

Preliminary Energy Audit Report



FARGO PUBLIC SCHOOLS | OCTOBER 2023





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Executive Summary

This preliminary energy assessment report (Prelim) was commissioned by the Fargo Public Schools to investigate, identify, and evaluate district-wide energy and operational cost savings opportunities.

The findings in this report complement the district-wide investigation work addressed in the Ameresco's facility condition assessment, HPM's educational adequacy study, and SEH Engineering's Architectural and ADA compliance investigation. These studies were conducted in unison allowing the sharing of data and information for their respective deliverables to the Fargo Public Schools.

This Prelim evaluates specific energy conservation (ECMs) and capital or facility improvement measures (FIMs) needed in district's facilities. The ultimate goal is to optimize and enhance the classrooms with upgrades to student environmental and learning spaces. The district is able to leverage energy savings while possibly and effectively using less capital improvement project (CIP) funds to address the infrastructure needs of its school facilities.

This report also identifies FIMs with long term return on investment (ROIs) needs which can be bundled with short ROI ECMs. This method of bundling improvements will allow the district to replace aging equipment/systems which have reached the end of its useful life with new high efficiency energy equipment/systems. This method will require less capital while leveraging the energy savings to fund the remaining cost. In addition, the end-of-life equipment/infrastructure will require future capital funds to replace and so leveraging the energy cost savings now minimizes the need to expend CIP funds to replace equipment in the future. This is referred to as avoided future costs.

As an example, one school has boilers at the end of useful life that currently require replacement within the district. Ameresco estimates the cost to develop, design, install, commission and train operators on these new boilers to be \$1,200,000. The new boilers currently available have greater efficiencies than the units that were originally purchased in the mid-2000's, in addition the newer units will reduce future operation and maintenance (O&M) costs as they will require minimal repairs service needs compared to the existing units that have parts failing due to age and corrosion. By leveraging the energy savings and lower O&M costs of these new boilers Fargo would pay only \$480,000 with energy savings and O&M costs paying for the remaining \$720,000.

FACILITY IMPROVEMENTS

Replacing or updating existing inefficient and obsolete systems with efficient technologies establishes higher-quality systems with fewer equipment failures and reduced maintenance.

The improvements made to lighting and temperature control will result in better performing occupants in the building.

Element	Total Need (\$)	Est SPB	Total Capital Provided by District	Total Capital provide by Energy and O&M Savings
Boiler	\$1,200,000	25.0	\$480,000	\$720,000

This report and its preliminary scope of work will generate energy and operational savings while addressing the comfort concerns, equipment replacement needs, facility improvement needs, as well as the health and safety issues that are identified during the facility audit. Implementation of the measures identified within this report will result in the district receiving the following benefits:

- Enhanced educational environment
- Improved Indoor Air Quality (IAQ)
- New, energy efficient heating, ventilation, and air conditioning equipment (HVAC)
- Increased equipment reliability
- Reduced operation and maintenance expense
- Reduction in energy consumption creating a sustainable annual energy cost reduction
- District reduction in greenhouse gas emissions (GHG) and carbon footprint
- This project will set an example for students (and parents) in their daily lives and as future lifelong energy consumers.

In the next phase of this project Ameresco will lay out a plan to best serve district needs and determine which projects to investigate in full detail. Then with the district's guidance, will further develop the energy measures to provide final savings and costs in a final project bundle.

As the District proceeds with the implementation of the identified project(s), Ameresco will further develop/design the project. The district having had time to consider the proposal, is able to enter into a fixed-price construction contract for specific capital improvements and energy conservation measures, as mutually agreed upon. With district's approval, Ameresco will administer a turn-key solution including the engineering design, construction management, installation, commissioning for proper operation, training of operators, and measurement and verification of energy savings.



Project-at-a-Glance

Fargo Public Schools

Project-at-a-Glance		Type																																			
Energy Conservation Measures (ECMs) Considered		Energy/Water Conservation Savings	Operation & Maintenance Savings	Deferred Maintenance Repair/Replaces	Capital Improvement Upgrade	South High School	North High School	Davies High School	Discovery Middle	Ben Franklin Middle	Carl Ben Eielson Middle	Kennedy Elementary	Bennett Elementary	Eagles Elementary	Ed C. Cupp Elementary	Centennial Elementary	Litch Elementary	Washington Elementary	Lewis and Clark Elementary	Langfellow Elementary	Jefferson Elementary	Clara Barton Elementary	Roosevelt Elementary	Mellison Elementary	Honore Mann Elementary	McKibbin Elementary	Hawthorne Elementary	Agassiz	District Office (OH)	Operations Center	Explorer Academy	District Office (New)	Trollwood Performing Arts				
Architectural Systems																																					
Building Envelope	Walls																																				
	Windows																																				
	Roofs																																				
	Building Insulation																																				
	Sealing - Doors / Windows																																				
Mechanical Systems																																					
Plumbing - Water Conservation	Plumbing Fixtures																																				
	Domestic Hot Water Heating																																				
	Irrigation																																				
HVAC & Indoor Air Quality	Boilers																																				
	O ₂ trim combustion control																																				
	Steam Trap Audit/Replacement																																				
	Chillers																																				
	Gym Cooling																																				
	AHU Replacements																																				
	VISHP / GSHP																																				
	RTUs																																				
	Split - Systems																																				
	DOAS																																				
	Energy Recovery																																				
	Mechanical Insulation / Duct Sealing																																				
Facility Mgmt Control Systems	Temperature/Humidity Controls																																				
	Demand Control Ventilation																																				
	Motor VFDs																																				
	Pneumatic to DDC Conversion																																				
	Energy Management																																				
	BAS front-end integration																																				
Electrical Systems																																					
Power	Utility Metering																																				
	Power Factor																																				
	Motors																																				
	Plug-Load Controls																																				
Lighting & Lighting Controls	Site																																				
	Interior																																				
	Sports lights																																				
Facility Mgmt Control Systems	Lighting																																				
	Security																																				
Renewable Energy Opportunities																																					
Solar Electric Systems	Photovoltaic (PV)																																				
Commissioning (Cx / RCx / RetroCx)																																					
Retro-Commissioning																																					
Energy Education																																					
Other ECM/FIMs																																					
Pool	Liquid Pool Cover																																				
	Chlorine Generators																																				



Utility Bill Assessment

SUMMARY OF ALL BUILDINGS

The basis for project developed is to maximize energy costs savings starting with an accurate energy use baseline for each building. The baseline is developed using the historical energy consumption data and the current utility rates (or tariffs) used from the utility invoices.

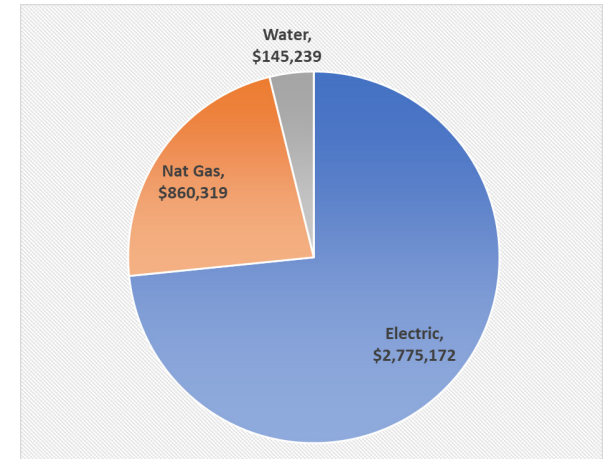
Ameresco assembled and analyzed three years of historical utility invoice data from the district's utility services providers. The district has multiple utility providers. The electric service is provided by two utilities, Xcel Energy and Cass County Electric Cooperative, natural gas service is provided by Xcel Energy, and water/wastewater service is provided by the City of Fargo.

Fargo Public Schools (FPS) preliminary energy analysis includes 28 buildings totaling approximately 3 million square feet of conditioned indoor space. The district's annual utility spend is approximately \$2.8 million in electricity and \$860 thousand in natural gas each year or a sum total of approximately \$3.66 million dollars.

Based on the baseline energy consumption and energy use for proposed equipment upgrades, Ameresco anticipates a sustainable annual costs savings project will deliver a reduction of approximately **10% in electricity and 5% in gas** utility spend. Based on estimated savings a preliminary annual cost savings will **self-fund \$9-11 million** in facility ECM replacements and upgrades when financed over fifteen years.

The district's annual electric utility spend is nearly 75 percent of the total utility spend. Typically, this electric utility spend, especially in a cold climate, is higher than the average for this region. Based on the Commercial Buildings Energy Consumption Survey (CBECS). However, six buildings, or +1M square feet use electric heat pumps for space heating.

Natural gas is 42% of the cost per unit of usable energy (heat) when compared to the cost per kW and kWh. Electricity is relatively inexpensive and has a pretty low "spark spread" of 2.4x. Electric energy will typically cost 4 – 5x when compared to natural gas.



AVERAGE RATES

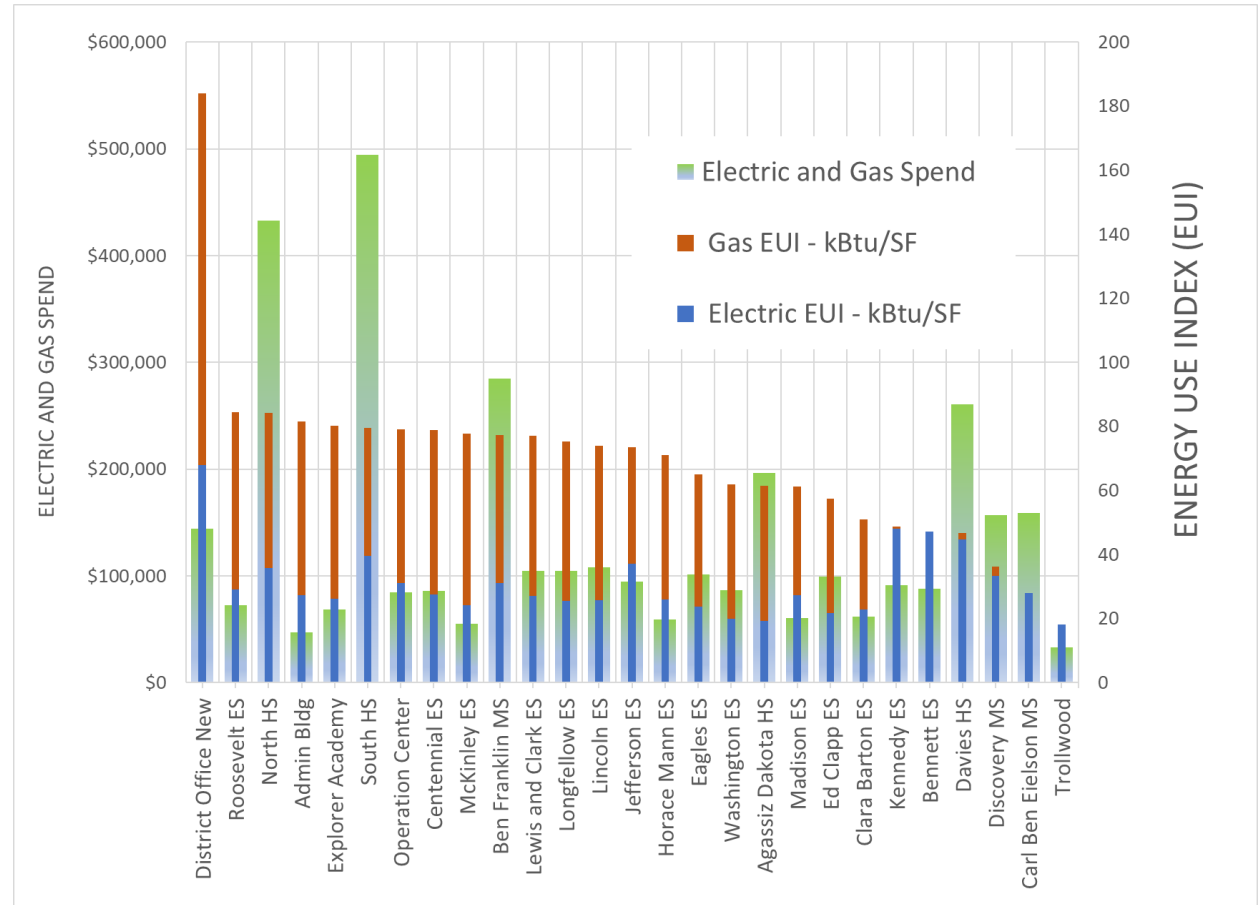
The blended cost of electricity is averaged at 10 cents per kilowatt (kWh), This blended rate includes the demand (kW) charge and energy (kWh) cost.

