Benefits

Reduced electricity consumption

Reduced water expenses

Positive occupant feedback due to newer equipment throughout the district

Potential rebates for equipment

Window Replacement

ECM Summary

The installation of new, energy efficient, windows will reduce the amount of heat lost to the exterior through better insulation. The installation of new windows will also ensure proper sealing around the windows reducing the amount of air leaking into the building. All of these benefits will save energy and increase occupant comfort.

Facilities Recommended for this Measure

Administration Building

Ocean Township Elementary School

Wayside Elementary School

Scope of Work

There are several spaces throughout each building which the District has identified as good candidates for window replacement. These windows were identified based on the age of the equipment and complaints throughout the building occupants. These windows are mostly original to the buildings and are schedule to be replaced in the next few years as part of the capital plan.

Administration Building second floor windows

Ocean Township Elementary School stairwell windows

Wayside Elementary School courtyard windows

For all windows the general scope of work is as follows:

Remove and dispose of existing windows, sills, insulated panels, associated blocking, and trim.

Existing lintels will be cleaned and prepared for re-finishing.

Existing lintels are to receive a high performance paint coating

New, architectural grade, thermally broken, pre-finished aluminum double-pane windows are to be installed

Provide new solid polymer sills at each new window

Benefits

Natural gas energy savings

Improved occupant comfort

Improved aesthetics of the building

Improved humidity control

Infiltration Reduction

ECM Summary

Infiltration drives energy costs higher by allowing unconditioned outside air to enter the building, thus adding to the building load and causing additional unnecessary heating and cooling loads. Each building within the scope was surveyed in order to identify potential improvements for outside air infiltration reduction. The main observations are listed below:

Air pathways through exterior doors, windows and roof / wall intersections allow air to infiltrate the buildings directly

The building chases (electrical, mechanical, etc.) allow air to freely flow through parts of the structure

Some soffit areas are open to the exterior

These deficiencies mostly reflect the skin of the buildings which have either existed since original construction of the building, were added during some retrofit periods, or were caused by deterioration.

Facilities Recommended for this Measure

Administration Building

Ocean Township High School

Ocean Township Intermediate School

Ocean Township Elementary School

Wanamassa Elementary School

Wayside Elementary School

Scope Narrative

Significant quantities of air infiltration into the buildings were discovered during the envelope survey period at the Ocean Township Board of Education. The facilities were found to be in a mixed set of conditions in regard to infiltration losses, mostly due to age and maintenance issues. Our team attempted to go into every room of every school, however due to class schedules we were unable to visit every classroom of every school. All observations given in this report are from areas with free access.

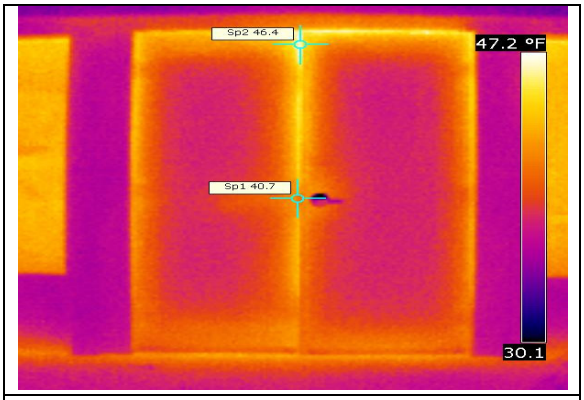
Roof-wall seams in Wayside Elementary School were found to be leaky and require spray foam to remediate the issue. Window sealant was found to be in failing in many facilities and replacement sealant is recommended. Door systems were found to be the largest areas of air infiltration. Almost every entrance double door needed one of the following: weather strip, sweeps and astragals. A few entrance doors had a set of vestibule doors just feet away to help stop unconditioned air flow. Vestibule doors should stay shut and many doors would benefit from adding sweeps, weather strip and astragals. Numerous penetrations through the building envelope, on all the structures, is also a contributing factor to energy loss and air in-filtration/ex-filtration.

