Performance Evaluation and Sustainability Assessment

Rye Public Works Building

Rye, New Hampshire

June 2009

Prepared for:

Town of Rye
10 Central Road
Rye, NH 03870

Prepared by:

anix, LLC
4 Margaret Lane
Lee, NH 03861

Acronyms and Abbreviations

ADA	American Disabilities Act
AFUE	Annual Fuel Utilization Efficiency
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigeration, and Air-Conditioning Engineers
AT/FP	Antiterrorism / Force Protection
BTU	British Thermal Unit
cf	Cubic Feet
CFM	Cubic Feet per Minute
CIP	Cast-In-Place
CMU	Concrete Masonry Unit
DoE	United States Department of Energy
EB	Existing Building
EER	Energy Efficiency Rating
EPA	United States Environmental Protection Agency
GWP	Global Warming Potential
HVAC	Heating, Ventilation, and Air-Conditioning
IBC	International Building Codes
IBCC	International Building Code Council
IEBC	International Existing Building Code
IECC	International Energy Conservation Code
IESNA	Illuminating Engineering Society of America
IR	Infra-Red
LEED	Leadership in Energy and Environmental Design
LPG	Liquefied Propane Gas

MEP	Mechanical, Electrical, and Plumbing
M&V	Measurement and Verification
MASB	Minimum Antiterrorism Standards for Buildings
MERV	Minimum Efficiency Rating Value
NC	New Construction
NEC	National Electrical Code
NFPA	National Fire Protection Association
NG	Natural Gas
O.C.	On Center
ODP	Ozone Depletion Potential
PESA	Performance Evaluation and Sustainability Assessment
psi	Pounds per Square Inch
SEER	Seasonal Energy Efficiency Rating
sf	Square Feet
UFC	Unified Facilities Criteria
USGBC	United States Green Building Council
UST	Underground Storage Tank
VRFZ	Variable Refrigerant Flow Zone
VAV	Variable Air Volume
WBDG	Whole Building Design Guide

Table of Contents

Figures

Exhibits

1.0 INTRODUCTION

Forward

Buildings constructed prior to 2003 likely do not comply with current energy efficiency standards for new buildings. In 2003, the *International Energy Conservation Code* (IECC) was developed and adopted by most state and municipal building regulators. The IECC was revised in 2009 which defines new standards including more efficient mechanical equipment and thermal performance of building envelopes.

Through diligent evaluation and enhancement of existing buildings and systems, overall building performance and sustainability can be improved substantially. Enhancements to the building will result in reduced consumption of non-renewable energy resources, improved occupant comfort, and reduced impacts to land, water, and air resources.

Purpose

Under an existing contract with the Town of Rye to perform Comprehensive Energy Audits, anix, LLC completed a building Performance Evaluation and Sustainability Assessment (PESA) of the Public Works Facilities Buildings located at 309 Grove Road in Rye, New Hampshire.

The primary objectives of this task are: 1) to evaluate the overall building performance as defined by energy consumption and building integrity; 2) to assess the overall sustainability of the building components and infrastructure; and, 3) provide recommendations that improve building performance and occupant comfort. Consistent with these objectives, the following general scope of this PESA includes: reviewing historical records and existing building drawings; visual inspection of the building components and systems and photographic documentation (Exhibit A); a thermal imaging survey of the building envelope (Exhibit B); and, evaluation and assessment of the building components and systems within the context of current building codes and industry standards.

On June 9th and 10th, 2009 anix completed a comprehensive inspection of the Public Works Facilities buildings. Results of this inspection and all information obtained are presented herein. This report also presents pertinent information gathered from a historical records review. Based upon the evaluation, recommendations are provided for consideration. A red flag ( ) symbol included the text body denotes a recommended action; these recommendations are tabulated in Section 6.0.

Relevant Codes and Standards

The following current building codes and industry standards are applicable to building performance and sustainability. Although determining total compliance with each code and standard is beyond the scope of this PESA, these serve as general guidelines for this building evaluation and assessment.

Table 1.1 – Relevant Codes and Standards

Current Code / Standard	Issuing Agency	Applicability
International Building Codes (IBC), 2006	International Building Code Council (IBCC)	Standards for building construction practices
International Energy Conservation Code (IECC), 2006	International Building Code Council (IBCC)	DoE recognized standard energy code
NFPA Standard 70, National Electrical Code (NES), 2008	National Fire Protection Association (NFPA)	Standards for electrical and life safety practices
NFPA Standard 101, Life Safety Code, 2009	National Fire Protection Association (NFPA)	Industry standard for life safety codes
NFPA Standard 5000, Building Construction and Safety Code, 2009	National Fire Protection Association (NFPA)	Industry standard for fire prevention requirements for new construction
American Disabilities Act (ADA), Title III (CFR 28 Part 36), 1994	U.S. Department of Justice (DoJ)	Building code requirements to accommodate disabled persons
ANSI/ASHRAE/IESNA Standard 90.1, 2007	American Society of Heating, Refrigerating and Air-Conditioning Engineers	DoE and USGBC recognized standard for mechanical and electrical systems
ANSI/ASHRAE Standard 62.1, 2007	American Society of Heating, Refrigerating and Air-Conditioning Engineers	DoE and USGBC recognized standard for ventilation systems
Energy Code for New Federal, Commercial and Multi-Family High-Rise Residential Buildings, 10CFR434.401, 2002	U.S. Department of Energy (DoE)	Older energy code for federal buildings (*currently under revision consistent with other referenced standards*)
ENERGY STAR® Guidelines for Energy Management, Buildings and Plants	U.S. Environmental Protection Agency (EPA)	Energy management program that defines processes to increase energy efficiency of commercial buildings
LEED® Reference Standard for New Construction and Major Renovation, v. 2.2, 2007	U.S. Green Building Council (USGBC)	Defines energy performance and sustainability standards required for LEED® certification of commercial buildings

Records Review

Historical records for the Public Works Facility buildings are limited and no original construction records are available. The following records were reviewed:

- Tax Assessment Records for the Public Works Building

Building Description and History

The Town of Rye Public Works facility is located at 309 Grove Road in Rye, New Hampshire (Figure 1). Main structures at the facility include a main Public Works Building, a recycling station, and a swap shop. There are several smaller structures including storage sheds, a fueling station, and an oil recycling station. The facilities are located within a 7.13 acre Town-owned parcel bounded by Washington Road to the northwest, Grove Road to the southwest, and residentially zoned properties to the northeast and southeast.

The Town acquired the land in 1904 and according to the tax records, the main Public Works Building was constructed in 1981. Based on observed conditions of the property, it is presumed that the historical property use has been primarily for public works activities including materials staging, equipment storage, and equipment maintenance operations.

Space Configuration and Use

The net conditioned area of the Public Works Building is approximately 6,100 square feet in area not including the open loft storage area. The loft storage area is approximately 496 square feet. Table 1.2 presents the estimated area based on the designated use for the Public Works building. Primary designated use spaces within the Public Works Facilities include office space, equipment maintenance, and storage.

Table 1.2 – Gross Floor Area by Use

Use Designation	Net Conditioned Area (sf)	% Gross Area
Office	80	1.2
Break Room / Dining	224	3.4
Storage (lower)	192	2.9
Storage (loft)	496	7.5
Equipment Maintenance	5,604	85.0
TOTAL:	6,596	100%

The majority of the building is used for vehicle and equipment maintenance including storage of equipment in the garage bays. It consists of five bay areas with overhead doors. The southeastern most bay is primarily used for repair and maintenance operations and the other four bays are used for equipment and vehicle storage. Bay No. 2 (looking at the front from left to right) is used to de-ice snowplowing equipment in the winter season.

Overall, the building space appears to accommodate the needs of the public works operations. Considerations for improving the space configuration include relocating the air-quality degrading maintenance operations that are presently completed in the main bay area (Bay No. 1) including welding, sanding, cutting, sand-blasting, painting, etc. into another bay. This would isolate the nuisance operations and minimize air pollutants to occupied spaces including offices, break area, and the lavatory. This is discussed further in Section 4.0, Indoor Air Quality.

2.0 BUILDING SYSTEMS PERFORMANCE EVALUATION

Envelope Integrity and Performance

The building envelope of the Public Works building was evaluated based on a visual inspection and a thermal imaging survey. Representative photographs are presented in Exhibit A and the infrared thermal survey report is presented as Exhibit B.

Foundation

No drawings were available but it presumed that the building is supported by a reinforced concrete shallow perimeter wall with spread footings. The concrete perimeter wall extends above grade approximately 36-inches and appears to be in satisfactory condition with no indications of settlement, cracking, or spalling.

Floors

The floor in the Public Works Building consists of a concrete slab-on-grade floor with a presumed thickness of 6-inches. Visual inspection of the concrete floor did not indicate any deficiencies.

Structural Members

The Public Works Building is a pre-engineered structure with steel members including roof joists, columns, girders, and lateral bracing. All steel members are coated with a primer and no deficiencies were noted including corrosion, gross deflection, or vertical misalignment.

Walls

With the exception of the office, storage rooms, lavatory, and break area, all perimeter walls are unfinished with exposed fiberglass batt insulation covering the metal panel siding. The concrete foundation wall extends approximately 3-feet from grade (lower wall section). Finished walls in the southwest rooms are covered with gypsum wallboard. Table 2.1 presents the perimeter wall sections for the Public Works Building.

Table 2.1 – Perimeter Wall Sections

Wall Location	Wall Section	Cavity Insulation
Garage Bays – Lower	6" Concrete wall	None
Garage Bays – Upper	Metal panel siding, 4" FGB w/ vapor barrier	FGB Batt
Southwest Rooms – Lower	6" Concrete wall, ¾" wood paneling	None
Southwest Rooms – Upper	Metal panel siding, 4" FGB w/ vapor barrier, 5/8" gypsum wallboard	FGB Batt

Legend: GWB = Gypsum Wall Board, EPS = Extruded Polystyrene, FGB = Fiberglass Batt

Ceilings

Most of the Public Works Building has exposed ceilings. Ceilings in the finished southwest rooms are suspended tile ceilings and gypsum board (break room). The ceiling tiles are extremely dirty indicating a substantial amount of airborne pollutants inside of the building (Photograph 45).

