3.0 Part 2: Energy Audit

AKTPEERLESS

3.1 Acknowledgements of Part 2: Energy Audit

The Energy Audit Report and Excel RPCA Model were completed by Jason Bing and Henry McElvery of AKT Peerless. AKT Peerless certifies that the report preparers meet the qualifications identified in the RAD Physical Condition Assessment Statement of Work and Contractor Qualifications Part 2.1 (Version 2, December 2013).

Jason Bing, RA, LEED AP
Senior Energy Analyst
AKT Peerless Environmental Services
Illinois Region
Phone: 734.904.6480
Fax: 248.615.1334
R.A. Certificate No. 1115311

Henry McElvery
Technical Director of Energy Services
AKT Peerless Environmental Services
Illinois Region
Phone: 773.426.5454
Fax: 248.615.1334
Building Analyst Professional No. 5023902
Building Performance Institute

Date: February 21, 2014

Part 2 Energy Audit Report and Excel RPCA Model were Received and Reviewed by Owner:

Lori Harris
Norstar Development USA, LP
733 Broadway
Albany, NY 12207
Phone: 518-431-1051
Fax: 518-431-1053

Date:___________________________

Rental Assistance Demonstration (RAD):
PART 2: ENERGY AUDIT

1701-1747 Green Road, Ann Arbor, Michigan 48105
GREEN BAXTER

PREPARED FOR Norstar Development USA, LP
733 Broadway
Albany, NY 12207

ON BEHALF OF The Ann Arbor
Housing Commission
727 Miller Ave
Ann Arbor, MI 48103

PROJECT # 8213E-2-96

PIC # MI064

DATE February 21, 2014

AKTPEERLESS

TABLE OF CONTENTS

Energy Audit

Green Baxter Court Apartments

1701-1747 Green Road
Ann Arbor, Michigan 48105

for

Ann Arbor Housing Commission

727 Miller Ave
Ann Arbor, Michigan, 48103

AKT Peerless Project No. #8213E-2-96

1.0 Executive Summary

This report presents the findings and recommendations from a RPCA Energy Audit conducted at Green Baxter Court Apartments located at 1704-1747 Green Road, Ann Arbor, Michigan. The Energy Audit follows industry standards and acceptable practice for assessing energy and water performance of commercial and multi-family buildings. The Energy Audit has been conducted by AKT Peerless and has involved a coordinated effort between AKT Peerless, the Client and building operating staff.

Documents were provided for review, interviews and field investigations were conducted, and building systems were analyzed. In the year analyzed (March, 2012 to February, 2013) the Ann Arbor Housing Commission spent $19,781 on all utilities at the subject property. Tenants spent an estimated $37,908 on utilities.

AKT Peerless identified seven (7) separate Energy Conservation Measures (ECMs) and one (1) Water Conservation Measures (WCMs). The annualized savings of all recommendations totals $11,104 (at current energy and water prices), with the potential to reduce total energy consumption and GHG emissions by 18%. If fully implemented, the payback period from annual energy savings for these ECMs is estimated to be 4.1 years. Measures associated with common areas (PHA expenses) and measures specific to tenant units have been separated for planning purposes.

Measures best suited for implementation at the End of Useful Life (EUL), advanced ECMs, and measures recommended for further evaluation have been identified and are included in Sections 11-12 of this report.

A preliminary energy use assessment was conducted prior to the cost reduction measure analysis. The figure below describes the historical annual energy consumption and cost for the subject property.

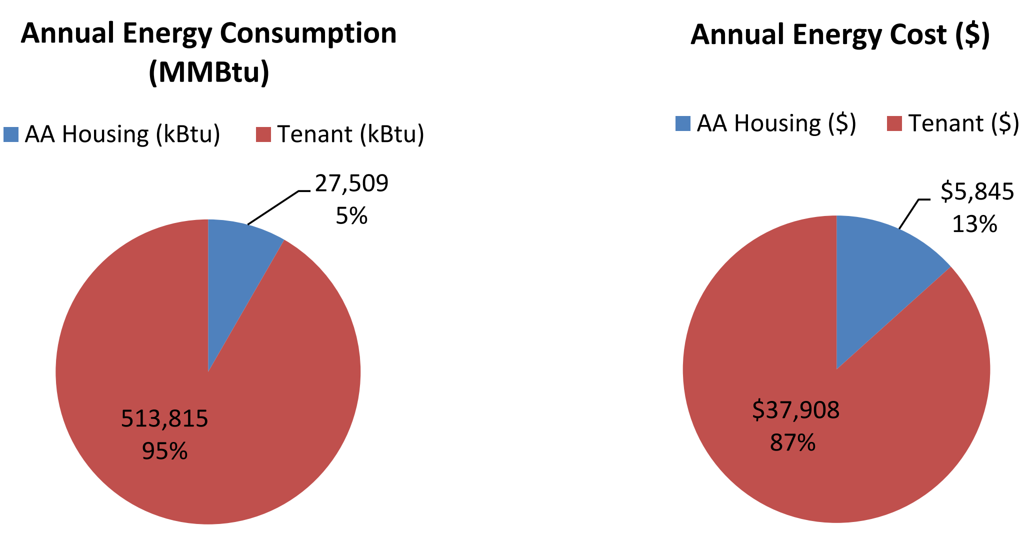


Figure 1. Historical Annual Energy Consumption and Cost

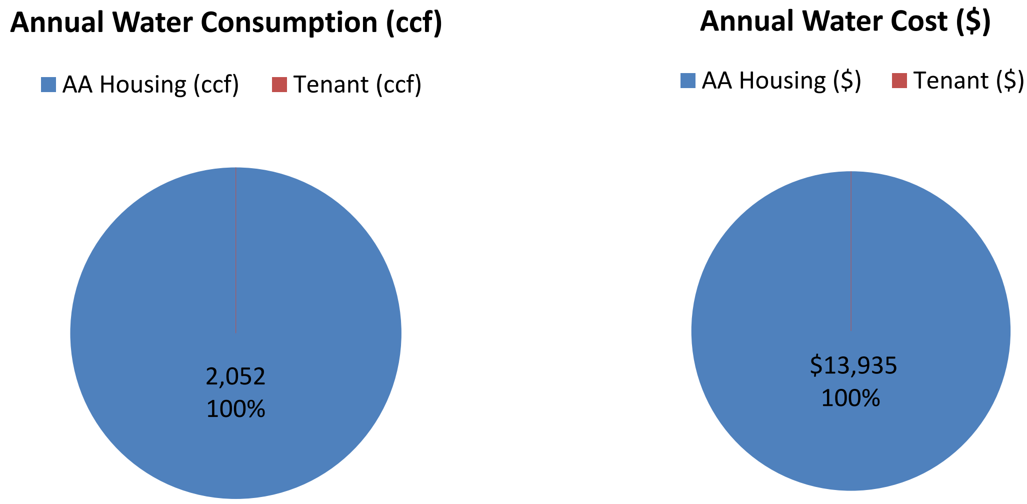


Figure 2. Historical Annual Water Consumption and Cost

The implementation costs and annual savings estimates for each proposed Energy and Water Conservations Measures are presented in Table 1 and Table 2. Table 1 outlines ECMs and WCMs that will directly impact the owner's annual costs.

Table 1. Financial Summary of All Conservation Measures (Owner)

Energy and Water Conservation Measures	ID	Additional First Cost ($)	Annual Savings ($)	Simple Payback (yrs)
Interior Lighting Retrofit at Community Center	ECM1	$847	$412	2.1
Exterior Lighting Retrofit (entire campus)	ECM2	$16,890	$4,201	4.0
Install Occupancy Sensors at Community Center	ECM3	$150	$32	4.7
Install Low-Flow Showerheads and Faucet Aerator (entire campus)	WCM1	$600**	$3,650	0.2
Owner Totals		**$18,487**	**$8,295**	**2.2**

**Natural gas consumption is paid for by tenants and a reduction in hot water use would primarily benefit tenant costs. Greater savings are achieved through water conservation in this measure, thus it was included in the owner operating costs analysis.

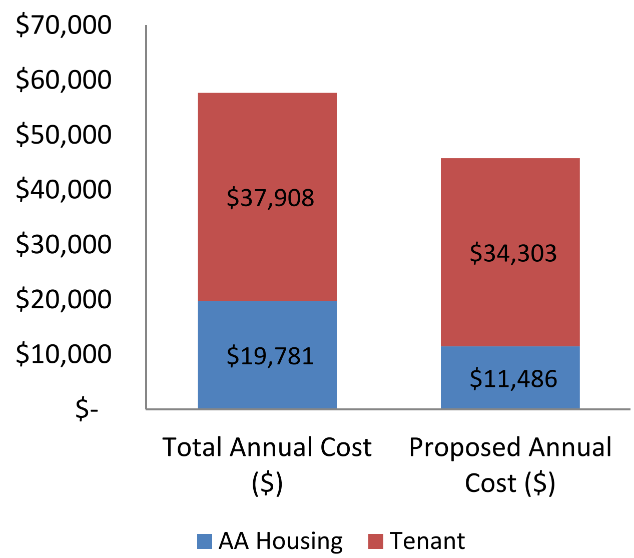
The following ECMs are recommended specifically for tenant spaces. Due to separate billing for tenants, energy and cost savings will primarily benefit the tenants; however, the reduction in energy bills can impact the tenant's decision to continue residing in the building. Furthermore, at times of turnover, and vacancy, the housing authority is responsible for individual unit costs and would capture the benefit associated with these improvements at those times.

Table 2. Financial Summary of All Conservation Measures (Tenant)

Energy and Water Conservation Measures	ID	Additional First Cost ($)	Annual Savings ($)	Simple Payback (yrs)
Install Programmable/Setback Thermostats at Tenant Apartments and Community Center	ECM4	$1,250	$744	1.7
Control Air Leakage	ECM5	$7,200	$1,198	6.0
Insulate and Seal Rim/Band Joist	ECM6	$3,762	$339	11.1
Insulate Attic Space to R-49	ECM7	$14,300	$1,324	10.8
Tenant Totals		**$26,512**	**$3,604**	**8.0**

Table 3. Impact Summary (Totals)

Energy Savings	25%
% Water Savings	20%
% Utility Cost Savings	21%
Annual Utility Cost Savings ($)	$11,899
% Reduction in GHG Emissions (CO_2 Equivalent Metric Tons)	22%



2.0 Purpose and Scope

Norstar Development USA, LP, on behalf of the Ann Arbor Housing Commission (the Client), retained AKT Peerless Environmental & Energy Services (AKT Peerless) to conduct a RPCA Energy Audit of Green Baxter Court Apartments located at 1701-1747 Green Road in Ann Arbor, Michigan.

AKT Peerless' scope of work for this Energy Audit is based on its proposal PE-14248, dated January 9, 2013 and revised March 13, 2013 and authorized by Norstar Development USA, LP on behalf of the Ann Arbor Housing Commission (the Client), and the terms and conditions of that agreement.

The purpose of this report is to assist the Client in evaluating the current energy and water use and energy and water cost of the subject property relative to other, similar properties; and also to identify and develop modifications that will reduce the energy and water use and /or cost of operating the property. This report will identify and provide the savings and cost analysis of all practical measures that meet the client's constraints and economic criteria, along with a discussion of any changes to operation and maintenance procedures. It may also provide a listing of potential capital-intensive improvements that require more thorough data collection and engineering analysis, and a judgment of potential costs and savings. Additionally, this report will identify the feasibility of green energy technologies, as well as, determine if further analysis is recommended.

Relevant documentation has been requested from the client that could aid in the understanding of the subject property's historical energy use. The review of submitted documents does not include comment on the accuracy of such documents or their preparation, methodology, or protocol. The following documents were available for review while performing the analysis:

- Energy Utility Bills
- 2009 United States Greenhouse Gas Inventory, Annex 2
- USEPA Climate Leaders Calculator for Low Emitters
- HUD Residential Energy Benchmark Tool
- HUD Residential Water Use Benchmarking Tool
- National Oceanic Atmospheric Administration "Normal Monthly Heating Degree Days (Base 65)" and "Normal Monthly Cooling Degree Days (Base 65)"

3.0 Additional Scope Considerations

In addition to fully satisfying the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) Procedures for Commercial Building Energy Audits, Second Edition 2011, Level II guidelines, this report includes all the necessary requirements of an Energy Audit as defined in the Rental Assistance Demonstration (RAD): Physical Condition Assessment (RPCA) statement of Work and Contractor Qualifications released by the Department of Housing and Urban Development (HUD) in December 2013 (Version 2). These items are identified as follows:

- Heating and cooling systems sized according to the methodology proposed in the Air Conditioning Contractors of America (ACCA) Manual J guide. (See Section 11.2)
- Hot water heater analysis of existing size of individual hot water heater and the appropriate efficiency replacement sizing using First Hour Rating or another professionally recognized sizing tool. (See Section 11.1)
- An initial assessment of the potential feasibility of installing alternative technologies for electricity, heating and cooling systems, and hot water heating at the property. (See Section 13.0)
- An expected end of useful life study for all recommended energy and water efficiency measures.
- Recommendations of any additional professional reports needed (including, for example alternative energy system feasibility studies, air infiltration tests for energy loss and ventilation needs, blower door tests, infrared imaging, duct blasting, etc.)

4.0 General Information

4.1 Audit Team

This audit is the result of a collaborative process between the following AKT Peerless and client personnel:

Table 4. Audit Team

Name	Organization	Title
Jason Bing	AKT Peerless	Building Energy Analyst
Lance Mitchell	Ann Arbor Housing Commission	Facilities & Maintenance Property Manager
Jennifer Hall	Ann Arbor Housing Commission	Executive Director

4.2 Audit Process

AKT Peerless collected historical energy data and floor plans for the building, when available. The square footage of all spaces was determined and the size and location of pertinent mechanical equipment was documented. AKT Peerless conducted a walk-through survey of the building on December 19, 2012 and then on May 8, 2013, collecting specific information on the mechanical, electrical, and plumbing systems as well as occupancy, scheduling, and use patterns.

AKT Peerless utilized industry accepted measuring devices, including but not limited to: a blower door to quantify air infiltration, an infrared camera to visually identify areas of potential energy loss, and a ballast discriminator to identify existing T12 lighting. Light levels were measured using a light meter in various areas to compare to Illuminating Engineering Society of North America (IESNA) recommended levels.

A visual inspection of the mechanical equipment, lighting systems, controls, building envelope and plug loads was performed. Mechanical equipment nameplate data was recorded and the specifications and performance data were reviewed and used in this analysis.

4.3 Energy Calculations Methodology

The primary methods of energy calculation for this analysis were simplified manual and spreadsheet tabulations based on professional standards. Actual calculation methods are discussed in each applicable section.

The energy end use consumption breakdown, found later in this report, is based on 2003 Commercial Buildings Energy Consumption Survey (CBECS) data for Lodgings of relatively similar scale and age.

Because historic utility bill information was only available for the shared operations of the facility (each tenant pays their own energy costs), the audit team did not have a complete or precise accounting of all energy consumption in the facility. The benchmark information provided in the 2009 Residential Energy Consumption Survey (RECS) and CBECS survey allowed our audit team to approximate the total energy end use consumption for the facility.

AKT Peerless used the HUD Energy Benchmarking Tool to evaluate the energy consumption data for the property. This tool allows the input of historic utility data of a facility to be compared to normalized data of a large database of facilities of its peers. The results will yield some information that can be used for general building evaluation.

A blower door test was conducted on one of the units during the site visit. The blower door test was used to quantify air leakage by determining the 50-pascal airflow rate. This blower door reading, expressed in cubic feet per minute (CFM50), is the actual flow rate measured at 50 Pascals of house pressure. CFM50 is the most direct measurement of the airtightness of a building.

5.0 Property Description

This section summarizes physical characteristics and general use of the subject property.

5.1 Location

The subject property is located in ASHRAE Climate Zone 5A. According to National Oceanic and Atmospheric Administration recording of heating and cooling degree days, on an annual basis Ann Arbor, MI is expected to experience an average of 6,818 heating degree days (HDD) and 840 cooling degree days (CDD) with a basepoint temperature of 65 degrees Fahrenheit.

5.2 Property Characteristics

General information pertaining to the subject building is summarized in the following table:

Table 5. Property Characteristics

Primary Building Type / Occupancy	Multi-Family (General)
Region	ASHRAE 5A
Date of Construction	1970; Renovated 1991
Number of Detached Buildings	Four (4)
Approximate Total Square Footage	38,466 ft^2

The subject property Primary Building Type is designated as Multi-Family (General). For all energy performance comparisons presented in this report the subject building will be compared to similar buildings of the same Primary Building Type.

5.3 Property Spaces

This complex is divided into four (4) approximately identical buildings. Each contains similar spaces, with the only exception in the building housing the community center. Spaces refer to the building as a whole and the rooms that comprise the building. Typically, the various space types will serve specific functions within the facility. The following table identifies the space types for the subject building.

Table 6. Summary of Property Spaces

Space	Use	Sq Footage (sf)	% of Total Area
Community Center	Assembly/Office	2,166 sf	7%

Space	Use	Sq Footage (sf)	% of Total Area
Eight (8) 2-bdr units	Residential Apartments	1,100 sf/unit	26%
Eleven (11) 3-bdr units	Residential Apartments	1,416 sf/unit	46%
Four (4) 4-bdr units	Residential Apartments	1,800 sf/unit	21%

5.4 Building Occupancy

Occupancy schedule has a significant impact on a facilities energy usage. In fact, the relationship between occupancy and system operating schedules and setpoints are typically more important than equipment efficiencies. The occupancy schedules for the subject building are as follows:

Table 7. Building Occupancy Schedule

Day	Time	Use	Average Population
Community Center			
School Year (Sunday-Monday)	3:00pm-8:00pm	Staff and Community	5-15
Summer (Sunday-Monday)	9:00am-8:00pm	Staff and Community	5-15
Residential Apartments			
Sunday-Monday	24/7	Primary Residence	2-4/unit

The Community Center maintains operating hours which are often related to the academic school year. As the center is a place for the neighborhood children to congregate, hours tend to reflect when the children are home from school. This translates in extended hours of use in the summer time.