Administration Building

The Administration Building is a three story 34,000 square feet structure with a brick exterior wall. The largest area of air infiltration is around entrance doors on all sides of the building. Weather strip, door sweeps and astragals (where applicable) are either, worn and damaged or missing all together. These should be replaced to reduce unwanted air in-filtration/ex-filtration. To maintain the attic area as an unconditioned space, R-30 insulation is recommended above the drop ceiling throughout the building. Failing sealant around almost all windows was observed during the assessment. Sealant replacement is recommended to reduce energy loss. Several penetrations from light fixtures, wall hydrants, electrical conduit, outlet boxes and key pad access units should be sealed. A few A/C units were discovered and it is recommended these units be covered or removed during the heating season.

Administration Building

Door # 7



Energy loss around door # 7

Conduit penetration requiring sealant

Sealant failure around windows

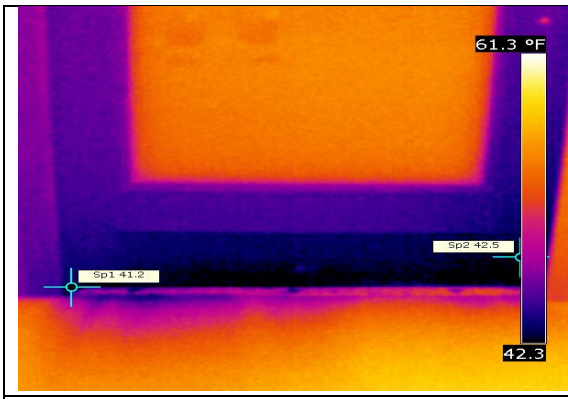
Sealant recommended at wall crack

Sealant recommended at wall crack

Ocean Township High School

Ocean Township High School is a two story 200,215 square feet school with a brick exterior wall. The largest area of air infiltration is around entrance doors on all sides of the building. Weather strip, door sweeps and astragals (where applicable) are either, worn and damaged or missing all together. These should be replaced to reduce unwanted air in-filtration/ex-filtration. Sealant failure was observed on a couple large windows. Sealant replacement is recommended for these areas to reduce energy loss. Several penetrations from light fixtures, wall hydrants, electrical conduit, outlet boxes, cameras, speaker boxes and key pad access units should be sealed.

Door # 1 (front entrance)

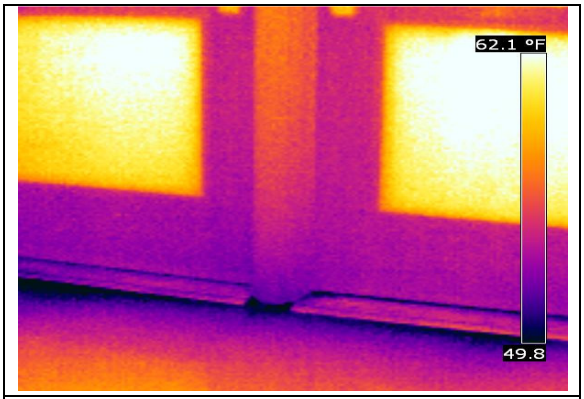


Energy loss under door # 1

Penetration requiring sealant

Penetration requiring sealant

Door # 3

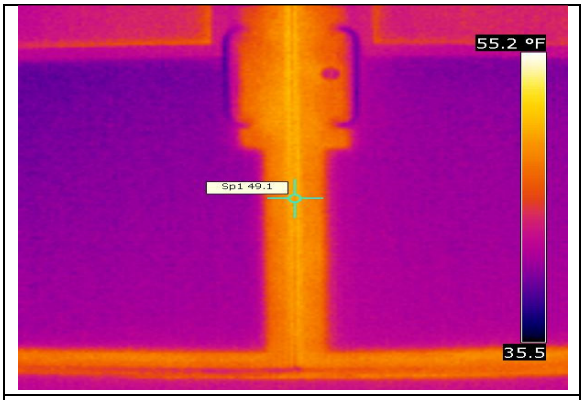


Energy loss under door # 3

Ocean Township Elementary School

Ocean Township Elementary School is a two story 76,160 square feet school with a brick exterior wall. The largest area of air infiltration is around entrance doors on all sides of the building. Weather strip, door sweeps and astragals (where applicable) are either, worn and damaged or missing all together. These should be replaced to reduce unwanted air in-filtration/ex-filtration. Sealant failure was observed along the bottom of several windows. Sealant replacement is recommended for these areas to reduce energy loss. Several penetrations from light fixtures, wall hydrants, electrical conduit, outlet boxes, cameras, speaker boxes and key pad access units should be sealed. Wall cracks should be sealed to prevent unwanted air in-filtration/ex-filtration.