Roof

The Public Works Building roof was inspected to assess the existing condition. The roof consists of a low-pitch bolted galvanized metal panel system. Several repairs have been made to the roof and overall condition is poor (Photographs 76-85). Water leakage was evident and several failed repairs and corroded sections were noted (Photographs 77, 81, 84, and 85).

The roof system is nearly 30-years old which is the expected service-life for a low-pitch thin-gauge metal roofing system in the New England region. If the building is expected to remain in service for more than five years, then the existing metal roof system should be removed and replaced with a light colored anodized metal system. Insulation on a new roof should achieve a minimum R-value of 40. Other considerations for a new roof include installing translucent roof panels to improve daylighting to the building and to reduce interior lighting power requirements.

Windows and Glazing

Windows and glazed units in the Public Works Building are limited to two single double-hung windows on the southwest face (break room and office) and lights on the garage doors. The windows and garage door lights have very low thermal performance and UV ratings (IR Report pp. 5, 6, and 14). A window air-conditioning unit was installed in the break room window and it appeared to be in-place throughout the winter months (Photograph 3). It is recommended that all window units be removed during heating seasons to reduce air infiltration and heat loss from the building (IR Report p. 16).

Doors

Single entry doors are located on the southwest and northeast sides of the Public Works Building. The doors are solid steel panel units with insulated cores. Recommendations include adding new weather-stripping to reduce air infiltration as evidenced by the infra-red thermal images (IR Report pp. 10 and 15).

Exterior Siding and Trim

Condition of the metal panel siding and trim is in satisfactory condition and no deficiencies were noted. The siding appears to have been recently painted (with the exception of the northwest/rear face) and is in satisfactory condition.

Mechanical Systems

Heating

Heating in the Public Works Building is provided by an oil-fired furnace with air distribution (Photographs 12, 14, 20, 21, and 29). This unit provides heating to Bay No. 1 and the southwest rooms. According to Town personnel, the furnace is unreliable and frequently shuts-down when operating for extended periods. On the evening prior to the infra-red thermal camera inspection, the furnace was turned on and the thermostat was set at a high temperature to help provide better thermal deviation and imaging. Upon arrival the next morning, the furnace was not operating and apparently shut-down during the overnight.

The furnace unit is original to the building and is very inefficient with an estimated AFUE of 70%. Additionally, the poor combustion efficiency results in increased gas and particulate emissions to the atmosphere. The furnace is undersized for the current use which includes partial heating of Bay No. 2 through a hole in the partition wall to help deice snow removal equipment in the winter (Photograph 57). Furnace air filters are low-efficiency and extremely dirty indicating a high level of airborne particulates inside the building (Photographs 29 and 30). Replacement of the entire heating system is recommended including the furnace and all ductwork. Installing a new high-efficiency unit will provide a substantial reduction in energy consumption and operating costs.

A new heating system should consider space re-configuration of the Public Works Building and heating requirements for the adjacent bay areas including equipment deicing during snow removal operations.

Cooling

Cooling in the Public Works Building is limited to a single window-mounted air-conditioning unit in the break room – the unit is not EnergyStar® rated. If the Town elects to install cooling systems in the conditioned areas of the Public Works Building, a high-efficiency unit having a minimum SEER rating of 18 is recommended.

Humidity Control

No humidity control systems are located in the Public Works Building and based on the building use, humidity control is not required.

Ventilation

There is no mechanical outdoor air supply to the Public Works Building. Combustion air for the furnace is obtained from the building interior and from air leakage in the building envelope such as overhead door gaps. This current configuration results in poor indoor air quality resulting from recycled air and reduces the thermal integrity of the building envelope by introducing unconditioned air through gaps when there is a net negative pressure differential. Installation of a programmable heat-recovering ventilation unit is recommended for the conditioned spaces of the building. This unit should be integrated with the new heating system sensors and controls.

Exhaust ventilation in the conditioned spaces (Bay No. 1) is provided by a ceiling mounted fan in the roof (Photographs 35 and 36) and a ceiling-mounted exhaust fan located in the lavatory (Photograph 48). The ducting for the lavatory exhaust contains numerous bends thereby reducing the fan efficiency (Photograph 25) – installation of new rigid ducting with a direct routing to the exterior wall is recommended. An unvented ceiling suspended air filtration unit is located in Bay No. 1 to filter the indoor air during dust producing activities including sandblasting, grinding, and sanding operations (Photographs 39 and 40). The intake filter is extremely dirty and according to Town personnel, the unit is ineffective and is not used. Other considerations associated with building ventilation include installing a vehicle exhaust collection and venting system to prevent combustion emissions (e.g., carbon monoxide) from accumulating inside the building during vehicle repair operations.

Air filters on a heating/ventilation system should be equipped with high-efficiency filters having a MERV rating of 13 or better. Considering the volume of airborne particulates inside the building, filters should be cleaned or replaced monthly during the heating season.

Electrical Systems

Supply and Distribution

Electric is supplied to the Public Works Facilities buildings via overhead transmission lines with a mast located on the southwest corner of the building (Photograph 68). The main 200-amp service panel is located in the break room (Photograph 1). The older panel is missing some breakers / blanks and installation of blanks is recommended and required by code.

The Public Works Building metered usage on the date of inspection was 0.47 kW (Photograph 70) when no HVAC equipment was operating. Assuming that the usage was for lighting and plug loads only, it represents approximately 22% of the peak load capacity at 43 amps (110v) which is within the acceptable range.

Based on building operations, the number of receptacles may be inadequate – installation of additional receptacles may be warranted based on worker needs. Other considerations include installing GFCI protected receptacles in the Bay areas. This will provide protection in wet conditions inside the building from snowmelt and when extension cords are used outside of the building in wet conditions.

Lighting

Lighting fixtures in the Public Works Building consist primarily of ceiling and wall-mounted fluorescent lamp fixtures (Photograph 6, 32, and 33). Incandescent lamp fixtures are located in the southwest rooms and in the loft storage area above. Exterior lighting fixtures consist of sodium halide lamps with light-sensitive controllers (Photograph 64).

Fluorescent fixtures in the Main Public Works Building are very low-efficiency units. Lighting fixture recommendations include replacing or retrofitting all fluorescent fixtures with low-wattage ballasts and lamps, replacing all exterior sodium halide lamps with LED fixtures and lamps, and replacing all incandescent lamps with compact fluorescent lamps (CFLs). Other recommendations include installing motion-sensitive controls for interior lighting. Lighting upgrades are recommended in all buildings at the Public Works Facility including the recycling station and swap shop. PSNH offers a lighting retrofit program to help offset the capital cost of retrofitting fluorescent lighting fixtures.

Lighting power density (LPD) in the southwest offices is insufficient and new fixtures are recommended including low-wattage fluorescent units. LPD in the garage bays appears to be sufficient assuming that task lighting is available for repair activities such as vehicle maintenance. Potential improvements include replacing the wall-mounted fluorescent fixtures with LED units – this would improve task lighting and reduce energy usage. The lighting fixtures in the loft storage area should be on a separate zone so they can be operated independent of the main lighting zone thereby reducing energy use.

Appliances

Electrical appliances in the Public Works Building include a compact refrigerator, microwave oven, coffee-maker, television, water-cooler, ceiling fan, and window air-conditioning unit (Photographs 52 and 54). None of the appliances are EnergyStar® rated and future replacement of appliances should consider using EnergyStar® rated units.

Mechanical Equipment

Electrically powered mechanical equipment includes the furnace fan blower, the ceiling exhaust fan, an air compressor, a domestic hot-water heater, and the self-contained air filtration unit. Heating and ventilation recommendations include replacement of the furnace and a new ventilation unit. According to Town personnel, the filtration unit is ineffective and seldom used. If the unit is to remain in service then filter replacement and frequent cleaning is required to ensure effective removal of airborne particulates.

Electronics

Electronic equipment in the Public Works Building is limited to computer systems and printers.

Plumbing Systems

Water Supply and Distribution

Water for the Public Works Facilities is supplied from a public distribution system managed by a State regulated utility company (Aquarion Water, Inc.). Water supply is limited to the lavatory fixtures (sink and toilet) and the wash sink in Bay No. 1 (Photograph 46). No distribution system issues were noted and supply pressures appear adequate for the current uses.

Domestic Hot Water

Domestic hot water is provided by a 30-gallon electric tank unit. This unit is older and inefficient with little jacket insulation and no pipe insulation. Considering that the demand for hot water is limited to two sinks, this large inefficient unit should be replaced with a high-efficiency wall-mounted tankless unit.

The unit could easily be installed in the same location as the tank unit utilizing the same electric and plumbing connections.

Fixtures

Plumbing fixtures in the Public Works Building are limited to a wash sink, a single lavatory sink, and a toilet. All fixtures were in good working condition and no deficiencies were noted.

Sanitary Systems

Although no drawings were available, all sanitary wastes are presumed to drain to an on-site distribution system. Recommendations include annual cleaning and inspection of the tank and distribution system to ensure proper operation.

Hazardous Building Materials

Completion of a detailed building materials hazardous survey is beyond the scope of this evaluation, however, the following information is provided based on the building age and observations noted during the inspection. This is not intended to be a comprehensive listing and is provided as anecdotal information only.

Asbestos Containing Materials

Some common asbestos containing materials (ACMs) used in building construction prior to the mid-1970s include:

- Pipe insulation
- Refractory masonry
- Asphaltic roofing
- Flooring tiles
- Mastics and adhesives
- Window glazing compound
- Wall plaster
- Siding (transite)
- Piping (transite)

Considering the age of the Public Works Building and infrastructure, it is unlikely that any ACMs are present. No suspect ACMs were identified during the inspection.

