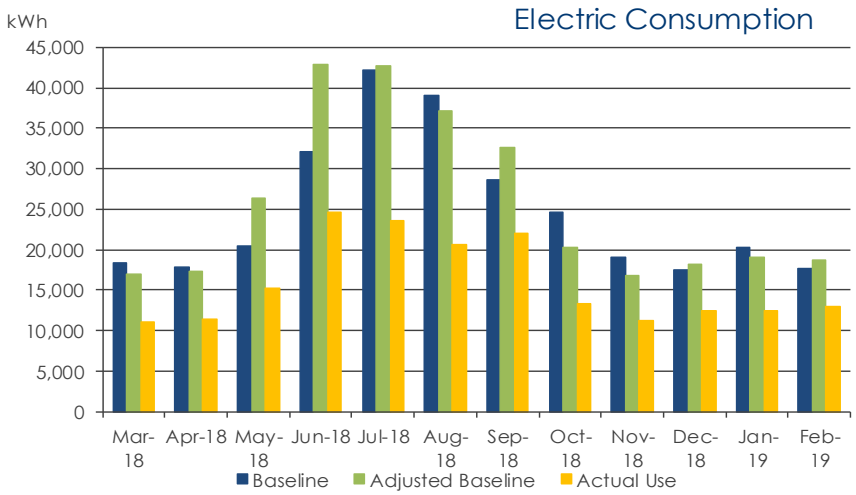


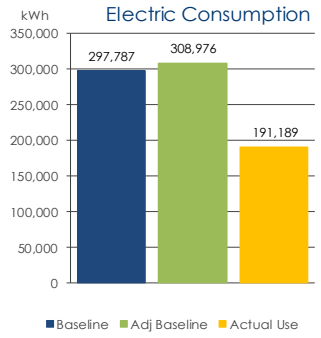
Facility Improvements:
* New supplemental electric heating in entries,
* Updated control sequences,
* New windows

East Lawrence Rec Center Electrical Performance

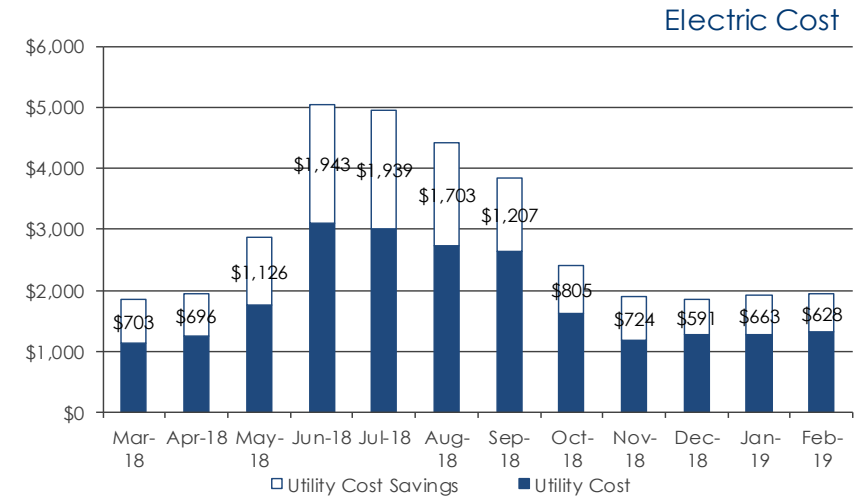
The following graphs illustrate the electrical performance for the East Lawrence Rec Center during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in electrical usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated electric savings.

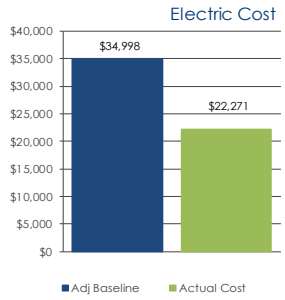






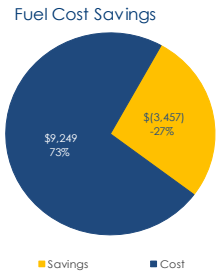
The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.



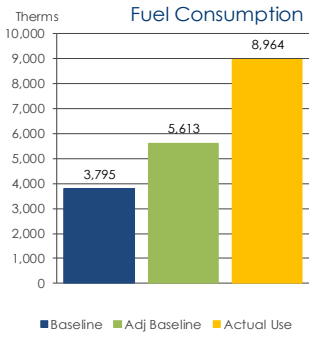


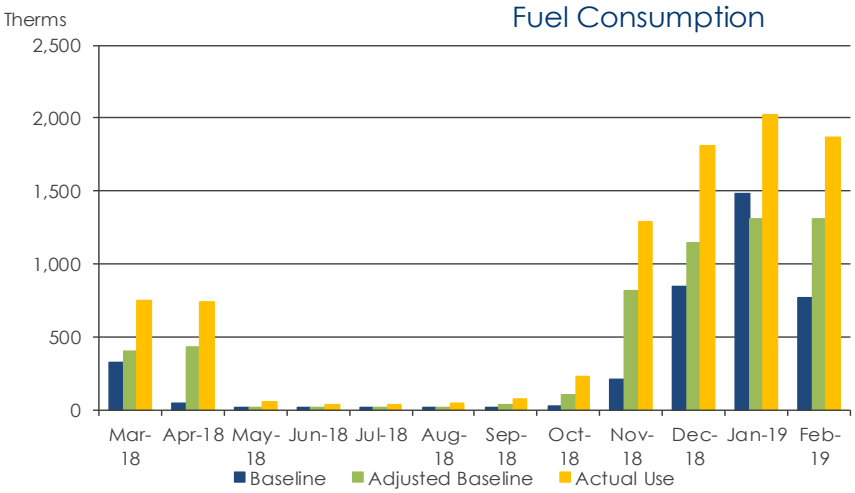
Facility Improvements:
* New packaged heating & cooling rooftop units (except W. side)
* Updated control sequences,
* LED lighting

East Lawrence Rec Center Fuel Performance

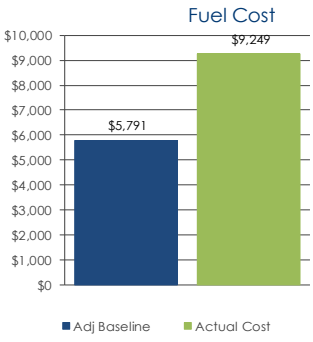


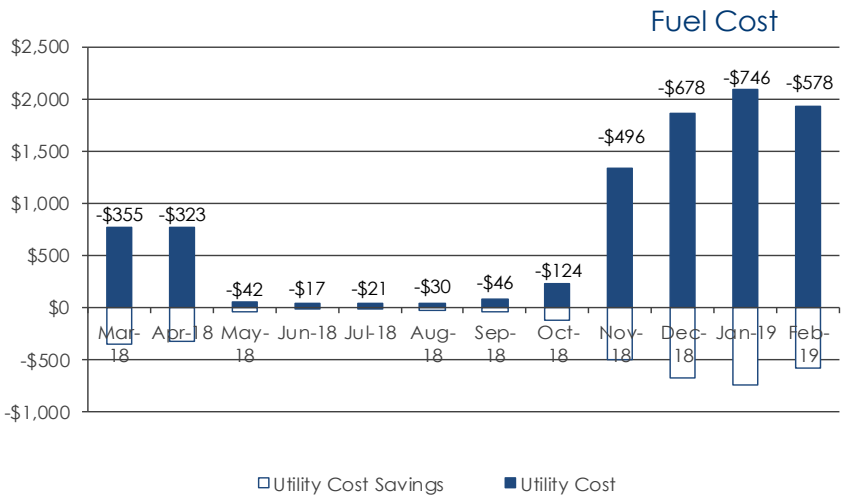
The following graphs illustrate the fuel performance for the East Lawrence Rec Center during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in fuel usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated fuel savings.





The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.