5.5 Building Envelope

This section summarizes physical characteristics of the subject building envelope(s). There are four detached buildings of nearly identical appearance, size and use. The community center, added to the complex in 1991, is included in the overall building envelope discussion.

5.5.1 Walls and Wall Insulation

The typical above grade wall construction appears to be a standard wood framed structure built on a poured concrete foundation with light grey vinyl siding to the outside mechanically fastened to an exterior grade board on 2x4 wood studs. Limited amounts of face brick and cement board siding create a decorative finish on around the main entries and porch entries on the first level. The overall 5" wide assembly is finished with painted drywall on the interior. Fiberglass insulation was observed in at least one exterior wall location and is assumed to be located throughout the perimeter at each building. Depth of insulation could not be determined but is assumed at 3.5" and rated at R-11. This is generally considered standard efficiency.

The basement walls appear to be 8" cast-in-place concrete with a poured slab floor. The walls and floor slab appear to be uninsulated. The rim band, or band joist, appears to be insulated with loose fitting fiberglass insulation stuffed in between floor joists at the perimeter. Insulation was visibly missing in some cavities, and the effective R-value of the band joist insulation is limited due to the installation technique. This is generally considered substandard efficiency.

The community center is a one story addition with exterior walls composed of face brick with an interior 2x4 stud wall and finished with painted drywall. The structure appears to set on a concrete, uninsulated crawl space. Insulation at the perimeter walls could not be determined but is assumed at 3.5” and rated at R-11. This is generally considered standard efficiency. It was noted that several wall cavities may be missing insulation in the area where the original building meets the newer community center addition. There may be exaggerated heat loss occurring in these areas.

5.5.2 Roof and Roof Insulation

The typical roof design on the four apartment buildings is a gabled, passively vented roof. Approximately 16” overhangs with continuous soffits run parallel to the ridge and balance a continuous ridge vent. The roof assembly is asphalt shingled roof (dark grey) over felted wood substrate mechanically fastened to prefabricated or site built 2x4 wood trusses. The typical attic appears to have 3.5” batts of R-11 insulation laid on the ceiling with approximately 3” of blown fiberglass insulation on top of the batts. The insulation observed onsite appeared to be poorly placed with the blown insulation often unevenly distributed. It was also noted that areas around the stairwell were missing insulation. This uneven distribution of insulation results in a lower effective insulation value in the attic. Overall, this insulation would be considered standard efficiency at best, or in some cases substandard efficiency (<R-21).

The community center (addition) attic was not accessible – but assumed to have approximately 6” of fiberglass batting rolled on the attic ceiling, based on observations of similar Ann Arbor Housing facilities/additions.

It was noted that the end units (3-br apartments) have an approximately 5’x15’ overhanging space on the second floor. The audit team was unable to determine if insulation exists in the floor joist cavities and believe this could be an area of heat loss for these units.

5.5.3 Windows and Other Fenestrations

The typical windows appear to be vinyl clad sliders/gliders, with double pane tempered insulating glass. The windows may have been replaced since 2009, as aluminum framed windows were identified in previous reports. Though they may be new, the windows are standard efficiency units and in some cases the team found the assemblies to be loose and dirty. Proper tenant maintenance will allow the windows to seat and close properly, increasing their effectiveness.

Areas around the window units (both interior and exterior) appeared to be caulked, but the blower door test revealed areas around the windows and the within the assemblies themselves that may need further attention, including cleaning and sealing.

The basement of each apartment has 1-3 glass block windows located above grade and 36”x8”. The frame around several of these windows was in fair to poor condition.

5.5.4 Doors

Typical doors appear to be metal insulated doors set in a wood frame, painted to match with keyed deadbolts and spy-eyes. Each entrance is equipped with a metal storm door. These doors are generally considered standard efficiency units.

The community center newer addition appears to have a hollow metal door that may be a source of exaggerated heat loss for the addition.

5.5.5 Infiltration

The audit team conducted a calibrated “blower door” test on a sample 3-bdr unit to determine the apartment’s airtightness. This test, utilizing several gauges for quantifying the analysis, pulls air out of the residential unit, lowering air pressure inside. This allows the (higher) outside air pressure to flow into the apartment through all unsealed cracks and openings.

The test recorded an infiltration rate of 1,750 cubic feet per minute (cfm) at 50 Pascals of pressure. Given the unit conditioned volume (approximately 11,328 cubic feet) this equates to 9.3 air changes per hour at 50 Pascals (ACH50), or approximately 0.5 natural air changes per hour(NaCH). Most standards recommend a target natural air change rate of 0.35 NaCH or less (if mechanically ventilated). This represents an infiltration rate of 30% more than the target.

5.6 Heating, Ventilation, and Air Conditioning (HVAC)

The HVAC system provides the primary heating, cooling and ventilation needs of the facility. The four (4) buildings at Green Baxter Court apartments have a decentralized HVAC system in place, with equipment located and zoned for each individual apartment.

Each apartment is equipped with a natural gas-fired up-flow furnace, located in the basement. None of the units are mechanically cooled. The furnaces are typically Goodman brand units, model #GMS80703ANCC with an input rating of 70,000 Btu/h and an output capacity of 56,000 Btu/h for an overall efficiency of 80%. These units appear to have been installed in 2001 and are considered standard efficiency units. Each furnace appears to be controlled by one thermostat, with limited programming capacity.

Heat to the apartment is supplied through sheet metal ducts, with no visible mastic for duct sealing. Return air is ducted to the furnace. Fresh air appears to be supplied by operable windows and natural infiltration. Mechanical exhaust is limited to the bathrooms, with overhead exhaust fans ducted to the outside.

The community center is also heated by two natural gas-fired furnaces, located in the basement of the retrofitted 3-bdr apartment. The units are: 1) a Goodman brand furnace, Model # GMS80703ANCC, with an input rating of 70,000 Btu/h and an output capacity of 56,000 Btu/h for an overall efficiency of 80%; and 2) a Trane brand PVC vented unit, Model #TUC060C936BA with a 60,000 Btu/h input and 54,000 Btu/h output capacity for an overall efficiency rating of 90%. The Goodman unit was installed in 2010 and is considered a standard efficiency unit. The Trane unit appears less than 8 years old. The community center has a cooling system in place. There are two condensing units: 1) is a Gibson brand system, Model # GS3BA-024ka, a 2 ton unit with a 10 SEER (Seasonal Energy Efficiency Ratio) rating; and

2) a Carrier brand unit, Model # 38CKC036341, a 3 ton unit with a 10 SEER rating. These are both considered substandard efficiency cooling units, and are nearing the end of their useful life(s).

Heat to the community center addition is supplied by a return and supply rectangular metal duct located in the crawl space beneath the floor. The crawl space appears to be uninsulated and no insulation was visible on the ducts. This may be a source of heat loss/inefficiency for the community center.

Domestic Hot Water

Hot water is supplied by a natural gas-fired hot water storage tank located in each tenant unit. Typical tank size is a 40 gallon tank, with a 34,000 Btu/h input rating. The ages of the tanks may vary in each unit, with some installed between 1990 and 2000 and others installed after 2000. The older tanks are at or nearing the end of the useful life and are approximately 20-30% less efficient than current standard efficiency models. Hot water tanks were noted to have insulation blankets in place, some several years old and starting to show signs of wear and tear.

The hot water tank located in the basement of the community center, a State Select model, appears to have been recently updated, and installed in 2012. This appears to be a standard efficiency unit.

5.7 Lighting

This section describes this property's interior and exterior lighting.

5.7.1 Interior Lighting

Interior Lighting in each of the typical residential units consists of the following:

Kitchen/Living/Bedroom/Bath

- Standard socket (A lamp) 13W Compact Fluorescent Lamp (CFL) - (14-16)
- Standard socket (A lamp) 60-75W Incandescent – various plug in fixtures (3-5)

Basement

- Standard socket (A lamp) 13W CFL - (4)

The incandescent lamps found in tenant owned, plug in light fixtures are substandard efficiency lamps.

Interior Lighting at the community center consists of the following:

- T8 (32W) 4-lamp 2x4 fixture with acrylic lens wrap - (4)
- T8 (32W) 4-lamp 2x4 fixture, recessed - (8)
- LED Exit sign <4W each - (2)
- Standard socket (A lamp) 60W Incandescent - (19)

The incandescent lamps located in the community center are considered substandard efficiency lamps. There are higher performance T8 lamps available (25 or 28W).

5.7.2 Exterior Lighting

Exterior lighting for the Green Baxter Court Apartments consists of the following for each of the typical four (4) buildings:

- 35W High Intensity Discharge (HID) wall-mounted porch light (10 each, +2 @CC - 42 total)
- 250W HID wallpack; security lighting (6 each, 24 total)

HID technology is considered standard efficiency and can be upgraded. The lighting appears to be operated by photo-sensors, which also may not be functioning properly.

There are two (2) light poles on site, providing additional parking lot lighting. These poles are estimated to house 400W HID lamps (3 total). This technology can be replaced with more efficient alternatives.

5.8 Other Equipment (Energy)

Typical apartment unit kitchens include a refrigerator, microwave and range hood for the natural gas-fired stove. Equipment is generally considered standard efficiency equipment. The range hood appears to only circulate air, and is not vented to the outside.

Each apartment unit also supplies an electric hook up (vent, water, and electricity) for a washer and dryer in the basement. Typical washers and dryers observed during field investigations were standard or substandard efficiency units.

The community center space utilized three (3) refrigerators throughout. One located in the kitchen area and two additional refrigerators were located in the basement and found upstairs in the office/storage area. More efficient models are available for these units. One of the units, located in the basement, did not contain any perishables in the freezer or cold storage area. A horizontal freezer unit was also identified and located in the basement.

The community center kitchen also contains a standard efficiency microwave and a natural gas-fired stove.

The audit team identified several computers and office equipment in the community center. A computer room, with four workstations and one additional PC, is located on the first floor adjacent to the kitchen. It was noted that workstations were turned on at the time of the site visit. Additional workstations were located upstairs. There are opportunities to increase the efficiency of these workstations.

5.9 Water Consuming Devices

Each typical apartment unit has devices in the kitchen, bath and basement that consume water. Typical apartment unit kitchens appear to have a standard double sink with standard efficiency aerators. Two and three bedroom apartments have one bathroom which has a lavatory, toilet and shower/bath. Four bedroom units have an additional half-bath with another lavatory and toilet. It appears most units have standard efficiency flow devices installed in each of the bathrooms, including showerheads and faucet aerators (2.5 gpm showerhead, 2.2 gpm faucet aerator). Toilets are 1.6 gpf units.

Each typical basement is equipped with a slop sink and laundry hook-up. Washers and slop sink aerators appear to be standard efficiency/flow units in most apartments.

The community center has one ADA compliant toilet room on the first floor, which has a standard flow aerator in the lavatory (2.2gpm) and a 1.6 gpf toilet. There is an additional lavatory at the computer room and has a standard flow (2.2 gpm) aerator in place. There are higher efficiency alternatives available for these devices. The community center kitchen also has a standard sink with a standard flow faucet.

5.10 Improvements since Previous Audits (2009)

The audit team believes the following equipment replacements/upgrades have taken place since the previous energy/water audits were conducted in 2009:

- New (high efficiency) furnace installed at Community Center
- New (standard efficiency) furnaces installed at each tenant apartment
- New CFLs replaced incandescent bulbs at tenant apartments

6.0 Energy Use Analysis

This section provides information on energy delivery to the subject property.

Energy use and cost indices for each fuel or demand type, and their combined total, have been developed using generally accepted industry methods and benchmarking tools provided by the Department of Housing and Urban Development (HUD) . The Energy Utilization Index (EUI) and cost index of the subject building are compared (benchmarked) with the EUI and cost index of similar buildings evaluated in the Residential Energy Consumption Survey (RECS) and Commercial Building Energy Consumption Survey (CBECS) conducted by the Energy Information Administration (EIA) of the United States Department of Energy.

AKT Peerless analyzed utility bills for the time period covered by provided records. The following figures summarize the most recent annual energy consumption and costs for this property. These graphs reflect the property owner's utility consumption and **estimate tenant contributions to consumption and cost.**

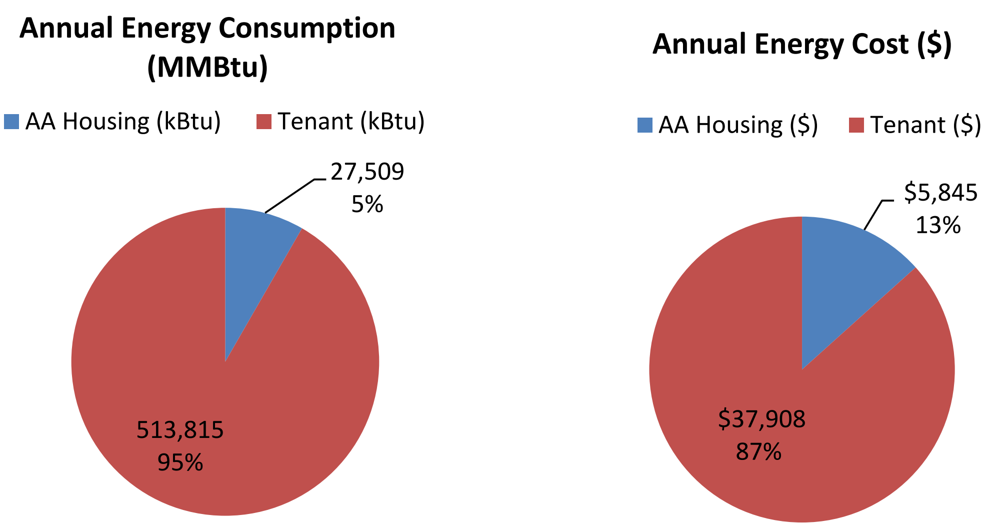


Figure 3. Historical Annual Energy Consumption and Cost

6.1 Electricity

Electricity is supplied and delivered to the subject property by DTE Energy. Historic common area electrical use and tenant use compared to cooling degree days is summarized in the following figure:

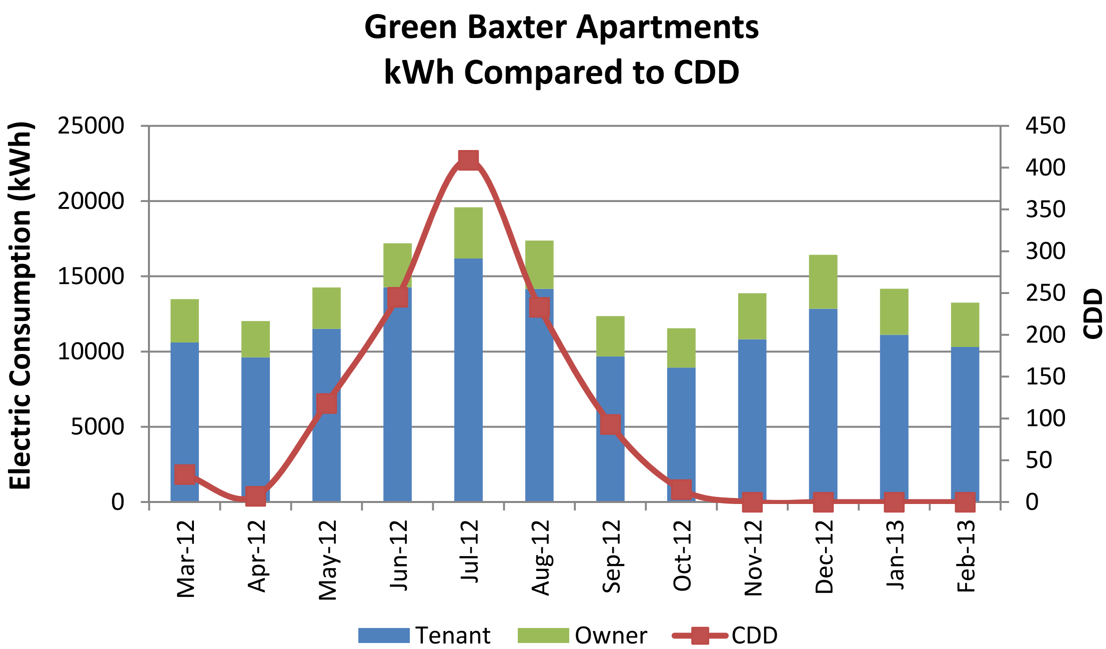


Figure 4. Electricity Consumption Graph

Table 8. Annual Electricity Metrics

	Owner	Tenant
Consumption	35,521 kWh	140,013 kWh
Energy Use Intensity	0.92 kWh / ft^2	3.64 kWh / ft^2
MMBtu	121 MMBtu	478 MMBtu

	Owner	Tenant
Cost per kWh	$0.144 / kWh	$0.157 / kWh
Cost per ft^2	$0.13 / ft^2	$0.57 / ft^2
Electricity Cost	$5,120	$21,932

Based on the method described in Section 4.3, Energy Calculations Methodology, the following figure shows the estimated electricity consumption per end use.