Lead Paint

Considering the age of the Public Works Facilities buildings and infrastructure, lead-containing paint may be present. Prior to disturbing painted surfaces (sanding, grinding, cutting, and welding), painted surfaces should be tested for the presence of lead.

Mercury

Mercury containing devices in the Public Works Facilities building include fluorescent light bulbs. Used bulbs should be segregated for proper disposal/recycling.

PCBs
Many older fluorescent lighting ballasts were manufactured with PCB containing capacitors. All of the older fluorescent units (pre-1980) should be suspected to contain PCB capacitors. Removal of the fixture housing will reveal the capacitors and unless they are clearly marked “DOES NOT CONTAIN PCBs”, then it should be presumed that the capacitors do contain PCBs.

Impacted Soils – Organic Compounds
Considering the historical land-use at the Public Works facility, organic compound impacted soils may be present. Although no buried petroleum storage tanks were identified, older underground storage tanks (USTs) may exist on the site. It is recommended that historical records be reviewed and if any USTs are identified then they should be removed or abandoned in-place in compliance with NHDES regulations.

Current activities that can be a source of petroleum contamination include filling and storage of heating oil, storage of engine and hydraulic oils, handling and disposal of waste oils (engine, hydraulic, transmission), handling of waste fuels, and equipment fueling operations. Other organic compounds may be present in soils due to historical activities. Consistent with historical vehicle maintenance operations, potential sources include solvents, cleaners, lubricants, and engine anti-freeze. It is recommended that best management practices are implemented to minimize the potential release of all organic compounds.

3.0 BUILDING CODE COMPLIANCE
Although establishing compliance with current building code and regulatory requirements including the *International Building Code* (IBC) standards and the *American Disabilities Act* (ADA) is not the objective of this evaluation, following are some observations that may warrant further evaluation as part of planned building maintenance and alterations. Planned building renovations should also consider compliance with current and applicable building code standards, particularly the *International Existing Building Code* (IEBC, 2009) and all standards referenced thereto.

Building Systems

Insulation
The current building envelope insulation does not comply with current *International Energy and Conservation Code, 2009* (IECC, 2009) standards. Potential improvements to the thermal envelope are discussed further in Section 2.0.

Mechanical
No mechanical code issues were noted during the inspection.

Electrical
The existing electrical distribution was evaluated based on current *National Electrical Code* (NEC, 2008) standards. Specific issues noted during inspection include:

- Missing blanks/breakers on the main circuit panel in break room.

Plumbing
No plumbing code compliance issues were noted during the inspection.

Sanitary
Cleaning and inspection of the on-site sanitary storage and distribution should be completed annually.

Life Safety
Ceiling-mounted heat detection units are mounted in the Public Works Building (Photograph 24) and a fire alarm pull-box is mounted on the southeast corner of the building (Photograph 15). A fire alarm notification system is located in the building presumably providing a direct alarm to the Rye Fire Department (Photograph 2). Annual testing of the detection and notification systems by the Rye Fire Department is recommended.

Fire extinguishers are present in various areas of the building however some were missing from the identified stations (Photograph 33). Missing extinguishers should be replaced and additional larger capacity dry-chemical units are recommended in the garage bays where hot-work activities are performed.

ADA Compliance

Parking
Handicap accessible parking spaces were not identified during the inspection. Marked spaces are recommended at the recycling station.

Access and Egress
The raised thresholds on the two entry doors do not comply with ADA standards for wheelchair access.

Lavatory Facilities
The public lavatory in the Public Works Building does not comply with ADA standards for space and fixture accessibility.

Alarms
In addition to audible alarms, ADA requires that visual alarms are also present in occupied areas. No visual indication alarms such as strobe lights are located in the lavatory.

4.0 SUSTAINABILITY ASSESSMENT
Although based largely upon the building performance evaluation, the following sustainability assessment provides a more holistic approach to evaluating the site and building and assessing overall sustainability, which by implication, also measures building performance. Because much of the information is provided in the Performance Evaluation narrative, the reader should review that section to establish a competent understanding of the site, building, and all components.

This assessment is consistent with current industry sustainability initiatives and more specifically the intent of the U.S. Green Building Council (USGBC), *Leadership in Energy and Environmental Design*

(LEED) program. The following sections provide a qualitative assessment of the Public Works Building and a general description of recommended performance and sustainability enhancements.

Site

The Public Works Buildings and associated infrastructure are located within a 7.1 acre parcel of Town owned land. Current land use designations include the main Public Works Building, a recycling station, a swap shop, equipment fueling station, materials staging, and equipment storage (Figure 1).

Storm water within the Public Works Facilities site generally flows from the north to the south eventually collecting and infiltrating soils at the southeast portion of the site. No storm water drainage structures were identified at the site. Landscaped areas include bordering tree stands and several small vegetated islands consisting of scrub vegetation. Paved impermeable areas include the driveway and vehicle staging area for the recycling station at the southwest portion of the site – this represents approximately 1.2 acres.

Unstabilized exposed soils cover a large portion of the site (2.5 acres) increasing the potential for soils erosion by wind, storm water, and vehicle traffic. Because much of the exposed soils area is not being utilized, suggestions to improve site conditions include consolidating the footprint of the staging areas and operations to minimize the area of exposed soils. Remaining soil areas should be seeded with native, drought-tolerant grasses and groundcover to stabilize soils. Other recommendations to stabilize soils and improve storm water quality include constructing a rain garden at the lower elevation southeast portion of the site.

Water

Water is supplied to the Public Works Facilities by a State regulated private utility company (Aquarian Water, Inc.) and water is sourced from deep wells located within Rye and surrounding communities. Water usage for the Public Works Building includes the plumbing fixtures in the lavatory and the wash sink.

Specific measures to reduce water consumption on the fixtures include installing low-flow aerators on all sink faucets, installing a low-flow toilet (1.2 gallons per flush or less), and installing motion-sensitive controlled faucets. Installing a local tankless hot water heating unit to supply the lavatory and wash sinks will also reduce water consumption by providing instant hot water at the tap.

Energy and Atmosphere

Mechanical Systems

The existing oil-fired heating unit in the Public Works Building is very inefficient and requires frequent repair. Recommendations to improve system efficiency and occupant comfort include:

- Installation of a new oil or propane fired high-efficiency furnace unit, or, a geothermal system.
- Installation of new ductwork with insulation of R-10 or better.
- Installation of air filters with MERV of 13 or better.
- Installation of programmable thermostat with setback management and pre and post-occupancy ventilation.

- Installing a heat-recovering ventilation unit with carbon dioxide sensor/controls and automatic exhaust fan controls .

Domestic Hot Water

Potential improvements for domestic hot water supply include installing a single high-efficiency tankless unit to replace the tank heater. This would reduce energy consumption and water consumption by providing instant hot water at the tap . Additional benefit includes eliminating the heat loss from uninsulated distribution piping in wall cavities.

Thermal Envelope

The existing thermal envelope for the Main Public Works Building and the Office Trailer were constructed to comply with earlier code standards (c. 1980) and do not meet current code standards. The integrity of the envelope has been further degraded due to bird intrusion and nesting in the eaves (Photographs 67 and 71) and uninsulated wall and roof penetrations. Assembly descriptions and associated R-values for the Main Public Works Building floors, walls, and roofs are summarized in Table 4.1.

Table 4.1 – Main Public Works Building Thermal Envelope R-Values

Building Component	Assembly Description	Effective Assembly R-Value(1)
Floors	6" Concrete	0.5
Garage Bays – Lower	6" Concrete wall	1.3
Garage Bays – Upper	Metal panel siding, 4" FGB w/ vapor barrier	13
Southwest Rooms – Lower	6" Concrete wall, ¾" wood paneling	2.2
Southwest Rooms – Upper	Metal panel siding, 4" FGB w/ vapor barrier, 5/8" gypsum wallboard	12
Roof	4" FGB w/ vapor barrier, metal panel decking	13

(1) Assembly values include interior air films (0.68 for walls and 0.61 for ceilings) and exterior air films (0.17).

With an R-value of 1.3, the lower concrete walls provide substantial thermal transfer and should be improved. The most cost-effective method to achieve this is to apply 2-inches of foil-faced polyisocyanurate panels to the exterior of the wall . The rigid insulation would be covered with a durable veneer finish such as stucco finish or thin-brick with an aluminum cap flashing. This system would improve the thermal value of the wall assembly from R-1.3 to R-16.3.

Improving the insulation on the upper sections of the metal sided walls would be completed from the building interior. In the southwest office spaces with gypsum wallboard, expanding polyurethane foam insulation would be applied through a series of small holes in the gypsum wallboard . Improving the exposed walls in the garage bays would be completed by removing the existing FGB insulation and applying 8-inches of sprayed-on polyurethane insulation . This would improve the upper wall sections to an R-50. Additional benefits of the sprayed-foam include an air barrier, sealing of penetrations, and filling the eave cavities where birds currently nest.

As part of the recommended roof replacement, the existing FGB insulation would be removed and 8-inches of new sprayed-on polyurethane foam insulation would be applied directly to the underside of the new metal decking (R-50) . It is recommended that the roof be replaced prior to insulating the walls to ensure the most cost-effective approach.

Based on the condition of the existing entry doors, overhead doors, and windows, improving the seals and weather-stripping would substantially improve the building envelope by reducing air infiltration. Improving the overhead door seals would yield the greatest value as there are significant air-gaps on the sides of the doors (Photograph 60, and IR Report p. 6).

Renewable Energy Considerations

To explore potential renewable energy applications, the following table (Table 4.2) presents a preliminary evaluation of potential technologies that might be practically implemented for the Public Works Facilities buildings considering site constraints and building function. Each renewable energy application should consider economics including initial capital costs and future cost-savings as well as the feasibility of the application based on specific site and building characteristics.