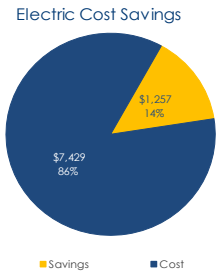


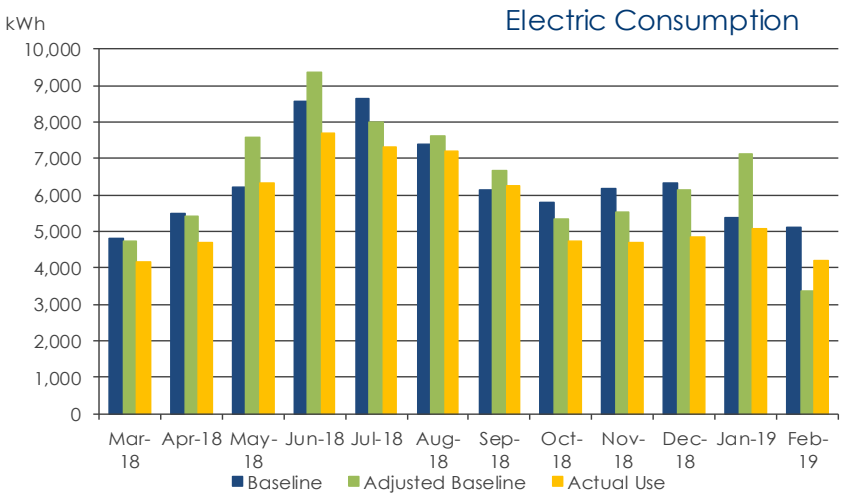


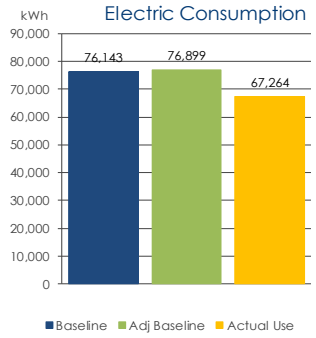
Facility Improvements:
* New packaged heating & cooling rooftop units (except W. side)
* Updated control sequences

Prairie Park Nature Center Electrical Performance

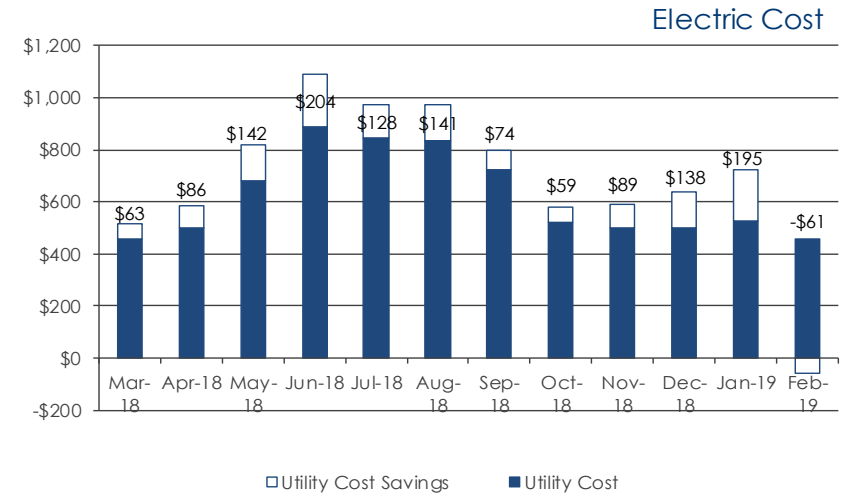
The following graphs illustrate the electrical performance for the Prairie Park Nature Center during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in electrical usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated electric savings.

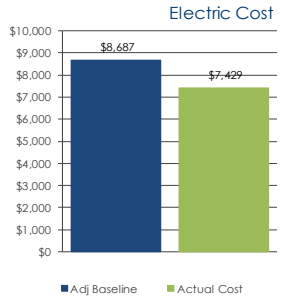






The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.

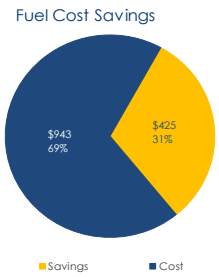




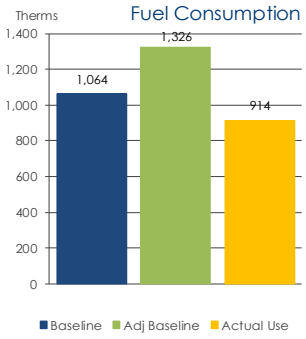
Facility Improvements:
* New AC split systems,
* New ventilation system,
* New DDC control system with updated sequences,
* LED lighting

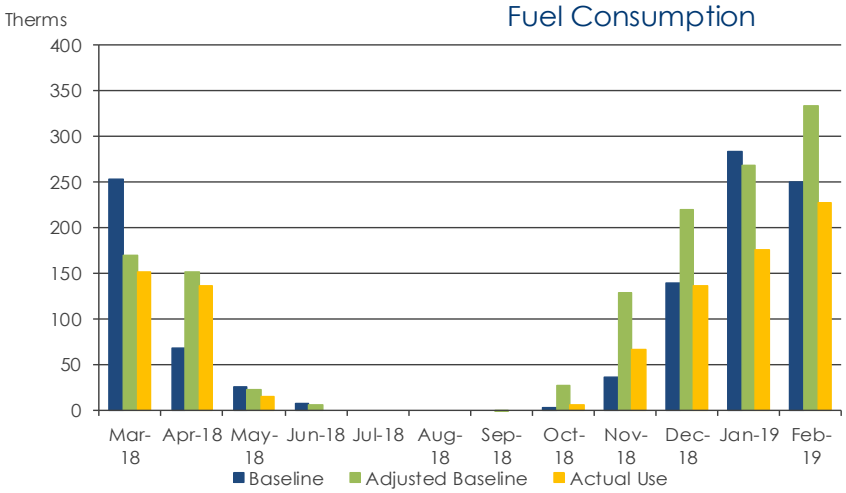
Bonus Improvements:
* New bipolar ionization cleaner on 3 split systems.

Prairie Park Nature Center Fuel Performance

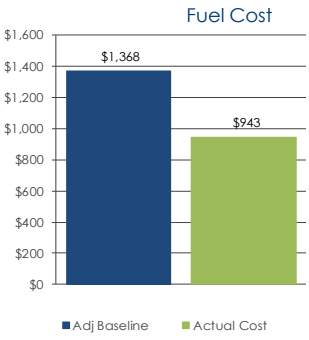


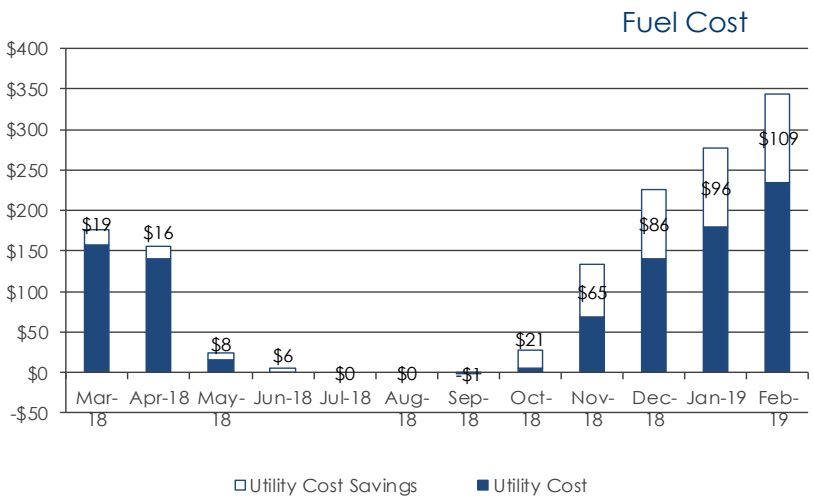
The following graphs illustrate the fuel performance for the Prairie Park Nature Center during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in fuel usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated fuel savings.





The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.



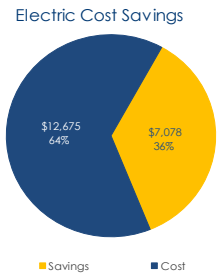


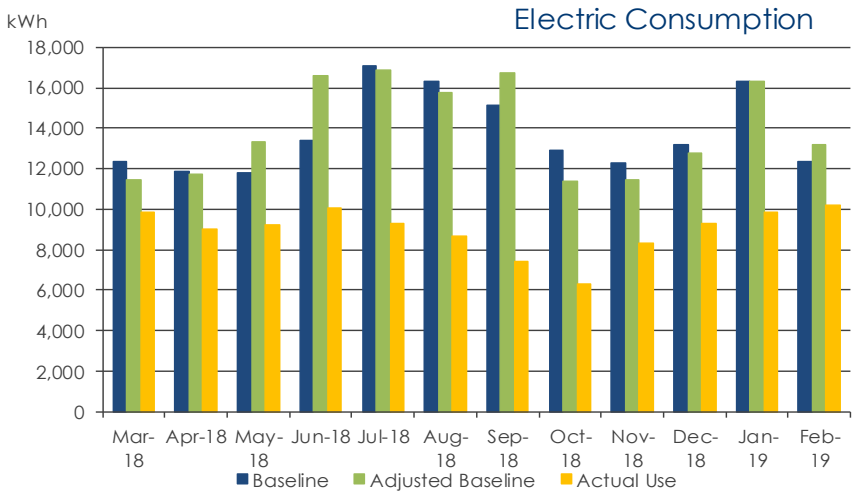
Facility Improvements:
* New gas furnaces,
* New ventilation system,
* New DDC control system with updated sequences

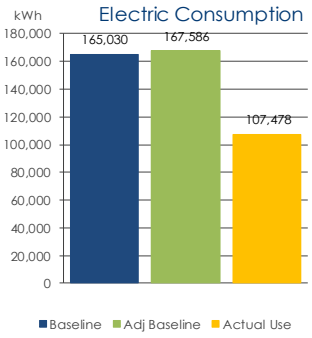
Bonus Improvements:
* New bipolar ionization cleaner on 3 furnaces.