Door # 1 (front entrance)



Energy loss around door # 1

Sealant recommended under A/C unit

Recommend sealant for wall crack

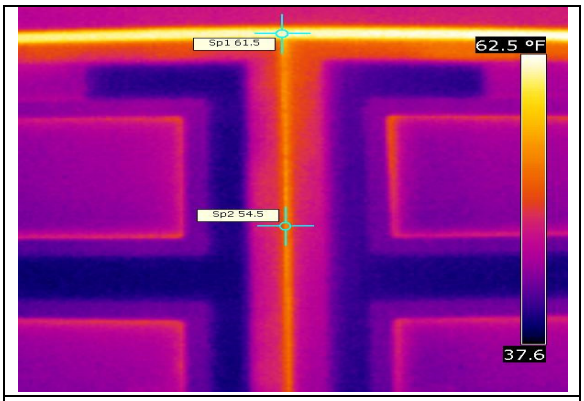
Sealant recommended for blank opening

Sealant recommended for wall crack

Ocean Township Intermediate School

Ocean Township Intermediate School is a two story 257,400 square feet school with a brick exterior wall. The largest area of air infiltration is around entrance doors on all sides of the building. Weather strip, door sweeps and astragals (where applicable) are either, worn and damaged or missing all together. These should be replaced to reduce unwanted air in-filtration/ex-filtration. Vestibule doors would also benefit from weather strip and sweeps. Sealant failure was observed on a few windows. Sealant replacement is recommended for these areas to reduce energy loss. Several penetrations from light fixtures, wall hydrants, electrical conduit, outlet boxes, cameras, speaker boxes and key pad access units should be sealed. Wall cracks should be sealed to prevent unwanted air in-filtration/ex-filtration.

Door # 22



Energy loss around door # 22

Sealant failure around window

Sealant recommended for wall crack

Penetrations requiring sealant

Sealant recommended around speaker

Wanamassa Elementary School

Wanamassa Elementary School located at is a two story 59,580 square feet school with a brick exterior wall. The largest area of air infiltration is around entrance doors on all sides of the building. Weather strip, door sweeps and astragals (where applicable) are either, worn and damaged or missing all together. These should be replaced to reduce unwanted air in-filtration/ex-filtration. Sealant failure was observed on a few windows. Sealant replacement is recommended for these areas to reduce energy loss. Several penetrations from light fixtures, wall hydrants, electrical conduit, outlet boxes, cameras, speaker boxes and key pad access units should be sealed. Wall cracks should be sealed to prevent unwanted air in-filtration/ex-filtration.