All of the proposed renewable energy applications would improve the sustainability of the Public Works Building. With the exception of Green Grid Power, each technology poses unique risks with respect to function, operating costs, and future costs of nonrenewable energies including coal, gas, and oil. The one consistent consideration among all of the renewable technologies is that the larger scale the application, the more economically feasible it becomes.

Table 4.2 – Potential Renewable Energy Applications

Energy Application	Economic Considerations	Feasibility Assessment
Photovoltaic Systems	PV systems are relatively expensive and without significant State financial incentives, the ROI period is long.	Although the roof is not oriented to south, it is low pitch and PV panels could be installed on the roof – structural loading would have to be considered. Also, there is sufficient land and solar trajectory to install a ground-mounted system.
Solar Domestic Hot Water	Systems are relatively expensive due to installation of piping network and they have a substantial ROI period.	Considering that the domestic hot water demand is very low for the Public Works Building, the payback period would be significant.
Combined Heat and Power Systems	CHP or cogeneration systems are proven technology in the industrial sector. Systems are typically developed for large power demand industrial and commercial facilities.	Because the unit is powered by a combustion engine, noise and exhaust emissions for a large-scale unit are a concern considering the proximity to residential areas. And a large fuel storage tank would be necessary. An alternative small-scale system could be powered on the waste oil collected at the recycling facility.
Geothermal Heating/Cooling	Geothermal heating/cooling systems can be very cost-effective systems depending on site constraints and are very simple and proven technology. ROI in the New England area varies from 5-20 years for the additional costs associated with the wells and piping system.	The site is large enough to accommodate wells for a conventional geothermal system. An in-floor radiant system would be particularly efficient in the building based on use (vehicle maintenance and deicing) and configuration (high bay ceilings).
Wind Power	Small-scale wind power systems are very costly compared to the net energy savings. Systems are proving to be less efficient than expected in New England. They are more cost effective for large-scale power generation.	Wind towers would require a State permit and a Town zoning variance based on the height. The town-owned lands to the southeast may provide conditions favorable for a wind turbine – a feasibility study would be required.
Biomass Heating	Biomass systems can be cost effective	Technology for small-scale applications is

	assuming an endless supply of inexpensive biofuel. Future costs and availability of unconventional fuels is unknown.	relatively new. Biomass fuel is a commodity with limited availability and pricing may increase with demand.
Green Grid Power	Regulated power supply from private energy companies provided at a higher rate. No capital investment in technology that can become obsolescent. Can terminate agreement at anytime.	Energy is developed by alternative Green technologies including wind farms, hydroelectric, and PV farms. Typically requires a minimum contract term (1-2 yrs.).

Materials and Resources

Utilizing building materials with high recycled content, such as metal roof panels for the recommended roof replacement, would help to reduce the use of non-renewable resources. Other considerations for the Public Works Building include using organic, biodegradable solvents and degreasers, and low-VOC paints.

Indoor Environmental Quality

Heating and Cooling Venting

As discussed in Section 2.0, outdoor air supply to the Public Works Building is inadequate and increased ventilation would improve indoor air quality and occupant comfort. This is best achieved by adding a heat-recovering ventilation unit.

Humidity Control

Considering the size and use of the Public Works Building the addition of a humidity control system may not be prudent. Instead the heat-recovering ventilation system provides much greater value and will help to control relative humidity levels inside the building.

Lighting

Replacement or retrofitting of the existing fluorescent and incandescent fixtures will reduce reliance on electrical energy for the Public Works Buildings. As mentioned in Section 2.0, PSNH offers a program to help finance the cost of retrofitting existing fixtures. Other recommendations include changing all incandescent lamps to compact fluorescent lamps (CFLs), and installing motion sensitive controls on light switches in common areas such as lavatories, meeting rooms, kitchens, and offices. Exterior yard lighting fixtures can be replaced with low-wattage LED fixtures.

Daylighting

Daylighting within the Public Works Building is provided by operable window and overhead door units. Table 4.3 presents a summary of the window areas for each wall in the Public Works Facilities.

Table 4.3 – Daylighting Areas

Wall Orientation	Wall Area (sf)	Glazing Area (sf)	% Total
Northeast	700	0	0%
Northwest	1,708	0	0%
Southeast	1,708	120	7.0%
Southwest	700	12	1.7%
TOTAL:	4,816	132	2.7%

Minimum daylighting as defined by LEED standards require a minimum glazing factor of 2% in at least 75% of regularly occupied spaces. Therefore, the Main Public Works Building exceeds the recommended standards with a net window area of 2.7% of the total wall area.

Suggestions to improve daylighting and reduce lighting power densities in the garage bays include installing translucent panels on the new roofing system.

Radon Gas

Radon gas is a naturally occurring radioactive gas that is regionally present within the New England region. Radon gas can enter buildings through small cracks in the foundation walls and floors and accumulate in the indoor atmosphere. The Public Works Building does not contain a radon mitigation system – to ensure that radon concentrations are below the EPA threshold; annual radon testing is recommended.

VOCs

Storage of VOC containing liquids in the occupied spaces of the Public Works Building creates a potential hazard to building occupants (Photographs 13, 23, 33, 34, and 43). VOCs in liquids such as cleaners, paints, lubricants, fuel oils, and gasoline will volatize in the indoor atmosphere creating an inhalation hazard to occupants. Recommendations include either relocating all VOC liquids to a storage area located outside of the occupied spaces or installing negative pressure in a closed storage room.

Airborne Particulates and Gases

Operations in Bay No. 1include welding, torch cutting, sanding, grinding, painting and other activities that release particulates and gases into the occupied spaces including the southwest office areas. Exhaust ventilation for the space is poor and as evidenced by heating system filters and dust film throughout the office areas. To improve indoor air quality, the airborne dust and gas generating activities should be completed in a confined space with separate exhaust ventilation capable of providing negative pressure. Suggestions include constructing a partition wall to divide Bay No.1 from the southwest offices, constructing a smaller confined room in a portion of Bay No. 1, or reconfiguring Bay No. 2 to accommodate these activities. The most prudent option depends upon the space requirements of the users.

5.0 ENERGY MODELING

Method and Purpose

Using the eQUEST energy simulation program (v. 3.63), a more quantitative assessment of the Public Works Facilities energy consumption was completed. This simulation program is recognized and accepted by the U.S. Department of Energy (DoE), Energy Efficiency and Renewable Energy (EERE) program and the USGBC LEED program. Independent models were completed to provide a more accurate evaluation of energy performance based on the building configurations and the designated use. Local public utility rates for electric (Public Services of New Hampshire) were used in all simulations. Net electric costs are estimated at $0.14/kWh based on current PSNH small commercial rates. Heating oil pricing of $2.80 per gallon ($2.01/therm) based on current, averaged local market pricing is assumed. Natural gas and propane rates are $1.65/therm based on current Keyspan commercial rates.

It is noted that the eQUEST simulation program is somewhat limited when replicating conditions in existing buildings and that there are variables that must be assumed based on unknown building conditions and use characteristics. Therefore, the simulation model should be considered as a tool used to establish benchmark conditions to which building and systems enhancements can be evaluated against to determine the enhancements that provide best value in terms of energy performance.

A baseline model and simulation was completed for the Main Public Works Building to establish the benchmark conditions against which enhancements are measured. A series of Energy Efficiency Measures (EEMs) were integrated into the baseline model to identify potential energy use reduction and the associated cost savings. The following EEMs were simulated:

1. Improve Building Envelope Roof: Remove existing fiberglass insulation and install 8-inches of sprayed-on polyurethane foam insulation.
2. Improve Building Envelope Wall: Install 2-inches of rigid polyisocyanurate insulation on exposed exterior concrete lower wall. Remove existing fiberglass insulation (upper wall) and install 8-inches of sprayed-on polyurethane foam insulation.
3. Reduce Lighting Power: Replace lighting fixtures with low-wattage ballasts and lamps. Replace all incandescent and sodium bulbs with compact fluorescent lamps.
4. New Oil-Fired Furnace: Install new high-efficiency oil condensing furnace unit with AFUE of 93%.
5. New Propane-Fired Furnace: Install new high-efficiency propane fired furnace with AFUE of 93%.

Simulation reports for the baseline and each EEM are presented in Exhibit C and include:

- Detailed monthly and annual energy consumption by use category;
- Estimated monthly and annual energy costs;
- Monthly peak consumption by use category; and,
- Summary monthly and annual consumption by energy type (electric and gas/oil).

Because there are many variables affecting actual consumption and associated costs including building use and occupancy, actual efficiencies of existing equipment and systems, controls, actual utility costs, and limitations inherent to the energy simulation software, the presented values should be considered within a -15% to +10% range.

Simulation Results

The baseline model yields an annual electric energy usage of 41,450 kWh and oil/gas usage of 1,224 therms (Exhibit C). Predicted annual costs for the existing building electrical and oil are $5,803 and $2,461 (oil fuel at $2.80/gallon), respectively.

Table 5.1 presents the current energy consumption and costs. Table 5.2 presents the incremental estimated energy consumption reductions and associated cost savings for each proposed EEM enhancement.

Table 5.1 – Baseline Simulation Energy Consumption

Baseline Condition	Annual Energy Consumption		Annual Energy Costs	
	Oil / Gas (therms)	Electric (kWh)	Oil	Electric
Low-efficiency oil-furnace (70%), poor envelope insulation (R-11), low-efficiency lighting fixtures	1,224	41,450	$2,461	$5,803

Table 5.2 – Energy Efficiency Measure Results

Potential Building Enhancements		Incremental Energy Reduction		Total Annual Cost Savings(1)
No.	EEM Description	Oil / Gas (therms)	Electric (kWh)	
1	Improve Building Envelope – New Roof Insulation (R-50)	166	72	$344
2	Improve Building Envelope – New Wall Insulation (R-43)	211	165	$437
3	Reduce Lighting Power	(114)	5,429	$530
4a	New Oil Condensing Furnace (AFUE = 93%)	238	0	$478
4b	New Propane Furnace (AFUE = 93%)	238	0	$564

(1) Negative entries (-) represent increase in energy consumption.
(2) Estimated costs are based on current (June 2009) public utility and heating-oil rates for the southern NH region.