The district is pays \$17 per kW per month and \$0.046 per kWh. The most recent 12-month gas rate is \$0.97 per therm (MBTU). The average of potable water and wastewater cost is \$6.7 per 1,000 gallons (kGal). There is a separate monthly meter charge of \$55 per month and \$4.2 per kGal for irrigation.

Note: Bennett Elementary School experienced significant irrigation costs in 2022 with utility invoices of \$12.6k during summer months, possibly due to high irrigation needs (dry conditions) or underground system leaks.

The graph to the right shows the buildings sorted from highest to lowest energy use index (EUI) in units of thousand Btu per square feet (kBtu/SF). The highest EUIs reflex a significant potential to save energy through HVAC controls recommissioning and equipment upgrades. The “New District Office” is the least efficient building (per ft2) shown demonstrating an EUI of 190. Trollwood is the most efficient building with an EUI at 20.

The graph also shows the last 12-month total electric and gas spend. South High School is the most expensive school and spent a half-million dollars on gas and electricity over 12-months. The recommissioning of building automation systems(BAS) and equipment upgrades which would reduce utility spend by 5% at South High. This equates to \$25k in annual utility cost savings.

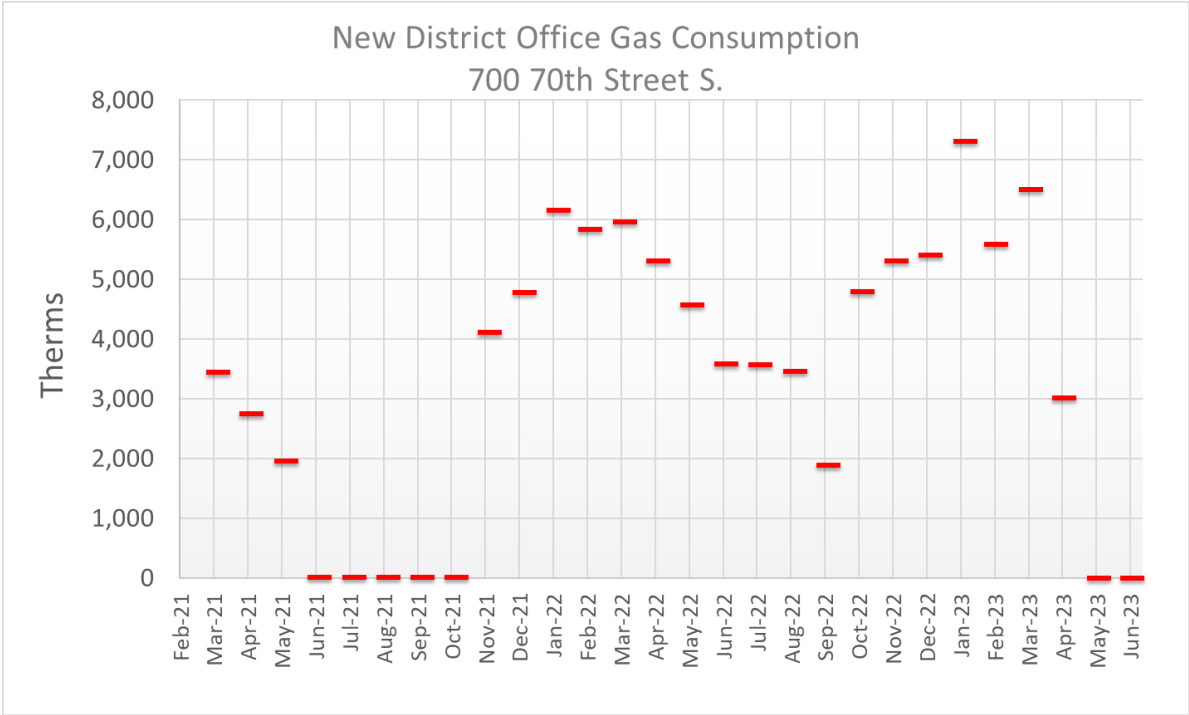


OBSERVATIONS AND OUTLIERS

While analyzing utility rate and historical consumption, Ameresco observed gas, electric and water consumption anomalies. A few examples of some of those anomalies are as follows.

NOTE: Utility services to a significant number of facilities generally lead to what appears to be unnecessary energy consumption. One purpose of this study is to identify and correct these concerns moving forward. These are not indications of unmanaged consumption but rather oversight of the daily use and the effects of old and inefficient equipment. These examples help to educate and create a road map for future efficient operations.

The New District Office had significant gas consumption during the summer of 2022 which pushed the buildings EUI higher than anticipated. It appears May and June of 2023 are trending toward a reasonable consumption level which leads us to believe gas use in 2022 was an anomaly.



Gas readings during the middle of the month – billing cycles 30 to 31 days each

Kennedy Elementary School has three separate electric meter services and Rate Code (RC) 200 which has a minimum “Electric Charges” of \$522 per month per meter. The district must use approximately 4,000 kWh per month to reach the “Capacity Min” as the maximum consumption in August of 2022 was only 2,600 kWh. The minimum capacity tariff charges started January 2023, however if the trend continues FPS will pay for 33,000 kWh per year which cannot use.

There may be additional savings offered by the utilities by switching to interruptible tariffs for both gas and electricity service. Many buildings have dual fuel boilers and backup emergency generators.



Building Descriptions

BENNETT ELEMENTARY SCHOOL

BUILDING CONDITION

Bennett was built in 2000 with the original HVAC equipment still in operation. The Spectra Water Furnace water-source heat pumps have continued useful operations but are beyond their expected useful service life.

The building is in good condition and the equipment is all original. The building's HVAC system, comprised of heat pumps, which use R-22 as its working fluid. R-22 has been phased out by the Environmental Protection Agency (EPA). Water faucets are high flow at 2.2 gpm. The BAS, building automation system, uses a combination of outdated Andover and Siemens Insite controls. The exterior has LED soffit lights, but the parking lot and walk-way lighting is metal halide (29 heads). The interior lighting is still fluorescent tubes.

EUI COMPARED TO INDUSTRY AVERAGE

Bennett has the lowest EUI of all 14 elementary schools of 47 kBtu per SF.

The HVAC system is very efficient, and the building does not use gas for space heating. According to CBECS an average K-12 school has an EUI of 58.2. There still remains additional opportunities to save energy. An example is to replace the R-22 refrigerant, global warming potential (GWP) refrigerant heat pumps with a new heat pump/refrigerant which is efficient and environmentally friendly.

This school had the highest water / wastewater spend of all school buildings. Approximately \$16k was invoiced for water and wastewater over a 12-month period.



Continued on next page

OPPORTUNITIES IDENTIFIED

Bennett Elementary School was a big irrigation user during the summer of 2022 and spent \$12.6k to irrigate the landscaping and green spaces. Smart meters are recommended to minimize irrigation whiling still maintaining healthy green spaces.

The installation of heat pump speed controls will increase operational efficiency. The core loop and ground loop heat pumps use VFDs which reduce speed while also reducing energy costs.

NOTE: The core loop pump speed was observed at 54 Hz and with the ground loop at 52 Hz which effected a temperature difference of 2.2°F. The small temperature drop will be investigated further to optimize performance.

Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Interior LED Lighting Retrofits	\$ 203,000	\$ 7,600	\$ 4,100
Lighting Controls Upgrades	\$ 14,000	\$ 700	\$ -
Parking Lot Lighting	\$ 35,000	\$ 800	\$ 700
Plumbing Upgrades	\$ 20,000	\$ 1,000	\$ 200
Envelope Weatherization	\$ 27,000	\$ 1,300	\$ -
DDC Master Systems Integration, RCx & Replacements	\$ 77,000	\$ 2,700	\$ -
WSHP	\$ 2,031,000	\$ 6,700	\$ 7,500
Irrigation	\$ 14,000	\$ 700	\$ -

The cost estimates are based upon square footage, standard scope of work and current pricing as of the report. Prices are subject to change due to market conditions and scope changes.

CENTENNIAL ELEMENTARY SCHOOL

BUILDING CONDITION

Centennial was constructed in 1989.

The one-level building is wood stud construction with a shingled gabled roof and with HVAC air handling units(s) located in the attic. The HVAC equipment has been properly maintained and is in reliable condition. This includes the boiler and chiller replaced in 2009. The building has a dual-fuel boiler which can operate as back-up during natural gas interruptions. The BAS is a non-supported version of Siemens Insite.

Hallway lighting has been converted to LED tubes, but remaining classrooms and ancillary spaces are still fluorescent T8.

EUI COMPARED TO INDUSTRY AVERAGE

Centennial has a high EUI at 79 kBtu per square feet and over half of that being from gas. According to CBECS an average K-12 school has an EUI of 58.2. There still remains additional opportunities to save energy with boiler controls and a conversion to LED lighting. The school spent \$4k in water and wastewater over a 12-month period.

OPPORTUNITIES IDENTIFIED

Heating water valves and controls, pipe insulation, interior lighting and weatherstripping were all identified as opportunities to reduce energy. Each of these ECMs will help reduce HVAC load and increase occupant comfort throughout the building as well as reduce operations and maintenance costs.



Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Interior LED Lighting Retrofits	\$ 113,000	\$ 2,600	\$ 2,300
Lighting Controls Upgrades	\$ 11,000	\$ 300	\$ -
Plumbing Upgrades	\$ 17,000	\$ 1,600	\$ 200
Envelope Weatherization	\$ 23,000	\$ 1,600	\$ -
DDC Master Systems Integration, RCx & Replacements	\$ 64,000	\$ 5,700	\$ -

CLARA BARTON ELEMENTARY SCHOOL

BUILDING CONDITION

Clara Barton Elementary is a 100-year-old single-story building. The school uses fluorescent lighting, hot water, and chilled water to serve multiple AHUs throughout the building. The exterior has inefficient single-pane windows. Exterior doors are still in good operational condition.

An autonomous digital Siemens controls system manages the buildings HVAC equipment. Some building controls rely on pneumatic controls. The roof is a ballasted EPDM system installed within the last decade. The restrooms have been updated are ADA compliant space.

EUI COMPARED TO INDUSTRY AVERAGE

Clara Barton Elementary School has an estimated EUI of 51.0. According to CBECS an average K-12 school has an EUI of 58.2. There still remains additional opportunities to save energy after completing an energy project and facility maintenance.

OPPORTUNITIES IDENTIFIED

Ameresco identified several opportunities related to the function of the HVAC system. The system was installed in or around 2005 (Chiller/cooling system in 2014). The BAS requires recommissioning to reduce inefficiencies and allow the system to operate more effectively. The lighting system should be converted to LED lighting to lower electrical consumption. The exterior doors are in fair condition but weatherstripping is recommended to reduce outside air infiltration. The bathrooms have been remodeled however additional cost savings could be realized from new plumbing fixtures.