Vehicle Maintenance Garage Electrical Performance

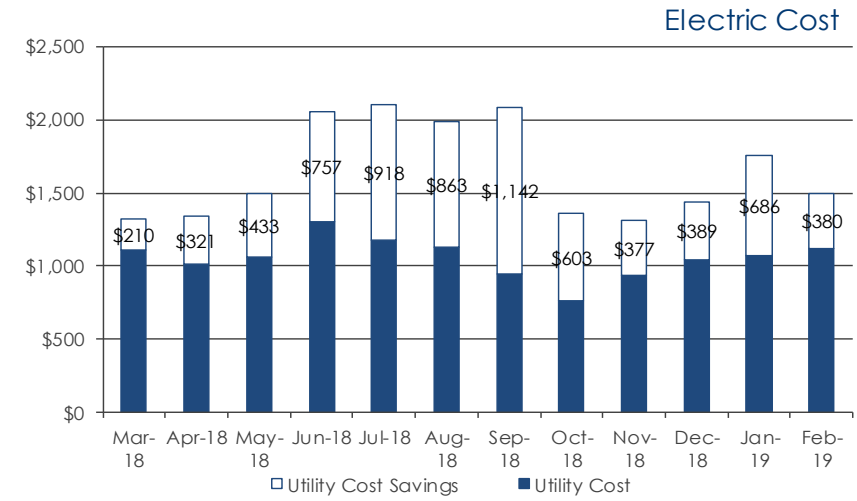
The following graphs illustrate the electrical performance for the Vehicle Maintenance Garage during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in electrical usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated electric savings.

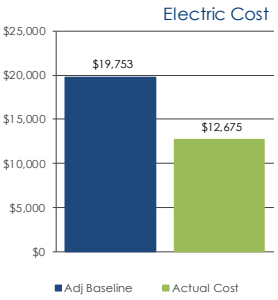






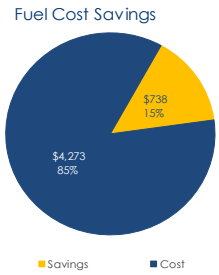
The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.



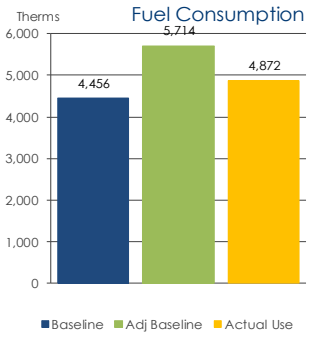


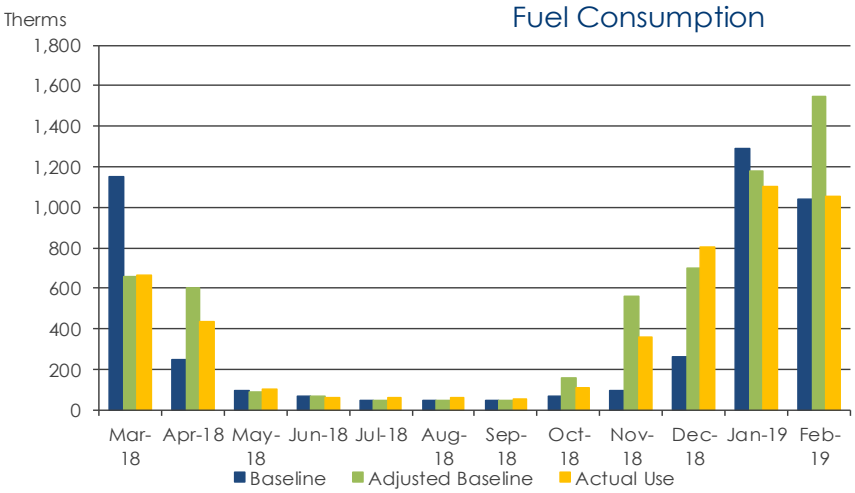
Facility Improvements:
* New AC ductless mini-split for Server Room,
* Internet-based thermostats,
* LED lighting

Vehicle Maintenance Garage Fuel Performance

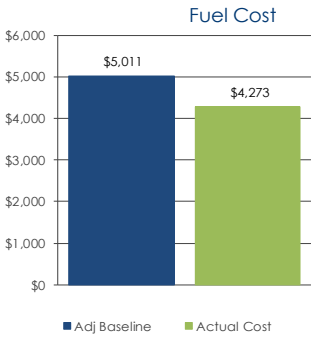


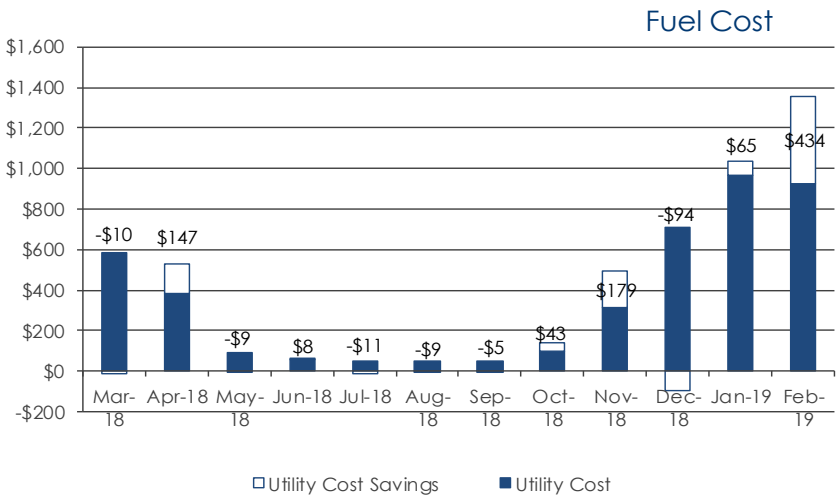
The following graphs illustrate the fuel performance for the Vehicle Maintenance Garage during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in fuel usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated fuel savings.





The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.

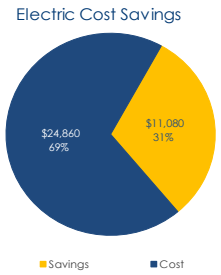


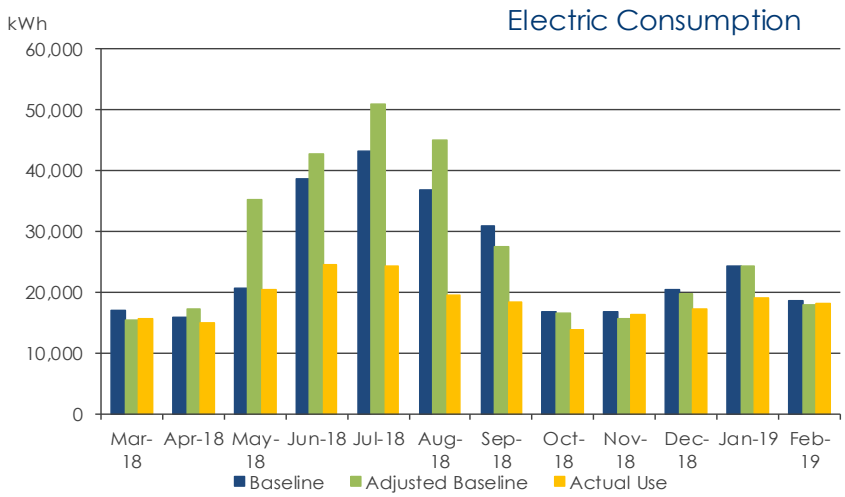


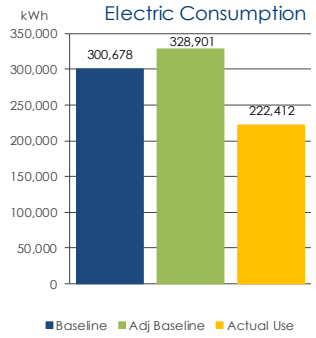
Facility Improvements:
* Internet-based thermostats