6.2 Natural Gas

Natural gas is supplied and delivered to the subject property by DTE Energy. Historic common area and tenant natural gas use is summarized in the following figure:

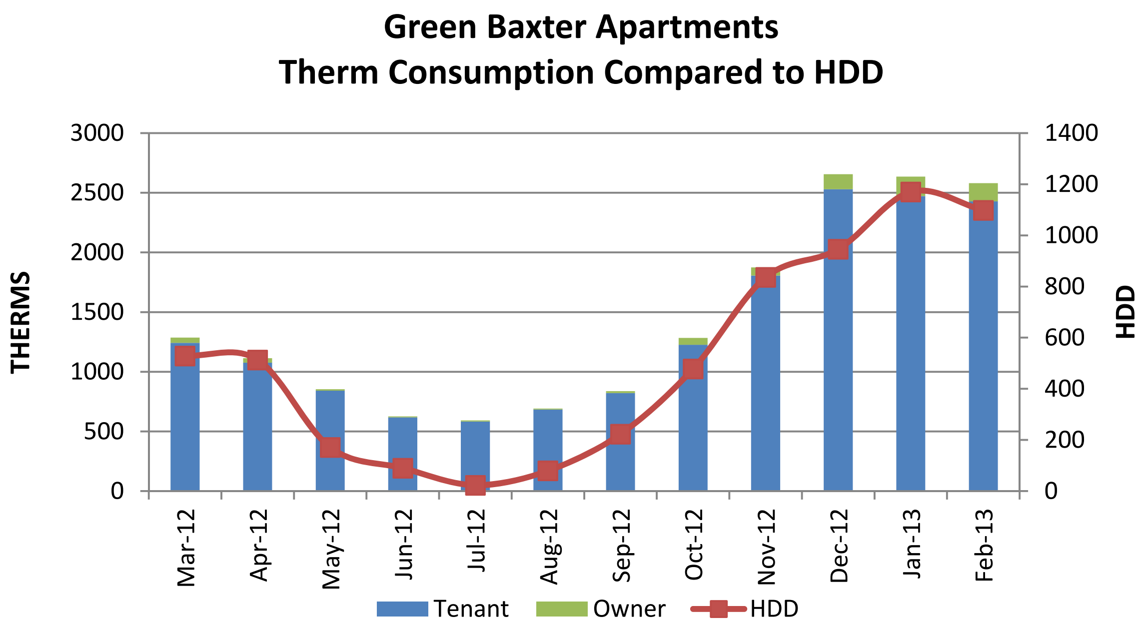


Figure 5. Natural Gas Consumption Graph

Table 9. Annual Natural Gas Metrics

	Owner	Tenant
Consumption	704 therms	16,327 therms
Energy Use Intensity	0.02 therms / ft^2	0.43 therms / ft^2
MMBtu	70 MMBtu	1,633 MMBtu

	Owner	Tenant
Cost per therm	$1.03 / therm	$0.98 / therm
Cost per ft^2	$0.02 / ft^2	$0.42 / ft^2
Natural Gas Cost	$725	$15,975

Based on the method described in Section 4.3, Energy Calculations Methodology, the following figure shows the estimated natural gas consumption breakdown by end use.

6.3 Domestic Water Use

For the time period covered by client provided records, historic domestic water use is summarized in the following figures.

Providers	Number of Meters	Unit of Consumption
City of Ann Arbor	4	CCF

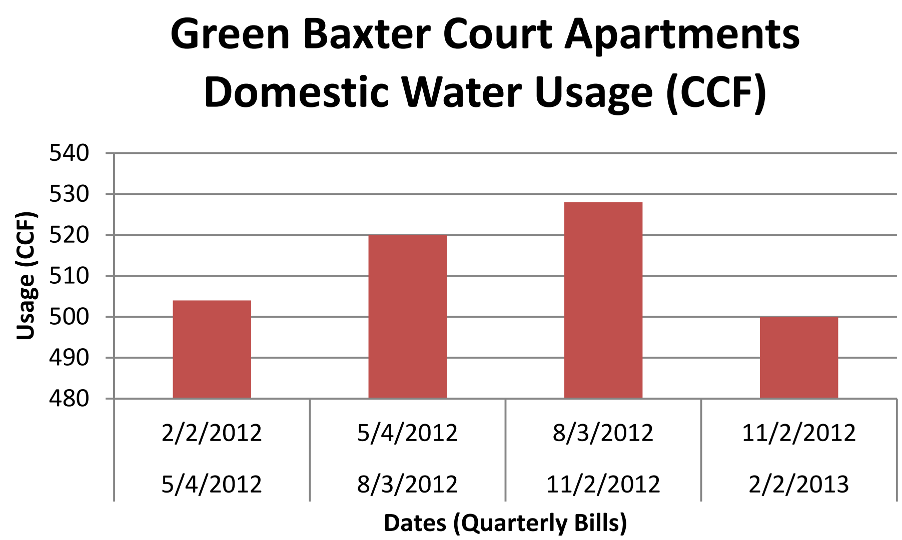


Figure 6. Domestic Water Consumption Graph (Owner)

Table 10. Annual Domestic Water Metrics

Consumption	2,052 CCF
Water Cost	$13,395

Cost per ccf	$6.80
Cost per ft^2	$0.36

Total annual water consumption was 2,052 CCF. Average cost per CCF for domestic water and sewer on an annual basis is $6.80. Total annual domestic water and sewer cost is $13,395.

According to the EPA, residential water use accounts for more than half of the publicly supplied water in the United States. For this reason, the EPA has introduced the WaterSense program to identify possible water efficiency methods and technologies for consumers throughout the country. Considering the responsibility that typically lies with the tenants, multi-family homes are no stranger to excessive water usage. Fortunately, implementation of improved technologies throughout these facilities can impact the water supply as well as the rising overhead costs associated with distribution and collection.

The HUD Energy Benchmarking Tool was used to compare water consumption data for the subject property to typical water consumption data for similar HUD properties. The tool utilizes normalized data from its database of more than 9,100 buildings to provide comparative metrics on domestic water consumption based on a facility's historic water data and design characteristics. Finally, a score is generated for the analyzed building to identify its ranking among similar buildings.

Water bills for this project were limited. The audit team was not able to inspect the specific sewer related costs, but often a significant reduction in water consumption will not translate directly into a significant reduction in costs, due to the percentage of sewer costs within the rate structure.

The Residential End Uses of Water study (REUWS) published in 1999 by the AWWA Research Foundation and the American Water Works Association is a research study that examined where water is used in single-family homes in North America. Conducted by Aquacraft, PMCL, and John Olaf Nelson, the REUWS was the largest study of its kind to be completed in North America and efforts are underway to repeat the effort and obtain updated results. The "end uses" of water include all the places where water is used in a single-family home such as toilets, showers, clothes washers, faucets, lawn watering, etc. The full REUWS final report is available to the public at no charge from the Water Research Foundation (WRF).

Figure 8 below shows the REUWS typical domestic water consumption breakdown by end use.

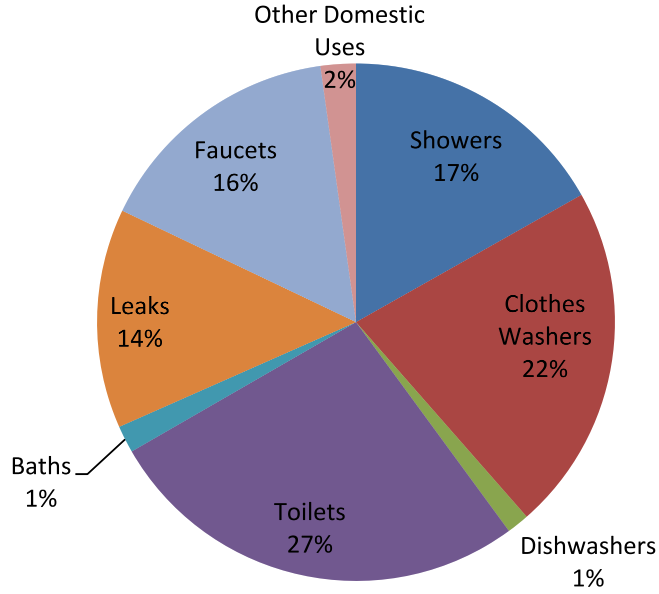


Figure 1. Domestic Water Typical End Use

6.4 Utility Use and Cost Breakdown

The disparate energy types (electricity and natural gas for this facility) and water costs have been aggregated to provide a breakdown of total utility cost by type. The breakdown of energy and water cost is based on the energy use breakdown, as described in Section 4.3, Energy Calculations Methodology.

The following table and charts detail the breakdown of energy and water costs. It should be noted that the consumption percentage identified in Section 5.1 Electricity, Section 5.2 Natural Gas, and Section 5.3 Domestic Water Use and the overall cost percentage for each end use are different. This is due to the cost difference for purchasing each energy type.

Currently, Ann Arbor Housing Commission pays $42.31 per MMBtu of electricity, $10.30 per MMBtu of natural gas, and $0.87 per 100 gallons of water consumed. Together, all of the tenants at Green Baxter Court Apartments currently pay an estimated $45.88 per MMBtu of electricity and $9.78 per MMBtu natural gas.

Table 11. Estimated Annual Utility Use Breakdown (Electric and Natural Gas)

Categories	Electricity (MMBtu)	NG (MMBtu)	Total Consumption (MMBtu)	Consumption (%)
Space Heating	36	1,336	1,371	60%
Cooling	60	0	60	3%
Ventilation	36	0	36	2%
Water Heating	30	257	287	12%
Lighting	318	0	318	14%
Cooking	6	111	118	5%
Refrigeration	30	0	30	1%
Office Equipment	5	0	5	0%
Computers	18	0	18	1%
Other	60	0	60	3%
TOTAL	**599**	**1,703**	**2,302**	**100%**

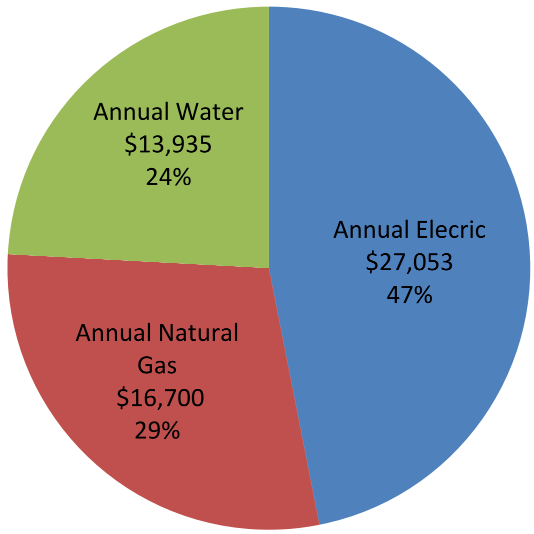


Figure 2. Annual Utility Cost by Type

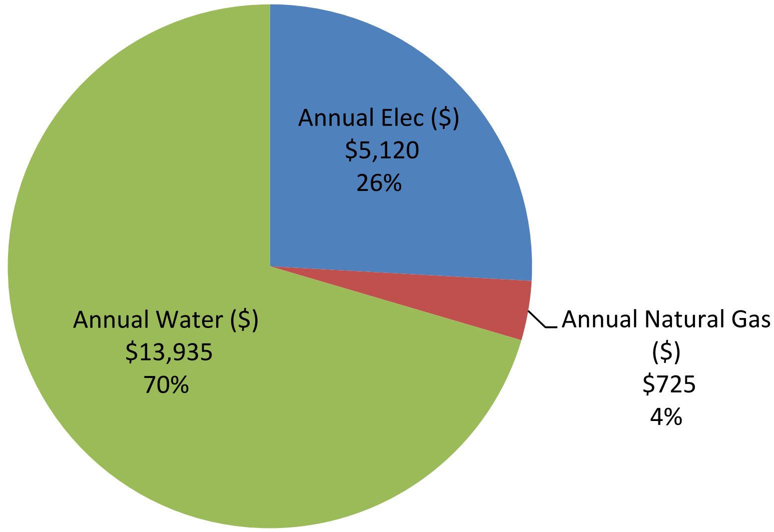


Figure 3. Annual Utility Cost by Type (Owner)

7.0 Energy Performance Benchmark

A benchmark is a standard by which something can be measured. Energy Benchmarking is the comparison of one building's energy consumption to the use of energy in a similar building. HUD's Office of Public and Indian Housing (PIH) has developed the Energy Benchmarking Tool to establish if a building's energy consumption is higher or lower than expected energy usage for similar buildings. AKT Peerless utilized the HUD Energy Benchmarking Tool to quantify the performance of the subject building relative to the family of HUD residential buildings.

This statistical analysis of the HUD tool is based on filters for the building’s location, gross square footage, total number of units and year of construction (refer to the appendix for more information regarding dataset filters). This filtered data set is used to calculate the benchmarks for an overall benchmark Energy Use Intensity (EUI) as well as the Energy Cost Intensity (ECI). The benchmarks shown in the portfolio summary are derived from the statistical analysis described in this section.

The following table compares the building energy performance of the subject property and the established benchmark.

Table 12. HUD Residential Energy Use Benchmarking Tool

	Actual	Benchmark
Score Against Peers	77	50
EUI (Energy Use Index)	59.8 kBtu/ft^2	84.2 kBtu/ft^2
$ ECI (Energy Cost Index)	1.14 $ / ft^2	1.60 $ / ft^2

7.1 Estimated Energy Star Score

ENERGY STAR is a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy dedicated to helping all building owners save money and protect the environment through energy efficient products and practices.

Results are already adding up. Americans, with the help of ENERGY STAR, saved enough energy in 2010 alone to avoid greenhouse gas emissions equivalent to those from 33 million cars — all while saving nearly $18 billion on their utility bills.

Because a strategic approach to energy management can produce twice the savings — for the bottom line and the environment — as typical approaches, EPA’s ENERGY STAR partnership offers a proven energy management strategy that helps in measuring current energy performance, setting goals, tracking savings, and rewarding improvements.

EPA provides an innovative energy performance rating system which businesses have already used for more than 200,000 buildings across the country. EPA also recognizes top performing buildings with the ENERGY STAR.

Energy Star certification is based on your building's performance against typical energy performance of similar buildings. A target efficiency rating of 75 is required to qualify for the Energy Star. Because the audit team does not have all the utility bills for the entire facility, and the energy performance utilized in this investigation is based on estimates generated through best practice software results, the facility at the subject property is not currently eligible for the Energy Star.

If the building owner would like to pursue Energy Star certification in the future, our audit team can work with ownership and tenants/lessees to establish an accurate benchmark and determine the necessary steps towards efficiency improvements required for the certification.

Energy Star Leaders Program

In addition to the Energy Star certificate for individual facilities, the Energy Star program recognizes ENERGY STAR partners who demonstrate continuous improvement organization-wide, not just in individual buildings. Organizations that achieve portfolio-wide energy efficiency improvements of 10%, 20%, 30% (or more) reductions may qualify for recognition as ENERGY STAR Leaders.

Ann Arbor Housing Commission may be eligible for this program. For more information on the program and eligibility, please visit: http://www.energystar.gov/index.cfm?c=leaders.bus_leaders#s2

8.0 Water Performance Benchmark

Water Benchmarking is the comparison of one building's water utilization to the use of water in a similar building. HUD's Office of Public and Indian Housing (PIH) has developed the preliminary benchmarking tool to establish if a building's water utilization is higher or lower than normal usage for similar buildings.

In order to develop the water consumption benchmarking tool, water consumption data was collected through voluntary release of information from thousands of buildings in nearly 350 PHAs nationwide. Regression analyses were performed on these datasets to see which of over 30 characteristics were most closely linked to water conservation.

Your building will score from 0 - 100, where 0 means water consumption is probably excessive and 100 means that the building probably uses water very efficiently. Important: this is a whole-building tool. Water use inputs include resident-paid consumption, when applicable/available.

The table below quantifies the performance of a user-defined building relative to the family of HUD residential buildings.

Table 13. HUD Residential Water Use Benchmarking Tool

	Actual	Benchmark
Score Against Peers	76	50
WUI (Water Use Intensity)	39.9 gal/ft^2	75.9 gal/ft^2
WCI (Water Cost Intensity)	0.36 $ / ft^2	0.69 $ / ft^2

9.0 Operations and Maintenance (O&M) Opportunities

Operation and maintenance make up the largest portion of the economic and environmental life cycle of a building and have become primary considerations of building owners and operators. Effective O&M is one of the most cost-effective methods for ensuring reliability, safety, and energy efficiency. Inadequate maintenance of energy-using systems is a major cause of energy waste in both the Federal government and the private sector. Improvements to facility maintenance programs can often be accomplished immediately and at a relatively low cost.

The following recommendations are believed to have the opportunity to reduce energy and water consumption for the facility.

9.1 Further Develop a Preventative Maintenance Plan for Equipment

Planned or preventative maintenance is proactive (in contrast to reactive) and allows the maintenance manager control over when and how maintenance activities are completed. When a maintenance manager has control over facility maintenance, budgets can be established accurately, staff time can be used effectively, and the spare parts and supplies inventory can be managed more efficiently.

Regardless of which strategy is used, maintenance should be seen as a way to maximize profit and/or reduce operating costs. From this perspective, the main functions of a maintenance department/staff are as follows:

- Control availability of equipment at minimum cost
- Extend the useful life of equipment
- Keep equipment in a condition to operate as economically and energy efficiently as is practical

The maintenance department/staff would be responsible for the following tasks:

- Maintenance planning
- Organizing resources, including staffing, parts, tools, and equipment
- Developing and executing the maintenance plan
- Controlling maintenance activities
- Budgeting

At the time of the assessment, the Facilities Director indicated that a plan is currently being established for the housing authority. It is recommended this continue. Additional considerations for the future plans should include, but not be limited to:

- Energy efficiency for vacant apartments at move-out
- Tenant education
- Tenant support maintenance program
- Tenant incentives program

9.2 Institute an Energy Star Purchasing Policy

Energy costs associated with electrical plug loads should be minimized where possible. Plug loads are electrical devices plugged into the building's electrical system and generally include things like appliances, computers, printers, and office equipment such as fax machines and copiers. When purchasing appliances, computers, and office equipment, the U.S. EPA ENERGY STAR standards should be specified. Manufacturers are required to meet certain energy efficiency criteria before they can label a product with the ENERGY STAR emblem, so these products represent your best energy saving value.