Each of the EEMs provides a relatively equivalent reduction in net energy usage for the Public Works Building. Assuming a new propane-fired furnace is installed (EEM 4b), the cumulative annual cost savings for implementing all of the EEMs is $1,875.

It is important to note that the EEM results are based on the current building systems with no cooling. If air-conditioning systems are added to the building the simulation results will change substantially.

6.0 SUMMARY RECOMMENDATIONS

The following summary recommendations are provided with the intent of improving the overall performance and sustainability of the Public Works Building. Determining which recommendations are appropriate for the building depend on the planned use designation and lifecycle, Town of Rye initiatives, and budgetary means. The red flag ( ) symbol included the text body denotes recommendations that are included in one of the three tier categories. The three tier categories are based on life safety concerns, implementation costs, potential energy reduction and cost savings, operation and maintenance costs, and occupant comfort.

1. **Tier I Recommendations**: Tier I recommendations include maintenance related items that are relatively simple and low-cost to implement. They also include critical items associated with life-safety concerns and items that if left unattended to could result in damage to building components. Tier I recommendations are presented in Table 6.1.
2. **Tier II Recommendations**: Tier II recommendations are those that should be considered in current budgetary planning for building improvements – they can be major or minor improvements. They generally will provide substantial energy savings and/or improved occupant comfort. Tier II recommendations are presented in Table 6.2.
3. **Tier III Recommendations**: Tier III recommendations are major improvements affecting one or more building components. These are generally longer-term capital improvements that may be

more economical to complete as part of a larger improvement project. Tier III recommendations are presented in Table 6.3.

Included in the tables are budgetary costs to implement the associated initiative. These costs are provided for planning purposes only and more detailed estimates should be prepared as initiatives are selected for implementation.

Table 6.1 – Tier I Recommendations

No.	Noted Item	Recommended Action	Budgetary Cost
1	Window air-conditioning unit in break room appears to be left in during winter allowing substantial air infiltration.	Remove unit during winter months.	$0
2	Entry and overhead doors have gaps allowing substantial air infiltration.	Seal / weather-strip all doors.	$1,700
3	Oil-fired furnace is extremely inefficient and unreliable.	Replace the furnace and ductwork with a propane-fired unit. Install heat-recovering ventilation unit and add heating to Bay No. 2 for equipment de-icing.	$42,000
4	Currently there is no outdoor air ventilation for the building.	Install heat-recovering ventilation unit as part of new heating system.	$0
5	Lavatory exhaust fan ductwork is poorly configured with long run and bends.	Install new rigid ducting with direct run to nearest eave.	$100
6	Air-borne particulate concentrations are extremely high inside the building and furnace air filters are clogged.	As part of new heating and ventilation system, install high-efficiency filters and replace frequently.	$0
7	Blanks missing on the electrical panel.	Replace blanks.	$80
8	Quantity of receptacles in work areas is low and no GFCI protected circuits for wet operations.	Install additional GFCI protected receptacles in Bay No. 1.	$300
9	Interior fluorescent and incandescent fixtures are low-efficiency units. Lighting power density in office areas is poor.	Replace fluorescent units with low-wattage ballasts and lamps. Replace all incandescent bulbs with CFLs.	$2,700
10	Lighting fixtures are manually controlled increasing electrical usage.	Install motion-sensitive controls.	$500
11	Single lighting zone in Bay No. 1 with loft storage lights.	Add second zone for loft storage lighting to reduce electrical usage.	$200
12	Poor task lighting in Bay No. 1 area. Fluorescent wall mounted units are inefficient.	Install task lighting at work stations to reduce overhead lighting requirements. Replace wall mounted fluorescent units with LED units.	$400
13	Exterior sodium lamp fixtures are inefficient.	Replace lamps with LED fixtures.	$450
14	Presumed on-site septic system requires inspection to ensure proper operation.	Inspect and clean septic system annually.	$300
15	Vehicle maintenance facilities are a common source of organic contaminants including oils, grease, lubricants, solvents, glycol, etc.	Implement a best management plan to minimize the potential for release to ground and water receptors.	$0
16	Testing of fire detection and notification systems not completed as part of this inspection.	Test all system annually by Rye Fire Department.	$0
17	Quantity of fire extinguishers inadequate with missing units.	Replace missing units and install additional stations and dry chemical extinguishers.	$300
18	Building does not comply with ADA standards.	Building is not routinely accessed by the public. Employ provisions to accommodate disabled persons on as-needed basis.	$0

19	Radon gas can migrate through floors and accumulate in occupied spaces.	Test building for radon on annual basis.	$120/year
20	Volatilization of stored VOC containing liquids (fuels, solvents, paints, cleaners, etc.) in occupied spaces can lead to high VOC concentrations.	Relocate all VOC liquids outside of occupied spaces (Bay No. 1) or install negative ventilation in the storage room and secure door.	$500

Table 6.2 – Tier II Recommendations

No.	Noted Item	Recommended Action	Budgetary Cost
1	Current air-quality degradation activities including welding, sanding, grinding, cutting, and sandblasting are completed in the conditioned occupied space adjacent to the office areas in Bay No. 1.	Relocate all activities to another bay, or, construct isolate the operations using walls. Install an adequately-sized heat-recovering ventilation unit to vent the space.	$5,000 - $25,000
2	30-year old roofing system shows indications of failure and has numerous patches and leaks. Birds nest in the eaves and have insulation is deteriorated.	Replace the roof with a new metal deck system and install spray-foam insulation on underside to improve envelope and restrict pest entry.	$110,000
3	Daylighting in the building is insufficient.	As part of roofing replacement, install translucent skylight panels to improve daylighting and reduce lighting power density loads.	$0
4	There is no combustion engine emission recovery in the building allowing noxious gases (CO) to accumulate inside the occupied spaces.	Install a vehicle exhaust ventilation system.	$7,000
5	Manual faucets on lavatory and wash sinks.	Install motion operated faucets on sinks.	$300
6	Building envelope / insulation is poor providing significant heat loss during winter.	Insulate roof as part of new roofing system (cost included in No. 2). Insulate lower and upper walls using rigid polyisocyanurate insulation and sprayed-on foam insulation.	$62,000

Table 6.3 – Tier III Recommendations

No.	Noted Item	Recommended Action	Budgetary Cost
1	Domestic hot water tank is inefficient and has little insulation.	Replace tank unit with a wall mounted tankless unit to reduce electric and water consumption.	$800
2	A large portion of the site consists of unstabilized soils subject to wind and water erosion.	Vegetate soil areas using native drought-tolerant grasses and groundcover.	$6,000
3	Stormwater quality is poor due to limited controls and exposed soils.	Construct a rain garden at the southeast portion of the site to promote on-site infiltration and improve stormwater quality.	$3,200

FIGURE 1

Site Map

anix
planning . design . development

anix, LLC
4 Margaret Lane
Lee, NH 03861
www.anixcm.com

CLIENT
Town of Rye, NH
10 Central Road
Rye, NH 03870

PROJECT
Comprehensive
Energy Audit

PROJECT NO.
09021

ISSUE
07.21.09

DRAWN BY
TN

Public Works Site Map

Figure 1

Exhibit A

Photographs

(separate electronic file)

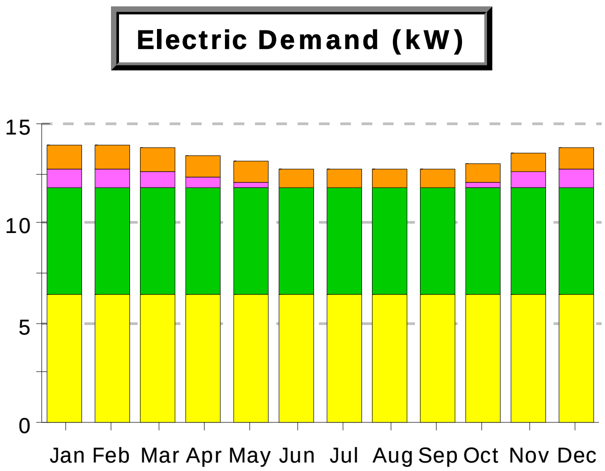
Exhibit B

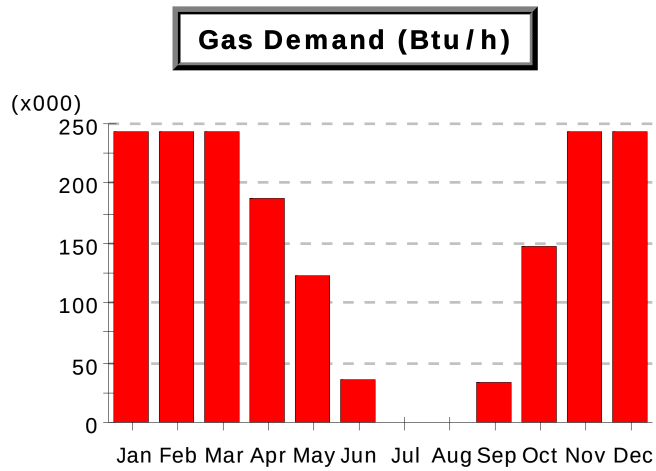
Infrared Thermal Imaging Report

(separate electronic file)