Wanamassa Elementary School

Door # 1

Energy loss around door # 1

Sealant recommended at penetration

Sealant recommended at wall crack

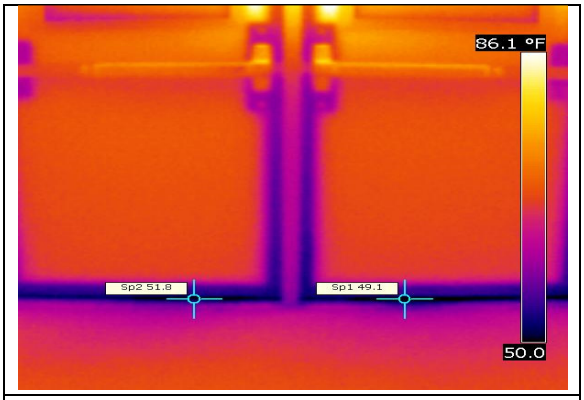
Sealant recommended around vent

Sealant recommended at wall crack

Wayside Elementary School

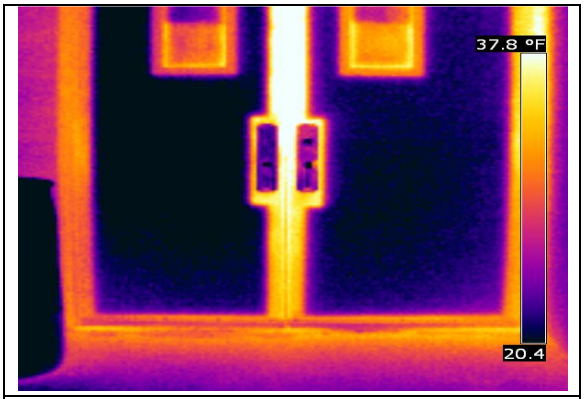
Wayside Elementary School is a one story 147,375 square feet school with a brick exterior wall. The largest area of air infiltration is around entrance doors on all sides of the building. Weather strip, door sweeps and astragals (where applicable) are either, worn and damaged or missing all together. These should be replaced to reduce unwanted air in-filtration/ex-filtration. Sealant failure was observed on a few windows. Sealant replacement is recommended for these areas to reduce energy loss. Several penetrations from light fixtures, wall hydrants, electrical conduit, outlet boxes, cameras, speaker boxes and key pad access units should be sealed. Wall cracks should be sealed to prevent unwanted air in-filtration/ex-filtration. Roof/wall seams in the multi-purpose and gym were found to be leaky and we recommend spray foam to properly seal this gap.

Door # 1



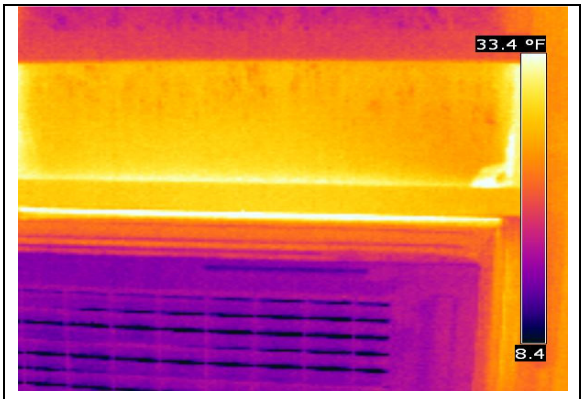
Energy loss around door # 1

Door # 33



Energy loss around door # 33

Window A/C unit



Energy loss around A/C unit

Scope of Work

Weather-Stripping – Door Sweeps

After the weather-stripping is installed, the doors will be aligned, balanced and tested for proper operation. The weather-stripping/sweep should be inspected annually. Components can be replaced as needed.

Door weather-stripping material is referred to as DF, which references DF Commercial/ Industrial weather-stripping. The reference to DS is for the door sweep material, which is also a Commercial/ Industrial product. All weather-stripping materials shall have a mill finish, unless otherwise specified.

Items listed as weatherization are not included in energy efficiency calculations.

SEALANTS

Polyurethane Sealants:

Polyurethane sealant will be installed in all wall cracks, concrete cracks, mortar cracks, control joints, and exterior applications unless otherwise specified.

Polyurethanes are usually considered better than silicones for most common exterior building applications. We will be installing a polyurethane sealant that adheres to most common construction materials without primers, offers long service life under severe climate conditions, excellent shear resistance, exceptional elasticity, resists sagging and is non-toxic when cured. Polyurethane sealant becomes tack-free within eight hours and cures fully in about a week. It can be painted, but the paint will not expand or contract with the sealant and may crack or peel.

Type: One-component, ultra-low moisture curing, fast skinning, commercial grade sealant; *DAP Premium Polyurethane Concrete and Masonry* Sealant, as manufactured by DAP Corporation, or equal.