9.3 Water Heater Tank and Pipe Insulation

A water heater keeps water continually heated to a specific, set temperature. As the water loses heat through the tank walls during periods of non-use, the burner or heating element has to reheat the water. An insulation jacket will reduce the heat loss and, as a result, the energy required to maintain the hot water temperature and the water heater will not need to cycle as often. The insulation jacket enables the heater to bring the water up to temperature quicker, too, saving additional energy. Certain manufacturers may prohibit this on newer models. Please consult the tank manufacturer for newer models.

During periods of non-use, the heated water will rise to the top of the tank. The pipes can actually draw heat out of the tank, like a *wick*, and should be insulated. The first ten feet of hot and cold piping, if accessible, should be wrapped. If the water heating system is located in an unconditioned (cold) area, all accessible piping should be insulated.

DTE/MichCon may be offering incentives to install pipe wrap insulation.

9.4 Reduce Domestic Hot Water Temperature

You can reduce your water heating costs by simply lowering the thermostat setting on your water heater. For each 10ºF reduction in water temperature, you can save between 3%–5% in energy costs. Although some manufacturers set water heater thermostats at 140ºF, most households usually only require them set at 120ºF. Water heated at 140ºF also poses a safety hazard—scalding. However, if you have a dishwasher without a booster heater, it may require a water temperature within a range of 130ºF to 140ºF for optimum cleaning.

Reducing your water temperature to 120ºF also slows mineral buildup and corrosion in your water heater and pipes. This helps your water heater last longer and operate at its maximum efficiency.

9.5 Adequately Seal Doors and Windows

Infiltration is the flow of air through openings in a building. In order to reduce infiltration, the cracks and holes in a building must be adequately sealed. Maintaining caulking and weather stripping in good condition saves both money and energy. It also preserves the building and improves the comfort of its occupants. Verify that all doors and windows are adequately sealed. Verify that doors in existing vestibules are being closed to prevent unnecessary infiltration. Also, inspect the exterior of the buildings for cracks or other damage.

Older windows can be a major source of heat loss and air leakage, and can greatly impact the heating load on a building. A detailed engineering study is generally required to determine the best way to upgrade windows. However, be sure to consider low-e high performance glazing when window replacement becomes necessary. The additional cost will usually be paid for in energy savings in less than ten years.

Solutions to increase the efficiency of high use doors/doorways near the warehouse should be investigated. Additionally, any abandoned (exhaust or other equipment) openings in the roof should be identified. Further analysis would be required to identify a cost savings for sealing the perimeter openings.

9.6 Operational Timers

Drinking fountains are often refrigerated types that keep chilled water available on a continuous basis. Much of the time, these units can be modified to save energy consumed by the Compressor to refrigerate the water. Overnight or during periods the building is unoccupied, the drinking fountain can be turned off (chilling of water during winter months is often unnecessary, too). Because a drinking fountain can cost as much to operate as a small refrigerator over the course of one year, the savings potential for turning it off when possible makes this measure worth consideration, especially if your facility has several units.

Short of shutting off power to the drinking fountain permanently, the best option is to install a timer to control hours of operation to coincide with building hours. An inexpensive 24-hour plug-in timer can be installed if a drinking fountain is the plug-in type. (For wired drinking fountains, individual timers have to be wired into each unit - usually; the savings will not justify the cost).

This measure would be applicable in the community center.

9.7 Decommission Unused Devices/Appliances

Leaving appliances or devices in service that are no longer providing a necessary purpose creates an unnecessary draw of electricity or natural gas. By simply unplugging appliances and removing devices that are not is use for long periods of time (or at all), significant quantities of electricity and natural gas can be conserved.

The audit team identified a refrigerator in the community center basement that was plugged in with no perishables in the freezer or cold storage compartments (nothing in it).

9.8 Utilize Intelligent Surge Protectors

Intelligent surge protectors work in two ways: first, they automatically turn off electricity to all the things you don't need. For example when you turn off your TV, a smart strip turns off power to DVD players, home theater components, cable boxes, game consoles and so on. When you're not using your computer, have it turn off your monitor, speakers, and all the other electronics you don't need.

Secondly the Smart Strip (a common brand name for intelligent surge protectors) monitors power consumption and can sense the difference between when computers and other devices are on or off. Upon figuring this out, it shuts off the power, eliminating the idle current drawn from them. This stops power consumption for electronics that consume energy even when turned off or also called "vampire" electronics.

This measure would be applicable for the community center in the computer room and office areas.

9.9 Furnace Filter Replacement for Tenants

A dirty air filter can increase energy costs and lead to early equipment failure. It is important to clean or change the air filter in your heating and cooling system regularly. Also, it's important to have the HVAC equipment checked seasonally to make sure it's operating efficiently and safely – check-ups can identify problems early. According to www.energystar.gov, dirt and neglect are the #1 causes of system failure.

The audit team noticed that in several locations, furnace filters were located inside the (sealed) blower compartment of the furnace. Typically, a furnace filter is located adjacent to the unit in the return air duct, making it easily accessible and convenient to replace. In several tenant apartments, the filters can only be changed by opening the furnace. In particular, this is problematic with Goodman brand units (Model #GMS80703ANCC). These units require removing both the burner compartment and blower compartment covers in order to access the filter. This can be fairly intimidating and challenging for anyone unfamiliar with this technology, and should be handled by a trained technician.

The audit team recommends a program to either: A) seasonally assist tenants in inspecting and replacing filters; and/or B) modifying return air ducts to accommodate filters so that tenants can change them as required.

Maintaining clean filters can also protect and improve the indoor air quality of the tenant apartments.

10.0 Proposed Energy Conservations Measures (ECMs) and Water Conservation Measures (WCMs)

This analysis identified and included three primary types of ECM/WCMs:

- ECM/WCMs impacting the Owner (the Client) costs; and
- ECM/WCMs impacting the Tenant(s) costs; and
- ECM/WCMs to be implemented at the End of Useful Life (EUL) of equipment (includes both Owner and Tenant impacts)

The energy and water audit of the facility identified seven (7) energy conservation measures (ECMs) and one (1) water conservation measures (WCMs). These conservation measures are estimated to provide approximately $11,899 in annual savings. The investment required to implement all of the measures before the inclusion of applicable utility incentives is estimated to be $44,999. These savings measures are summarized within this section.

Incentives are not included in the calculation of payback times and savings calculations. Utilizing available incentives is expected to reduce project costs and decrease simple payback.

Table 14. Financial Summary of ECMs and WCMs

Energy and Water Conservation Measures	ID	Additional First Cost ($)	Annual Savings ($)	Simple Payback (yrs)
Interior Lighting Retrofit at Community Center	ECM1	$847	$412	2.1
Exterior Lighting Retrofit (entire campus)	ECM2	$16,890	$4,201	4.0
Install Occupancy Sensors at Community Center	ECM3	$150	$32	4.7
Install Low-Flow Showerheads and Faucet Aerator (entire campus)	WCM1	$600	$3,650	0.2
Install Programmable/Setback Thermostats at Tenant Apartments and Community Center	ECM4	$1,250	$744	1.7
Control Air Leakage	ECM5	$7,200	$1,198	6.0
Insulate and Seal Rim/Band Joist	ECM6	$3,762	$339	11.1
Insulate Attic Space to R-49	ECM7	$14,300	$1,324	10.8
Totals		**$44,999**	**$11,899**	**3.8**

Table 15. Summary of Savings for ECMs and WCMs

Energy or Water Conservation Measure	kWh Annual Savings (kWh)	Therm Annual Savings (Therms)	Water Annual Savings (ccf)	GHG Reduction (Metric Tons)
Interior Lighting Retrofit at Community Center	2,632	0	0	1.95
Exterior Lighting Retrofit (entire campus)	29,142	0	0	21.57
Install Occupancy Sensors at Community Center	223	0	0	0.17
Install Low-Flow Showerheads and Faucet Aerator (entire campus)	0	893	409	4.74
Install Programmable/Setback Thermostats at Tenant Apartments and Community Center	0	760	0	4.04
Control Air Leakage	0	1,224	0	6.50
Insulate and Seal Rim/Band Joist	0	347	0	1.84
Insulate Attic Space to R-49	0	1,353	0	7.18
Totals	**31,997**	**4,576**	**409**	**47.98**

Table 1. Measures for Consideration at the End of Useful Life (EUL) of Equipment

Energy Cost Reduction Measure (ECM)	ID	Additional First Cost	Annual Savings	Simple Payback (yrs)
Install High Efficiency Furnaces	ECM8	$14,300	$1,222	11.7
Replace Hot Water Heaters with Energy Star Models	ECM9	$225	$31	7.6
Total		**$14,525**	**$1,253**	**11.6**

10.1 ECM1 - Interior Lighting Retrofit at Community Center

Summary						
Cost to Implement	Estimated Annual Cost Savings	Simple Payback (years)	Electricity Savings (kWh)	Natural Gas Savings (therms)	Water Savings (gallons/year)	GHG Emissions (Metric Tons)
$847	$412	2.1	2,632	0	0	1.95

Recommendation Description

A total of (19) incandescent lamps, in various fixtures, were observed in the community center during the site visit. The majority of the incandescent lamps were 60 watt, with some 75 watt lamps observed. It is recommended that **all** incandescent lamps be upgraded to compact fluorescent lamps (CFLs). The existing incandescent lamps are inefficient and require unnecessary amounts of energy. The incandescent lamps are a mix of 60 watt and 75 watt, which have 16 watt and 19 watt CFL replacements respectively.

Compact fluorescent lamps are a great alternative to incandescent bulbs. On average, CFLs use seventy-five percent less electricity than incandescent bulbs and have a lifetime that is 10 times longer. Advances in technology over the past few years have brought great improvements to CFLs in terms of light quality and appearance, and they are available in a variety of shapes and sizes.

The Green Baxter Court Apartments community center had various types of linear florescent lighting fixtures installed throughout the building, primarily in the recreation room and computer room. Site observations revealed the building was still using older, less efficient T8 lamps were observed in these areas. Site observations revealed four (4) T8 (32W) 4-lamp 2x4 fixture with acrylic lens wrap, and eight (8) T8 (32W) 4-lamp 2x4 fixture, recessed.

It is recommended that these fixtures be retrofit with low power (25 or 28 watt) T8 lamps and appropriate electronic ballasts as soon as possible.

Assumptions

This ECM is calculated using a replacement total of 19 CFLs and (12) 2 lamp T8 2x4 retrofit kits w/reflectors. All lamps are assumed to operate 1,456 hours per year (an average of 4 hours per day each). It is assumed all of the existing incandescent lamps will be replaced with 16 watt CFLs and all the existing linear fluorescent lamps will be replaced with 28 watt T8s. The lighting calculator spreadsheet is included in the appendix.

Calculations

$$Energy\ Cost\ Savings = Energy\ Consumption\ Savings\ \times Energy\ Cost\ per\ kWh$$

Where:

$$Energy\ Consumption\ Savings = Existing\ Usage - Proposed\ Usage$$

$$Usage = \sum(\#\ of\ fixtures\ \times watts\ per\ fixture\ \times burn\ hours)$$

Incentives
DTE Energy's Multifamily Program is offering direct install incentives for replacing incandescent lamps with CFLs in tenant spaces. The required application for these incentives is included in the appendix.
Expected Useful Life Study
Incandescent lamps have an expected useful life of 1-2 years. Alternatively, compact fluorescent lamps have an expected useful life of 6-8 years, depending on the amount of usage per day.

10.2 ECM2 - Replace Exterior HID Wall Pack Lighting with LED (entire campus)

Summary						
Cost to Implement	Estimated Annual Cost Savings	Simple Payback (years)	Electricity Savings (kWh)	Natural Gas Savings (therms)	Water Savings (gallons/year)	GHG Emissions (Metric Tons)
$16,890	$4,201	4.0	29,142	0	0	21.57

Recommendation Description

The outside grounds of the Green Baxter Court Apartments property are lighting throughout the evening hours for safety and security. There are exterior lighting (wall pack) fixtures located near the front and rear entrance doors of each home. These wall packs are of the high intensity discharge (HID) type with high pressure sodium (HPS) lamps that appeared to be 35 watts each. There are also larger flood lights installed on the gable ends (mostly) to light the grounds. These flood lights are of the high intensity discharge (HID) type with high pressure sodium (HPS) lamps that appeared to be 250 watts each. The site visit light count total was 50 of the smaller wall packs and 30 of the larger flood lights.

Please note that the exterior lighting on two of the buildings was operating during daytime hours (at time of site visit). This is most likely due to a faulty photocell control. This should be repaired (wasted energy cost of $1,285 annually), but is not factored into this ECM analysis.

The existing HID exterior lighting is outdated, and significantly more efficient lighting options are readily available. For this application, it is recommended that exterior lighting be retrofitted with more efficient light emitting diode (LED) lighting.

Along with significant electrical savings at equivalent lumen output, maintenance will be greatly reduced as the LED lights proposed have an L70 lifespan of 100,000 hours. L70 is an industry standard to express the useful lifespan of an LED. It indicates the number of hours before light output drops to 70% of initial output. Maintenance reduction is not factored into the savings calculated for this report. LED lighting is considered a green technology due to the high fixture efficacy and the absence of mercury, arsenic, and ultraviolet (UV) light.

This ECM analysis was based on replacing the existing wall pack fixtures with model #WPLED5N (RAB Lighting,) **or equivalent**, 5 watt high performance LED wall packs. The existing flood lights are replaced with model #FXLED78T (RAB Lighting) **or equivalent**, 78 watt high performance LED flood. The specification sheets for the analyzed models are included in the appendix.

The initial cost of this project is the material cost for 42 wall packs and 24 flood lights. The fixtures have provisions for junction box and surface mount for recessed box applications, and are assumed to be installed by in-house maintenance staff. Again, the additional savings associated with reduced maintenance costs are not included in the calculated savings.

Assumptions

Installation of new LED wall packs would be performed by in-house maintenance staff at no additional labor cost.

It is assumed that the proposed fixtures will provide adequate light level for safety and security purposes. The lighting calculator spreadsheet result is included in the appendix.

The existing wall packs contain 35 watt high pressure sodium (HPS) lamps and have an input wattage of 46 watts each.

The existing flood lights contain 250 watt high pressure sodium (HPS) lamps and have an input wattage of 295 watts each.

Calculations

$$Energy\ Cost\ Savings = Energy\ Consumption\ Savings\ \times Energy\ Cost\ per\ kWh$$

Where:

$$Energy\ Consumption\ Savings = Existing\ Usage - Proposed\ Usage$$

$$Usage = \sum (\#\ of\ fixtures\ \times watts\ per\ fixture\ \times burn\ hours)$$

Incentives

DTE Energy's Multifamily Program is offering incentives for replacing existing HID exterior lighting with LED lighting. Existing lighting must operate more than 3,833 hours per year and replacement must result in at least a 40% power reduction. In addition, the replacement lamp must have an efficacy of at least 35 lumens per watt. The application and specifications for these incentives is included in the appendix.

Expected Useful Life Study

Lamps in the exterior light fixtures were installed in 2008 and have an expected useful life of six years. It is believed that the lamps will need to be replaced next year. The expected useful life of an LED replacement fixture is typically around 15 years.

10.3 ECM3 - Occupancy Sensors for Lighting Control at Community Center

Summary						
Cost to Implement	**Estimated Annual Cost Savings**	**Simple Payback (years)**	**Electricity Savings (kWh)**	**Natural Gas Savings (therms)**	**Water Savings (gallons/year)**	**GHG Emissions (Metric Tons)**
$150	$32	4.7	223	0	0	0.17

Recommendation Description

The simplest way to reduce the amount of energy consumed by lighting systems is to turn lights off when they are not needed. In the Hikone community center building, the majority of lighting fixtures are controlled directly with the manual switches which are turned on by the staff or tenants. This ECM calculates the energy savings expected by installing occupancy sensors in the Community Center Recreation Room. Installing occupancy sensors can better regulate the necessity of lights in these areas of varied occupancy.

Excerpt from the Energy Star website (www.energystar.gov):
Occupancy sensors are most effective in spaces where people move in and out frequently in unpredictable patterns: for example, private offices, lecture halls, auditoriums, warehouses, restrooms, and conference rooms. Occupancy sensors are less likely to be effective in open-plan offices, where one or more people may be present throughout the day or in reception areas, lobbies, retail spaces, or hospital rooms. The savings achievable with occupancy sensors, even in the most appropriate spaces, varies widely, depending on local conditions.

The three most common types of occupancy sensors are passive infrared (PIR), ultrasonic, and those that combine the two technologies. PIR devices are the least expensive and most commonly used type of occupancy sensor. They detect the heat emitted by occupants and are triggered by changes in infrared signals when, for example, a person moves in or out of the sensor's field of view. PIR sensors are quite resistant to false triggering and are best used within a 15-foot radius. Ultrasonic sensors can detect motion at any point within the contour lines. Infrared sensors "see" only in the wedge-shaped zones, and they do not generally see as far as ultrasonic units. Some sensors see farther straight ahead than to the side. The ranges shown here are representative; some sensors may be more or less sensitive.

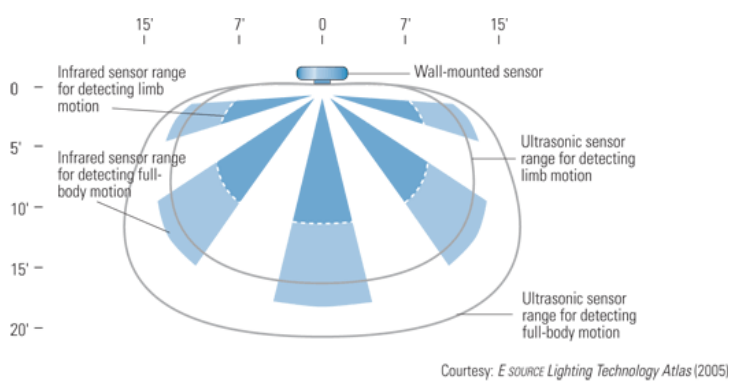


Figure 7. Occupancy Sensor Coverage Patterns

Ultrasonic devices emit a sound at high frequency—above the levels audible to humans and animals. The sensors are programmed to detect a change in the frequency of the reflected sound. They cover a larger area than PIR sensors and are more sensitive. They are also more prone to false triggering. For example, ultrasonic sensors can be fooled by the air currents produced by a person running past a door, moving curtains, or the on-off cycling of an HVAC system.