Community Building Electrical Performance

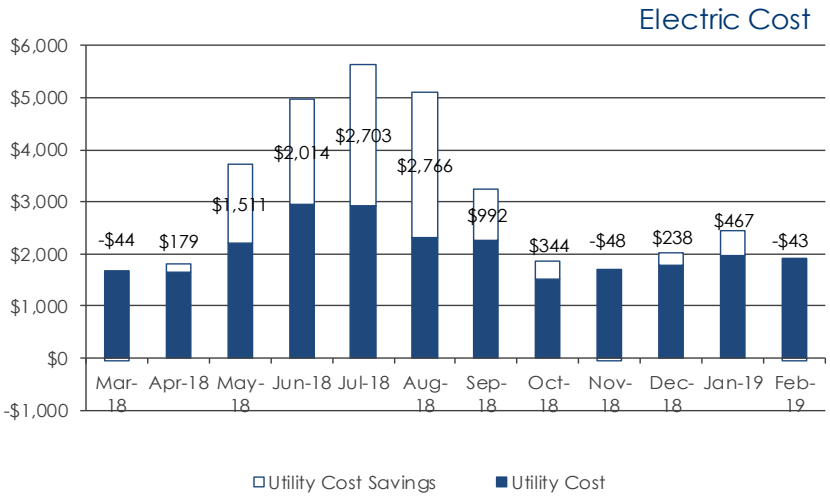
The following graphs illustrate the electrical performance for the Community Building during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in electrical usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated electric savings.

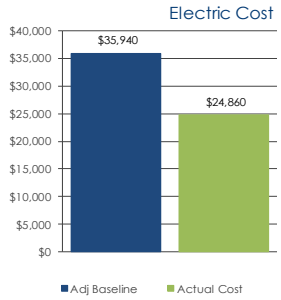






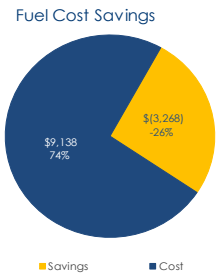
The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.



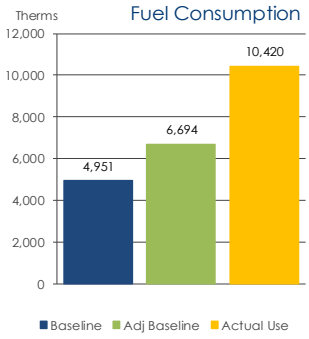


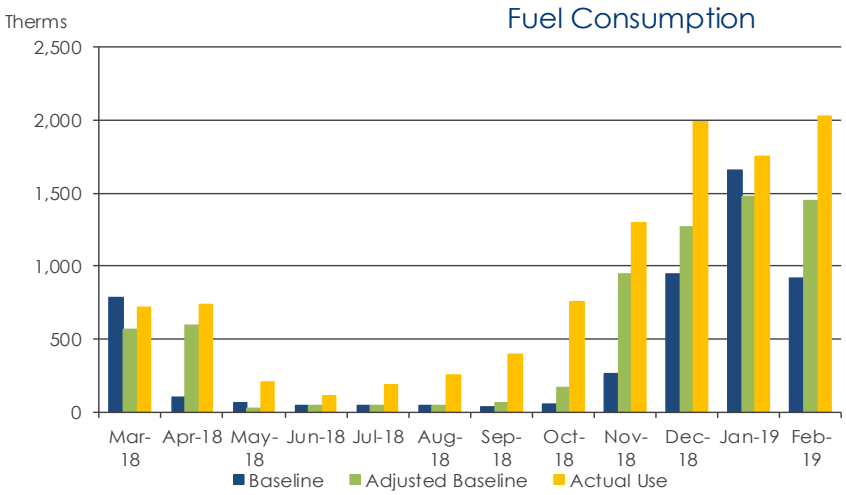
Facility Improvements:
* New packaged heating & cooling rooftop units (except RTU-11),
* Updated control sequences,
* New roof
* LED lighting

Community Building Fuel Performance

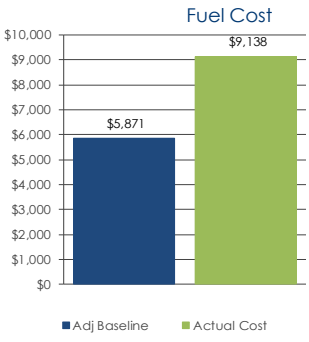


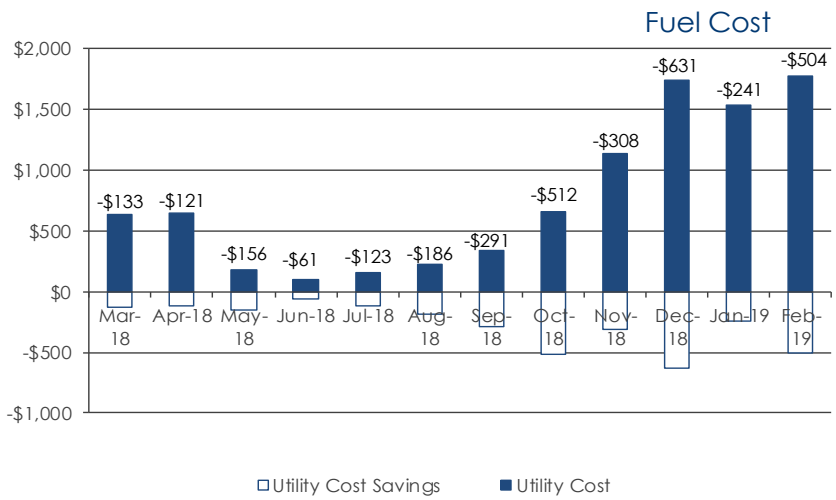
The following graphs illustrate the fuel performance for the Community Building during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in fuel usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated fuel savings.





The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.

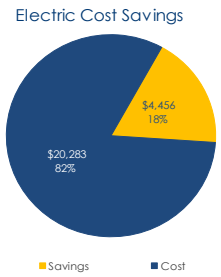


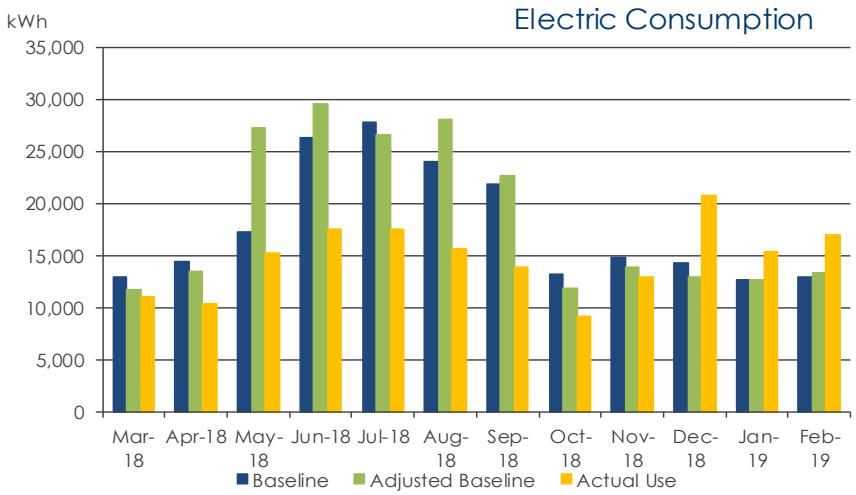


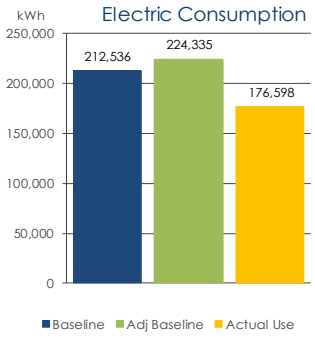
Facility Improvements:
* New packaged heating & cooling rooftop units (except RTU-11),
* Updated control sequences
* New roof

Holcom Park Rec Center Electrical Performance

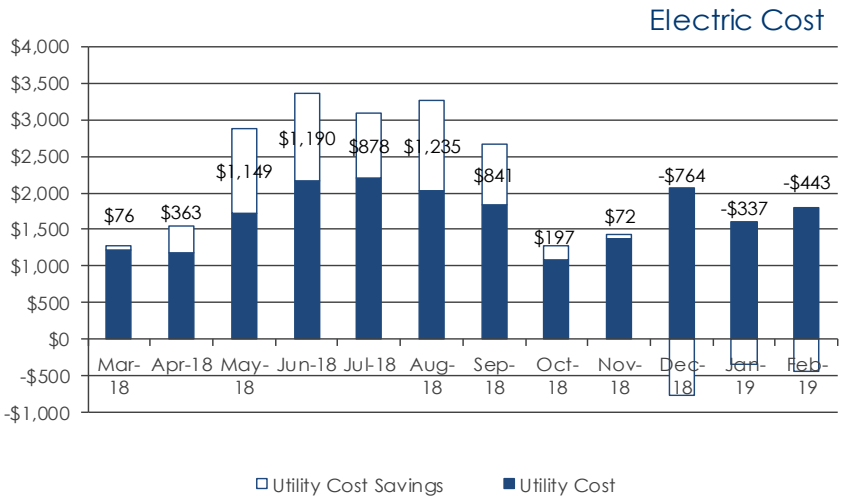
The following graphs illustrate the electrical performance for the Holcom Park Rec Center during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in electrical usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated electric savings.