Compliance: Sealant shall meet or exceed requirements of these standards:

1. ASTM C920, Type S, Grade NS, Class 50, Use NT, M, A, and O.

Silicone Sealants:

Silicone sealant will be installed for all silicone weather-strip application, for capping the exterior edges of any EPDM glazing gaskets, and for sealing joints between non-porous surfaces such as metal and glass unless otherwise specified.

Although silicones are often considered extremely durable, the bonding characteristics of most silicones are not as good as polyurethanes. We will install silicone sealant for adhering weather-strip when specified, for capping the exterior edges of any EPDM glazing gaskets, and for sealing joints between non-porous surfaces such as metal and glass.

Type: One-component, ultra-low modulus, neutral-cure silicone rubber sealant; *Dow Corning®* 790 Silicone Building Sealant, as manufactured by Dow Corning Corporation, or equal.

Compliance: Sealant shall meet or exceed requirements of these standards:

1. ASTM C920, Type S, Grade NS, Class 100/50, Use T, NT, G, M, A, and O.
2. GSA CID A-A-272A.
3. GSA CID A-A-1556.

Administration Building

Quantity	Envelope Improvements
1.40	Sq/ft - Penetrations sealed with polyurethane sealant
2199	LF - Wall cracks, window/door frames and vents sealed with polyurethane sealant
24	Sets of weather-strip DF
24	Door sweeps
5	Astragals (weather-strip for center of double door)
4,731	Sq/ft - Batt insulation over drop ceiling-R-30
2	Sets of weather-strip DF (OH Door)
2	Door sweeps (OH Door)

Ocean Township High School

Quantity	Envelope Improvements
1.41	Sq/ft - Penetrations sealed with polyurethane sealant
573	LF - Wall cracks, window/door frames and vents sealed with polyurethane sealant
95	Sets of weather-strip DF
95	Door sweeps
32	Astragals (weather-strip for center of double door)

Quantity	Weatherization/Preventative Maintenance
4	Sets of weather-strip DF
4	Door sweeps
2	Astragals (weather-strip for center of double door)

Ocean Township Elementary School

Quantity	Envelope Improvements
1.37	Sq/ft - Penetrations sealed with polyurethane sealant

2059	LF - Wall cracks, window/door frames and vents sealed with polyurethane sealant
35	Sets of weather-strip DF
35	Door sweeps
10	Astragals (weather-strip for center of double door)

Ocean Township Intermediate School

Quantity	Envelope Improvements
1.74	Sq/ft - Penetrations sealed with polyurethane sealant
255	LF - Wall cracks, window/door frames and vents sealed with polyurethane sealant
66	Sets of weather-strip DF
66	Door sweeps
24	Astragals (weather-strip for center of double door)
2	Sets of weather-strip DF (OH Door)
2	Door sweeps (OH Door)

Quantity	Weatherization/Preventative Maintenance
12	Sets of weather-strip DF
12	Door sweeps
6	Astragals (weather-strip for center of double door)

Wanamassa Elementary School

Quantity	Envelope Improvements
1.96	Sq/ft - Penetrations sealed with polyurethane sealant
110	LF - Wall cracks, window/door frames and vents sealed with polyurethane sealant
33	Sets of weather-strip DF
33	Door sweeps

10	Astragals (weather-strip for center of double door)

Wayside Elementary School

Quantity	Envelope Improvements
1.20	Sq/ft - Penetrations sealed with polyurethane sealant
60	Sets of weather-strip DF
60	Door sweeps
15	Astragals (weather-strip for center of double door)
585	LF - Spray Foam Roof/Wall Seam

Quantity	Weatherization/Preventative Maintenance
12	Sets of weather-strip DF
12	Door sweeps
2	Astragals (weather-strip for center of double door)

Ocean Township BOE – Overall Scope of Work

Quantity	Envelope Improvements
9.08	Sq/ft - Penetrations sealed with polyurethane sealant
5196	LF - Wall cracks, window/door frames and vents sealed with polyurethane sealant
313	Sets of weather-strip DF
313	Door sweeps
96	Astragals (weather-strip for center of double door)
585	LF - Spray Foam Roof/Wall Seam
4	Sets of weather-strip DF

4	Door sweeps
4,731	Sq/ft - Batt insulation over drop ceiling-R-30

Quantity	Weatherization/Preventative Maintenance
28	Sets of weather-strip DF
28	Door sweeps
10	Astragals (weather-strip for center of double door)

Savings Methodology

The energy savings derived from this measure are a result of the heating and cooling systems (chillers and boilers) not having to work as hard to achieve the desired environmental conditions. The amount of savings is dependent on the existing building conditions and the amount of air leakage under the current operating conditions.