Hybrid devices that incorporate both PIR and ultrasonic sensors are also available. These take advantage of the PIR device's resistance to false triggering and the higher sensitivity of the ultrasonic sensor. Some hybrid sensors combine PIR with sensors for audible sound. That design has proved useful in cases where the frequencies used in ultrasonic sensors interfere with equipment such as hearing aids—a problem that is less frequent than it used to be because sensor manufacturers have learned to use frequencies that minimize the issue.

Evaluating the economic feasibility of an installation is best done by monitoring lighting and occupancy patterns. The use of inexpensive automatic data logging systems will indicate the total amount of time the lights are on when the space is vacant, the time of day the savings take place, and the frequency of lamp cycling. Data can also be gathered through the use of recording ammeters connected at lighting breaker panels; through random surveys, such as observing a building's exterior at night or interviewing custodial and security personnel; and through existing timers, scheduling controllers, and energy management systems…

…Sensor placement is also crucial to success. Wall-mounted sensors are suitable in smaller rooms—offices, bathrooms, and equipment rooms that are only intermittently occupied. In larger spaces or wherever the lighting load is higher, it is better to mount the sensor in the ceiling. Some units can be mounted in the corner or on the wall near the ceiling.

It is recommended to install occupancy sensors in the Community Center Recreation Room and Computer Room. Occupancy sensors could also be beneficial in the bathroom, the first floor kitchen, and offices, but these areas are not included in this ECM calculation as the operating hours are more difficult to estimate accurately. Payback times would likely be greater for these areas, unless lights are typically left on after people leave these areas.

Assumptions

Savings estimates for this ECM are based on a 30% reduction of existing usage for the lighting fixtures in the subject areas. Existing burn hours in these areas were assumed to be 1,456 hours per year in the Community Center Recreation Room and Computer Room.

Calculations

$$Energy\ Cost\ Savings = Energy\ Consumption\ Savings\ \times Energy\ Cost\ per\ kWh$$

Where:

$$Energy\ Consumption\ Savings = Existing\ Usage - Proposed\ Usage$$

$$Usage = \sum (\#\ of\ fixtures\ \times watts\ per\ fixture\ \times burn\ hours)$$

Incentives

DTE Energy's Multifamily Program is offering incentives for installing occupancy sensors in areas of low occupancy. The application and specifications for these incentives is included in the appendix.

Expected Useful Life Study
Occupancy sensors typically have an expected useful life of twenty years.

10.4 WCM1 - Install Low-Flow Showerheads and Faucet Aerators (entire campus)

Summary						
Cost to Implement	Estimated Annual Cost Savings	Simple Payback (years)	Electricity Savings (kWh)	Natural Gas Savings (therms)	Water Savings (gallons/year)	GHG Emissions (Metric Tons)
$600	$3,650	0.2	0	893	305,932	4.74

Recommendation Description

In some areas, water and sewer rates have increased dramatically over the past few years and are rivaling the cost of energy. Reducing water use through conservation strategies can generate significant cost savings. These strategies include implementing low flow shower heads and faucet aerators.

WaterSense, a program sponsored by the U.S. Environmental Protection Agency (EPA), is helping consumers identify high performance water-efficient toilets that can reduce water use in the home and help preserve the nation's water resources.

It is recommended to install a low-flow faucet aerator (0.5 GPM) in each bathroom on the entire campus. Additionally, it is recommended to replace every showerhead with a low-flow showerhead (1.5 GPM).

Assumptions

Calculation of savings is based on replacing twenty-three (23) showerheads currently using 2.5 GPM with a new showerhead using 1.5 GPM. A value of 8 minutes of shower use per occupant per day (from the REUWS survey referenced in Section 5.3) was used, assuming two occupants or greater in each house.

Lavatory water savings calculation were based on replacing one (1) faucet aerator using 2.2 GPM with a low-flow faucet aerator (>0.5 or equal to 1 GPM) in each of the residential unit bathrooms. In total, the analysis of replacing showerheads and faucet aerators produced a water savings of greater than or equal to 12,740 gallons per household (24 total households).

Incentives

At the present time, DTE Energy’s Multifamily Program does offer a direct install incentive for low-flow aerators and showerheads. The application for this program is included in the appendix of this report.

Expected Useful Life Study

Faucet aerators and showerheads have an expected useful life of ten years. It is believed that the faucets and showerheads were installed approximately 10 years ago and are need of replacement.

10.5 ECM4 - Install Programmable Thermostats

Summary

Cost to Implement	Estimated Annual Cost Savings	Simple Payback (years)	Electricity Savings (kWh)	Natural Gas Savings (therms)	Water Savings (gallons/year)	GHG Emissions (Metric Tons)
$1,250	$744	1.7	0	760	0	4.04

Recommendation Description

Currently, control of the furnace heat in each home is by a manual thermostat located in the living room. Please note that although the thermostat observed during the site visit (and possibly others) is electronic with a digital display, it is not programmable.

It is recommended that a programmable thermostat is installed to control the heat. The programmable thermostats would allow a nighttime setback to be employed, thereby saving energy on heating during overnight hours.

Because the thermostat is controlled by the resident, a "tamper-proof" type design should be considered. Tenant or resident energy education is crucial when replacing manual thermostats with temperature limiting programmable thermostats. At the time of installation, tenants and residents should be informed about why the thermostats were selected and how they operate. Recommended temperature settings are included below.

	Heating Daytime Setting	Heating Nightime Setback
Current Setpoints (estimated)	72 °F	72 °F
Proposed Setpoints	72 °F	68 °F

Calculations

Calculations were performed using an energy savings calculator that was developed by the U.S. EPA and U.S. DOE for estimating purposes. The calculator was modified to more closely represent the actual building heating load. Weekday and weekend typical usage pattern used an 8 hour nighttime setback of 68 degrees and a regular setpoint of 72 degrees.

Assumptions

The subject energy savings calculator assumes the following:
Savings per Degree of Setback (Heating Season) = 3% based on Industry Data 2004

The baseline energy consumption for heating dedicated to the building was estimated using a combination of the consumption profiles in Section 5.2 and the auditor's judgment. Resultant consumption was 1,942 MMBtu for heating. A reduction of 4 degrees (nighttime setback of 68 degrees) for an 8 hour setback every night was assumed.
Incentives
DTE Energy's Multifamily Program is offering a direct install incentive for installing programmable thermostats in the individual units. The application for these incentives is included in the appendix.
Expected Useful Life Study
Manual thermostats have an expected useful life of 15 years. At the time of replacement, it is recommended that the manual thermostats be replaced with programmable thermostats with the same expected useful life.

10.6 ECM5 - Control Air Leakage

Summary						
Cost to Implement	Estimated Annual Cost Savings	Simple Payback (years)	Electricity Savings (kWh)	Natural Gas Savings (therms)	Water Savings (gallons/year)	GHG Emissions (Metric Tons)
$7,200	$1,198	6.0	0	1,224	0	6.50

Recommendation Description

Air leakage through holes, gaps, cracks, penetrations, and electrical receptacles is a major source of heat loss from a dwelling unit. Controlling this air leakage through a combination of weather stripping and strategic sealing can significantly reduce the amount of heat lost to the outside, thus reducing the amount of energy needed to heat the dwelling unit. Insulation also can help reduce air leakage.

In addition to saving energy, controlling air leakage can reduce moisture problems and reduce the influx of odors and contaminated air from the basement and other units, while increasing the overall comfort of the residents.

But reducing air leakage through air-sealing techniques is more complicated than simply weather-stripping and caulking. Two important principles must be understood. First, even if a building is full of holes, air will not move through those holes unless there is a difference in pressure between indoors and outdoors. This pressure differential depends on the difference between indoor and outdoor temperatures, wind speed and direction, and mechanical ventilation. If there is no pressure differential, the air stands still and does not leak in or out. This is important because sealing a hole where there is no pressure differential will not save energy. Pressure tends to be highest on upper and lower floors and in basements. In the heating season, hot air rises and pushes on the ceiling, creating high positive pressure and eventually leaking out. When it does leak out, it is replaced by cold air coming into the lower part of a building, where the pressure is negative from all the warm air moving upward. This force is called the "stack effect."

The second important principle is that air sealing can affect air quality. Air leakage is the primary source of ventilation in many buildings. Tightening a building by reducing air leakage can endanger the health of the occupants in buildings with no mechanical ventilation. This risk is highest in buildings with significant sources of indoor air pollution, such as back drafting from gas appliances or high occupancy levels. If a building does not have mechanical ventilation, it is recommended that a ventilation system be installed before any significant air leakage is significantly reduced.

<u>For the subject property, Green Baxter Court Apartments:</u>

The blower door test determined that air leakage is adequate for ventilation.
The blower door airflow rate was 1,750 CFM_{50}.
The building tightness limit (BTL) is 1,323 CFM_{50}.
Therefore, an air leakage reduction limit of 24% should not be exceeded.

<u>Air Sealing Strategy:</u>

Air seal the home to the minimum ventilation rate (MVR) for air leakage, but **not** below.

During the blower test of one representative sample unit (3 bedroom), most of the air leakage was identified to be from and around the windows, doors, and penetrations into the attic/ceiling. All interior window casing should be sealed with caulk (both on the outside of the casing to the wall and on the inside of the casing to the window jamb). Products such as Dap's Seal & Peal (removable weather-strip caulk provides a watertight and weatherproof seal to temporarily seal out drafts and save energy / peels away when removal is desired / won't damage painted surfaces) can be used to air seal the leaks between the slider units and window frame. The tested unit had weather stripping at the entry doors (complete jambs and new threshold sweep), but all unit homes should be checked for the same. All attic hatches should also be weatherized with adhesive weather strip. The cost used in this ECM is based on this scope of work.

Next step would be to air seal the attic. This would include ceiling and top plate penetrations (electrical and plumbing vent stack).

Assumptions

See Section 4.3.

Calculations

The sensible heat loss due to excess air leakage was estimated based on a 24% reduction of existing air leakage (29 CFM). This preserves the MVR detailed in the recommended description above. Equation used for estimation was: $Q = 1.08 * (29\ cfm) * (6818\ HDD) * 24\ hr/day = 5{,}094{,}895\ Btu$ (approx. 51 therms) per unit.

Incentives

DTE Energy's Multifamily Program is not offering incentives for air sealing at the present time.

Expected Useful Life Study

Depending on the applied location, the life expectancy of caulks and sealants can be in the range of five to ten years. It is believed that the areas identified with air leakage have either never been sealed in the past or need to be resealed.

10.7 ECM6 - Insulate and Seal the Rim/Band Joist

Summary						
Cost to Implement	Estimated Annual Cost Savings	Simple Payback (years)	Electricity Savings (kWh)	Natural Gas Savings (therms)	Water Savings (gallons/year)	GHG Emissions (Metric Tons)
$3,762	$339	11.1	0	347	0	1.84

Recommendation Description

In order to improve the comfort, efficiency, durability and healthfulness of buildings, it's necessary to control the movement of heat, air and moisture within and through a building envelope. Attention to insulation and air-sealing details throughout a house is critical. One area that is commonly overlooked or undervalued is the rim or band joist, located in the basement and between floors.

The typical residential unit at Green Baxter Court Apartments was observed to have Kraft-faced, R-11 insulation tucked into rim cavities in the basement. Almost all areas were poorly installed and many areas were missing insulation completely. Stuffing fiberglass batts between floor joists is a common method of insulating the rim joist in many homes, but it's a flawed technique. Fiberglass works best in an enclosed space where it can trap air (between drywall and the exterior sheathing of a stud wall, for example). In a typical (poorly) insulated fiberglass installation, as observed tenant units, air moves freely around the batts, as well as through the fiberglass itself.

As an alternative, relatively new to the market, two-component spray-foam kits offer a quick, effective solution to tricky insulating problems. The kit consists of two liquid chemicals that mix together in the tip of a gun, and then expand once they hit the surface. The foam is highly adhesive, so it sticks and stays in place as it expands to fill gaps. Once cured, the foam provides an effective air seal as well as insulation.

This ECM analyzes the removal of existing fiberglass batts, and the application of 1-2 inches of closed cell foam in the rim/band joist cavity. Fiberglass could be set aside and properly reinstalled/reapplied after the closed cell foam application has fully cured in place. It is assumed that after reapplication of fiberglass, the effective R-value would be targeted at R-19.

The International Residential Code (IRC) allows the exposed use of spray foam at rim joists (i.e., without a 15-minute thermal barrier such as drywall), as long as the thickness is less than 3-¼".
High density (closed cell, 2 PCF) spray foams were approved in the 2003 IRC, and low density (open cell, 0.5 PCF) foams were approved in the 2009 IRC, as well as any intermediate densities.

Calculations

The conductive heat loss due through the ceiling was estimated based comparing an R-6 or less rim/band joist area with an R-19 rim/band joist area. Equation used for estimation was the standard

heat loss: Q = U * A * (6,818 HDD) * 24 hr/day
Incentives
At the present time, DTE Energy’s Multifamily Program is not offering incentives to install insulation to walls.
Expected Useful Life Study
Aside from potential exposure to environmental elements, insulation, for the most part, has an expected useful life of over fifty years. Adding insulation to the existing layer should be considered when the existing insulation is still in good condition and is sufficient to fulfill code requirements.

10.8 ECM7 - Increase Attic Insulation to R-49

Summary						
Cost to Implement	Estimated Annual Cost Savings	Simple Payback (years)	Electricity Savings (kWh)	Natural Gas Savings (therms)	Water Savings (gallons/year)	GHG Emissions (Metric Tons)
$14,300	$1,324	10.8	0	1,353	0	7.18

Recommendation Description

Attic insulation reduces the amount of heat that flows from a dwelling unit through the attic to the cold outside air. By reducing this heat loss, attic insulation reduces the amount of energy needed to heat the dwelling unit in the winter. In the summer, attic insulation saves on cooling costs and keeps buildings more comfortable by reducing the conduction of heat from the hot attic through the ceiling and into the unit.

A material's resistance to heat flow is measured in units of "R-value". The higher the R-value, the better the insulating property. The R-value of insulation depends on the type of insulation and its thickness. Optimal R-value for attic insulation depends on the existing insulation, fuel costs, and climate.

The typical attic appears to have 3.5" (nominal) batts of R-11 insulation laid on the ceiling with approximately 3" of blown fiberglass insulation on top of the batts. The estimated R-value of this insulation type and level is R-19 (loose fill fiberglass, 0.6 lb/ft^3, horizontal application, open blow, R-value 2.8 per inch. The insulation observed onsite appeared to be poorly placed with the blown insulation often unevenly distributed. It was also noted that areas around the stairwell were missing insulation. This uneven distribution of insulation results in a lower effective insulation value in the attic. Overall, this insulation would be considered standard efficiency at best, or in some cases substandard efficiency (<R-21).

This ECM explored adding an additional insulation level of R-30, bringing the total to R-49, which is the target Energy Star recommended insulation level for retrofitting wood-framed buildings in this climate zone.

The community center attic – both the addition and retrofitted apartment - was observed to have approximately 6" of fiberglass batting rolled on the attic ceiling with an additional 3" of blown fiberglass on top of the batts. The community center appeared to have a better overall effective insulation layer than the typical apartment. This is generally considered a standard efficiency solution.

It was noted that the end units (3-bedroom apartments) have an approximately 5'x15' overhanging space on the second floor. The audit team was unable to determine if insulation exists in the floor joist cavities and believe this could be an area of heat loss for these units.

If the attic insulation is increased at some point in the future, be sure to do any required air sealing first.

Also, rafter vents (insulation baffles) will likely be required to achieve the desired insulation depth near the eaves. The following is from the Energy Star website regarding rafter vents:

To completely cover your attic floor with insulation out to the eaves you need to install rafter vents (also called insulation baffles). Complete coverage of the attic floor along with sealing air leaks will ensure you get the best performance from your insulation. Rafter vents ensure the soffit vents are clear and there is a channel for outside air to move into the attic at the soffits and out through the gable or ridge vent. To install the rafter vents, staple them directly to the roof decking. Rafter vents come in 4-foot lengths and 14-1/2 and 22-1/2 inch widths for different rafter spacings. Rafter vents should be placed in your attic ceiling in between the rafters at the point where your attic ceiling meets your attic floor.

Once they are in place, you can then place the batts or blankets, or blow insulation, right out to the very edge of the attic floor. Note: Blown insulation may require an additional block to prevent insulation from being blown into the soffit. A piece of rigid foam board placed on the outer edge of the top plate works very well for this

Calculations

The conductive heat loss due through the ceiling was estimated based comparing an effective insulation value of R-12 in the ceiling area with an R-49 ceiling area. Equation used for estimation was for standard heat loss: Q = U * A * (6,818 HDD) * 24 hr/day

Incentives

DTE Energy's Multifamily Program does not currently offer incentives to install insulation in the attic wall cavities of a facility.

Expected Useful Life Study

Aside from potential exposure to environmental elements, insulation, for the most part, has an expected useful life of over fifty years. Adding insulation to the existing layer should be considered when the existing insulation is still in good condition and is sufficient to fulfill code requirements.

11.0 ECMs for Replacement at End of EUL

The following are ECMs for which the calculated payback period exceeds the useful life of the product, when considered for immediate replacement. However, these ECMs have a viable payback period when the replacement occurs at the end of the product's estimated useful life (EUL), since the item would be replaced at this time in any case. In order to demonstrate the benefit of upgrading to an energy efficient product, only the premium cost for upgrading to the energy efficient product is considered in the initial investment. The premium cost is the difference between the cost of the energy efficient item and the standard replacement item.