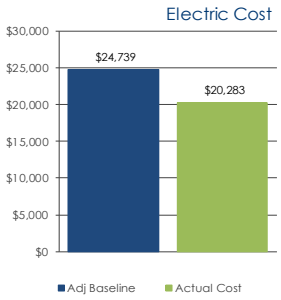






The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.

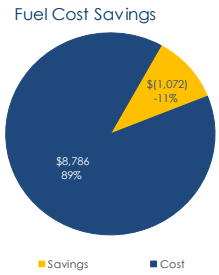




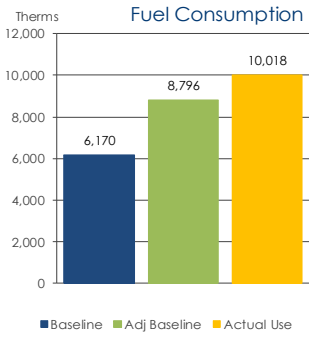
Facility Improvements:
* New packaged heating & cooling rooftop units for Gym,
* New gas duct heaters for air handlers (remove hydronic heating),
* Updated control sequences,
* LED lighting

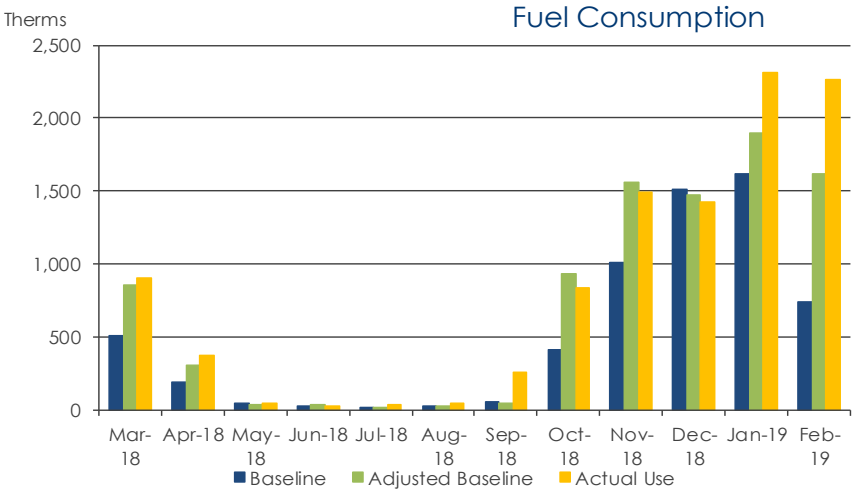
Bonus Improvements:
* Rebalance airflows to improve comfort

Holcom Park Rec Center Fuel Performance

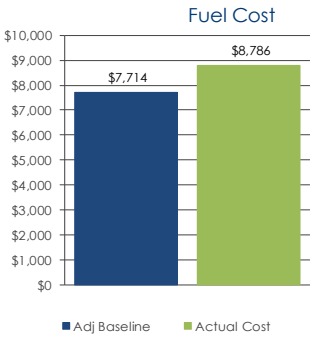


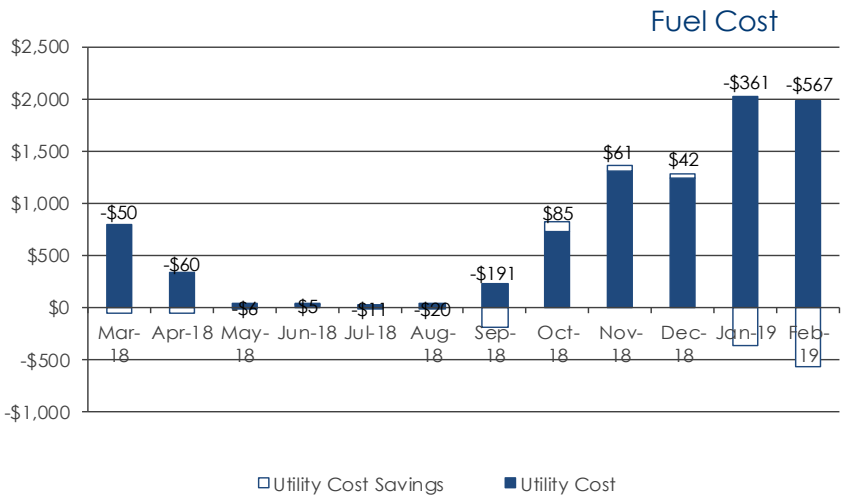
The following graphs illustrate the fuel performance for the Holcom Park Rec Center during the measurement and verification period. The first graph below illustrates the weather adjustments and savings that occurred in fuel usage. The blue bar represents the baseline, the green bar represents the adjustments made to the baseline based on actual weather, and the yellow bar is the current usage. The difference between the blue and green bars is the savings (or loss) due to weather effects, and the difference between the green and yellow bars is the calculated fuel savings.





The graph below illustrates the monthly cost savings achieved through the project. The white bar represents savings, and the blue bar represents the new monthly costs.





Facility Improvements:
* New packaged heating & cooling rooftop units for Gym,
* New gas duct heaters for air handlers (remove hydronics),
* Updated control sequences

Bonus Improvements:
* Retro-commission to improve comfort

Appendix

Overall Project Performance Summary

The cumulative energy savings performance across the Lawrence city-wide energy conservation project met the project savings guarantee, exceeding net expected savings by $3,845 in the first year of Measurement and Verification. While this is a successful overall project result, some individual buildings performed better than individual facility model estimates, and some buildings performed worse than initial model estimates. Ultimately, more City of Lawrence buildings exceeded energy savings expectations, which offset poorer performing buildings.

Willdan recognizes that despite the overall project success, individual building performance issues can create a utility budgeting challenge, specifically for the poorer performing Indoor Aquatic Center (IAC). Willdan is committed to working with the City of Lawrence to help the City understand why this building did not perform as expected, as well as identify areas for improved function and reporting related to energy savings.

Indoor Aquatic Center – Building Performance

The Indoor Aquatic Center has not performed as well as expected during the Measurement and Verification period. As shown in previous sections of this report, both gas and electric savings are lower than predicted. Several issues contributed to this outcome, including project components that were not fully executed. A brief description of each issue and its impact is shown below.

Unoccupied Pool Turndown – Not Executed

This measure has had the most impact on the expected savings. During construction, Willdan installed variable-speed drives for the pool circulation pumps. The intent was to reduce the amount of water pumped at night when the pools are closed. Building codes require a minimum amount of pumped water to travel through the filtration system. These same codes allow for a reduction in pumped water when the pool is unoccupied. The planned pumping reduction saves both electricity and heat.