Energy savings are based on the ASHRAE crack method calculations. If the process reveals any variation in the as-built conditions, then savings will be adjusted accordingly. Determination of air current air leakage rates is based on many factors, including:

Linear feet of cracks

Square feet of openings

Stack coefficient

Shield class

Average wind speed

Heating or cooling set point

Average seasonal ambient temperatures

Savings due to infiltration reduction:

The following equation is based on the ASHRAE crack method:

Heat loss per hour: $\dot{q}$ = 1.08 x Q x ΔT

Where Q represents the airflow in cubic feet per minute (CFM) and is calculated in the following manner:

$$Q = A_{crack} \times \sqrt{(C_s \Delta T + C_w V^2}$$

In this equation, A_{crack} represents the crack area in square inches to be reduced. The other values in the equation are standard for these buildings and are based on shelter class, height, and local wind speed.

Cw = wind coefficient = 0.0104 average

V = wind speed = 8.8 average mph

Cs = stack coefficient = 0.0299 (two-story typical)

ΔT = temperature difference = Tout – Tin

ΔT is calculated by subtracting the average outdoor air temperature per hour from the indoor temperature, using 24 data points per month to accurately account for weather variances, and subsequently calculating airflow and heat loss for each set of data. Therefore, 288 data points are used, and Δt is the number of hours each data point represents. The total heat loss is calculated as follows:

$$q = \sum_{x=1}^{288} 1.08 \times A_{crack} \times \sqrt{C_s (T_{out} - T_{in}) + C_w V^2} \times (T_{out} - T_{in}) \times \Delta t$$

Maintenance

After the building envelopes have been improved, operations and maintenance should be reduced, due to improved space conditions and lower humidity during the cooling season. The maintenance staff should maintain the newly installed equipment per manufacturers' recommendations. The manufacturer specification sheets will be provided for exact maintenance requirements.

Benefits

Electrical energy savings

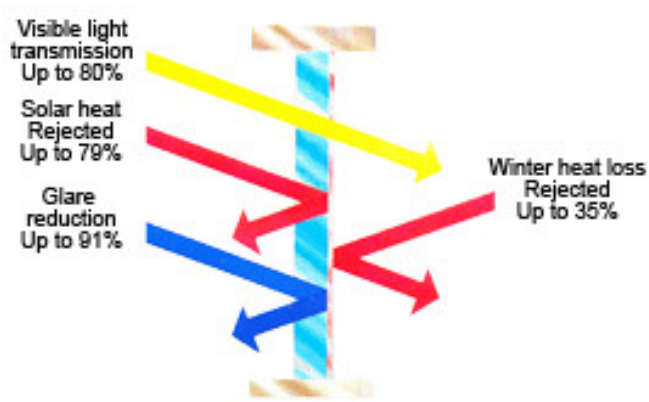
Fuel energy savings

Increased thermal comfort

Window Film

ECM Summary

Window film stops the heat gain/loss on the glass. The air conditioned areas of the buildings are fitted with exterior windows that allow infrared radiation heat gains in the summer and heat loss in the winter. This measure proposes the installation of window film on the interior side of the windows to prevent further energy loss.



Facilities Recommended for this Measure

Ocean Township High School

Scope of Work

Provide all labor, management, equipment and materials to safely install Solar Control Film on courtyard and bridge windows

Furnish all necessary floor protection and ladders to gain access to all areas

All equipment will be used accordance with the OSHA standards.

Savings Methodology

Savings for the window film will be completed by changing the glass type within the eQuest model for the High School.