The windows are fairly recent and are in good condition. The EPDM roof was replaced in the last decade. Ameresco recommends that the following systems be upgraded:

Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Interior LED Lighting Retrofits	\$ 111,000	\$ 4,400	\$ 2,200
Lighting Controls Upgrades	\$ 8,000	\$ 200	\$ -
Plumbing Upgrades	\$ 12,000	\$ 600	\$ 100
Envelope Weatherization	\$ 16,000	\$ 800	\$ -
DDC Master Systems Integration, RCx & Replacements	\$ 47,000	\$ 1,700	\$ -
Gym Cooling	\$ 150,000	\$ -	\$ -



EAGLES ELEMENTARY SCHOOL

BUILDING CONDITION

Eagles Elementary School has been remodeled through the years. An addition to the original building was added in 2015. The building chilled water system is undersized, however an ice storage system(thermal storage) regenerates at off peak hours. The gym space is not cooled. Johnson Controls BAS controls the hot water boilers cooling equipment. All their AHUs are in good condition.

EUI COMPARED TO INDUSTRY AVERAGE

Eagles Elementary School EUI is average at 65 kBtu per square feet. According to CBECS an average K-12 school has an EUI of 58.2. The school is an older structure but remodeled in the past 10 years. This building does not present significant opportunities to save energy as it has an optimized infrastructure. The school spent \$5k in water and wastewater over a 12-month period.

OPPORTUNITIES IDENTIFIED

The district may consider Gym space cooling. This upgrade will provide a comfortable space use during warmer weather while minimizing conditions for biological growth. The gym space can be made available for large summer events or as a resilient place of refuge for residents from extreme heat conditions.



Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Plumbing Upgrades	\$ 19,000	\$ 1,500	\$ 200
Envelope Weatherization	\$ 25,000	\$ 1,600	\$ -
DDC Master Systems Integration, RCx & Replacements	\$ 71,000	\$ 3,100	\$ -
Gym Cooling	\$ 150,000	\$ -	\$ -

ED CLAPP ELEMENTARY SCHOOL

BUILDING CONDITION

Ed Clapp was built in 2013. Equipment is original to the building. The Elementary School has induction units, a chiller and three hot water condensing boilers. The building automation system (BAS) is Johnson Controls. The roof is the original rock ballast. The lighting has been converted to LED with WattStopper controls. The building has a Caterpillar uninterruptable power source (UPS) generator and a radon mitigation system.



EUI COMPARED TO INDUSTRY AVERAGE

Ed Clapp has a low EUI of 58 kBtu per square feet and minimal opportunities to save energy. According to CBECS an average K-12 school has an EUI of 58.2. The school was constructed in 2014 and is well-maintained and controlled. The district spends \$12k in water and wastewater over a 12-month period. The school has a separate two-inch irrigation meter for grass sports fields – no charge on wastewater and still room to save with smart watering.

OPPORTUNITIES IDENTIFIED

Exterior doors require weatherstripping to minimize outdoor air infiltration. There are noticeable gaps through which conditioned air is escaping. Opportunities to minimize water irrigation and low-flow restroom fixtures may reduce water consumption.

Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Plumbing Upgrades	\$ 19,000	\$ 5,400	\$ 200
Envelope Weatherization	\$ 25,000	\$ 600	\$ -
DDC Master Systems Integration, RCx & Replacements	\$ 71,000	\$ 1,300	\$ -
Irrigation	\$ 14,000	\$ 500	\$ -

HAWTHORNE ELEMENTARY SCHOOL

BUILDING CONDITION

Hawthorne Elementary is a 60+ year-old single story building. The building has fluorescent lighting, with forced air HVAC supplied to classroom spaces. The building has a chiller with two hot water boilers. The windows are efficient double pane windows. Exterior doors are in good condition. Their building automation system directs their heat and cooling equipment and is currently using Siemens controls. The roof is a ballasted EPDM system installed in recent years. The bathrooms have been remodeled however additional cost savings could be realized from new plumbing fixtures.



EUI COMPARED TO INDUSTRY AVERAGE

Hawthorne has an estimated EUI of 66.7. According to CBECS an average K-12 school has an EUI of 58.2. This is above industry average but can be improved through an energy project and facility maintenance.

OPPORTUNITIES IDENTIFIED

Ameresco has identified several opportunities related to the function of the HVAC system. The system was installed 2005 which typically will require recommissioning to; reduce inefficiencies, allow the system to operate more effectively, and may extend the useful life of the system. An LED lighting conversion should be completed building-wide replacing fluorescent lighting to minimize electricity consumption and O&M costs. The exterior doors are in good condition, however, weatherstripping is recommended to reduce outdoor air infiltration. The restrooms have been remodeled with high efficiency fixtures having been installed.

The windows are aluminum framed double pane and are in good operational condition. The roof was recently replaced. The controls are partially using pneumatic which should be replaced with direct digital controls (DDC). Ameresco recommends the following systems be considered for upgrades.

Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Interior LED Lighting Retrofits	\$ 72,000	\$ 3,300	\$ 1,500
Lighting Controls Upgrades	\$ 6,000	\$ 200	\$ -
Parking Lot Lighting	\$ 5,000	\$ 200	\$ 100
Plumbing Upgrades	\$ 8,000	\$ 600	\$ 100
Envelope Weatherization	\$ 11,000	\$ 700	\$ -
DDC Master Systems Integration, RCx & Replacements	\$ 30,000	\$ 1,500	\$ -
Gym Cooling	\$ 150,000	\$ -	\$ -

HORACE MANN ELEMENTARY SCHOOL

BUILDING CONDITION

Horace Mann is a 100+ year-old 3-story building. The building has fluorescent lighting, induction units for heating and cooling within the classroom. The building HVAC is delivered from a single chiller and two hot water boilers. The exterior has single pane windows with insulated panels or EIFS (exterior insulation finishing systems) like materials which cover a sizable portion of the exterior. The exterior doors are beyond their useful life rusting and in need of replacement. An autonomous Trane controls system operates building HVAC equipment and systems. The roof is a rock ballast system with access via roof hatch through the third-floor ceiling access point. The bathrooms have been remodeled and are ADA compliant space.



EUI COMPARED TO INDUSTRY AVERAGE

Horace Mann has an EUI of 71. According to CBECS an average K-12 school has an EUI of 58.2. This is well above the industry average but can be improved through an energy project and facility maintenance.

OPPORTUNITIES IDENTIFIED

Ameresco identified several opportunities related to the function of the HVAC system. The system was installed 2014 which typically will require recommissioning to; reduce inefficiencies, allow the system to operate more effectively, and may extend the useful life of the system. An LED lighting conversion should be completed building-wide replacing fluorescent lighting to minimize electricity consumption and O&M costs. The exterior doors beyond their useful life, at least weatherstripping should be installed if replacement is deferred as there are noticeable gaps through which conditioned air escapes and outside air infiltrates. Opportunities to reduce water use are not currently present within the facility as the restrooms have been recently upgraded.

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The exterior has single pane windows with insulated panels or EIFS (exterior insulation finishing systems) like materials which cover a sizable portion of the exterior. The single pane windows should be replaced as have reached the end of their useful life. The current windows have increased the HVAC system loading while reducing occupant comfort. The roof is also at the end of its useful life and requires replacement.

Ameresco recommends the following systems be considered for upgrades.

Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Interior LED Lighting Retrofits	\$ 89,000	\$ 4,000	\$ 1,800
Lighting Controls Upgrades	\$ 7,000	\$ 200	\$ -
Parking Lot Lighting	\$ 6,000	\$ 200	\$ 100
Plumbing Upgrades	\$ 10,000	\$ 700	\$ 100
Envelope Weatherization	\$ 13,000	\$ 900	\$ -
DDC Master Systems Integration, RCx & Replacements	\$ 37,000	\$ 1,800	\$ -
Windows	\$ 690,000	\$ 5,900	\$ -
Roofing Replacements	\$ 416,000	\$ 2,000	\$ -

JEFFERSON ELEMENTARY SCHOOL

BUILDING CONDITION

Jefferson Elementary School is a 16-year-old, single-story building. The building has T-8 fluorescent lighting throughout. HVAC space conditioning is provided by five (x5) 4-pipe variable air volume (VAV) air handling units (AHUs). Chilled water is provided by a single air-cooled chiller with a capacity of one hundred tons. Hot water is provided by two (x2) condensing hot water boilers with a capacity of 1,880 MBH each. An autonomous Johnson Controls system controls building HVAC systems. The windows throughout the building are double pane windows and are in good condition. The roof is a built-up EPDM system with access via a roof hatch through the ceiling access point.



EUI COMPARED TO INDUSTRY AVERAGE

Jefferson Elementary School has an EUI of 73.6. According to CBECS an average K-12 school has an EUI of 58.2. There are opportunities to create energy cost reduction via an energy project and improved facility maintenance program.

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OPPORTUNITIES IDENTIFIED

We identified several opportunities related to the function of the HVAC system. The controls system requires retro commissioning to reduce inefficiencies and improve operational effectiveness.

The facility currently has fluorescent lighting that should be upgraded to LED. The restrooms have been remodeled with efficient fixtures.

Ameresco recommends the following systems be considered for energy efficiency upgrades.

Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Interior LED Lighting Retrofits	\$ 134,000	\$ 4,800	\$ 2,700
Lighting Controls Upgrades	\$ 9,000	\$ 300	\$ -
Parking Lot Lighting	\$ 16,000	\$ 400	\$ 300
Plumbing Upgrades	\$ 14,000	\$ 1,400	\$ 100
Envelope Weatherization	\$ 18,000	\$ 1,200	\$ -
DDC Master Systems Integration, RCx & Replacements	\$ 52,000	\$ 2,800	\$ -
Gym Cooling	\$ 150,000	\$ -	\$ -

KENNEDY ELEMENTARY SCHOOL

BUILDING CONDITION

Kennedy was built in 2006. The building is in great condition and the equipment is all original. The HVAC equipment uses forty (x40) water-source heat pumps with 21 - 2-inch ground loops for heat transfer. The building’s HVAC system, comprised of heat pumps, which use R-22 as its working fluid. R-22 has been phased out by the Environmental Protection Agency (EPA). Water faucets are high flow at 2.2 gpm. The Siemens building automation system is outdated. The shared areas use LED strips; however, the remaining building lighting is fluorescent.



EUI COMPARED TO INDUSTRY AVERAGE

Kennedy has an exceptionally low EUI of 49 kBtu per SF. According to CBECS an average k-12 school has an EUI of 58.2. The HVAC system is very efficient, and the building does not use gas for space heating. Still, there are opportunities to reduce energy and replace the R-22 heat pumps with global warming potential (GWP) refrigerant to an alternative refrigerant which is efficient and environmentally friendly.

The school spent \$4k in water and wastewater over a 12-month period.

OPPORTUNITIES IDENTIFIED

The heat pump can be become more efficient using variable frequency drives (VFDs) or speed controls. The core loop and ground loop use VFDs and should be controlled further or slowed. The speed was at 100% and the ground loop only temperature differential was only 3°F. Three loops were manually closed to increase pressure remaining eighteen loops. This may have been a practical solution for pressure control; however, this requires further to optimize performance.

Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Interior LED Lighting Retrofits	\$ 137,000	\$ 8,200	\$ 2,700
Lighting Controls Upgrades	\$ 14,000	\$ 1,200	\$ -
Plumbing Upgrades	\$ 20,000	\$ 400	\$ 200
Envelope Weatherization	\$ 27,000	\$ 2,100	\$ -
DDC Master Systems Integration, RCx & Replacements	\$ 77,000	\$ 4,400	\$ -
WSHP	\$ 2,047,000	\$ 9,000	\$ 7,600

LEWIS & CLARK ELEMENTARY SCHOOL

BUILDING CONDITION

Lewis & Clark Elementary School is a 70-year-old, single-story building with several additions over the years and a full remodel completed in 2009. They have T-8 fluorescent lighting throughout the building. Heating and cooling are provided by four (4) 4-pipe variable air volume (VAV) air handling units (AHUs) and three (3) split system DX units. Chilled water is provided by a single air-cooled chiller with a capacity of one hundred tons. Three (3) condensing units located on the roof provide additional cooling and have a combined capacity of thirty tons. Hot water is provided by two (2) condensing hot water boilers with a capacity of 1,880 MBH each. An autonomous Johnson Controls Building automation system controls the buildings HVAC operations. The buildings windows are double pane windows but are in poor condition with the flashing peeling away on several observed windows. The roof is a built-up EPDM system with access via roof hatch through the ceiling.