Exhibit C

Building Energy Simulation Reports



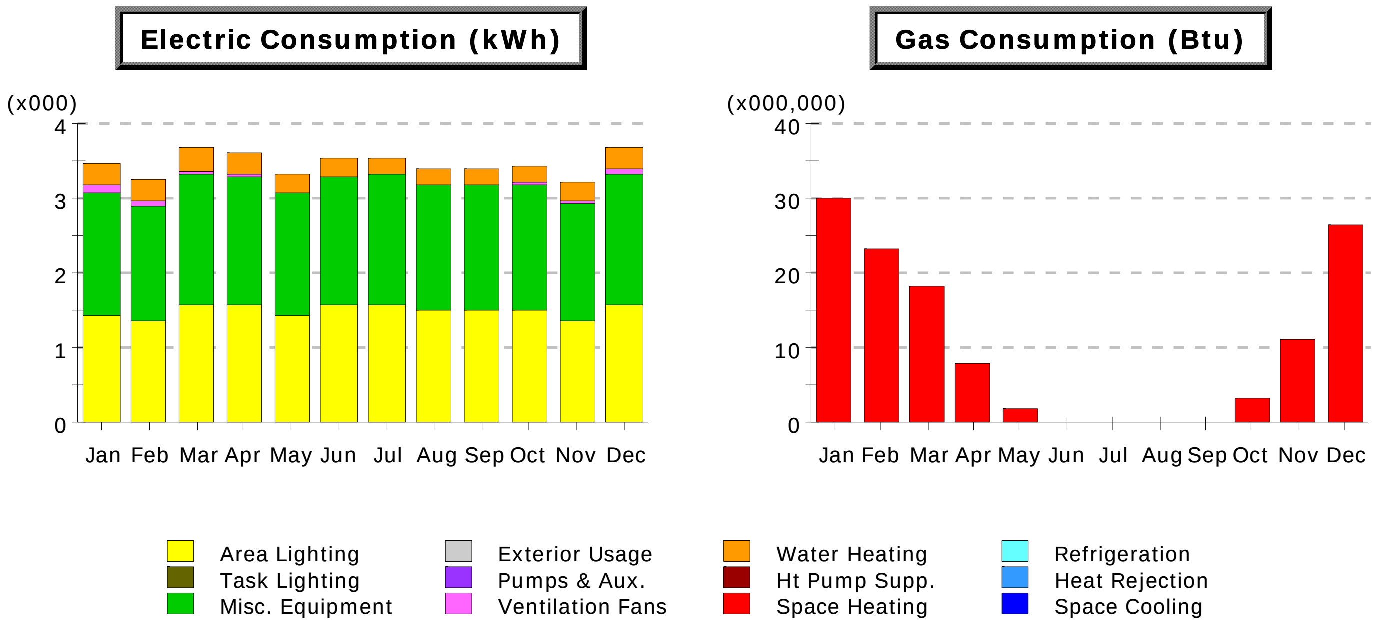


Electric Demand (kW)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	1.14	1.18	1.17	1.15	1.08	1.00	0.93	0.89	0.89	0.93	0.99	1.07	12.43
Vent. Fans	1.00	1.00	0.86	0.50	0.23	-	-	-	-	0.28	0.77	1.00	5.64
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	5.35	5.35	5.35	5.35	5.35	5.35	5.35	5.35	5.35	5.35	5.35	5.35	64.25
Task Lights	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.17
Area Lights	6.42	6.42	6.42	6.42	6.42	6.42	6.42	6.42	6.42	6.42	6.42	6.42	77.04
Total	13.92	13.96	13.82	13.44	13.10	12.79	12.72	12.68	12.68	12.99	13.55	13.86	159.52

Gas Demand (Btu/h x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	244.2	244.2	244.2	187.6	122.7	34.7	-	-	33.7	147.0	244.2	244.2	1,746.5
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	244.2	244.2	244.2	187.6	122.7	34.7	-	-	33.7	147.0	244.2	244.2	1,746.5



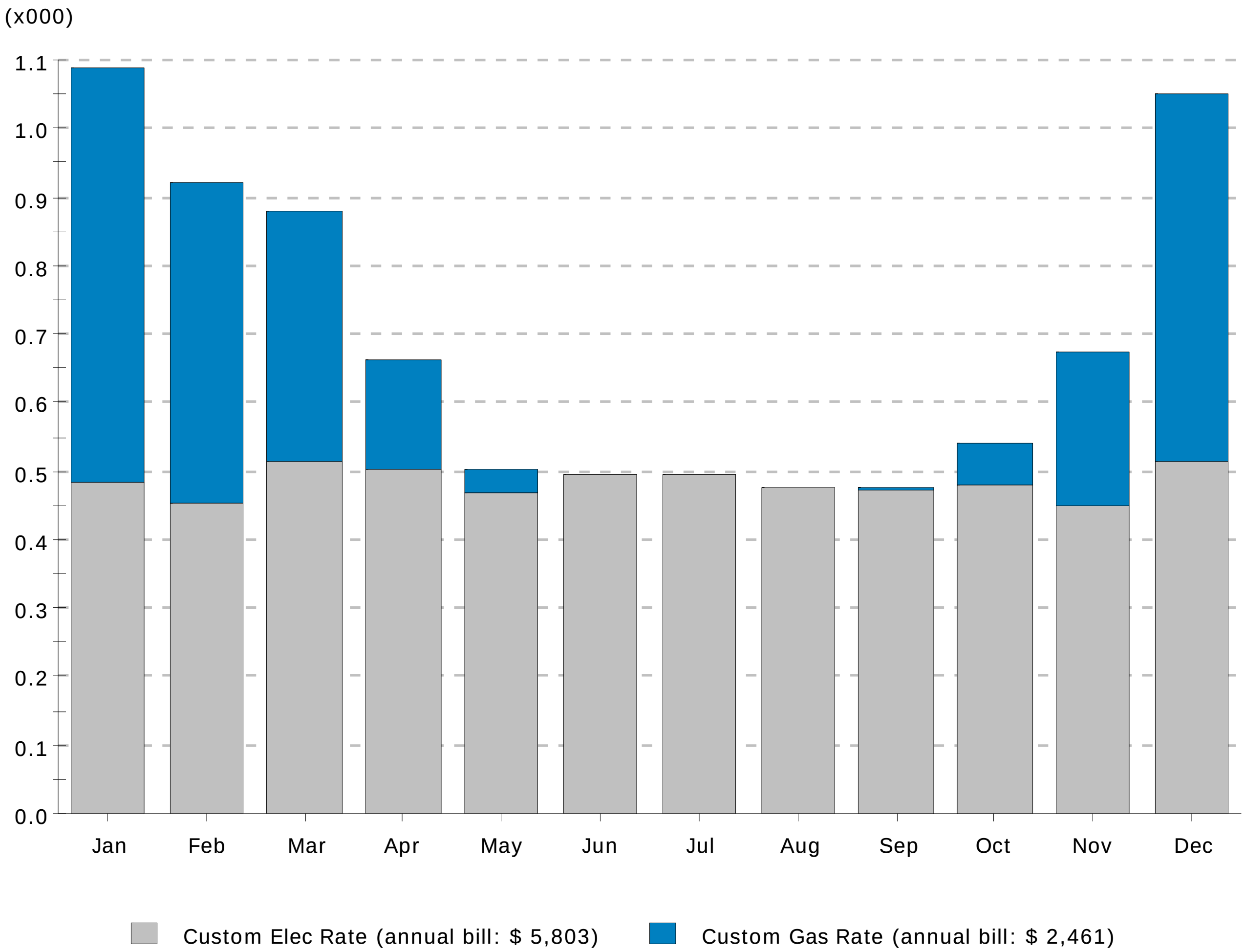
Electric Consumption (kWh x000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	-	-	-	-	-	-	-	-	-	-	-	-	-
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	0.27	0.26	0.29	0.29	0.25	0.24	0.23	0.21	0.21	0.23	0.22	0.27	2.97
Vent. Fans	0.12	0.09	0.07	0.03	0.01	0.00	-	-	0.00	0.01	0.04	0.10	0.46
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	1.66	1.54	1.75	1.72	1.66	1.72	1.75	1.71	1.68	1.71	1.59	1.75	20.25
Task Lights	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
Area Lights	1.41	1.34	1.55	1.55	1.41	1.55	1.55	1.48	1.48	1.48	1.34	1.55	17.74
Total	3.46	3.23	3.67	3.59	3.33	3.52	3.53	3.40	3.38	3.43	3.21	3.68	41.45

Gas Consumption (Btu x000,000)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Space Cool	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Reject.	-	-	-	-	-	-	-	-	-	-	-	-	-
Refrigeration	-	-	-	-	-	-	-	-	-	-	-	-	-
Space Heat	30.04	23.34	18.27	7.95	1.82	0.06	-	-	0.05	3.10	11.20	26.59	122.42
HP Supp.	-	-	-	-	-	-	-	-	-	-	-	-	-
Hot Water	-	-	-	-	-	-	-	-	-	-	-	-	-
Vent. Fans	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumps & Aux.	-	-	-	-	-	-	-	-	-	-	-	-	-
Ext. Usage	-	-	-	-	-	-	-	-	-	-	-	-	-
Misc. Equip.	-	-	-	-	-	-	-	-	-	-	-	-	-
Task Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Area Lights	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	30.04	23.34	18.27	7.95	1.82	0.06	-	-	0.05	3.10	11.20	26.59	122.42

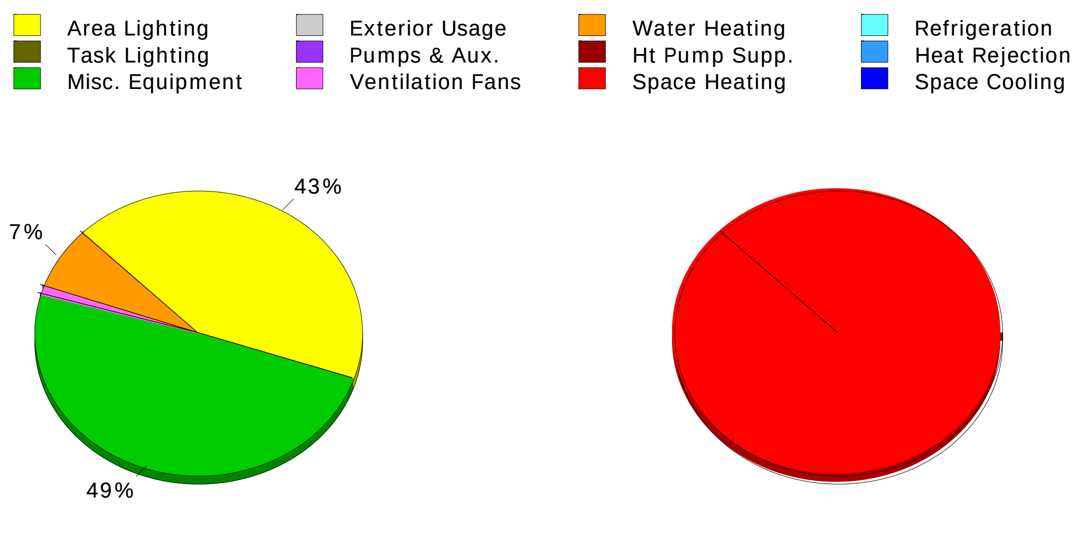
Monthly Utility Bills ($)