Maintenance Requirements

Maintenance requirements will be identified by the manufacturer upon successful award of bids.

Benefits

Improves overall system efficiency

Rejects heat in the summer

Keeps heat in the winter

Domestic Hot Water Fuel Conversion

Energy Conservation Measure Summary

Due to the high cost of electricity compared to natural gas, heating domestic hot water electrically becomes very expensive. These units should be replaced with natural gas-fired domestic hot water heaters in order to achieve utility cost savings.

Facilities Recommended for this Measure

Ocean Township Elementary School

Scope of Work

The hot water heaters at Ocean Township Elementary School are electric model and are recommended to replace with natural gas fired unit to achieve utility cost savings

In order to install the new gas-fired water heater, new gas piping will have to be run to the unit from the gas main located in the adjacent boiler room. In addition, a new flue stack will need to be installed per the manufacturer's recommendations. Based on the layout of the mechanical room, the new gas piping and exhaust flue should be feasible.

Hot Water Heater Location	Quantity	Manufacturer	Max Wattage	Recommended for Replacement
OTES - Boiler Room	1	American Water Heater Company	4.500	Yes
OTES - Basement	1	A.D. Smith	1,500	No
OTES - Kitchen	2	Bradford White Corporation	4,500	Yes
OTES – Kitchen	1	Mar-Fro Industries	4,500	Yes

Scope of Work

Provide labor, materials, tools, and supervision to perform the following:

Remove existing electric domestic water heater

Pipe new natural gas lines to tie into existing lines

Startup and 1 year warranty service

Water heaters to match existing size and BTUs

Insulation of piping

New electric service to burner

Training for personnel

Savings Methodology

The savings for the electric to gas hot water heater conversion were calculated using the following methodology. The hot water consumption was compared to the overall water use in order to calibrate the baseline water and provide realistic savings calculations from the fuel switch.

Existing Heater:

Existing Heater		
Btu Needed to Heat Water [HWB]	=	DHW Gallons x Specific Heat x 8.34 Conversion Constant x ΔT
Input HW Btu [HW IN]	=	HW IN / (Combustion Efficiency – Cycling Losses)
Skin Losses (SL)	=	Nameplate Input Capacity x 0.5% x 8760 hrs / yr
Loop Losses (LL)	=	Nameplate Input Capacity x 3.0% x 1920 hrs / yr
Input Needed to Recover Losses (Loss IN)	=	(SL + LL) / (Combustion Efficiency – Cycling Losses)
Annual Consumption in Btu	=	Input HW Btu + Input Needed to Recover Losses

For electric hot water heaters the combustion efficiency is 100% and the typical cycling losses are 1%.

Proposed Heater:

Proposed Heater		
Btu Needed to Heat Water [HWB]	=	DHW Gallons x Specific Heat x 8.34 Conversion Constant x ΔT
Input HW Btu [HW IN]	=	HW IN / (Combustion Efficiency – Cycling Losses)
Skin Losses (SL)	=	Nameplate Input Capacity x 0.5% x 8760 hrs / yr
Loop Losses (LL)	=	Nameplate Input Capacity x 3.0% x 1920 hrs / yr
Input Needed to Recover Losses (Loss IN)	=	(SL + LL) / (Combustion Efficiency – Cycling Losses)
Annual Consumption in Btu	=	Input HW Btu + Input Needed to Recover Losses

The gas-fired hot water heaters have a combustion efficiency of 85% and the typical cycling losses are 1%.

In the case of the fuel switch, the utility rates result in cost savings. The conversions from Btu to electric and Therms of natural gas areas are as follows:

1 Therm	=	100,000 Btu
1 kWh	=	3,413 Btu

Maintenance Requirements

Maintenance requirements will be identified by the manufacturer upon successful award of bids.

Benefits

Utility cost savings

Capital improvements to heating equipment

Demand Response

A detailed analysis of the Demand Response opportunity for Ocean Township Schools is included in Appendix 3 of this report.

Facilities Recommended for this Measure

Ocean Township High School

Ocean Township Intermediate School