EUI COMPARED TO INDUSTRY AVERAGE

Lewis & Clark Elementary School has an EUI of 77.0. According to CBECS an average K-12 school has an EUI of 58.2. There are opportunities to create energy cost reduction via an energy project and improved facility maintenance program.



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OPPORTUNITIES IDENTIFIED

Several energy savings opportunities are relevant to improving HVAC system efficiencies. The system requires retro commissioning to increase operational and energy system efficiencies.

The facility currently has fluorescent lighting which should be upgraded to LED. Additional cost savings could be realized from new high efficiency/low flow plumbing fixtures.

Ameresco recommends the following systems be considered for energy efficiency upgrades.

Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Interior LED Lighting Retrofits	\$ 166,000	\$ 7,600	\$ 3,300
Parking Lot Lighting	\$ 5,000	\$ 100	\$ 100
Plumbing Upgrades	\$ 17,000	\$ 1,400	\$ 200
Envelope Weatherization	\$ 22,000	\$ 1,500	\$ -
DDC Master Systems Integration, RCx & Replacements	\$ 63,000	\$ 5,400	\$ -
Gym Cooling	\$ 150,000	\$ -	\$ -
Windows	\$ 404,000	\$ 4,100	\$ -

LINCOLN ELEMENTARY SCHOOL

BUILDING CONDITION

Lincoln Elementary School is a 61-year-old, single-story building with several additions over the years and several remodels. The building has T-8 fluorescent lighting with some LED lighting at the entrance and in the front offices. Heating and cooling are provided by four (x4) 4-pipe variable air volume (VAV) air handling units (AHUs) and five (x5) split system DX units. Chilled water is provided by a single air-cooled chiller with a capacity of 190 tons. Five (x5) condensing units located on the roof provide additional cooling and have a combined capacity of sixty-five tons. Hot water heat is distributed from two (x2) non-condensing hot water boilers with a combined capacity of 5,480 MBH each. A combination of Johnson Controls and Siemens controls manage the buildings HVAC operations autonomously. The windows throughout the building are double pane windows and are in good condition. The roof is a built-up rock ballast system with access via roof hatch through the ceiling access point.

EUI COMPARED TO INDUSTRY AVERAGE

Lincoln Elementary School has an EUI of 74.0. According to CBECS an average K-12 school has an EUI of 58.2. There are opportunities to create energy cost reduction via an energy project and improved facility maintenance program.



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OPPORTUNITIES IDENTIFIED

We identified several opportunities related to the function of the HVAC system. The system requires retro commissioning to increase operational and energy system efficiencies. A single control system can will provide a consistent control system and increased energy management capabilities.

The facility currently has fluorescent lighting that should be upgraded to LED. Opportunities to reduce water use are present because the restroom fixtures throughout the building have not yet been upgraded. Regarding facility improvement measures. Ameresco recommends that the following systems be upgraded at the below costs for improvement.

Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Interior LED Lighting Retrofits	\$ 152,000	\$ 6,100	\$ 3,000
Lighting Controls Upgrades	\$ 11,000	\$ 300	\$ -
Plumbing Upgrades	\$ 17,000	\$ 1,400	\$ 200
Envelope Weatherization	\$ 23,000	\$ 1,600	\$ -
DDC Master Systems Integration, RCx & Replacements	\$ 64,000	\$ 5,900	\$ -
Boiler Replacement	\$ 239,000	\$ 7,000	\$ 1,300

LONGFELLOW ELEMENTARY SCHOOL

BUILDING CONDITION

This 72,000 ft² single story brick building was built in 1962 with its most recent addition/renovation work in 2007. The building envelope is in fair condition overall however there are recommended building envelop repairs that include tuck pointing under some of the eaves (we noted wasps nesting near door #3) and soffit repair are pulling away from the eaves near doors 11 & 12. The roof is a low-pitched built-up roof (BUR) w/ gravel ballast and is in good condition. However roughly 20% of gutter downspouts are damaged and need to be replaced. Exterior entry doors (e.g., #25) should be replaced and all exterior doors would benefit from new weather stripping.

The boilers, chiller, AHUs, and water DHW heaters are in good condition and appear to have been updated during a 2005 HVAC renovation project. Siemens Apogee DDC controls. Many of the AHUs utilize CO₂ based demand-controlled ventilation to optimize ventilation rates.

The lighting systems are comprised of high-efficiency LED for exist signs, office-area light fixtures, and a portion of the exterior wall packs. All remaining classroom lighting is standard-efficiency T-8 fluorescent fixtures and or high intensity discharge (HID) fixtures.

Restroom plumbing fixtures utilize standard-efficiency flush valves and a mix of standard and high- efficiency faucets.

EUI COMPARED TO INDUSTRY AVERAGE

Longfellow has an EUI of 75 kBtu per ft². According to CBECS an average K-12 school has an EUI of 58.2. There are opportunities to create energy cost reduction via an energy project and improved facility maintenance program. The buildings recent annual utility cost for electric water and gas was \$108k.



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OPPORTUNITIES IDENTIFIED

Ameresco identified several opportunities with lighting, HVAC controls, improvements to the restroom fixtures, along with exterior doors and windows. The facility currently uses fluorescent lighting which should be upgraded to LED. The restrooms have been remodeled with hi efficient fixtures.

Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Interior LED Lighting Retrofits	\$ 148,000	\$ 6,400	\$ 3,000
Lighting Controls Upgrades	\$ 11,000	\$ 300	\$ -
Plumbing Upgrades	\$ 16,000	\$ 1,400	\$ 200
Envelope Weatherization	\$ 22,000	\$ 1,700	\$ -
DDC Master Systems Integration, RCx & Replacements	\$ 62,000	\$ 3,300	\$ -
Gym Cooling	\$ 15,000	\$ -	\$ -

MADISON ELEMENTARY SCHOOL

BUILDING CONDITION

Madison Elementary is a 60+ year-old single story building. The building has LED lighting with induction units for heating and cooling within the classroom. Induction units are terminal components similar to a fan coil unit that provide heating and cooling with minimal fan energy. They have a chiller and two hot water boilers. The windows are efficient with double pane. The exterior doors are in fair condition. An autonomous Trane building automation system controls the buildings HVAC operations.

An autonomous controls system directs their heating and cooling equipment using Trane controls. The roof is a ballasted EPDM system. The bathrooms have been remodeled and are in good condition with efficient plumbing fixtures.

EUI COMPARED TO INDUSTRY AVERAGE

Madison Elementary has an EUI of 61. According to CBECS an average k-12 school has an EUI of 58.2. The school is at the industry average and will see improvement through an energy project and facility maintenance.



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OPPORTUNITIES IDENTIFIED

Ameresco identified several opportunities related to the function of the HVAC system. The cooling system was installed around 2014 while the hot water boilers were installed in 2011. The HVAC equipment has plenty of life left, but there are commissioning strategies to allow the systems work more effectively. . .

The gym does not have cooling capabilities. There is an opportunity to cool the gym in order to be comfortable and used all summer. Ameresco recommends that the following systems be upgraded:

Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Plumbing Upgrades	\$ 10,000	\$ 600	\$ 100
Envelope Weatherization	\$ 13,000	\$ 700	\$ -
DDC Master Systems Integration, RCx & Replacements	\$ 37,000	\$ 1,700	\$ -
Gym Cooling	\$ 150,000	\$ -	\$ -
Solar PV - (2.2MW) Rooftop	\$ 989,000	\$ 12,800	\$ -

MCKINLEY ELEMENTARY SCHOOL

BUILDING CONDITION

McKinley Elementary School is a 65-year-old, single-story building with several additions and remodels over the years. The building has T-8 fluorescent lighting throughout with a small amount of LED lighting in the library.

Building HVAC is provided by two (x2) 4-pipe variable air volume (VAV) air handling units (AHUs). Chilled water is provided by a single air-cooled chiller with a capacity of seventy tons. Hot water heat is provided by two (x2) condensing hot water boilers with a capacity of 2,000 MBH each. An autonomous Johnson Controls building automation system controls the building's HVAC operations. Windows are double pane windows and are in good condition. The roof is a built-up EPDM with access via door from an attic/teacher's lounge.

EUI COMPARED TO INDUSTRY AVERAGE

McKinley Elementary School has an EUI of 77.7. According to CBECS an average K-12 school has an EUI of 58.2. There is opportunity to create energy cost reduction via an energy project and improved facility maintenance program.



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OPPORTUNITIES IDENTIFIED

We identified several opportunities related to the function of the HVAC system. The system requires retro commissioning to increase operational and energy system efficiencies.

The facility currently has fluorescent lighting that should be upgraded to LED. Opportunities to reduce water use are not currently present within the facility as the bathrooms have been recently upgraded.

Regarding facility improvement measures, Ameresco recommends that the following systems be upgraded at the below costs for improvement.

Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Interior LED Lighting Retrofits	\$ 82,000	\$ 3,500	\$ 1,600
Plumbing Upgrades	\$ 9,000	\$ 700	\$ 100
Envelope Weatherization	\$ 11,000	\$ 900	\$ -
DDC Master Systems Integration, RCx & Replacements	\$ 32,000	\$ 1,800	\$ -
Gym Cooling	\$ 150,000	\$ -	\$ -
Roofing Replacements	\$ 1,176,000	\$ 2,300	\$ -

ROOSEVELT ELEMENTARY SCHOOL

BUILDING CONDITION

Roosevelt elementary school is a 110+ year-old 3-story building. The school has fluorescent lighting with induction units for heating and cooling within the classroom. They have a chiller and hot water boilers and single-pane windows with insulated panels that make up a sizable portion of the exterior. The exterior doors are scratched, worn and need replacement. An autonomous controls system directs their heat and cooling equipment and is currently using Johnson controls. The roof is a rock ballast system. The bathrooms are outdated and could use low-flow fixtures to save water.

EUI COMPARED TO INDUSTRY AVERAGE

Roosevelt has an EUI of 84. According to CBECS an average k-12 school has an EUI of 58.2. This is well above the industry average and can be easily improved through an energy project and facility maintenance.



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OPPORTUNITIES IDENTIFIED

Ameresco identified several opportunities related to the function of the HVAC system. The system requires retro commissioning to increase operational and energy system efficiencies. The building lighting system should be converted to LED lighting. The exterior doors are in disrepair require weatherstripping in the short-term, however full replacement is recommended. There are noticeable gaps through which conditioned air escapes and outside air infiltrates. There are opportunities to reduce water use within the facility as the bathrooms are old and the fixtures are inefficient.

The windows are also single pane with insulated panels installed above the glazing. The single pane windows should be replaced since they have reached the end of their useful life and are increasing the load on the HVAC system. The drafts and heat-transfer from the windows is uncomfortable for the students and the teachers. Ameresco recommends the following systems be considered for energy efficiency upgrades.

Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Interior LED Lighting Retrofits	\$ 95,000	\$ 4,500	\$ 1,900
Lighting Controls Upgrades	\$ 7,000	\$ 200	\$ -
Parking Lot Lighting	\$ 6,000	\$ 200	\$ 100
Plumbing Upgrades	\$ 11,000	\$ 1,000	\$ 100
Envelope Weatherization	\$ 14,000	\$ 1,100	\$ -
DDC Master Systems Integration, RCx & Replacements	\$ 40,000	\$ 2,300	\$ -
Gym Cooling	\$ 150,000	\$ -	\$ -
Windows	\$ 1,082,000	\$ 8,400	\$ -

WASHINGTON ELEMENTARY SCHOOL

BUILDING CONDITION

Washington Elementary School is an approximately 35-year-old, single-story building. The building has T-8 fluorescent lighting throughout the building with limited LED lighting in the front entrance and offices. Heating and cooling are provided by eleven (x11) 4-pipe variable air volume (VAV) air handling units (AHUs). Seven (x7) air-cooled condensing units located on the roof provide cooling and have a combined capacity of 137 tons. It appears two (x2) of the condensing units may not be in use due to age and condition, comprising of thirty-one tons of lost cooling capacity. Hot water is provided by two (x2) non-condensing hot water boilers with a capacity of 2,410 MBH each. An autonomous controls system directs their heat and cooling equipment and is currently using a Johnson Controls system. The windows throughout the building are single-paned, wooden framed windows and are in poor condition, and have been nailed shut. The roof is a built-up rock ballast system with access via roof hatch through the ceiling.

EUI COMPARED TO INDUSTRY AVERAGE

Washington Elementary School has an EUI of 61.9. According to CBECS an average k-12 school has an EUI of 58.2. This is slightly above the industry average and shows that there could be room for improvement.



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OPPORTUNITIES IDENTIFIED

We identified several opportunities related to the function of the HVAC system. The system requires retro commissioning to reduce inefficiencies and allow the system work more effectively. Several of the condensing units are more than 15 years old and should be replaced with a high efficiency equivalent. The facility currently has fluorescent lighting that should be upgraded to LED.

Opportunities to reduce water use are not present within the facility as the bathrooms have been recently upgraded.

Regarding facility improvement measures. Ameresco recommends that the following systems be upgraded at the below costs for improvement.

Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Interior LED Lighting Retrofits	\$ 150,000	\$ 6,200	\$ 3,000
Lighting Controls Upgrades	\$ 11,000	\$ 300	\$ -
Parking Lot Lighting	\$ 2,000	\$ 100	\$ -
Plumbing Upgrades	\$ 17,000	\$ 1,200	\$ 200
Envelope Weatherization	\$ 22,000	\$ 1,400	\$ -
DDC Master Systems Integration, RCx & Replacements	\$ 63,000	\$ 2,600	\$ -
Boiler Replacement	\$ 434,000	\$ 4,400	\$ 2,400
Split System Replacements	\$ 186,000	\$ 700	\$ 900
Gym Cooling	\$ 150,000	\$ -	\$ -
Windows	\$ 89,000	\$ 1,400	\$ -

BEN FRANKLIN MIDDLE SCHOOL

BUILDING CONDITION

This 202,000 ft² facility was built in 1951 and the latest addition/renovation was performed in 1991. Original portions of the building have three floors, while the addition is a single-story structure. The windows are in poor condition and need to be replaced. Several entry doors should be replaced as well. Mechanically, we recommend replacing the 2002-vintage chiller (R-22). There are three smaller RTUs which have exceeded their useful life that should be replaced. The Dx-split systems serving the walk-in coolers should be replaced as well. The scotch marine steam boilers, which were repurposed from the North HS during its 2002 HVAC renovation) appear to be in good condition. The building automation systems are primarily Andover DDC, although there are still pneumatic controls in use as well. Many of the AHUs utilize CO₂ based demand-controlled ventilation to help optimize ventilation rates. The lighting systems are comprised of high-efficiency LED exist signs, exterior wall packs and high bay fixtures in one of the two gyms, otherwise standard-efficiency fluorescent and HID fixtures are in use. Restroom plumbing fixtures utilize standard-efficiency flush valves and a mix of standard and high- efficiency faucets.

EUI COMPARED TO INDUSTRY AVERAGE

Ben Franklin has an EUI of 77 kBtu per ft². According to CBECS an average k-12 school has an EUI of 58.2. The site's recent annual utility cost for electric water and gas was \$291k and the ECI was \$1.41/sf/year.



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OPPORTUNITIES IDENTIFIED

Ameresco identified several opportunities with lighting, HVAC controls improvements to the water fixtures, doors, and windows. The lighting system can be upgraded by removing the fluorescent lighting and replacing them with LED retrofits to lower the electricity use of the facility.

Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Interior LED Lighting Retrofits	\$ 409,000	\$ 16,700	\$ 8,200
Lighting Controls Upgrades	\$ 30,000	\$ 1,000	\$ -
Parking Lot Lighting	\$ 5,000	\$ 100	\$ 100
Plumbing Upgrades	\$ 45,000	\$ 2,900	\$ 500
Envelope Weatherization	\$ 61,000	\$ 3,800	\$ -
DDC Master Systems Integration, RCx & Replacements	\$ 172,000	\$ 8,600	\$ -
Chillers	\$ 375,000	\$ 3,300	\$ 6,800
RTU Savings	\$ 143,000	\$ 2,700	\$ 1,000
Split System Replacements	\$ 78,000	\$ 1,200	\$ 400
Windows	\$ 14,000	\$ 400	\$ -

CARL BEN EIELSEN MIDDLE SCHOOL

BUILDING CONDITION

Carl Ben Eielsen Middle School is a 16-year-old, 3-story building. They have fluorescent lighting within the classrooms and throughout the building. Heating and cooling are provided by several 4-pipe variable air volume (VAV) air handling units (AHUs). A 225-ton, air-cooled chiller provides chilled water and is supplemented with an ice storage system. Hot water is provided by two (2) non-condensing hot water boilers with a capacity of 2,678 MBH each. An autonomous controls system directs their heating and cooling equipment and is currently using Siemens controls. The windows throughout the school are double pane windows in good condition. The roof is a built-up, EPDM system with access via roof hatch through the 3rd floor ceiling.

EUI COMPARED TO INDUSTRY AVERAGE

CBE Middle School has an EUI of 27.9. Typically, EUI is considered for energy comparisons instead of just electricity however, natural gas data was not available at the time of this report. According to CBECs data a typical k-12 school should have an kWh/ft² of 58.2. This compares favorably with the industry average.



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OPPORTUNITIES IDENTIFIED

We identified several opportunities related to the function of the HVAC system. The system requires retro commissioning to increase operational and energy system efficiencies. The ice storage system was not working at the time of this assessment. The school's single mechanical chiller provides only half of the necessary cooling load. Further investigation is required to identify solutions. The facility currently has fluorescent lighting that should be upgraded to LED. The restrooms have been remodeled with high efficient fixtures. Regarding energy conservation measures Ameresco recommends that the following systems be investigated as cost savings upgrades.

Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Interior LED Lighting Retrofits	\$ 382,000	\$ 12,400	\$ 7,600
Lighting Controls Upgrades	\$ 27,000	\$ 700	\$ -
Parking Lot Lighting	\$ 14,000	\$ 300	\$ 300
Plumbing Upgrades	\$ 40,000	\$ 1,400	\$ 400
Envelope Weatherization	\$ 54,000	\$ 600	\$ -
DDC Master Systems Integration, RCx & Replacements	\$ 152,000	\$ 6,900	\$ -
Boiler Replacement	\$ 482,000	\$ 11,500	\$ 2,700
Chillers	\$ 312,000	\$ 2,300	\$ 5,600

DISCOVERY MIDDLE SCHOOL

BUILDING CONDITION

Discovery Middle School was completed in 1994. The facility HVAC is supplied by 196 water-source heat pumps. The heat pumps were installed in 2003 with units replaced as they fail. The dedicated outdoor air system (DOAS) has energy recovery components, and they are manually turned off in the summer during unoccupancy. This school has a 1 MW standby emergency generator.

The heat pumps use 688 wells 150 feet deep for their thermal exchange. The well field provides the heat source and heat rejection to maintain the building core loop at 45° in the winter and 62° in the summer, respectively.

The building has had several updates in the past. A 7k square foot addition was added three years ago. A roof top dry cooler was added to supplement the ground-loop heat rejection. Auxiliary terminal electric reheats were added, but new modular 4-pipe heat-pump chillers were installed to help temper the building core loop from getting too cold in the winter, and too hot in the summer. A 15 yr. old Siemens Insite controls system manages the buildings HVAC operations.

EUI COMPARED TO INDUSTRY AVERAGE

Discovery has an exceptionally low EUI already, at 36 kBtu per SF. According to CBECS an average K-12 school has an EUI of 58.2. The HVAC system is very efficient, and the building does not use gas for space heating. Summer use and occupancy is limited. There are gas-fired on-demand domestic water heaters that use very little energy, last year cost on average of \$500 per month (650 dekatherms per year). The building's interior and exterior has already been converted to LED type lighting.

The school spent \$11k in water/wastewater over a 12-month period.



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OPPORTUNITIES IDENTIFIED

Discovery is operating and at high level of efficiency. A big efficiency boost for this building was the recent removal of the electric reheats. The EUI is already exceptionally low, providing a few opportunities for additional savings. One significant opportunity is the replacement of the 20+ year old heat pumps which are at the end of their useful life. Energy saving benefits would be realized but O&M avoided costs would be the largest share of savings for this building.

Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Plumbing Upgrades	\$ 51,000	\$ 1,700	\$ 500
Envelope Weatherization	\$ 67,000	\$ 3,900	\$ -
DDC Master Systems Integration, RCx & Replacements	\$ 191,000	\$ 8,100	\$ -
WSHP	\$ 5,058,000	\$ 15,200	\$ 18,700

AGASSIZ-DAKOTA HIGH SCHOOL

BUILDING CONDITION

Agassiz-Dakota High School is a 100+ year-old 3-story building with multiple additions over the decades. They have fluorescent lighting, hot water boiler heat and multiple AHUs and RTUs throughout the building. The northern addition on the building still has older single pane windows with insulated panels that make up a significant portion of this section of the building exterior. The exterior doors are aged, rusting and need replacement. An autonomous controls system directs their heat and cooling equipment and is currently using Siemens controls. The roof is EPDM. The bathrooms have been remodeled and provide for an appealing and ADA compliant space.

EUI COMPARED TO INDUSTRY AVERAGE

Agassiz-Dakota HS has an EUI of 61.4. According to CBECS an average k-12 school has an EUI of 58.2. This is close to the industry average but can be improved through additional energy saving projects and facility maintenance.



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OPPORTUNITIES IDENTIFIED

Ameresco identified several opportunities related to the function of the HVAC system. The HVAC system could benefit from recommissioning to reduce inefficiencies and allow the system to work more effectively. The lighting system can be upgraded by removing the fluorescent lighting and replacing them with LED to lower the electricity use of the facility. Many exterior doors are in disrepair and require at least weatherstripping and more likely full replacement. There are noticeable gaps through which conditioned air escapes and outside air infiltrates. Opportunities to reduce water use are present within the facility as only a few of the bathrooms have been recently upgraded.

The windows in a portion of the building are single pane with insulated panels installed above the glazing. The single pane windows should be replaced since they have reached the end of their useful life and are increasing the load on the HVAC system and reducing comfort of the students and the teachers. This section is not always conditioned but in the future it could be. The roof requires replacement which is a significant investment. Ameresco recommends that the following systems be upgraded:

Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Interior LED Lighting Retrofits	\$ 366,000	\$ 13,500	\$ 7,300
Lighting Controls Upgrades	\$ 27,000	\$ 700	\$ -
Parking Lot Lighting	\$ 11,000	\$ 200	\$ 200
Plumbing Upgrades	\$ 41,000	\$ 2,800	\$ 400
Envelope Weatherization	\$ 54,000	\$ 3,400	\$ -
DDC Master Systems Integration, RCx & Replacements	\$ 154,000	\$ 11,600	\$ -
Gym Cooling	\$ 150,000	\$ -	\$ -
Windows	\$ 294,000	\$ 4,500	\$ -
Roofing Replacements	\$ 2,663,000	\$ 7,400	\$ -

DAVIES HIGH SCHOOL

BUILDING CONDITION

Davies High School is the newest high school in the district. The building HVAC is provided by ground source heat pumps year-round with multiple AHUs and RTUs throughout the building.