11.1 EUL1 - Replace Hot Water Heaters with Energy Star Models (x24)

Summary (per unit)					
Premium Cost	Estimated Annual Cost Savings	Simple Payback (years)	Electricity Savings (kWh)	Natural Gas Savings (therms)	GHG Reduction (Metric Tons)
$225	$40	6.1	0	41	0.22

Recommendation Description

Usually, a water heater is replaced only when it fails. But if the existing water heater is at least ten years old, it is near the end of its useful life, and it may make sense to replace it before it fails. By replacing the water heater before it stops working, the Housing Authority may enjoy significant energy savings, in addition to avoiding a situation in which residents are without hot water while a new system is being selected. Replacements of old water heaters that are oversized will generally yield higher savings than if the old system is appropriately sized. In any case, if the old water heater is leaking or shows signs of heavy rust or water streaking in the combustion chamber, it should be replaced (Weingarten and Weingarten 1996).

The energy factor (EF) indicates a water heater's overall energy efficiency based on the amount of hot water produced per unit of fuel consumed over a typical day. This includes the following:

- Recovery efficiency – how efficiently the heat from the energy source is transferred to the water
- Standby losses – the percentage of heat loss per hour from the stored water compared to the heat content of the water (water heaters with storage tanks)
- Cycling losses – the loss of heat as the water circulates through a water heater tank, and/or inlet and outlet pipes.

A new standard efficiency 40-gallon gas water heater has a current minimum Energy Factor of 0.59, due to inefficiencies of combustion, a central flue carrying heat away with combustion exhaust, and a continuous gas pilot light, as well as standby losses through insulation and thermo-siphoning.

This ECM recommends Energy Star qualified gas water heaters (Energy Factor of 0.67 or greater). This represents a 14% percent savings compared to a standard efficiency gas water heater. In addition to reducing standby losses with added insulation and anti-thermo-siphon device (heat traps), these improved efficiencies can be achieved for very little added cost by using electronic ignition instead of a pilot light, having automatic draft dampers, and reducing losses out the flue by recovering more of the heat first.

Energy Star Qualifying Models: Residential High-Efficiency Gas Storage Water Heaters
http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=WGS

- Minimum Energy Factor (EF) of 0.67 as of September 1st, 2010.
- Minimum First Hour Rating (FHR) of 67 gallons
- Annual energy savings of 14% (Based on the National Gas Average Energy Cost and a comparison to a conventional gas water heater with an EF rating of 0.59)

Calculations

Data used in this ECM are from a cost comparison study conducted by the American Council for an Energy-Efficient Economy (ACEEE). http://aceee.org/about

Incentives

DTE Energy's Multifamily Program is not offering incentives for replacing older hot water heaters with Energy Star models at this time.

Expected Useful Life Study

Hot water heaters have an expected useful life of ten years. The existing hot water heaters were installed at different times. The following lists the hot water heaters per tenant unit and their installed date:

Tenant Unit #	Tank Size	Installed Date
1701, 1737	40 gallon	2012
1709	40 gallon	2011
1717	40 gallon	2010
1725	40 gallon	2009
1719	40 gallon	2005
1743	40 gallon	2004
1703, 1705, 1711, 1713, 1715, 1721, 1723, 1727, 1729, 1733, 1735, 1739, 1741, 1745, 1747	40 gallon	2002

Most of the tenant units have hot water heaters that are at their expected useful life and are recommended for replacement in the near future.

First Hour Rating Calculation

Use	Avg. Gal. of Hot Water Use		Times used during 1 hour		Gallons used in 1 hour
Shower (8 minutes avg.)	10	x	# of tenants	=	10/20
Shaving (.05 gpm)	2	x	1	=	2
Hand Dishwashing or Food prep (2 gpm)	4	x	1	=	4
Clothes Washer (one load)	7	x	1	=	7
			Total Peak Hour Demand	=	23/33

Depending on the anticipated number of tenants in a unit, the recommended size for replacement hot water heaters is 30 gallon tanks. Some of the existing tank sizes in units are adequate for standard replacements; however, it is recommended that any existing 40 gallon tanks be replaced with 30 gallon tanks at the end of their useful life.

11.2 EUL2 - Install High-Efficiency Furnaces

Summary						
Premium Cost to Upgrade	**Estimated Annual Cost Savings**	**Simple Payback (years)**	**Electricity Savings (kWh)**	**Natural Gas Savings (therms)**	**Water Savings (gallons/year)**	**GHG Emissions (Metric Tons)**
$14,300	$1,324	10.8	0	1,353	0	13.18

Recommendation Description

Replacing the old heating plant in a building can generate considerable savings if the existing equipment is inefficient and/or the fuel source is expensive compared to other options. A furnace near the end of its useful life is a particularly good candidate for replacement with high-efficiency equipment. Unfortunately, this opportunity was missed by the AAHC when twenty-four (24) of the furnaces were recently replaced with standard efficiency (80%) units in 2011.

Because of technology advances, new furnaces are much more efficient than they used to be, presenting opportunities for significant savings on heating costs. Existing furnaces have a designed efficiency of 80-81%. Replacement units are available with efficiencies of up to 95%. Significant energy savings can be realized with the installation of more efficient units. This ECM is calculated for replacing all twenty-four (24) Goodman furnaces, model #GMS80703ANCC (80% AFUE) with Goodman furnaces, model #GKS90703CX (92% AFUE) at the end of useful life.

Calculations

Natural gas consumption of existing furnaces is equal to 73% of total consumption (12,106 therms for furnace heating). Efficiency gain from 80% to 92% with high efficiency units.

Base cost of $759 for standard efficiency Goodman model #GMS80703ANCC (80% AFUE).
Base cost of $1,056 for standard efficiency Goodman model # GKS90703CX (92% AFUE).
Additional labor cost of $200 per furnace for high efficiency installation. This is for the cost of installing necessary PVC venting runs through the exterior wall.

Incentives

The Detroit HVAC Incentives offers up to $300 in incentives for a replacement of natural gas furnaces. An implementation of this incentive with the ECM would aggregate savings with labor and the new furnace to $300 for a natural gas furnace of 94% or higher efficiency. Refer to table in appendix for further details. A retrofit of 24 new furnaces on the property amounts to a potential of $7,200 in incentives.

Additional Federal Tax Credits are available for replacing furnaces where up to 30% of the installed cost or $1,500 for all systems in each unit retrofit, whichever is less, can be reimbursed at the end of the year. With the new furnace up to Energy Star standards, an additional $10,500 in saving may be available in the form of tax credits. Refer to table in appendix for details and link below for more information. http://www.energystar.gov/index.cfm?c=tax_credits.tx_index#c

Expected Useful Life Study

Furnaces have an expected useful life of 20 years. The existing units were installed at different dates. The following lists the furnaces per tenant unit and their installed date:

Tenant Unit #	Model	Installed Date
1701, 1705, 1707, 1713, 1717, 1719, 1725, 1729, 1729, 1731, 1735, 1737, 1743, 1747	GMS80703AN	2011
1703, 1709, 1715, 1719, 1721, 1727, 1733, 1739, 1745	GMS80453AN	2011
1723	G40OUH-36A-070	2010
1737	TUC060C936BA	2005
1741	TG85080B12MP11A	2010

The community center has a furnace that is near its expected useful life. At the time of replacement, it is recommended to replace them with high efficiency furnaces.

Manual J Calculations

To confirm appropriate sizing of the recommended heating equipment, AKT Peerless performed calculations in accordance with Air Conditioning Contractors of America (ACCA) Manual J guidelines. An industry accepted software program, HVAC-Calc Residential 4.0.58c, was used to calculate the heat loss and heat gain in a unit. A detailed report of the Manual J calculations is included in the appendix of this report.

Tenant Unit #	Unit Like	Heat Gain (Btu/h)	Heat Loss (Btu/h) w/ 25% factor
1701, 1723	830	10,116	28,406
1703, 1709, 1715, 1721	828	6,130	17,906
1705, 1717 three	864	8,354	20,144
1707, 1719 four	866	8,692	24,491
1711, 1713	820	10,148	28,778
1725	810	10,721	28,376
1727, 1733, 1739, 1745	802, 888	8,195	18,235
1729, 1741 three	804	10,723	24,466
1731, 1743 four	806	11,226	24,416
1735, 1747	800	10,859	28,766
1737	880	13,197	41,959

Overall values for the heat loss within the software are often increased by a factor of 15% to 25% to account for averages used in the winter design temperatures. It should be noted that these calculations have assumed previously recommended ECMs have already been implemented. Because high-efficiency furnaces are not typically manufactured with a rating below 45kBtu/h, it is believed that the existing furnace size is appropriate for all of the units.

12.0 Advanced ECMs and/or ECMs Recommended for Further Evaluation

The following capital intensive measures may be feasible but would require an additional, detailed engineering analysis.

12.1 FE1 - Replace/Invest in Energy Star Clothes Washers

Recommendation Description

Because the Owner of the property is responsible for paying the water utility, the audit team believes an investigation into high efficiency clothes washers may be a sound investment for the Ann Arbor Housing Commission.


Inefficient Clothes Washer

Typically, residents are responsible for providing their own washers and dryers. This reduces a first cost for the housing commission – however, residents appear to be installing/utilizing the cheapest functioning units available. These units are often very old, and extremely inefficient. This results in high electrical energy consumption, but even greater water consumption.

In the past few years, the change in design and operation of the clothes washer units has allowed the consumer to reduce water usage and drying time. Typical high-efficiency washers use 27 gallons of water per load. In contrast, conventional models that were built from 1980 to the late nineties consumed between 43 and 51 gallons of water per load.

In addition to a reduction in water usage, many of the energy efficient washers will minimize the amount of hot water use by utilizing cold water as much as possible. The faster cycle on the efficient washers also minimizes the time needed to dry clothes, which overall minimizes the electrical consumption for laundry.

The existing washers at the subject property were identified to be approximately 10-20 years old. It is assumed that all tenant units are occupied; however, the typical usage of the laundry units is unknown and would require additional analysis to properly determine the savings from installing Energy Star rated washing machine units. Additionally, converting the existing washing machines to only using a cold rinse can also provide substantial savings based on tenant usage.

Because the Owner is responsible for water consumption, and water costs continue to rise, the team recommends a further life cycle investigation into funding and installing Owner-supplied (cold rinse) Energy Star units.

Incentives
DTE Energy's Multifamily Program is not offering incentives for insulation at this time.
Expected Useful Life Study
With typical use, the average clothes washing machine has an expected useful life of 14 years. It is believed that the existing units are at or near the end of their useful life.

13.0 Feasibility Assessment of Green Technologies

The following Green Energy Technologies were evaluated for their application at the subject property:

13.1 Photovoltaic for Electricity

Implementing photovoltaic panels for electricity at the subject property has been considered by the Ann Arbor Housing Commission. The south-facing orientation of each of the roofs at this property provides optimal solar energy collection. Unfortunately, renewable energy incentives are not currently available to the Client to reduce high installation costs.

13.2 Solar Thermal for Hot Water Heating

Hot water usage at the subject property is not high enough to justify initial costs of solar heating therefore the property is not a viable candidate of solar thermal for hot water heating. Further study is not recommended.

13.3 Wind Turbine

The property is not a viable candidate of installing wind turbines due to insufficient wind power in this geographic area. Further study is not recommended.

13.4 Combined Heat and Power

The property has less than 80 units (a rule of thumb for minimum number of units for feasibility) and does not have a central power source. The property is not a viable candidate of implementing combined heat and power and further study is not recommended.

13.5 Fuel Cells

Due to the high initial costs associated with fuel cells, implementation is not recommended at the subject property. Further study is not recommended.

14.0 Recommendations & Impact

Based on the analysis described in this report, AKT Peerless believes substantial energy conservation opportunities are available, and recommends implementation of all proposed ECMs.

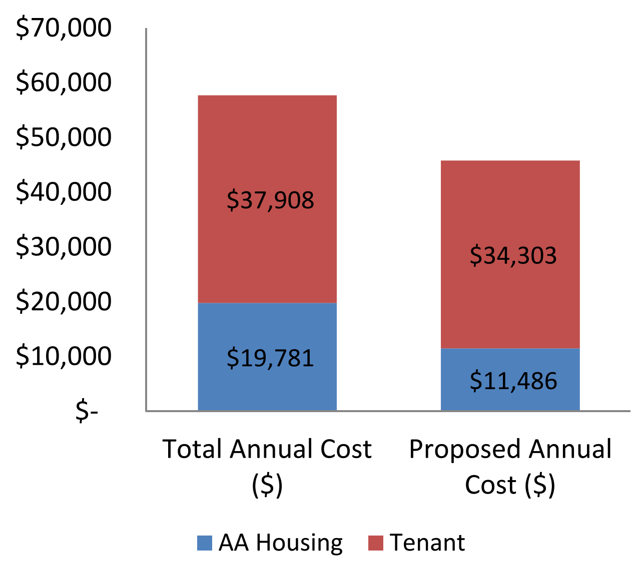
The combined annual EUI for the subject building is 59.85 kBtu per square foot per year. The annual energy cost index is $1.14 per square foot per year. Reduction of fuel (non-electrical) and electrical energy consumption through the implementation of recommended ECMs will potentially result in a reduced EUI of 45.11 kBtu per square foot per year, a potentially reduced annual cost index of $0.83 per square foot per year, and potential total annual cost savings of $11,899 per year.

An additional result of implementing the recommended ECMs would be the reduction of greenhouse gas (GHG) emissions by 22%. Measurements of greenhouse gas emissions are based on data gathered from the United States Environmental Protection Agency (USEPA) eGRID database.

The subject building is located in eGRID electric utility sub-region RFCW. Greenhouse gas emissions from electrical consumption are based on emissions data measured at the electrical generating facilities serving consumers located in the specified eGRID utility sub-region, and therefore greenhouse gas emissions and the estimated reduction in greenhouse gas emissions reflect the mix of fuel sources used by the regional electrical utilities serving the subject property. Emissions factors for natural gas consumption are based on data gathered from the 2009 United States Greenhouse Gas Inventory, Annex 2.

Table 16. Impact Summary (Totals)

% Energy Savings	25%
% Water Savings	20%
% Utility Cost Savings	21%
Annual Utility Cost Savings ($)	$11,899
% Reduction in GHG Emissions (CO_2 Equivalent Metric Tons)	22%



15.0 Limitations

AKT Peerless accepts responsibility for the competent performance of its duties in executing this assignment and preparing this report in accordance with the normal standards of the profession, but disclaims any responsibility for consequential damages. Although AKT Peerless believes the results contained in herein are reliable, AKT Peerless cannot warrant or guarantee that the information provided is exhaustive, or that the information provided by the client, third parties, or the secondary information sources cited in this report is complete or accurate.

Nothing in this report constitutes a legal opinion or legal advice. For information regarding individual or organizational liability, AKT Peerless recommends consultation with independent legal counsel.

ASHRAE *Procedures for Commercial Building Energy Audits* recommends that the Energy Analyst apply a consistent definition of building square footage to both the subject building and to similar buildings used for energy performance comparisons. AKT Peerless cannot evaluate the accuracy or consistency of building square footage measurements of similar buildings included in the comparison database. However, in order to improve the consistency and accuracy of building measurements and comparisons within the Client's own building portfolio, a procedure for measuring the subject building square footage has been incorporated into the Basic Buildings Characteristics form provided to the Client and located in the appendix.

The Energy Analyst has not verified the accuracy of building floor area as reported by the building owner/operator and has not verified that the building owner/operator's definition of building usage is consistent with the definitions used in the CBECS.

The Energy Analyst has not evaluated the potential financial savings from changing to a different utility price structure.

Also, the Energy Analyst has not verified that the property owner/operator has reported all sources and records of energy consumed at the subject property. Potentially unreported information may include, but is not limited to, bills, meters, and types of energy consumed. Inaccurate information provided to the energy analyst and information not reported to the energy analyst may influence the findings of report. Information provided by the owner/operator of the subject building or other client representatives is summarized in the Basic Building Characteristics form located in the appendix and the utility bills and other energy invoices included in the appendix.