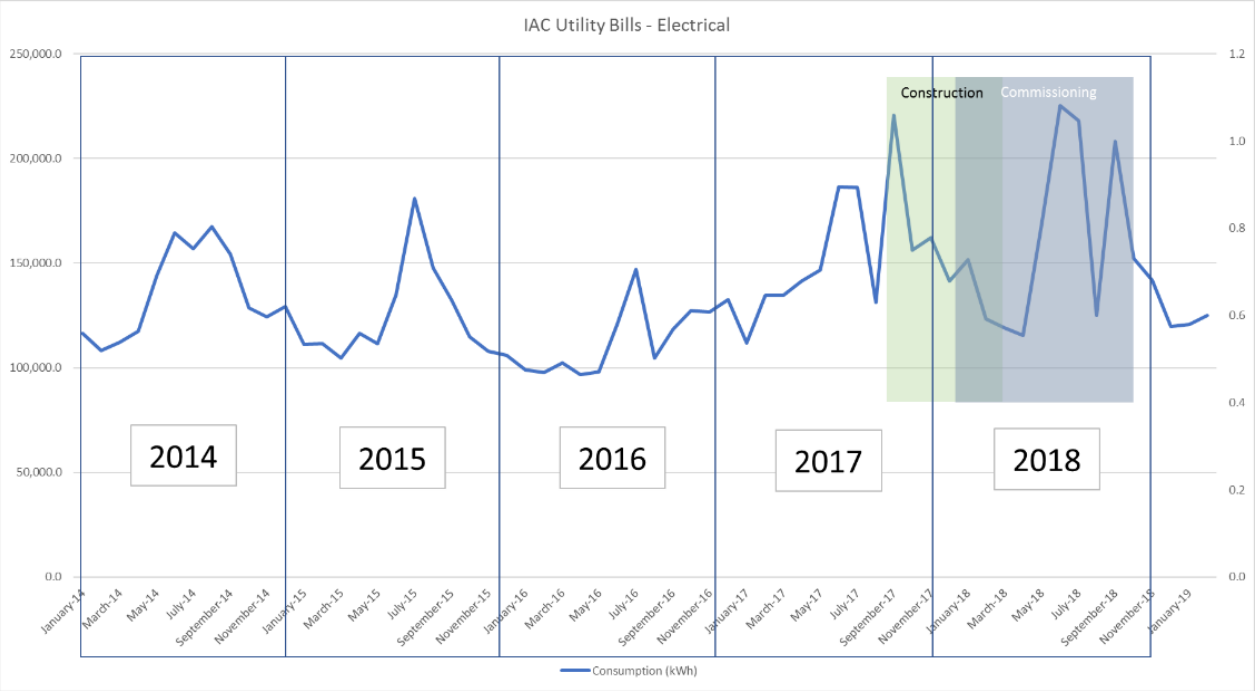
The pool pumps are in an underground vault below the mechanical room. The chemical treatment system is on the first level, in the mechanical room. To activate the chemical system, a portion of the circulated pool water is diverted to the chemical treatment system. Because the diverted water must move vertically upward to reach the chemical treatment system, extra pressure, known as “head”, is required. The existing piping system uses a manual reducing valve to provide necessary head in the diversion loop. When the pool water circulation pumps are slowed down, a manual adjustment of the reducing valve would be required to maintain enough head for the chemical treatment loop.

The manual reducing valve for artificial flow resistance is contrary to recommended design. A better design would be the addition of a circulation pump that maintains required head without introducing artificial restrictions. If an additional circulation pump is installed for the chemical treatment system, the large pool circulation pumps can be turned down at night to achieve the expected energy savings.

Leisure Pool Dehumidification Unit (DHU) - Consumes More than Expected

The Leisure Pool DHU was replaced as a separate project just prior to the Willdan construction project. The new DHU uses considerably more gas and electricity than the original unit that it replaced. The increase in electrical consumption can be seen in the summer months of 2017 in the graph below. This

increase was not considered in the baseline calculations (2014-2015) used to determine cost savings. The extra utility costs incurred from the new Leisure Pool DHU continue to contribute to the overall utility costs of the Indoor Aquatic Center.



Pool Flow Meters – Not Accurate During IGA

During the Preliminary Analysis, Willdan engineers examined the existing flow meters for the pool circulation loops. They discovered that the pool circulation flows were higher than the design flow, resulting in wasted electrical energy. During the construction phase of the project, Willdan discovered that the circulation flow meters gave inaccurate readings. The actual pool circulation flows were at or lower than design flows. The circulation flow could not be lowered further, eliminating the potential savings.

Summary

The unexpected variations to the Willdan design and energy calculations have changed the expected utility costs of the Indoor Aquatic Center. Willdan continues to monitor the IAC building performance and can make further recommendations for energy reduction if the City of Lawrence would like to explore potential opportunities. While net project savings city-wide offset the poorer than expected performance at the IAC, Willdan recognizes individual building performance still creates challenges, and we are committed to helping the City with continued documentation of building performance and savings to assist in utility budget allocations, etc.

Utility Rate Adjustment

The utility rates were adjusted for the current year's CPI according to Schedule C, Section 7 of the contract.

Table 1 - Utility Rates used for determining Actual Energy Savings

Utility Rate	Program Year	Electric Rate
Westar MGS	0	$ 0.0470 / kWh (Jun – Sept) $ 0.0390 / kWh (all other months) $ 22.22 / kW (all months)
Westar SGS	0	$ 0.0850 / kWh (all months) $ 8.47 / kW (Jun – Sept) $ 5.38 / kW (all other months)
Natural Gas (Low Rate)	0	$ 0.70 / Therm
Natural Gas (Medium Rate)	0	$ 0.85 / Therm
Natural Gas (High Rate)	0	$ 1.00 / Therm
All Rates	Future Years	Year zero rate adjusted for current year's CPI or future year's actual rate, whichever is greater.

The current year's CPI was determined using the CPI Table for the Mid-Atlantic region on the U.S. Bureau of Labor Statistics' website:

https://www.bls.gov/regions/mid-atlantic/data/consumerpriceindexhistorical_us_table.htm

The CPI for March 2017 was used for the Baseline (year zero) CPI since the Contract Start Date was 2/28/2017. The average CPI was used for the Year 1 Performance Period (future year) CPI of March 2018 to February 2019 as follows:

CPI for 3/2017 = 243.801
Avg. CPI for 3/2018 to 2/2019 = 251.543

Rate adjustment = (251.543 – 243.801) / 243.801 = 0.0318

New Rates:

Westar MGS	$0.0485 / kWh (June – Sept) $0.0402 / kWh (all other months) $22.926 / kW (all months)
Westar SGS	$0.0877 / kWh (all months) $8.739 / kW (June – Sept) $5.551 / kW (all other months)
Natural Gas (Low Rate)	$0.722 / Therm
Natural Gas (Medium Rate)	$0.877 / Therm
Natural Gas (High Rate)	$1.032 / Therm

Baseline Energy Adjustments – Not included in Savings

The following conditions were identified which according to the contract could be analyzed to determine adjustments to the Baseline Consumption. However, the adjustment associated with each item was not analyzed since Year 1 Savings produced enough savings to meet the guarantee. The items have been included in the Appendix for informational purposes to illustrate that additional savings beyond those reported could have been achieved.

East Lawrence Recreation Center

1) Unoccupied setpoints were found to be higher than the contract Unoccupied heating setpoint of 55F. All setpoints were higher than 60F, with some areas being overridden to 70-72F for Unoccupied heating setpoint.

    a. Lobby/Weight Rm, & Gymnastics Rm had Unocc. Heat Setpoint set to 68F.

    b. RTU-1, & Party/Conference Rm had Unocc. Heat Setpoint set to 70F.

Holcom Park Recreation Center

1) Unoccupied setpoints were found to be higher than the contract Unoccupied heating setpoint of 55F.

    a. North Gym RTU, & South Gym RTU both had Unocc. Heat Setpoint overridden to 71F.

2) Improved comfort by adjusting Baseline Zone Differential setpoint from 3F to 1F, meaning previously a zone had to get 3F off setpoint before enabling heat or cool for that zone. Now, a zone will enable heat or cool when 1F off setpoint. This has provided vastly improved comfort in all areas of building, but will use more energy to achieve these comfort levels.

City Setpoint Policy Changes updated January 1, 2018

Due to numerous comfort complaints at various buildings in both heating & cooling season, the city elected to update the setpoint policy on January 1, 2018 (Policy #121). Sections of the policy document have been included below:

All interior office workspaces within the City must have the following setpoints.
During normal operating hours, thermostats shall have a setpoint between 68°F and 72°F during the heating season and between 72°F and 76°F during the cooling season.
The following spaces are exempt from the aforementioned standards:

a) Pool spaces shall be kept at 2°F above pool water temperature setpoints;
b) Gyms, community gathering areas, locker rooms and other changing areas shall be set for occupant comfort; and
c) Residential sleeping quarters for first responders may have a setpoint between 70°F and 76°F during the cooling season.

The setpoints in red above conflict with the contractual setpoints in Schedule I, Section 1 of the contract (see below) and would result in increased energy consumption.