Total Annual Bill Across All Rates: $ 8,264

Annual Energy Consumption by Enduse

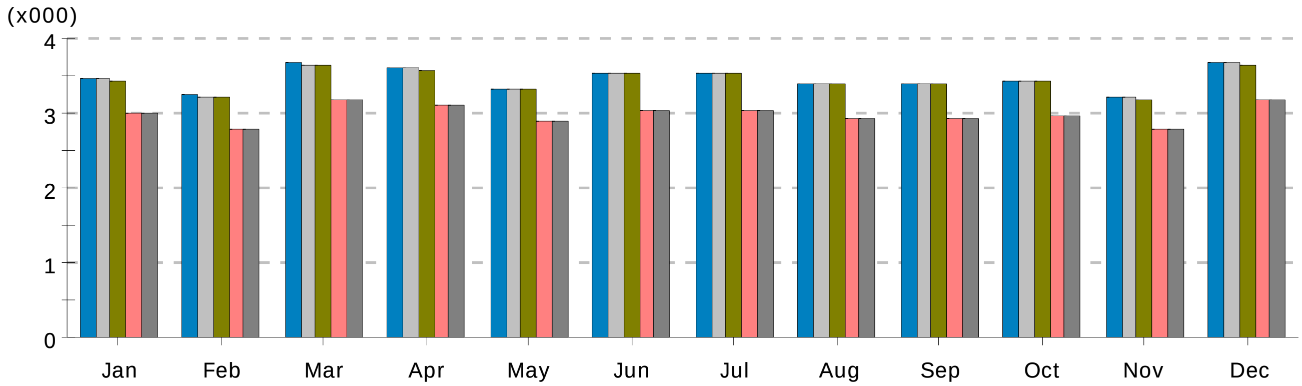
	Electricity kWh	Natural Gas MBtu	Steam Btu	Chilled Water Btu
Space Cool	-	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	-	122.42	-	-
HP Supp.	-	-	-	-
Hot Water	2,969	-	-	-
Vent. Fans	458	-	-	-
Pumps & Aux.	-	-	-	-
Ext. Usage	-	-	-	-
Misc. Equip.	20,250	-	-	-
Task Lights	36	-	-	-
Area Lights	17,738	-	-	-
Total	41,450	122.42	-	-



Electricity

Natural Gas

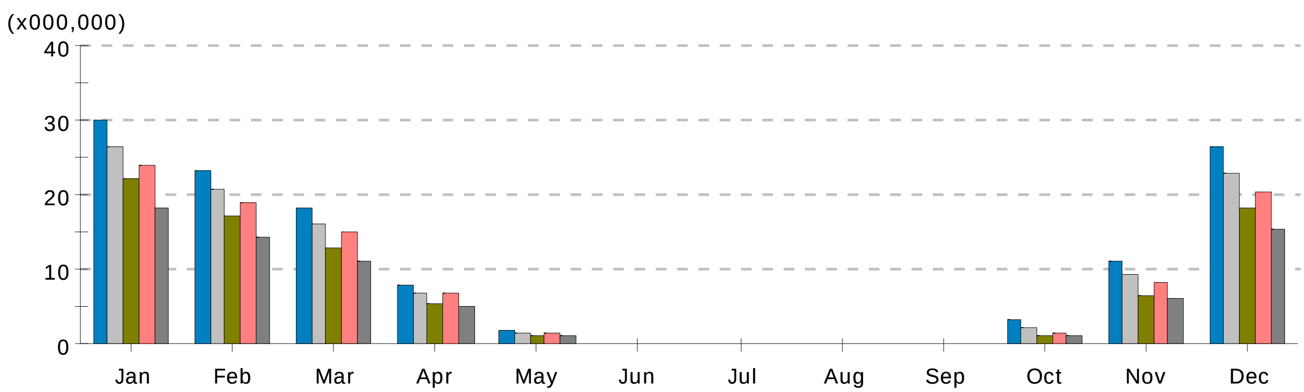
Electric Consumption (kWh)



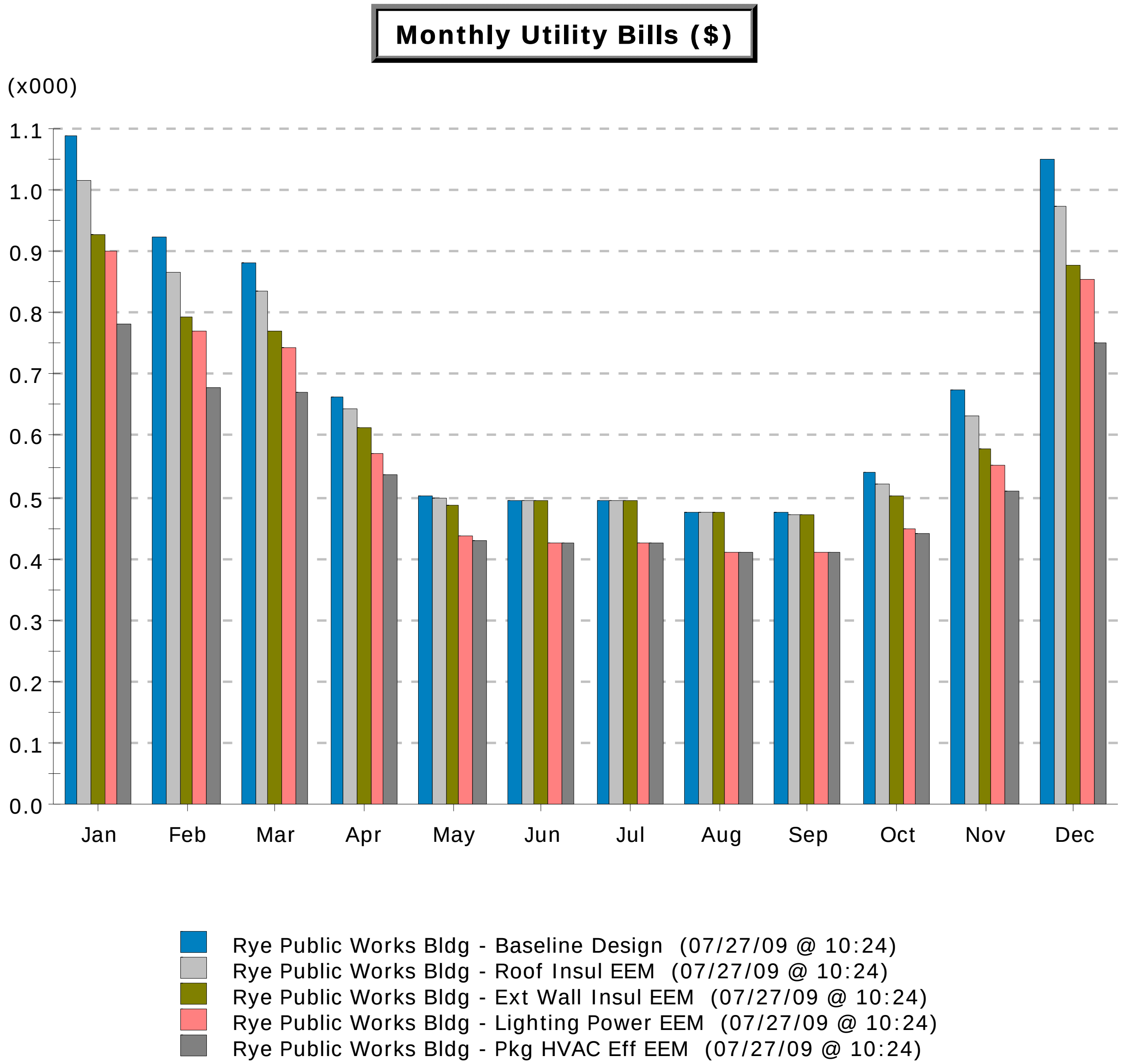
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Run 1.	3.46	3.23	3.67	3.59	3.33	3.52	3.53	3.40	3.38	3.43	3.21	3.68	41.45
Run 2.	3.45	3.22	3.66	3.59	3.33	3.52	3.53	3.40	3.38	3.43	3.20	3.66	41.38
Run 3.	3.43	3.21	3.65	3.58	3.33	3.52	3.53	3.40	3.38	3.42	3.19	3.64	41.28
Run 4.	3.00	2.80	3.17	3.11	2.90	3.04	3.05	2.94	2.92	2.97	2.78	3.17	35.86
Run 5.	3.00	2.80	3.17	3.11	2.90	3.04	3.05	2.94	2.92	2.97	2.78	3.17	35.86