The facility currently has fluorescent lighting that should be upgraded to LED. The exterior lighting is HID, which are high energy fixtures. The windows are all energy efficient. The school has a full-size pool, large indoor gymnasium, performance arts center and auditorium, and large library. The exterior doors are in good condition and have useful life into the future. A Siemen's building automation system controls the building's HVAC operations.

The roof is EPDM construction and is in good shape. The bathrooms have efficient plumbing fixtures and are ADA compliant.

EUI COMPARED TO INDUSTRY AVERAGE

Davies High School has an EUI of 47. According to CBECS an average K-12 school has an EUI of 58.2. This is higher than industry average, however, there still exists opportunities for energy cost reduction via an energy project.



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OPPORTUNITIES IDENTIFIED

Ameresco identified several opportunities with lighting and the buildings HVAC system. The HVAC system will benefit from the replacement of the heat pump units with new high efficiency units. We recommend upgrading the facility fluorescent lighting to LED lighting. Pool cost savings can be generated from a liquid pool cover. This safe technology has been successfully used elsewhere and retains heat and water. In addition, chlorine generators should be considered which converts salt into chlorine lowering chemical treatment costs. The windows are in great shape and efficient. The roof is in good condition. The irrigation system has potential for additional savings through irrigation controls and efficient sprinklers. Ameresco recommends that the following systems be upgraded:

Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Interior LED Lighting Retrofits	\$ 565,000	\$ 37,200	\$ 11,300
Lighting Controls Upgrades	\$ 42,000	\$ 3,900	\$ -
Sports Field Lighting (High Schools)	\$ 252,000	\$ 2,600	\$ 7,600
Parking Lot Lighting	\$ 89,000	\$ 3,100	\$ 1,800
Plumbing Upgrades	\$ 63,000	\$ 2,200	\$ 600
Envelope Weatherization	\$ 84,000	\$ 2,500	\$ -
Liquid Pool Cover	\$ 9,000	\$ 7,600	\$ (4,000)
Chlorine Generators	\$ 165,000	\$ -	\$ 19,300
DDC Master Systems Integration, RCx & Replacements	\$ 237,000	\$ 10,700	\$ -
WSHP	\$ 6,278,000	\$ 23,800	\$ 23,300
Irrigation	\$ 14,000	\$ 400	\$ -

NORTH HIGH SCHOOL

BUILDING CONDITION

The North High School building (288,000 ft²) was constructed in 1965 with the most recent addition/renovation completed in 2007. The envelope of the facility is in fair condition, although several exterior doors and the roof above the Spartan Dome should be scheduled for replacement. Much of the building's HVAC systems were replaced during a 2002 renovation project. Several packaged RTUs and Dx-split systems are beyond their useful service lives. The 420-ton air-cooled chiller is in fair condition as it approaches its useful life as well. The building automation systems is primarily JCI Metasys, although there remains some Siemens and pneumatic controls in use. The lighting systems has a mix of high-efficiency LED exit signs and exterior wall packs, otherwise the use of standard-efficiency T-8 fluorescent fixtures and HID fixtures are in service. Restroom plumbing fixtures utilize standard-efficiency faucets and flush valves.

EUI COMPARED TO INDUSTRY AVERAGE

North has an EUI of 84 kBtu per ft². According to CBECS an average K-12 school has an EUI of 58.2. The fact that North has both indoor and outdoor pool facilities (which are energy intensive operations) should be noted when considering its EUI score. The site's recent annual utility cost for electric water and gas was \$456k and the energy cost index (or ECI, which excludes water) was \$1.50/sf/year.



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OPPORTUNITIES IDENTIFIED

Ameresco identified several opportunities with lighting, HVAC controls and improvements to the water fixtures and pools. The lighting system can be upgraded by removing the fluorescent lighting and replacing them with LED retrofits to lower the electricity use of the facility. Pool cost savings can be generated from a liquid pool cover. This safe technology has been successfully used elsewhere and retains heat and water. In addition, chlorine generators should be considered which converts salt into chlorine lowering chemical treatment costs. Ameresco recommends that the following systems be upgraded:

Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Interior LED Lighting Retrofits	\$ 635,000	\$ 32,700	\$ 12,700
Lighting Controls Upgrades	\$ 43,000	\$ 1,300	\$ -
Sports Field Lighting (High Schools)	\$ 180,000	\$ 1,200	\$ 5,400
Parking Lot Lighting	\$ 23,000	\$ 500	\$ 500
Plumbing Upgrades	\$ 65,000	\$ 4,400	\$ 600
Envelope Weatherization	\$ 86,000	\$ 5,600	\$ -
Liquid Pool Cover	\$ 9,000	\$ 6,500	\$ (3,900)
Chlorine Generators	\$ 165,000	\$ -	\$ 18,400
DDC Master Systems Integration, RCx & Replacements	\$ 245,000	\$ 20,900	\$ -
Demand Control Ventilation	\$ 12,000	\$ 2,600	\$ -
RTU Savings	\$ 128,000	\$ 1,300	\$ 1,000
Split System Replacements	\$ 68,000	\$ 200	\$ 300
Roofing Replacements	\$ 814,000	\$ 5,600	\$ -
AHUs	\$ 580,000	\$ 2,900	\$ -
Motor Replacements	\$ 10,000	\$ 400	\$ -

SOUTH HIGH SCHOOL

BUILDING CONDITION

The 317,000 ft² South High School was built in 1967 and the latest addition/renovation was performed in 1986. Original portions of the building have similar construction as North High School. Much of the building's envelope is in fair to poor condition. High priority repairs include replacement of the dome-roofing system and several exterior entry and overhead doors. Roofing sections covered with pea-gravel over BUR (built-up roofing) (including indoor pool roof) are in fair to poor condition and should be planned for replacement soon. Similarly, the double-pane aluminum framed windows should be planned for replacement.

The building's HVAC systems need significant upgrades/replacements. AHUs in the tunnel, industrial arts and dome-gym areas are original equipment that should be replaced. Chiller replacements are currently under contract by others. The RTUs and Dx splits have exceeded their useful lives. Despite their age, the scotch marine steam boilers are in good condition. The steam fired DHW heater has significant rust corrosion and should be replaced. The building automation systems are primarily Andover DDC, although there are some Siemens and pneumatic controls in use as well. The lighting systems are comprised of high-efficiency LED exit signs and exterior wall packs, otherwise standard-efficiency fluorescent and HID fixtures are in use. Restroom plumbing fixtures utilize standard-efficiency faucets and flush valves. We noted that in Pool Electrical room T-1 that IT equipment is mounted directly above the 45kVA transformer. Relocation of that IT equipment is recommended to extend its service life.

EUI COMPARED TO INDUSTRY AVERAGE

South has an EUI of 79 kBtu per ft². According to CBECS an average k-12 school has an EUI of 58.2. The fact that facility has both indoor and outdoor pools (which are energy intensive operations) should be noted when considering its EUI score. The site's recent annual utility cost for electric water and gas was \$506k and the ECI was \$1.56/sf/year.



Continued on next page

OPPORTUNITIES IDENTIFIED

Ameresco identified several opportunities with lighting, HVAC controls and improvements to the water fixtures and pools. The lighting system can be upgraded by removing the fluorescent lighting and replacing them with LED retrofits to lower the electricity use of the facility. Pool cost savings can be generated from a liquid pool cover. This safe technology has been successfully used elsewhere and retains heat and water. In addition, chlorine generators should be considered which converts salt into chlorine lowering chemical treatment costs. The AHUs in the tunnels could have significant energy savings from sealing the ducts.

Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Interior LED Lighting Retrofits	\$ 698,000	\$ 34,000	\$ 14,000
Lighting Controls Upgrades	\$ 48,000	\$ 1,300	\$ -
Sports Field Lighting (High Schools)	\$ 96,000	\$ 600	\$ 2,900
Parking Lot Lighting	\$ 89,000	\$ 1,800	\$ 1,800
Plumbing Upgrades	\$ 71,000	\$ 4,200	\$ 700
Envelope Weatherization	\$ 95,000	\$ 5,500	\$ -
Liquid Pool Cover	\$ 9,000	\$ 6,700	\$ (3,900)
Chlorine Generators	\$ 165,000	\$ -	\$ 18,400
DDC Master Systems Integration, RCx & Replacements	\$ 269,000	\$ 20,800	\$ -
Demand Control Ventilation	\$ 12,000	\$ 2,700	\$ -
RTU Savings	\$ 124,000	\$ 3,200	\$ 800
Split System Replacements	\$ 60,000	\$ 200	\$ 300
Roofing Replacements	\$ 814,000	\$ 5,800	\$ -
Solar PV - (2.2MW) Rooftop	\$ 5,675,000	\$ 90,800	\$ -
Duct Sealing	\$ 211,000	\$ 27,800	\$ -
AHUs	\$ 3,076,000	\$ 3,600	\$ 4,800
Motor Replacements	\$ 28,000	\$ 600	\$ -

EXPLORER ACADEMY

BUILDING CONDITION

Explorer Academy is a 3-year-old, 2-story building. They have energy efficient LED lighting throughout the building. Heating and cooling are provided by five (5) 4-pipe variable air volume (VAV) air handling units (AHUs). One (1) air-cooled chiller with a capacity of 110 tons provides chilled water to the AHUs. Hot water is provided by two (2) condensing, hot water boilers with a capacity of 1,880 MBH each. An autonomous controls system directs their heat and cooling equipment and is currently using Siemens controls. The windows throughout the building are double pane windows and are in good condition. The roof is a built-up, EPDM system with access via roof hatch through a door in the attic/mechanical room.



EUI COMPARED TO INDUSTRY AVERAGE

Explorer Academy has an EUI of 80.2. According to CBECS the average k-12 school has an EUI of 58.2. This does not compare favorably with the industry average and shows that there may be room for improvement despite the school being new.

OPPORTUNITIES IDENTIFIED

The facility currently has LED lighting throughout and there are no opportunities for improvement. Opportunities to reduce water use are not currently present within the facility as the bathrooms have been recently upgraded. Ameresco recommends the following upgrades:

Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Plumbing Upgrades	\$ 10,000	\$ 1,000	\$ 100
Envelope Weatherization	\$ 14,000	\$ 1,100	\$ -
DDC Master Systems Integration, RCx & Replacements	\$ 39,000	\$ 2,200	\$ -

TROLLWOOD PERFORMING ARTS CENTER

MOORHEAD, MINNESOTA



BUILDING CONDITION

Trollwood was built in 2008 and operating efficiently just across the ND-MN border in Moorhead. The building is in good condition with exposed beams and an open floorplan. The common spaces have decorative indirect LED lighting. Rooms use common 2x4 LED fixtures and the building's HVAC system is comprised of heat pumps using R-410A as its working fluid. R-410 is beginning to be phased out by the Environmental Protection Agency (EPA). The plumbing shows opportunities for efficiency improvements. The site is currently irrigated and has an opportunity to reduce water consumption.

EUI COMPARED TO INDUSTRY AVERAGE

Trollwood has the lowest EUI of all FPS buildings at 18 kBtu per SF. According to CBECS the average k-12 school has an EUI of 58.2. The HVAC system is very efficient, and the building does not use gas for space heating. Propane is used for cooking and most recently they purchased 270 gallons at \$1.83 per gallon. There are limited opportunities to save energy and most equipment is in good condition.

OPPORTUNITIES IDENTIFIED

Water saving could reach 20% with smart irrigation and low-flow faucet aerators. Both water savings opportunities are inexpensive and effective to save money over the long term. In addition, there are opportunities to replace the domestic hot water heating system with a more efficient unit.

Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Plumbing Upgrades	\$ 11,000	\$ -	\$ 100
Envelope Weatherization	\$ 14,000	\$ 300	\$ -
DDC Master Systems Integration, RCx & Replacements	\$ 41,000	\$ 700	\$ -
Irrigation	\$ 14,000	\$ 600	\$ -

DISTRICT OFFICE BUILDING

BUILDING CONDITION

The District Office Building is an approximately 30-year-old, 2-story building. They have LED lighting throughout the building. Heating and cooling are provided by three (3) 4-pipe variable air volume (VAV) air handling units (AHUs). Three (3), air-cooled Aeon condensing units provide cooling to the AHUs with a combined capacity of 165 tons. Hot water is provided by two (2) non-condensing hot water boilers with a capacity of 1,517 MBH each. An autonomous controls system directs their heat and cooling equipment and is currently using Siemens controls. The windows throughout the building are double pane windows and are in good condition. The roof is a rock ballast system with access via exterior door located in the attic mechanical room.



EUI COMPARED TO INDUSTRY AVERAGE

The District Office has an EUI of 184.0. According to CBECS the average office building has an EUI of 67.3. This does not compare favorably with the industry average for offices and shows that there is great opportunity for improvement at energy management.

OPPORTUNITIES IDENTIFIED

We identified several opportunities related to the function of the HVAC system. The system requires retro commissioning to reduce inefficiencies and allow the system work more effectively. The facility currently has LED lighting throughout and is not a suitable candidate for lighting replacement. The current boilers would provide a great benefit by upgrading to a high-efficiency condensing boilers. Opportunities to reduce water use are not currently present within the facility as the bathrooms have been recently upgraded.

Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Plumbing Upgrades	\$ 10,000	\$ 1,900	\$ 100
Envelope Weatherization	\$ 13,000	\$ 2,700	\$ -
DDC Master Systems Integration, RCx & Replacements	\$ 37,000	\$ 9,000	\$ -
Boiler Replacement	\$ 273,000	\$ 6,900	\$ 1,500

OPERATIONS CENTER

BUILDING CONDITION

The Operations Center was built in 2016. The equipment is original and in good condition. There is a large commercial cooler and freezer to receive food and a kitchen to prep FPS cafeteria food. The building is mostly tall, open ceilings for warehouse storage. There are two Aerco 1500 condensing boilers. There is a scroll chiller and remote condenser on the roof with an RTU for office spaces. The building has LED lighting, and the building envelope is in good condition and energy efficient.



EUI COMPARED TO INDUSTRY AVERAGE

The Operations Center has an EUI at 79 kBtu per SF. According to CBECS the average office building has an EUI of 67.3. The EUI is high compared to other buildings in the district, but considering the commercial refrigeration and conditioned warehouse space, it is better than average. Also, the equipment is in good condition and less than 10 years old, there is no need to replace or update in the near future.

The Ops Center spent \$5k in water and wastewater over a 12-month period.

OPPORTUNITIES IDENTIFIED

One of the boilers and pumps were on to keep the heating water at 120° for reheat. Setpoints could be adjusted to save significant boiler heat and pumping energy in the summer months.

Measure Description	Cost Estimate (+/- 10%)	Utility Savings Estimate (\$/yr)	Operational Savings Estimate
Plumbing Upgrades	\$ 15,000	\$ 1,400	\$ 200
Envelope Weatherization	\$ 20,000	\$ 1,500	\$ -
DDC Master Systems Integration, RCx & Replacements	\$ 57,000	\$ 5,200	\$ -



ECM Descriptions

INTERIOR LED LIGHTING RETROFITS

Ameresco recommends lighting retrofit, and in some cases fixture replacements, to replace inefficient lighting with new high efficiency light-emitting diode (LED) lighting technologies. These upgrades lead to dramatic reductions in energy use, improved light quality and reduced O&M costs. We will perform a full room by room lighting audit to determine the best solution for each space.

As an example, T-8 and T12- fluorescent fixtures are often used as the primary lighting source in many commercial buildings. Re-lamping these fluorescent fixtures with linear LED tube lamps provides a cost-effective means to reduce fixture wattage by 40% or more, while providing consistent illumination levels and reducing lamp replacement cycles.

Ameresco has successfully upgraded fluorescent lighting to LED lighting at numerous facilities.

This measure will provide an optimized solution that could include:

- Retrofit/replacement of HID or fluorescent fixtures with LED lamps/fixtures
- Retrofit of existing fluorescent fixtures with LED lamps
- Replacement of incandescent and CFLs bulbs with LED lamps
- Installation of reflectors where appropriate
- De-lamping of fixtures where appropriate
- Replacement of CFL and incandescent exit signs to LED fixtures
- Cleaning of dirty fixture lenses during retrofits
- Replacement of broken lenses as necessary
- Providing a spare lamp inventory for future use



LIGHTING CONTROLS

OCCUPANCY SENSORS

This measure consists of installing infrared and/or ultrasonic lighting occupancy sensors in many spaces with intermittent occupancy patterns during the facility's normal operating schedule. Energy savings are achieved by automatically turning lighting fixtures off during times when the space is unoccupied. The controlled lights will automatically turn back on whenever occupancy is sensed within a space. Generally speaking, the uses of occupancy sensors are not recommended unless you have at least 25% of "off time" when people are not around.

DAYLIGHTING CONTROLS

The addition of daylight harvesting controls will be considered in areas where adequate natural lighting is available. These controls automatically dim the electric lighting systems to maintain adequate lighting levels based on the availability of natural light in the space served. Ameresco will evaluate the applicability of these controls in areas with significant daylighting fenestrations to determine if they will be an effective energy saving strategy.

EXTERIOR LIGHTING CONTROLS

Ameresco will evaluate the existing exterior lighting control systems to look for opportunities to add motion sensor, photocell, and time clock controls.

SPORTS FIELD LIGHTING

This measure will replace the HID sports lighting fixtures at the high schools with new LED fixtures specialized and designed for outdoor athletic facilities and ball fields.

PARKING LOT LIGHTING

This measure includes retrofitting and/or replacing the existing fixtures with new, high-efficiency LED technologies which will improve visual acuity, improve illumination in areas where security cameras are located, while reducing utility and maintenance costs.

PLUMBING UPGRADES

The district's restroom fixtures are typically comprised of 1.6 gallon per flush (gpf) water closets, 1.0 gpf urinals and 2.0 gpm lavatory faucets. Ameresco recommends retro commissioning existing water closet flush valves to ensure they are operating as intended, replacing urinal flush valves with 0.5 gpf units to reduce water use while utilizing the existing porcelain, and replacing the faucet aerators with 0.5 gmp units for water and domestic how water savings. The objective of this approach is to save utility expense and increase the performance of existing plumbing fixtures while avoiding the cost of full fixture replacement.

ENVELOPE WEATHERIZATION

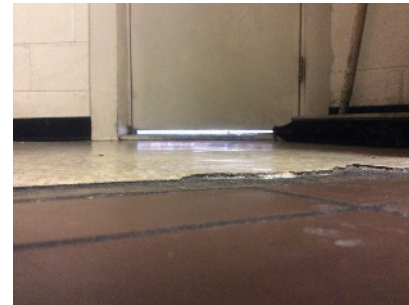
Pressure differences driven by wind and the chimney (or stack) effect cause air to move through gaps in a building's envelope. This uncontrolled air leakage can affect the integrity of the envelope through moisture migration, increases HVAC system loads, and adversely impacts thermal comfort.

Control of air leakage involves the sealing of gaps, cracks and holes using appropriate materials such as fire retardant, polyurethane foam, caulks, and appropriate weatherization materials. The goal is to create a continuous plane of "airtightness" to completely encompass the building envelope.

Ameresco will perform an envelope audit to evaluate opportunities to reduce air leakage. Typical areas buildings involved under this measure include door frames and thresholds, window frames, electrical/mechanical penetrations through walls, and roof-wall joints.

LIQUID POOL COVER

Roughly 70% of a pool's heating load is due to pool surface evaporation losses. Ameresco recommends utilizing liquid pool covers, which eliminate the need deploy and retract a fabric cover while providing similar energy and water savings benefits.



CHLORINE GENERATORS

Pools have to be chemically treated to prevent the spread of waterborne germs. Currently most pools are treated with chlorine in the form of hypochlorite tablets or other chloride compounds. The costs of these chemicals can be significant as well as other safety issues with the storage of such chemicals. Ameresco recommends installing on-site chlorine generators which only require salt as a raw material. The cost of salt for this system is approximately 1/10 the cost of other chloride chemicals and is safer to store.

DDC MASTER SYSTEMS INTEGRATION, RCX AND REPAIRS

MASTER SYSTEMS INTEGRATION SERVICES

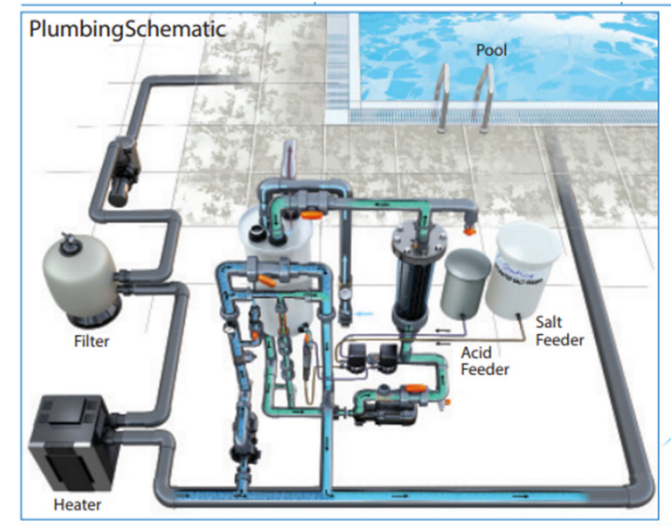
Master Systems Integration (MSI) Services are being offered to help the district unify approximately seven disparate BAS in order to increase ease of use and extend the useful life potential of the legacy systems. This process includes creating a unified front-end and graphical user interface on an open-source integration platform allowing for scheduling, sequencing of operations, consistent addressing, increased efficiency.

SCHEDULING AND PROGRAMMING STANDARDIZATION

This scope of work would be employed in parallel with the MSI work and includes programming and scheduling changes to the existing BAS system to unify the district on a set standard. This would make all changes possible within the existing systems capabilities with a focus on creating standard occupancy schedules, standardizing setpoints, and standardizing industry best practice energy savings programs (within constraints of the existing systems.)

RETROCOMMISSIONING (RCX) SERVICES

RetroCommissioning Services are being offered to help the district address existing facility operations issues including but not limited to non-optimized sequences of operation, inaccurate or failed sensors, incomplete sensor arrays, and out-of-calibration sensors and/or actuators. This process systematically optimizes the energy performance of HVAC and control systems in existing buildings. RCx activities includes on-site check-out of the HVAC equipment to ensure all sensors, actuators, pumps, valves, etc. are operating as intended. This effort will provide the district with a report of findings and recommendations with cost impacts to address them. In



most cases, these fixes will reduce energy consumption and/or improve comfort. This complete scope of work is described in Appendix C.

RCX REPAIR BUDGET/ALLOWANCE

Ameresco believes in limiting surprises and collaborative decision making. We recommend to all our customers that they plan to carry a repair budget to go along with any retro commissioning project. This funding is to be spent only at the client's discretion, but it enables for issues to be fixed in real-time as they are found and dramatically improves the outcome in our experience. These budgets are indicative and not a guarantee that they will be needed or are enough to cover all potential problems discovered during the study.

BAS REPLACEMENT & STANDARDIZATION

Ameresco believes in the BACnet standard and recommending controls system manufacturers that have the most end customer-focused business models. When evaluating a control system manufacturer, we recommend our customers evaluate the systems for at least the following attributes.