1) **HVAC systems: ESCO will install systems capable of maintaining the following standards of comfort:**

    a) **Occupied heating set points: 70°F**

    b) **Occupied cooling set points: 74°F**

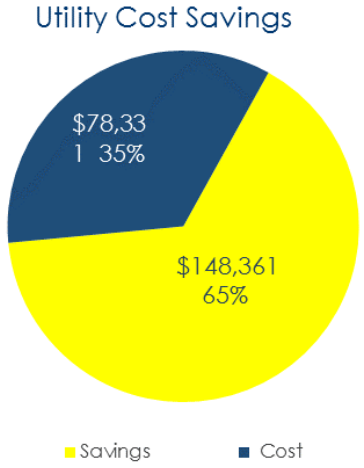
Option A Measurement & Verification of Electrical Energy Savings

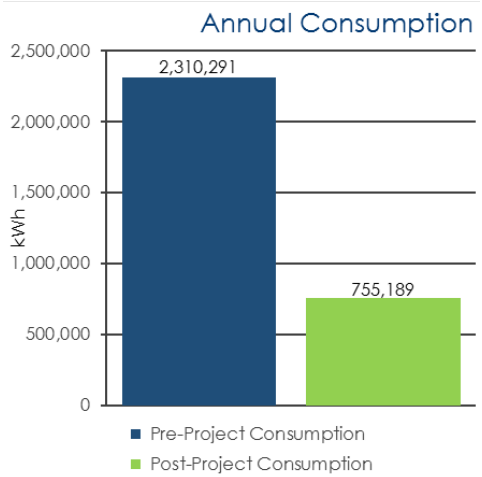
The table below demonstrates the amount of savings achieved throughout all facilities in which Option A Savings was calculated. The table breaks down the essential measured parameters (kWh, kW) which were used to determine the achieved savings. Based on the analysis performed, the facilities saw a combined savings of $166,406 this was $27,651 more than the guaranteed savings of $138,755. The graphs shown below the table are to illustrate the impact the energy saving measures have had on your facilities.

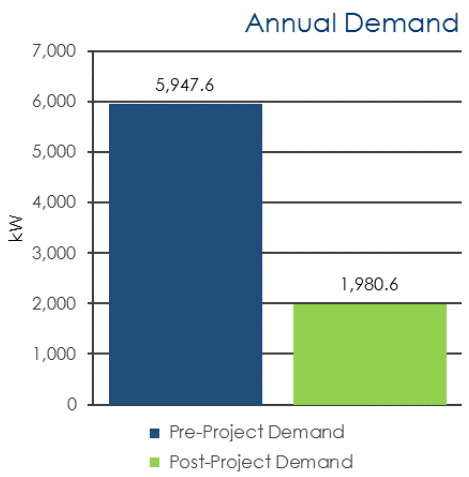
City-Wide Building Lighting

Building Name	Pre-Project Consumption (kWh)	Pre-Project Demand (kW)	Pre-Project Cost ($)	Post-Project Consumption (kWh)	Post-Project Demand (kW)	Post-Project Cost ($)	Consumption Savings (kWh)	Annual Demand Savings (kW)	Annual Savings ($)
Edgewood Park	24,847	68.1	$ 2,541	6,721	18.4	$ 789	18,126	49.7	**$ 1,752**
Hand Park	1,308	3.6	$ 266	301	0.8	$ 168	1,007	2.8	**$ 97**
Hobbs Park	8,681	36.1	$ 1,020	1,735	4.8	$ 307	6,946	31.3	**$ 713**
Holcomb Park	2,854	7.8	$ 415	587	1.6	$ 196	2,267	6.2	**$ 219**
Japanese Garden	1,586	4.3	$ 293	293	0.8	$ 168	1,293	3.5	**$ 125**
John Taylor Park	9,442	25.9	$ 1,052	2,307	6.3	$ 362	7,136	19.5	**$ 690**
Ludlam Park	2,178	6.0	$ 350	1,079	3.0	$ 244	1,099	3.0	**$ 106**
Lyons Park	6,672	18.3	$ 784	95	1.8	$ 154	6,577	16.5	**$ 630**
Prairie Park	6,174	16.9	$ 736	1,395	3.8	$ 274	4,778	13.1	**$ 462**
Rotary Arboretum	837	2.3	$ 220	117	0.3	$ 151	721	2.0	**$ 70**
South Park	35,107	96.2	$ 3,533	8,056	22.1	$ 918	27,051	74.1	**$ 2,615**
Walnut Park	2,615	7.2	$ 392	602	1.6	$ 198	2,014	5.5	**$ 195**
Youth Sports Complex	56,419	154.6	$ 5,593	15,728	43.1	$ 1,660	40,691	111.5	**$ 3,933**
Carnegie Buildings	16,291	77.9	$ 1,648	6,083	41.3	$ 744	10,208	36.6	**$ 905**
27th Street Maintenance E	11,905	45.6	$ 1,199	6,270	24.0	$ 698	5,634	21.6	**$ 502**
Eagle Bend Clubhouse and	9,543	25.4	$ 977	4,285	11.6	$ 518	5,258	13.7	**$ 458**
New Hampshire Parking Ga	349,215	530.4	$ 32,458	73,231	117.6	$ 6,938	275,984	412.8	**$ 25,520**
Union Pacific Depot	23,184	76.9	$ 2,284	6,593	26.3	$ 748	16,591	50.6	**$ 1,536**
Solid Waste	8,390	34.7	$ 855	4,512	18.5	$ 523	3,878	16.3	**$ 331**
South Park Admin	13,635	58.9	$ 1,316	5,360	33.3	$ 635	8,275	25.6	**$ 681**
Outdoor Aquatic Center	7,924	167.0	$ 1,394	3,135	58.4	$ 610	4,789	108.6	**$ 784**
Street Division Office + Re	27,164	122.8	$ 2,928	11,329	54.7	$ 1,314	15,835	68.1	**$ 1,614**
Riverfront Garage and Sur	103,482	196.3	$ 9,848	29,441	49.3	$ 2,879	74,041	147.0	**$ 6,969**
Salt Domes and Wakarusa	20,863	79.0	$ 2,229	5,160	17.4	$ 649	15,702	61.6	**$ 1,580**
North Lawrence Pump Sta	13,012	38.7	$ 1,407	3,523	11.3	$ 485	9,488	27.4	**$ 922**
Parks and Rec Maintenanc	13,103	50.2	$ 1,454	7,064	27.1	$ 848	6,039	23.1	**$ 606**
Downtown Parking Lots an	9,887	27.1	$ 1,095	2,924	8.0	$ 422	6,964	19.1	**$ 673**
Broken Arrow Park	8,325	22.8	$ 944	2,173	6.0	$ 349	6,152	16.9	**$ 595**
Brook Creek Park	4,186	11.5	$ 544	342	0.9	$ 172	3,844	10.5	**$ 372**
Burcham Park	864	2.4	$ 223	13	0.0	$ 141	851	2.3	**$ 82**

Building Name	Pre-Project Consumption (kWh)	Pre-Project Demand (kW)	Pre-Project Cost ($)	Post-Project Consumption (kWh)	Post-Project Demand (kW)	Post-Project Cost ($)	Consumption Savings (kWh)	Annual Demand Savings (kW)	Annual Savings ($)
Centennial Park	27,464	75.2	$ 2,794	6,684	18.3	$ 785	20,780	56.9	**$ 2,008**
Chief Jim McSwain Park	6,095	16.7	$ 728	1,551	4.3	$ 289	4,544	12.4	**$ 439**
Clinton Park	10,367	28.4	$ 1,141	2,115	5.8	$ 344	8,252	22.6	**$ 798**
Constant Park	4,656	12.8	$ 589	1,208	3.3	$ 256	3,448	9.4	**$ 333**
Dad Perry Park	11,904	32.6	$ 1,290	406	1.1	$ 179	11,498	31.5	**$ 1,111**
Deerfield Park	11,299	31.0	$ 1,231	2,691	7.4	$ 399	8,608	23.6	**$ 832**
Eagle Bend Golf	4,186	11.5	$ 544	558	1.5	$ 193	3,628	9.9	**$ 351**
Maintenance Building	41,709	154.4	$ 3,734	8,039	31.2	$ 837	33,670	123.1	**$ 2,897**
Community Hangar	44,731	122.6	$ 4,463	4,854	13.3	$ 609	39,876	109.3	**$ 3,854**
Hangar A	8,393	41.9	$ 1,014	1,585	5.8	$ 298	6,809	36.0	**$ 717**
Hangar B	7,353	74.2	$ 1,032	1,630	10.9	$ 318	5,723	63.3	**$ 714**
Hangar C	7,208	70.7	$ 1,008	1,552	9.0	$ 305	5,657	61.7	**$ 702**
Sports Pavilion	945,164	2,219.6	$ 90,250	378,107	887.9	$ 36,187	567,057	1,331.6	**$ 54,062**
Lawrence Street Lighting	380,067	1,041.3	$ 36,875	133,755	366.5	$ 13,067	246,313	674.8	**$ 23,807**
Totals	2,310,291	5,947.6	$ 226,692	755,189	1,980.6	$ 78,331	1,555,102	3,967.1	**$ 148,361**