16.0 Signatures

Report submitted by:

Jason Bing, RA, LEED AP
Senior Energy Analyst
AKT Peerless Environmental Services
Michigan Region
Phone: 734.904.6480
Fax: 248.615.1334
R.A. Certificate No. 1115311

Report reviewed by:

Henry McElvery
Technical Director of Energy Services
AKT Peerless Environmental Services
Illinois Region
Phone: 773.426.5454
Fax: 248.615.1334
Building Analyst Professional No. 5023902
Building Performance Institute

Recent annual electricity consumption, cost is summarized in the following tables:

Natural Gas

NATURAL GAS UBA									
AAHC Site:	**Green Baxter Ct (Common)**								
Meter #:	**8164722 08**								
Month	**Start**	**End**	**Days**	**HDD**	**Consumption CCF**	**Actual (0) Estm. (1)**	**Delivery $**	**Gas $**	**Total $**
Mar-12	3/15/2012	4/13/2012	29	529	45	0	$ -	$46.18	$46
Apr-12	4/13/2012	5/15/2012	32	513	38	0	$ -	$40.63	$41
May-12	5/15/2012	6/15/2012	31	171	12	0	$ -	$18.62	$19
Jun-12	6/15/2012	7/14/2012	29	90	8	0	$ -	$16.83	$17
Jul-12	7/14/2012	8/13/2012	30	23	9	0	$ -	$17.49	$17
Aug-12	8/13/2012	9/12/2012	30	80	9	0	$ -	$17.49	$17
Sep-12	9/12/2012	10/11/2012	29	223	17	0	$ -	$23.80	$24
Oct-12	10/11/2012	11/9/2012	29	478	57	0	$ -	$55.27	$55
Nov-12	11/9/2012	12/11/2012	32	478	69	0	$ -	$80.37	$80
Dec-12	12/11/2012	1/14/2013	34	478	125	0	$ -	$120.30	$120
Jan-13	1/14/2013	2/13/2013	30	478	163	0	$ -	$148.13	$148
Feb-13	2/13/2013	3/14/2013	29	478	152	1	$ -	$139.90	$140
					704				**$725**
									$1.030 $/CCF

NATURAL GAS UBA									
AAHC Site:	**Green Baxter Ct (Tenant)**								
Month	**Start**	**End**	**Days**	**HDD**	**Consumption CCF**	**Actual (0) Estm. (1)**	**Delivery $**	**Gas $**	**Total $**
Mar-12	3/15/2012	4/13/2012	29	529	1242	0	$ -	$1,245.83	$1,246
Apr-12	4/13/2012	5/15/2012	32	513	1076	0	$ -	$1,105.22	$1,105
May-12	5/15/2012	6/15/2012	31	171	842	0	$ -	$862.21	$862
Jun-12	6/15/2012	7/14/2012	29	90	618	0	$ -	$713.30	$713
Jul-12	7/14/2012	8/13/2012	30	23	583	0	$ -	$688.38	$688
Aug-12	8/13/2012	9/12/2012	30	80	683	0	$ -	$775.67	$776
Sep-12	9/12/2012	10/11/2012	29	223	821	0	$ -	$897.49	$897
Oct-12	10/11/2012	11/9/2012	29	478	1226	0	$ -	$1,242.51	$1,243
Nov-12	11/9/2012	12/11/2012	32	478	1806	0	$ -	$1,779.72	$1,780
Dec-12	12/11/2012	1/14/2013	34	478	2530	0	$ -	$2,307.86	$2,308
Jan-13	1/14/2013	2/13/2013	30	478	2472	0	$ -	$2,212.50	$2,213
Feb-13	2/13/2013	3/14/2013	29	478	2428	1	$ -	$2,144.78	$2,145
				4019	**16,327**				**$15,975**
									$0.978 $/CCF

Electricity

ELECTRICAL UBA											
AAHC Site: **Green Baxter Ct (Common)**											
Month	Start	End	Days	HDD	CDD	Actual (0) Estm. (1)	Consumption kWh	Demand kW	Consumption Charges ($)	Demand Charges ($)	Total Charges ($)
Mar-12	3/15/2012	4/13/2012	29	529	33	0	2,879		$417.72	$0	$ 418
Apr-12	4/13/2012	5/15/2012	32	513	7	0	2,412		$357.03	$0	$ 357
May-12	5/15/2012	6/15/2012	31	171	118	0	2,753		$385.58	$0	$ 386
Jun-12	6/15/2012	7/14/2012	29	90	245	0	2,929		$430.39	$0	$ 430
Jul-12	7/14/2012	8/13/2012	30	23	409	0	3,410		$496.36	$0	$ 496
Aug-12	8/13/2012	9/12/2012	30	80	233	0	3,210		$472.44	$0	$ 472
Sep-12	9/12/2012	10/11/2012	29	223	93	0	2,674		$392.27	$0	$ 392
Oct-12	10/11/2012	11/9/2012	29	478	15	0	2,608		$378.73	$0	$ 379
Nov-12	11/9/2012	12/11/2012	32	478	15	0	3,063		$432.26	$0	$ 432
Dec-12	12/11/2012	1/14/2013	34	478	15	0	3,581		$502.29	$0	$ 502
Jan-13	1/14/2013	2/13/2013	30	478	15	0	3,065		$431.69	$0	$ 432
Feb-13	2/13/2013	3/14/2013	29	478	15	0	2,937		$423.71	$0	$ 424
							35,521		**$5,120**	**$0**	**$5,120**
									$0.144		**$0.144**
								Avg & Max	**$ / kWh**	**$ / kW avg**	**Blended $/kWh**

ELECTRICAL UBA											
AAHC Site: **Green Baxter Ct (Tenant)**											
Month	Start	End	Days	HDD	CDD	Actual (0) Estm. (1)	Consumption kWh	Demand kW	Consumption Charges ($)	Demand Charges ($)	Total Charges ($)
Mar-12	3/15/2012	4/13/2012	29	529	33	0	10599		$1,691.89	$0	$ 1,692
Apr-12	4/13/2012	5/15/2012	32	513	7	0	9609		$1,565.61	$0	$ 1,566
May-12	5/15/2012	6/15/2012	31	171	118	0	11504		$1,527.49	$0	$ 1,527
Jun-12	6/15/2012	7/14/2012	29	90	245	0	14267		$2,297.14	$0	$ 2,297
Jul-12	7/14/2012	8/13/2012	30	23	409	0	16180		$2,541.06	$0	$ 2,541
Aug-12	8/13/2012	9/12/2012	30	80	233	0	14160		$2,222.42	$0	$ 2,222
Sep-12	9/12/2012	10/11/2012	29	223	93	0	9677		$1,546.57	$0	$ 1,547
Oct-12	10/11/2012	11/9/2012	29	478	15	0	8936		$1,452.85	$0	$ 1,453
Nov-12	11/9/2012	12/11/2012	32	478	15	0	10814		$1,725.27	$0	$ 1,725
Dec-12	12/11/2012	1/14/2013	34	478	15	0	12848		$2,027.74	$0	$ 2,028
Jan-13	1/14/2013	2/13/2013	30	478	15	0	11111		$1,716.37	$0	$ 1,716
Feb-13	2/13/2013	3/14/2013	29	478	15	0	10308		$1,618.00	$0	$ 1,618
							140,013		**$21,932**		**$21,932**
									$0.157		**$0.157**
								Avg & Max	**$ / kWh**	**$ / kW avg**	**Blended $/kWh**

HUD Residential Energy Use Benchmarking Tool

For single-family, semi-detached, row/townhouse, multi-family walk-up, and elevator buildings.

The HUD Residential Energy Use Benchmarking Tool quantifies the performance of a user-defined building relative to the family of HUD residential buildings. A score of 75 denotes performance at the top 25th percentile of HUD residential buildings. A score of 50 denotes performance at the 50th percentile (in the middle) of HUD residential buildings. For definitions or help on the terms below, simply click on any underlined text. Click on "Return" to come back to this page.

***Directions**: Provide entries in ALL the grey spaces that apply for your Building Description and Annual Energy Consumption.*

Building Description

Preliminary: 9/17/07

Building Name: Green Baxter Court Apartments (optional entry)

5-digit Zip Code: 48105 — *Not Sure?*

Heating Degree Days: 6818

Cooling Degree Days: 840

Mapping Location: *Ann Arbor, MI*

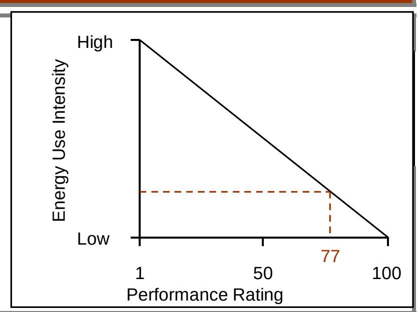
	Gross Floor Area (ft2)	Total Number of Units	Is This a Multifamily Building with Central Laundry?	Is this a Multi-Family Walkup Building? (Y/N)	Heated Floor Area (ft2)	Year Built
Building Description:	38,466	24	n	n	38,466	1970

Annual Consumption

	Electricity	Gas	#2 Fuel Oil	#4 Fuel Oil	District Steam	District Hot Water	Propane
Select Units:	kWh	Therms	Gal	Gal	kLbs	MMBtu	Gal
Energy	175,534	17,031					
Cost ($)	27,053	16,700					
Calculated unit cost:	$0.15 $/kWh	$0.98 $/therm	$/gallon	$/gallon	$/klbs	$/kBtu	$/gallon

Results

	Your Building	HUD Typical
Score Against Peers	77	50
Building Site Energy Use (kBtu/year)	2,302,022	3,238,743
Site Energy Use Intensity (kBtu/ft2-year)	59.8	84.2
Energy Cost Intensity ($/ft2-year)	1.14	1.60
Total Annual Energy Cost ($/year)	43,753	61,557



HUD Residential Water Use Benchmarking Tool

For single-family, semi-detached, row/townhouse, multi-family walk-up and elevator buildings.

The HUD Residential Water Use Benchmarking Tool quantifies the performance of a user-defined building relative to the family of HUD residential buildings. A score of 75 denotes performance at the top 25th percentile of HUD residential buildings. A score of 50 denotes performance at the 50th percentile (in the middle) of HUD residential buildings. For definitions or help on the terms below, simply click on any underlined text. Click on "Return" text to come back to this page.

Directions: Provide entries in the gray spaces below with your building description and annual water consumption.

Building Description

RNL 8/22/200

Building Name: Green Baxter Court Apartments (optional entry)

5-digit Zip Code: 48105 **Not Sure?**

Mapping Location: *Ann Arbor, MI*

	Gross Floor Area of Building(s) (ft2)	Building(s) is Single-Family Detached or Semi-	Is Residents Water Use Paid Directly by the PHA?	Number of Units in Building(s)	Number of Units in Building(s) with In-Unit Laundry Hookups or	How Many Buildings share this Water
Building Description:	38,466	N	Y	24	24	4

Annual Consumption

Building Annual Water Use: 1,534,896 (gallons/year)

Building Annual Water Use Cost: 13,935 ($/year)

Average Annual Water Cost: **$0.9** ($/100 gallons)

Results

	Your Building	HUD Typical
Score Against Peers	**76**	**50**
Annual Water Use (gal/year)	**1,534,896**	**2,918,269**
Annual Water Use Intensity (gal/ft2-year)	**39.9**	**75.9**
Annual Water Cost Intensity ($/ft2-year)	**0.36**	**0.69**
Total Annual Water Cost ($/year)	**13,935**	**26,495**

Photo 1: Exterior view of the complex

Photo 2: Gardening area

Photo 3: Entrance with exterior lighting

Photo 4: Typical vinyl window

Photo 5: Exterior wall-pack near each entrance

Photo 6: Typical storm door on unit entrance

Photo 7: Standard Maytag clothes washer

Photo 8: Insulation between basement walls

Photo 9: Typical bathroom showerhead

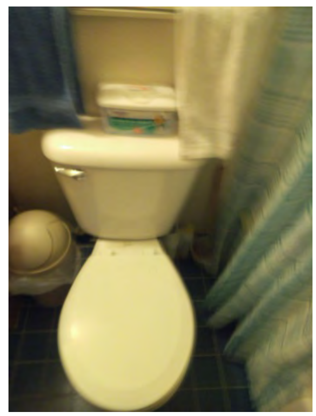


Photo 10: Standard toilet in bathrooms

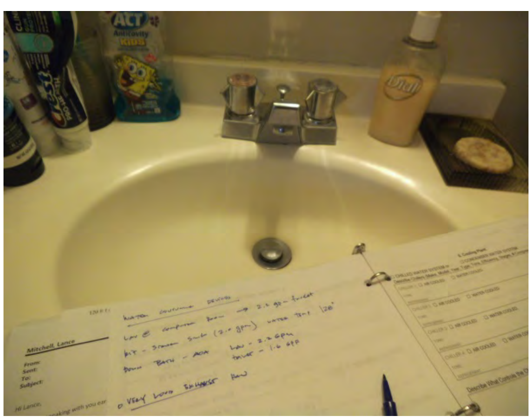


Photo 11: Faucet aerator on sink faucet

Photo 12: Bathroom light fixture

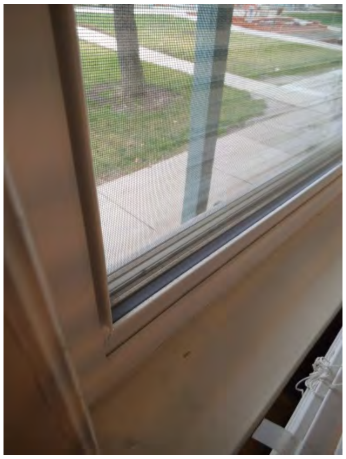


Photo 13: Window frame

Photo 14: Insulated DHW storage tank

Photo 15: Manual thermostat in community center

Photo 16: Community center condensing unit

Photo 17: Insulation surrounding attic hatch

Photo 18: Minimal insulation in some areas

Photo 19: Additional refrigerator in storage area

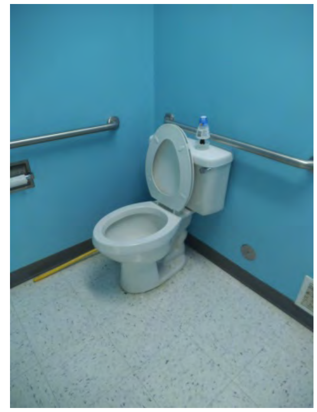


Photo 20: ADA accessible toilet

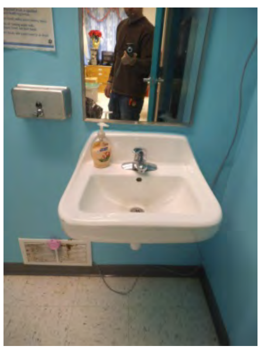


Photo 21: ADA accessible sink

Photo 22: Community Center Rec Room

Photo 23: Digital thermostat in community center

Photo 24: Typical computer work station

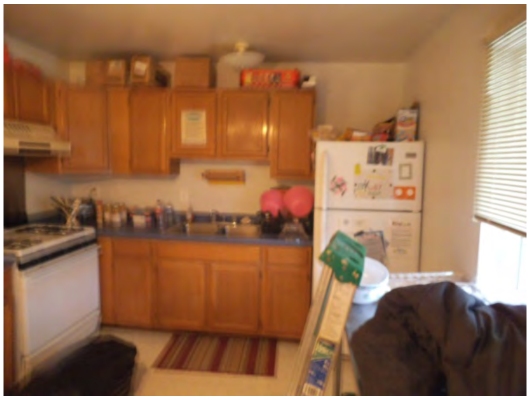


Photo 25: Community Center Kitchen area

Photo 26: Stove-top oven range

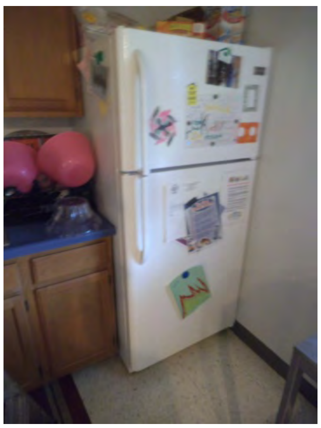


Photo 27: Standard refrigerator in kitchen

Photo 28: DHW tank in Community Center

Photo 28: Furnace in community center basement

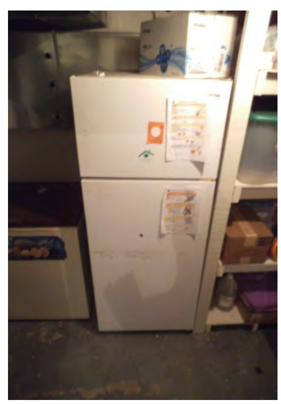


Photo 29: Additional refrigerator in basement

Lighting Summary

Interior Lighting

Zone / Space	Qty	Burn Hours	Existing Fixture Type	Existing Fixture	Input Watts per Fixture	Annual Consumption (kWh)	Proposed Fixture Type	Proposed Fixture	Input Watts per Fixture2	Annual Consumption (kWh)3	Demand Reduction (kW)	Retrofit Cost ($)	Annual Energy Savings (kWh)	Annual Cost Savings ($)	SP (yrs)
Community Center	19	1456	Incandescent	Incandescent - 60W	60	1660	CFL	16 watt CFL	16	443	0.84	$ 66.50	1217	$159.46	0.4
Rec Room	12	1456	4ft fluorescent	4ft Fluorescent - 4L 2x4 T8	132	2306	4ft Fluorescent	4 Ft - 2L (28 W) retrokit w reflecto	51	891	972.00	$ 780.00	1415	$185.40	4.2
										TOTALS	972.84	$ 846.50	2,632	$344.85	2.5

Exterior Lighting

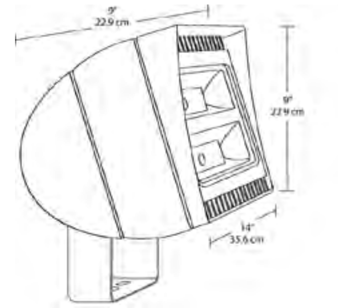
Zone / Space	Qty	Burn Hours	Existing Fixture Type	Existing Fixture	Input Watts per Fixture	Annual Consumption (kWh)	Proposed Fixture Type	Proposed Fixture	Input Watts per Fixture2	Annual Consumption (kWh)3	Demand Reduction (kW)	Retrofit Cost ($)	Annual Energy Savings (kWh)	Annual Cost Savings ($)	SP (yrs)
Exterior Wallpacks	42	4380	HPS35	35 watt High Pressure Sodium	46	8462	WPLED5N	RAB 5w LED Wall Pack	5	764	N/A	$5,250.00	7698	$1,008.41	5.21
Exterior Wallpacks	24	4380	HPS250	250 watt High Pressure Sodiun	295	31010	FXLEDSFN/PCS	RAB 78w LED Wall Pack	91	9566	N/A	$11,640.00	21444	$2,809.23	4.14
										TOTALS		$16,890.00	29,142	$3,817.63	4.42

FXLED78T

High power, wide distribution LED floodlight. Replaces 250W MH. Patent Pending airflow technology ensures long LED and driver lifespan. Use for building facade lighting, sign lighting, LED landscape lighting and instant-on security lighting.

Color: Bronze

Weight: 24.0 lbs



LED Info

Watts:	78W
Color Temp:	5100K (Cool)
Color Accuracy:	67
L70 Lifespan:	100000
LM79 Lumens:	5,927
Efficacy:	65 LPW

Driver Info

Type:	Constant Current
120V:	0.79
208V:	0.49
240V:	0.42
277V:	0.37
Input Watts:	91W
Efficiency:	86%

Technical Specifications

UL Listing:
Suitable for wet locations. Suitable for mounting within 1.2m (4ft) of the ground.

Lumen Maintenance:
100,000-hour LED lifespan based on IES LM-80 results and TM-21 calculations.