- BACnet: Is the system a Native BACnet control system and does the manufacture submit regular updates to the BACnet testing laboratory.
- Dealer Network Rules: Understanding of the rules that the manufacturer operates in terms of dealer network. This includes but is not limited to-
 - Will I have multiple dealers/service providers that I can hire?
 - Will I be able to own all software tools to program my system?
- Planned Obsolescence: Past 10-year history of product line. Did the manufacturer obsolete any hardware or software during that time?
- Fees: Ongoing licensing fees of hardware or software. If present, disclose the costs up front.

SCOPE OF WORK

The school district will have a combination of building controls needs, and if choosing to move forward with complete controls replacements, appropriate budgeting should consider site conditions. The per square foot budgeting contained in this proposal is representative of other K-12 sites where we have completed projects in the last 12-24 months. We assume that all new communication cabling will have to be run, that conduit will be needed in boiler/mechanical rooms, and in classrooms if running surface mount, and that no major asbestos or other impediments exist for normal installation. We have provided a pricing range to accommodate for variations in site conditions and installation schedules. Pricing is broken out by building size and whether new valves and installation thereof are needed for hydronic systems.

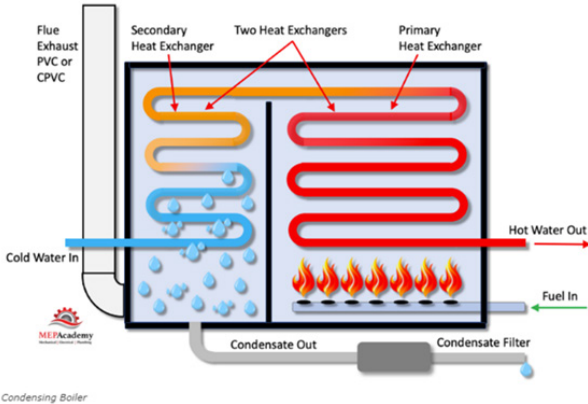
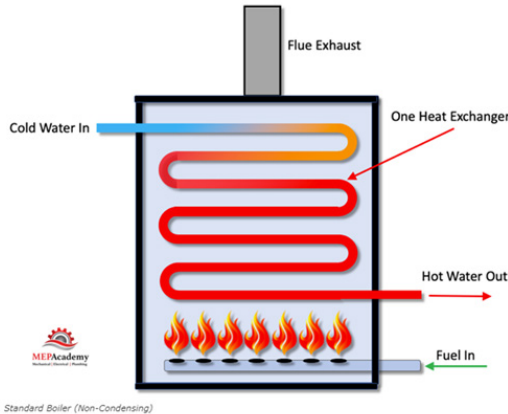
BAS Replacement Matrix (\$/ft2)

Size ↑	Large	\$3.20	\$5.85	\$6.00	\$7.75
	Medium	\$3.55	\$6.05	\$6.25	\$8.00
	Small	\$3.75	\$6.25	\$6.50	\$8.50
		Low	High	Low	High
		No Valves		With Valves	

Note: Other than the unit-costing table above, we have not included the estimated cost for BAS Replacements in the energy project summary.

DEMAND CONTROL VENTILATION

Ameresco recommends adding carbon-dioxide (CO2) based demand-controlled ventilation to the dome gymnasiums at North and South High Schools to automatically adjust outside air ventilation rates based on space utilization.



BOILER REPLACEMENT

Ameresco recommends replacing the existing standard boilers throughout the school district with condensing boilers. Condensing boilers are more efficient and typically require less space while providing the same amount of hot water needed for heating.

CHILLER REPLACEMENT

This facility improvement measure will replace older chillers utilizing R22 refrigerant with more efficient units utilizing readily available refrigerants.

RTU REPLACEMENT

This ECM involves replacing older, less efficient (<10 SEER) packaged roof top unit HVAC equipment with new high efficiency RTU equipment (> 14 SEER). Several of the existing RTUs have R-22 as a refrigerant which is no longer produced and expensive to replace. New high efficiency RTUs have newer refrigerants which can also lower operation and maintenance costs.

SPLIT SYSTEM REPLACEMENT

This ECM involves replacing older, less efficient (<10 SEER) split system (SS) direct expansion (DX) HVAC equipment with new high efficiency SS equipment (> 14 SEER). Several of the existing SSs have R-22 as a refrigerant which is no longer produced and expensive to replace. New high efficiency RTUs have newer refrigerants which can also lower operation and maintenance costs.

GYM COOLING

Ameresco has identified four community gyms that were not used in the summer because of the heat. Cooling the gyms would allow FPS to use this space an extra 3 months per year. Typically, a 20-ton packaged unit would provide cooling, but additional design and value engineering is required to fully understand the scope of work required at each gym. For instance, Longfellow Elementary School has the chilled water coil already in-place. The scope here includes control valves and piping the chilled water to the existing coil and updating building automation. The other gyms have heating-only units and most likely better to replace with a new RTU instead of retrofitting old equipment with a new cooling coil.

WATER SOURCE HEAT PUMP REPLACEMENT

There are four schools identified at FPS that have end-of-life water-source heat-pumps. There are hundreds of heat pumps at the 20-year expected service life and some are starting to fail. The heat pumps may work for a while longer, but Ameresco recommends a full-building change out to minimize unexpected failures (unexpected and higher costs for emergency repairs). The energy savings is not expected to pay for the upgrade, however the cost to repair R-22 heat pumps and replace them one-by one can be a daunting task for the staff. Planning and interruptions can be minimized when updating all at once.

IRRIGATION EFFICIENCY

There are irrigation controls available to limit city water used for lawns. Ameresco has identified the top three irrigation water users in the district to provide smart water controllers to skip watering days during rain and forecasted rain. An irrigation control would include the following functionality:

- New Wi-Fi enabled front-end controller
- Flow monitoring and alarming for leak detection
- Cloud-based central monitoring, control and remote access from PC, laptop, phone, etc.
- Local weather connected – forecasting to reduce water consumption

WINDOW EFFICIENCY UPGRADES

The replacement of single pane or failed windows that have been observed to have outside air infiltration and poor conductivity with new and efficient double pane windows increasing the comfort of the occupancy and the efficiency of the HVAC system.

ROOFING INSULATION UPGRADES

When a roof requires replacement, this ECM provides additional insulation for the roof reducing the amount of heating and cooling lost through the roof and increasing space comfort.

SOLAR PV ROOFTOP

The installation of solar panels on the roof of schools to offset their current electrical usage through the production of renewable energy.



DUCT SEALING

The tunnel AHUs at South HS were noted to be quite leaky. We recommend the application of Aeroseal's duct sealing products to correct this condition.

AHU REPLACEMENT

Several AHUs at South High Schools and other sites were noted to have exceeded their useful lives. This facility improvement measure will replace these AHUs. Note that this FIM includes allowances to replace the Leakey medium-pressure ductwork in the South HS tunnels.

MOTOR REPLACEMENT

This ECM will replace standard efficiency motors with NEMA-Premium efficiency motors.



Conclusion

This preliminary energy assessment report (Prelim) has investigated, identified, and evaluated district-wide energy and operational cost savings opportunities. The findings in this report complement the district-wide investigation work addressed in the Ameresco's facility condition assessment, HPM's educational adequacy study, and SEH Engineering's Architectural and ADA compliance investigation.

This Prelim evaluated specific energy conservation measures (ECMs) and capital or facility improvement measures (FIMs) identified in district's facilities. The ultimate goal is to optimize and enhance the classrooms with upgrades to students environmental and learning spaces. The district can leverage energy savings while possibly and effectively using less capital improvement project (CIP) funds to address the infrastructure needs of its school facilities.

This prelim study has identified several options showing a mix of energy and O&M savings with a corresponding capital expenditure for different bundles addressing district needs while significantly improving their energy efficiency. The summary table below and the options detailed showing the potential of energy project bundling. Additional engineering investigation and design work are required to secure final and fixed costs.

Ameresco is proud to present this preliminary energy assessment to the Fargo Public School District. The implementation of an energy project will allow the district to reduce their energy consumption while address aging equipment replacement needs all while leveraging the energy cost savings to fund the project. Implementation of an energy project will also assist Fargo Public Schools with its greenhouse gas emissions, GHG, and reducing an overall carbon footprint.

Ameresco appreciates Fargo Public Schools for its selection of our Team to complete this study and report. We look forward to serving you in the future as you move forward with your goals.

Option A	Option B	Option C	Option D	ECM Description	Project Costs	Utility Savings	O&M Savings	Capital Contribution Needed for 15 Yr Payback
X	X	X	X	Interior LED Lighting Retrofits	\$ 4,706,000	\$ 214,000	\$ 94,000	
				Lighting Controls Upgrades	\$ 414,000	\$ 16,000	\$ -	
X	X	X	X	Sports Field Lighting (High Schools)	\$ 528,000	\$ 5,000	\$ 16,000	
X	X	X	X	Parking Lot Lighting	\$ 305,000	\$ 8,000	\$ 6,000	
X	X	X	X	Plumbing Upgrades	\$ 656,000	\$ 45,000	\$ 7,000	
X	X	X	X	Envelope Weatherization	\$ 875,000	\$ 51,000	\$ -	
X	X	X	X	Liquid Pool Cover	\$ 28,000	\$ 21,000	\$ (12,000)	
X	X	X	X	Chlorine Generators	\$ 494,000	\$ -	\$ 56,000	
X	X	X	X	DDC Master Systems Integration, RCx & F	\$ 2,480,000	\$ 154,000	\$ -	
X	X	X	X	Demand Control Ventilation	\$ 24,000	\$ 5,000	\$ -	
	X	X	X	Boiler Replacement	\$ 1,428,000	\$ 30,000	\$ 8,000	
	X	X	X	Chillers	\$ 687,000	\$ 6,000	\$ 12,000	
	X	X	X	RTU Savings	\$ 394,000	\$ 7,000	\$ 3,000	
	X	X	X	Split System Replacements	\$ 392,000	\$ 2,000	\$ 2,000	
	X	X	X	Gym Cooling	\$ 1,365,000	\$ -	\$ -	
		X	X	WSHP	\$ 15,414,000	\$ 55,000	\$ 57,000	
X	X	X	X	Irrigation	\$ 57,000	\$ 2,000	\$ -	
			X	Windows	\$ 2,573,000	\$ 25,000	\$ -	
			X	Roofing Replacements	\$ 5,883,000	\$ 23,000	\$ -	
				Solar PV - (2.2MW) Rooftop	\$ 6,664,000	\$ 104,000	\$ -	
X	X	X	X	Duct Sealing	\$ 211,000	\$ 28,000	\$ -	
		X	X	AHUs	\$ 3,655,000	\$ 6,000	\$ 5,000	
		X	X	Motor Replacements	\$ 38,000	\$ 1,000	\$ -	
Total for Projects in Option A					\$ 10,365,000	\$ 533,000	\$ 167,000	
Total for Projects in Option B					\$ 14,630,000	\$ 578,000	\$ 192,000	\$ 3,085,000
Total for Projects in Option C					\$ 33,737,000	\$ 640,000	\$ 254,000	\$ 20,331,000
Total for Projects in Option D					\$ 42,193,000	\$ 688,000	\$ 254,000	\$ 28,071,000

Option A – Represents a self-funding project that is paid for through savings and O&M costs over a 15-year period.

Option B – Represents the combination of capital contribution plus energy savings by addressing all of Option A and in addition replacing much of the immediate HVAC replacement needs currently identified in the district.

Option C – Represents all of Option B with the inclusion of WSHP replacements at multiple schools as well as AHU and motor replacements identified during the preliminary site visits. The capital contribution represents avoided costs for district since these are expenses that are expected to occur within the next five years

Option D – Represents all of Option C with the inclusion of energy efficient windows and roofs that are currently in need of replacement. These are also avoided costs as these windows and roofs already require replacement and are expected to occur in the next five years.



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