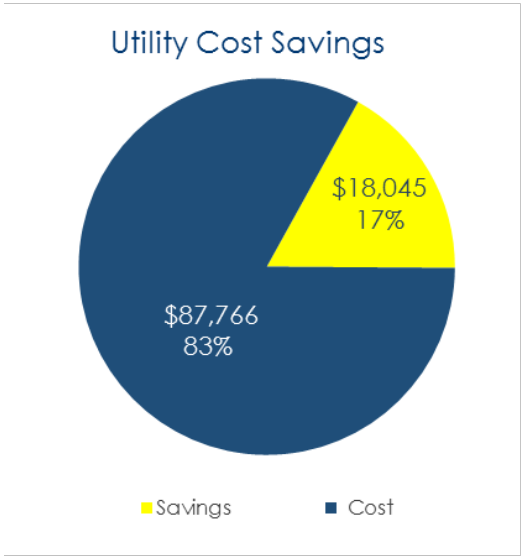


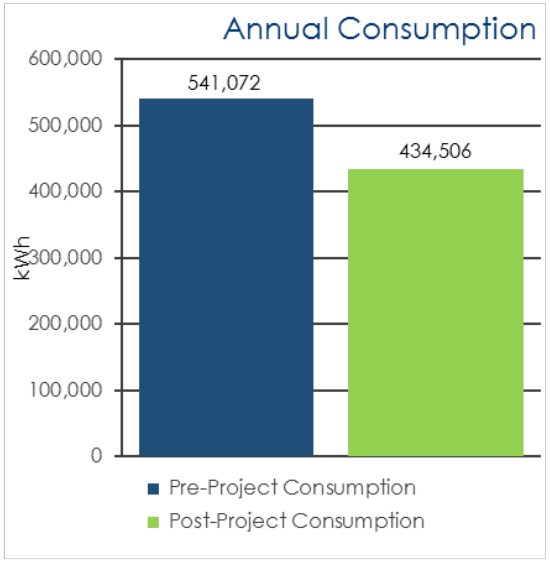


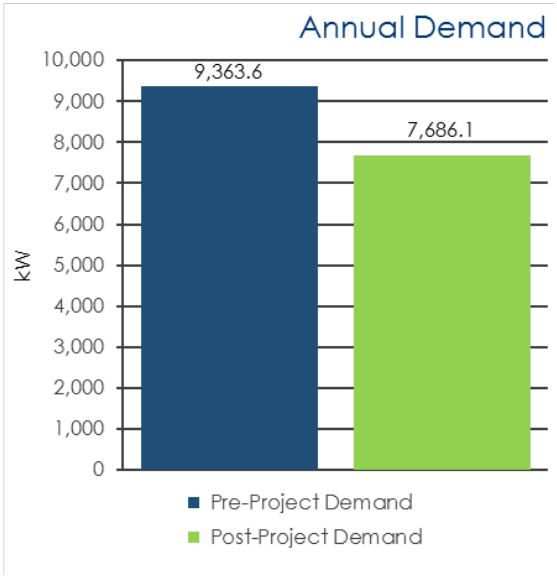


Sports Field Lighting

Building Name	Pre-Project Consumption (kWh)	Pre-Project Demand (kW)	Pre-Project Cost ($)	Post-Project Consumption (kWh)	Post-Project Demand (kW)	Post-Project Cost ($)	Annual Consumption Savings (kWh)	Annual Demand Savings (kW)	Annual Savings ($)
Broken Arrow Park	28,965	554.3	$ 4,537	17,233	329.8	$ 2,756	11,732	224.5	**$ 1,781**
Centennial Park	7,167	137.2	$ 1,228	4,420	84.6	$ 811	2,747	52.6	**$ 417**
Chief Jim McSwain Park	2,867	54.9	$ 575	1,768	33.8	$ 408	1,099	21.0	**$ 167**
Deerfield Park	4,300	82.3	$ 792	2,652	50.8	$ 542	1,648	31.5	**$ 250**
Holcomb Park	11,468	219.5	$ 1,881	7,073	135.4	$ 1,213	4,395	84.1	**$ 667**
Lyons Park	57,552	1,101.5	$ 8,878	46,656	892.9	$ 7,224	10,896	208.5	**$ 1,655**
Veterans Park	8,601	164.6	$ 1,445	5,304	101.5	$ 945	3,296	63.1	**$ 501**
Youth Sports Complex	383,249	6,851.0	$ 81,812	325,570	5,945.7	$ 70,718	57,679	905.3	**$ 11,094**
Holcom	-	-	$ 139	3,484	9.5	$ 476	(3,484)	(9.5)	**$ (337)**
Clinton Softball Complex	2,405	6.6	$ 305	5,229	14.3	$ 500	(2,824)	(7.7)	**$ (195)**
19th and Moodie	14,374	80.0	$ 1,665	5,932	41.0	$ 796	8,442	39.0	**$ 869**
Horticulture	9,836	46.7	$ 1,157	5,192	24.8	$ 677	4,644	21.9	**$ 480**
Oak Hill Cemetery	3,718	27.0	$ 555	935	5.6	$ 240	2,783	21.4	**$ 315**
15th Street Cemetery	6,572	38.0	$ 842	3,059	16.3	$ 462	3,513	21.7	**$ 380**
Totals	541,072	9,363.6	$ 105,812	434,506	7,686.1	$ 87,766	106,566	1,677.5	**$ 18,045**







Option A Measurement & Calculated Savings Methodology

The following section explains how measurements were taken to determine the savings achieved.

A. Savings calculated for Option A were determined by following the guidelines laid out in the International Performance Measurement & Verification Protocol Volume I. As prescribed by the instructions for Option A: Partially Measured Retrofit Isolation, the equipment affected by the energy conservation measures (ECM) was isolated and measured prior to the retrofit, and again post retrofit, to determine the impact of the ECM on the energy usage of the equipment.

B. Sampling was conducted to obtain a 90% confidence and 20% precision according to Appendix B of the Federal Energy Management Program (FEMP) M&V Guidelines v4.0. The purpose of sampling is to monitor a representative sample of points rather than the entire population. The end result is to obtain reliable estimates within a specified precision and statistical confidence. The basic equation used in sample group sizing for 90% confidence and 20% precision is:

$$n = \frac{z^2 \cdot (C_v)^2}{(P)^2} = \frac{(1.645)^2 \cdot (0.5)^2}{(0.2)^2} = 16.91$$

Where, z = Z-statistic, 1.645 for 90% confidence; C_v = Coefficient of Variance, 0.5; P = Precision, 20%.

For populations less than 500, the sample size should be modified using the finite population correction equation:

$$n^* = \frac{Nn}{n+N}$$

Where, n* = sample size corrected for population size; n = sample size for infinite population; N = population size.

Furthermore, the sample size includes a 10% oversampling factor in case of data collection device failure or unexpectedly high data scatter.

$$n^* = \frac{Nn}{n+N} = \frac{(92)(16.91)}{16.91+92} = 14.28\ x\ 10\% = 15.7 = 16$$

C. Pre-retrofit & post-retrofit measurements were taken at the various fixtures themselves, and then the average difference between the measurements was applied to all the fixtures in the sample set. The resulting savings was evaluated using the average occupancy, operations, and annual use to determine the total building energy savings.

D. Pre-retrofit & post-retrofit annual usage was estimated for each fixture to calculate an annual consumption for each building.

E. Pre-retrofit & post-retrofit annual consumption was then multiplied by the contractual energy rates to determine the annual energy costs.

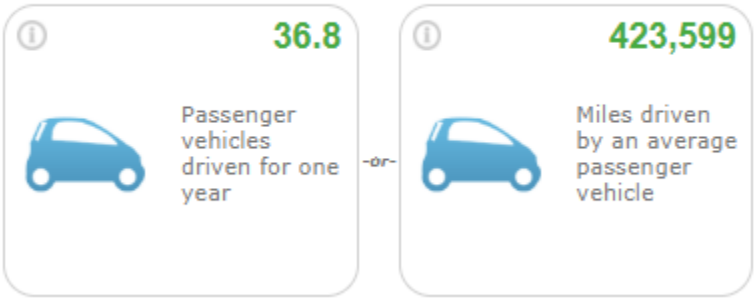
F. The pre-retrofit energy cost was then compared to the post-retrofit energy cost to determine the annual energy savings solely from the energy conservation measure.

Solar PV Performance and Savings

The 100kW Solar PV array was installed on the roof of Fire/Medical #5 (1911 Stewart Ave.) in the summer of 2017. Since that time, this system has produced over 245,000 kWh of electrical power that would have been purchased from the electric utility.

Equivalent savings to 245,000 kWh includes the following:

Greenhouse gas emissions from



CO_2 emissions from

Carbon sequestered by