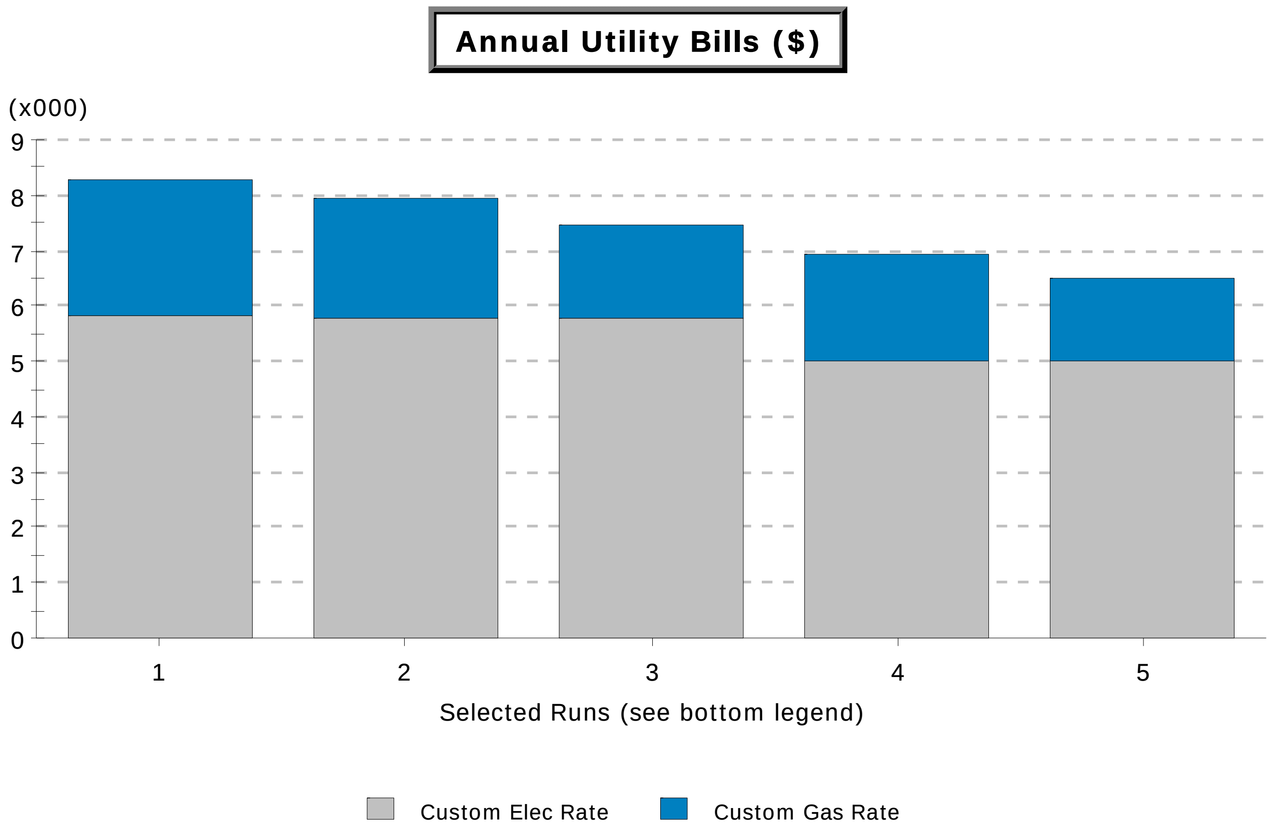
1. Rye Public Works Bldg - Baseline Design (07/27/09 @ 10:24)
2. Rye Public Works Bldg - Roof Insul EEM (07/27/09 @ 10:24)
3. Rye Public Works Bldg - Ext Wall Insul EEM (07/27/09 @ 10:24)
4. Rye Public Works Bldg - Lighting Power EEM (07/27/09 @ 10:24)
5. Rye Public Works Bldg - Pkg HVAC Eff EEM (07/27/09 @ 10:24)

Gas Consumption (Btu)



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Run 1.	30.04	23.34	18.27	7.95	1.82	0.06	-	-	0.05	3.10	11.20	26.59	122.42
Run 2.	26.53	20.65	16.01	6.93	1.50	0.05	-	-	0.02	2.10	9.15	22.87	105.81
Run 3.	22.19	17.09	12.90	5.48	1.04	0.03	-	-	-	1.08	6.60	18.32	84.73
Run 4.	23.97	18.82	14.94	6.81	1.53	0.05	-	-	-	1.60	8.09	20.36	96.16
Run 5.	18.04	14.17	11.24	5.12	1.15	0.04	-	-	-	1.20	6.09	15.32	72.38


Monthly Utility Bills ($)
(x000)
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Rye Public Works Bldg - Baseline Design (07/27/09 @ 10:24)
Rye Public Works Bldg - Roof Insul EEM (07/27/09 @ 10:24)
Rye Public Works Bldg - Ext Wall Insul EEM (07/27/09 @ 10:24)
Rye Public Works Bldg - Lighting Power EEM (07/27/09 @ 10:24)
Rye Public Works Bldg - Pkg HVAC Eff EEM (07/27/09 @ 10:24)



1. Rye Public Works Bldg - Baseline Design (07/27/09 @ 10:24) (annual bill: $ 8,264)
2. Rye Public Works Bldg - Roof Insul EEM (07/27/09 @ 10:24) (annual bill: $ 7,920)
3. Rye Public Works Bldg - Ext Wall Insul EEM (07/27/09 @ 10:24) (annual bill: $ 7,483)
4. Rye Public Works Bldg - Lighting Power EEM (07/27/09 @ 10:24) (annual bill: $ 6,953)
5. Rye Public Works Bldg - Pkg HVAC Eff EEM (07/27/09 @ 10:24) (annual bill: $ 6,475)

Annual Energy and Demand (pg 1 of 2)

		Ann. Source Energy		Annual Site Energy		Lighting	HVAC Energy			Peak	
		Total Mbtu	EUI kBtu/sf/yr	Elect kWh	Nat Gas Therms	Electric kWh	Electric kWh	Nat Gas Therms	Total Mbtu	Elect kW	Cooling Tons
Annual Energy USE or DEMAND											
0	Base Design	547	89.64	41,450	1,224	17,774	458	1,224	124	14	--
1	0+Roof Insul EEM	529	86.80	41,378	1,058	17,774	391	1,058	107	14	--
2	1+Ext Wall Insul EEM	507	83.19	41,285	847	17,774	309	847	86	14	--
3	2+Lighting Power EEM	463	75.95	35,856	962	12,295	352	962	97	12	--
4	3+Pkg HVAC Eff EEM	440	72.05	35,856	724	12,295	352	724	74	12	--
Incremental SAVINGS	**(values are relative to previous measure (% savings are relative to base case use), negative entries indicate increased use)**										
1	0+Roof Insul EEM	17	2.84 (3%)	72 (0%)	166 (14%)	0 (0%)	66 (14%)	166 (14%)	17 (14%)	0 (0%)	--
2	1+Ext Wall Insul EEM	22	3.61 (4%)	93 (0%)	211 (17%)	0 (0%)	83 (18%)	211 (17%)	21 (17%)	0 (0%)	--
3	2+Lighting Power EEM	44	7.24 (8%)	5,429 (13%)	-114 (-9%)	5,479 (31%)	-43 (-9%)	-114 (-9%)	-12 (-9%)	2 (14%)	--
4	3+Pkg HVAC Eff EEM	24	3.90 (4%)	0 (0%)	238 (19%)	0 (0%)	0 (0%)	238 (19%)	24 (19%)	0 (0%)	--
Cumulative SAVINGS	**(values (and % savings) are relative to the Base Case, negative entries indicate increased use)**										
1	0+Roof Insul EEM	17	2.84 (3%)	72 (0%)	166 (14%)	0 (0%)	66 (14%)	166 (14%)	17 (14%)	0 (0%)	--
2	1+Ext Wall Insul EEM	39	6.46 (7%)	165 (0%)	377 (31%)	0 (0%)	149 (33%)	377 (31%)	38 (31%)	0 (1%)	--
3	2+Lighting Power EEM	84	13.69 (15%)	5,594 (13%)	263 (21%)	5,479 (31%)	106 (23%)	263 (21%)	27 (21%)	2 (15%)	--
4	3+Pkg HVAC Eff EEM	107	17.59 (20%)	5,594 (13%)	500 (41%)	5,479 (31%)	106 (23%)	500 (41%)	50 (41%)	2 (15%)	--

Annual Costs (pg 2 of 2)

		Annual Utility Cost					Incentives		LCC
		Electric kWh($)	Electric kW($)	Electric Total($)	Nat Gas Total($)	Total ($)	Owner ($)	Design Team ($)	Total (PV$)
Annual COST									
0	Base Design	$ 5,803	--	$ 5,803	$ 2,461	$ 8,264			$ 55,901
1	0+Roof Insul EEM	$ 5,793	--	$ 5,793	$ 2,127	$ 7,920			$ 53,184
2	1+Ext Wall Insul EEM	$ 5,780	--	$ 5,780	$ 1,703	$ 7,483			$ 49,732
3	2+Lighting Power EEM	$ 5,020	--	$ 5,020	$ 1,933	$ 6,953			$ 46,801
4	3+Pkg HVAC Eff EEM	$ 5,020	--	$ 5,020	$ 1,455	$ 6,475			$ 43,002
Incremental SAVINGS	**(values are relative to previous measure (% savings are relative to base case cost), negative entries indicate increased cost)**								
1	0+Roof Insul EEM	$ 10	--	$ 10	$ 334	$ 344			$ 2,718
2	1+Ext Wall Insul EEM	$ 13	--	$ 13	$ 424	$ 437			$ 3,452
3	2+Lighting Power EEM	$ 760	--	$ 760	$ -230	$ 530			$ 2,931
4	3+Pkg HVAC Eff EEM	$ 0	--	$ 0	$ 478	$ 478			$ 3,800
Cumulative SAVINGS	**(values (and % savings) are relative to the Base Case, negative entries indicate increased cost)**								
1	0+Roof Insul EEM	$ 10	--	$ 10	$ 334	$ 344			$ 2,718
2	1+Ext Wall Insul EEM	$ 23	--	$ 23	$ 758	$ 781			$ 6,169
3	2+Lighting Power EEM	$ 783	--	$ 783	$ 528	$ 1,311			$ 9,100
4	3+Pkg HVAC Eff EEM	$ 783	--	$ 783	$ 1,006	$ 1,789			$ 12,900