IP Rating:
Ingress Protection rating of IP66 for dust and water

EPA:
2

NEMA Type:
6H x 5V Beam Spread

Replacement Range:
The FXLED78 can be used to replace 150 - 320W Metal Halide Floodlights based on delivered lumens.

LEDs:
Six multi-chip, 13Watt high-output, long-life LEDs

Drivers (3):
Constant Current, Class 2, 720mA, 100 - 277V, 50 - 60 Hz, 100 - 277VAC 0.4 Amps

Fixture Efficacy:
65 Lumens per Watt

Surge Protection:
6 KV

Ambient Temperature:
Suitable for use in 40°C ambient temperatures.

Cold Weather Starting:
The minimum starting temperature is -40°F/-40°C.

Thermal Management:
Superior heat sinking with external Air-Flow fins.

Housing:
Die-cast aluminum housing and door frame

Mounting:
Heavy-duty Trunnion mount with stainless steel hardware

Color Stability:
RAB LED products exceed industry standards for chromatic stability.

Color Accuracy:
67 CRI

Color Temperature (Nominal CCT):
5100K

Color Uniformity:
RAB's range of CCT (Correlated Color Temperature) follows the guidelines of the American National Standard for (SSL) Products, ANSI C78.377-2008.

Reflector:
Semi-specular anodized aluminum

Gaskets:
High-temperature silicone gaskets

Finish:
Chip and fade resistant polyester powder coat finish.

Green Technology:
Mercury and UV free

IESNA LM-79 & LM-80 Testing:
RAB LED luminaires have been tested by an independent laboratory in accordance with IESNA LM-79 and LM-80, and have received the Department of Energy Lighting Facts label.

California Title 24:
FFLED78 complies with California Title 24 building and electrical codes.

Warranty:
RAB LED fixtures give you peace of mind because both the fixture and driver components are backed by RAB's 5 Year Warranty. For more information,

Patents:
The FXLED78 design is protected by Taiwan Patent 01510949 and patents pending in the U.S., Canada, China, and Mexico.

DTE Energy Multifamily Program Lighting Specifications

LIGHTING SPECIFICATIONS

All lighting projects are expected to comply with the Illuminating Engineering Society of North America (IESNA) recommended lighting levels or the local code. All final applications must include manufacturers' specification sheets for lamps and ballasts. All incentives are for one-for-one replacements except as noted.

Compact Fluorescent Lamps, Screw-In (≤ 31 Watts)
Incentives are available for the replacement of incandescent lamps with CFLs that are ENERGY STAR® rated or that meet ENERGY STAR® criteria. The lamps must have a luminous efficacy of ≥ 50 lumens per watt (LPW). Incentive is per lamp. *Note: This incentive is not available for CFLs purchased at retail stores participating in the DTE Energy CFL discount program. Incentives for CFLs purchased from those retailers is included in the discounted price.*

Compact Fluorescent Lamps, Screw-In (> 31 Watts)
Incentives are available for the replacement of incandescent lamps with high wattage CFLs. The new lamp must have a luminous efficacy of ≥ 65 lumens per watt (LPW). Incentive is per lamp. *Note: This incentive is not available for CFLs purchased at retail stores participating in the DTE Energy CFL discount program. Incentives for CFLs purchased from those retailers is included in the discounted price.*

Compact Fluorescent Fixtures
Incentives are available for upgrades to interior hardwired compact fluorescent fixtures. Replacement fixtures must be new fixtures or modular hardwired retrofits with hardwired electronic ballasts. The compact fluorescent ballast must be programmed start or programmed rapid start with a power factor (PF) ≥ 0.90 and a total harmonic distortion (THD) ≤ 20%. Incentive is per fixture.

Compact Fluorescent Reflector Flood Lamps
Incentives are available to install CFL reflector flood lamps to replace incandescent reflector flood lamps. The CFL reflector flood lamps must have a luminous efficacy of ≥ 33 lumens per watt (LPW). Incentive is per lamp. *Note: This incentive is not available for CFL's purchased at retail stores participating in the DTE Energy CFL discount program. Incentives for CFLs purchased from those retailers is included in the discounted price.*

42W 8-Lamp Compact Fluorescent High Bay Fixture
Incentives are available in high-bay applications (ceiling heights over 15 feet) for replacing any lighting fixtures greater than or equal to 350W with 42 Watt, 8 lamp compact fluorescent fixtures. Replacement fixtures must contain specular reflectors and electronic ballasts with a power factor (PF) ≥ 0.90. Incentive is per fixture.

ENERGY STAR® Qualified LED Recessed Down Light
Incentives are available to replace incandescent recessed lights with ENERGY STAR® qualified LED recessed down lights. Replacement lights must have a minimum efficacy of 35 lumens per watt. Incentive is per lamp. *Note: This incentive is not available for lamps purchased at retail stores participating in the DTE Energy lamp discount program. Incentive for lamps purchased from those retailers is included in the discounted price.*

Standard Linear Fluorescent Retrofit
Incentives are available for replacing existing T12 lamps and magnetic ballasts with T8 or T5 lamps and electronic ballasts. The new fixture lamps must have a color rendering index (CRI) ≥ 80. The electronic ballast must be high frequency (≥ 20 kHz), UL listed, and warranted against defects for a minimum of 5 years. Ballasts must have a power factor (PF) ≥ 0.90. Ballasts for 4-foot lamps must have total harmonic discharge (THD) ≤ 20 % at full power output. For 2 and 3-foot lamps, ballasts must have THD ≤ 32 % at full light output. Incentive is per fixture.

High Output T8/T5 Lamp and Ballast replacing T12 Fluorescent Lamp
Incentives are available for replacing existing T12 lamps and magnetic ballasts with T5HO or T8HO lamps and electronic ballasts. The replacement lamps must have a CRI ≥ 80. Incentive is per fixture.

Low Wattage 4-foot T8 Lamps (Lamps Only)
Incentives are available for replacing 32 Watt T8 lamps with reduced (low) wattage T8 lamps when an electronic ballast is already present. The lamps must be reduced wattage in accordance with the Consortium for Energy Efficiency© (CEE©) specifications (www.cee1.org) and as summarized in Table 2 below. Low wattage lamps must be either 25W or 28W and CEE© Listed. Qualified products can be found at http://www.cee1.org/com/com-lt/com-lt-main.php3. Incentive is per lamp.

High Performance 4-foot T8 Lamp and Ballast
Incentives are available for replacing existing T12 or T12HO lamps and magnetic ballasts or standard T8 lamps and electronic ballasts with high performance T8 lamps and electronic ballasts. Replacement fixtures must high performance in accordance with the Consortium for Energy Efficiency© (CEE©) high performance T8 specification, available at www.cee1.org, which and is summarized in Table 1 below. A list of qualified lamps and ballasts can be found at: http://www.cee1.org/com/com-lt/com-lt-main.php3. Both the lamp and ballast must meet the specification in order to be eligible for an incentive. Incentive is per fixture.

LIGHTING SPECIFICATIONS

Table 1: High Performance T8 Specifications

High Performance T8 and T5 Characteristics				
Mean System Efficacy	≥ 90 Mean Lumens per Watt (MLPW) for Instant Start Ballasts			
	≥ 88 MLPW for Programmed Rapid Start Ballasts			
Performance Characteristics for Lamps				
Color Rendering Index (CRI)	≥ 80			
Minimum Initial Lamp Lumens	≥ 3100 Lumens *			
Lamp Life	≥ 24,000 Hours			
Lumen Maintenance or Minimum Mean Lumens	≥ 94% or ≥ 2900 Mean Lumens			
Performance Characteristics for Ballasts				
Ballast Efficacy Factor (BEF) BEF = (BFx100)/Ballast Input Watts	**Instant Start Ballast (BEF)**			
	Lamps	Low BF ≤ 0.85	Norm 0.85 < BF ≤ 1.0	High BF ≥ 1.01
	1	> 3.08	> 3.11	NA
	2	> 1.60	> 1.58	> 1.55
	3	≥ 1.04	≥ 1.05	≥ 1.04
	4	≥ 0.79	≥ 0.80	≥ 0.77
	Programmed Rapid Start Ballast (BEF)			
	1	≥ 2.84	≥ 2.84	NA
	2	≥ 1.48	≥ 1.47	≥ 1.51
	3	≥ 0.97	≥ 1.00	≥ 1.00
	4	≥ 0.76	≥ 0.75	≥ 0.75
Ballast Frequency	20 to 33 kHz or ≥ 40 kHz			
Power Factor	≥ 0.90			
Total Harmonic Distortion	≤ 20%			

* For lamp with color temperatures ≥ 4500k. 2950 minimum initial lamp lumens are allowed.

Low Wattage 4-foot T8 Lamp and Ballast

Incentives are available for replacing T12 systems with reduced (low) wattage lamp and electronic ballast systems. The lamps and ballasts must meet the Consortium for Energy Efficiency© (CEE©) specification (www.cee1.org) and summarized in Table 8-2 on the following page. Qualified lamp and ballast products can be found at http://www.cee1.org/com/com-lt/com-lt-main.php3. Both the lamp and ballast must qualify in order to receive an incentive for the system. Incentive is per fixture.

Table 2: Reduced (Low) Wattage 4-foot Lamps and Ballasts

Performance Characteristics for Lamps(1)		
Mean System Efficacy	≥ 90 MLPW	
Color Rendering Index (CRI)	≥ 80	
Minimum Initial Lamp Lumens	≥ 2585 Lumens for 28 W ≥ 2400 Lumens for 25 W	
Lamp Life(2)	≥ 18,000 hrs at three hours per start	
Lumen Maintenance –or- Minimum Mean Lumens(3)	≥ 94% -or- ≥ 2430 Lumens for 28 W ≥ 2256 Lumens for 25 W	
Performance Characteristics for 28 and 25 W Ballasts		
Ballast Frequency	20 to 33 Hz or ≥ 40 kHz	
Power Factor	≥ 0.90	
Total Harmonic Distortion	≤ 20%	
Performance Characteristics for Ballasts(4), 28 W systems		
Ballast Efficiency Factor (BEF)	Instant Start Ballast (BEF)	
BEF = [BF x 100]/Ballast Input Watts Based on: (1) Type of ballast (2) No. of lamps driven by ballast (3) Ballast Factor	Lamps	All BEF Ranges
	1	≥ 3.52
	2	≥ 1.76
	3	≥ 1.16
	4	≥ 0.88
Performance Characteristics for Ballasts(4), 25 W systems		
Ballast Efficiency Factor (BEF)	Instant Start Ballast (BEF)	
BEF = [BF x 100]/Ballast Input Watts Based on: (1) Type of ballast (2) No. of lamps driven by ballast (3) Ballast Factor	Lamps	All BEF Ranges
	1	≥ 3.95
	2	≥ 1.98
	3	≥ 1.32
	4	≥ 0.99

(1) Lamps ≥ 4500 K and/or 24,000 hours have a system efficacy specified ≥ 88 MLPW. Minimum initial and mean lumen levels are specified as follows: for 28 W lamps, limits are 2600/2340. For 25 W lamps, limits are 2300/2185.

(2)Life rating is based on an Instant Start Ballast tested in accordance with ANSI protocols. When used for Programmed Start Ballast, life may be increased depending upon the operating hours per start.

(3) Mean lumens measures at 7,200 hours

(4) Multi-Voltage Ballasts must meet or exceed the listed Ballast Efficiency Factor when operated on at least one of the intended operating voltages.

LIGHTING SPECIFICATIONS

High Output T5 and 4-foot T8 New Fixture Replacing HID

Incentives are available for replacements of HID fixtures with T8 or T5HO lamps and electronic ballasts. The T8 or T5HO lamps must have a color rendering index (CRI) ≥ 80. The electronic ballast must be high frequency (≥ 20 kHz), UL listed, and warranted against defects for 5 years. Ballasts must have a power factor (PF) ≥ 0.90. Ballasts for 4-foot lamps must have total harmonic distortion (THD) ≤ 20% at full light output. This incentive is available for high-bay and low-bay fluorescent applications. Incentive is per fixture.

Pulse Start Metal Halide (retrofit only)

Incentives are available for replacing existing HID fixtures with pulse start metal halide fixtures in high-bay applications. Incentive is per fixture.

Exterior HID to LED/Induction Lighting Retrofit

Incentives are available for exterior applications for replacing existing high intensity discharge fixtures with LED or Induction fixtures. Existing fixtures must operate > 3,833 hours per year (> 10.5 hours per day). Fixture replacement must result in at least a 40% power reduction. LED fixtures must have a minimum efficacy of 35 lumens per watt. Eligible applications include canopy lighting and wall-packs. This incentive can be combined with incentives for exterior/garage bi-level control. Incentive is per fixture.

Garage HID to LED/Induction Lighting Retrofit

Incentives are available for garage and parking deck applications for replacing existing high intensity discharge fixtures with LED or Induction fixtures. Existing fixtures must operate 8760 hours per year or whenever the garage is open. Fixture replacement must result in at least a 40% power reduction. LED fixtures must have a minimum efficacy of 35 lumens per watt. Incentive is per fixture.

Exit Signs

Incentives are available for high-efficiency exit signs replacing or retrofitting an existing incandescent exit sign. Electroluminescent, T1, and LED exit signs are eligible. Non-electrified and remote exit signs are not eligible. All replacement exit signs must be UL or ETL listed, have a minimum lifetime of 10 years, and have an input wattage ≤ 5 Watts per face or be ENERGY STAR® listed. Incentive is per sign.

LED Traffic and Pedestrian Lights

Incentives are available for LED traffic lights on a per-signal basis (including arrows) that replace or retrofit an existing incandescent traffic signal. At minimum, red and green lamps must be retrofitted to qualify for the signal incentive. LED Signals must have a wattage of ≤17 watts per signal. Incentives are not available for spare lights. Lights must be hardwired, with the exception of pedestrian hand signals. Incentive is per signal.

Occupancy Sensors

Incentives are available for occupancy sensors for low occupancy interior areas, which automatically turn lights on when movement is detected. The minimum amount of time for the lights to stay on when no movement is sensed (delay set time) should be 10 minutes. The sensors can be passive infrared (PIR) or ultrasonic. All sensors should be hard-wired and control interior lighting fixtures. *To assist in rebate processing, provide the inventory of the controlled fixtures with the Final Application*. Incentive is per sensor.

Central Lighting Control

Incentives are available for automated central lighting control systems with override capabilities. This measure includes time clocks, package programmable relay panels, and complete building automation controls. Photo-sensors may also be incorporated into the central lighting control system. Incentive is per 10,000 square feet of controlled area.

Switching Controls for Multilevel Lighting

Incentives are available to install switching controls for multilevel lighting which may be used with daylight or occupancy sensors. If combined with daylight sensors, the controls must be commissioned in order to ensure proper sensor calibration and energy savings. This measure is applicable to spaces that require various lighting schemes such as classrooms, auditoriums, conference rooms and warehouses with skylights. Incentive is per 10,000 square feet of controlled area.

Daylight Sensor Controls

Incentives are available for new daylight sensor controls in spaces with reasonable amounts of sunlight exposure and areas where task lighting is not critical. The controls can be on/off, stepped, or continuous (dimming). The on/off controller should turn off artificial lighting when the interior illuminance meets the desired indoor lighting level. Daylight sensor controls are required to be commissioned in order to ensure proper sensor calibration and energy savings. Incentive is per 10,000 SF of controlled area.

Exterior Lighting, Bi-Level Control with Override

Incentives are available for retrofitting existing, exterior HID lighting with bi-level controls that reduce lighting levels by at least 50% when the space is unoccupied. The HID lighting must have an electronic ballast capable of reduced power levels, and be coupled with motion sensors to bring the light back to full lumen output for security reasons. Eligible controls include on-off controls, dimmers, and hi-lo ballast controls. This measure is applicable to exterior fixtures that are on during the night. Incentive is per fixture.

Light Tube

Incentives are available for new light tubes (tubular skylights) 10 inches to 21 inches in diameter. This measure is applicable to spaces that normally require electric lighting during peak hours (1 - 4 p.m. weekdays during the summer). The light tube must still allow an adequate amount of light during overcast conditions and must be coupled to daylight sensing controls. Incentive is per tube.

Delamping

Incentives are available for the permanent removal of existing fluorescent lamps. Permanent lamp removal is the net reduction in the quantity of lamps after a project is completed. Customers are responsible for determining whether reflectors are necessary in order to maintain adequate lighting levels. Lighting retrofits are expected to meet the Illuminating Engineering Society of North America (IESNA) recommended light levels. Unused lamps, lamp holders, and ballasts must be removed permanently from the fixture and disposed of in accordance with local regulations. This measure is applicable when retrofitting from T12 lamps to T8 lamps only. Removal of lamps from a T12 fixture that is not being retrofitted with T8 lamps is not eligible for this incentive, but may be eligible for other incentives. Incentive is per lamp removed.

Tenant Unit Programmable Thermostats (24)

This energy savings calculator was developed by the U.S. EPA and U.S. DOE and is provided for estimating purposes only. Actual energy savings may vary based on use and other factors. The calculator was modified by the auditor as detailed in subject report.

Enter your own values in the gray boxes or use our default values.

Number of Units	24
Initial Cost for one programmable thermostat	$51
Initial Cost for one manual thermostat	$1
Unit Fuel Cost (Cooling) ($/kWh)	$0.131
Unit Fuel Cost (Heating) ($/Therm)	$0.90

24 Hour Typical Usage Patterns*

	Weekday	Weekend
Nighttime Set-Back/Set-Up Hours	8	8
Daytime Set-Back/Set-Up Hours	16	16
Hours without Set-Back/Set-Up	0	0

Choose your city from the drop-down menu

City: MI-Detroit

Heating Season*

Typical Indoor Temperature w/o Set-Back	72
Nighttime Set-Back Temperature (Average)	68
Daytime Set-Back Temperature (Average)	72
Heating System Type	Gas Furnace

Cooling Season*

Typical Indoor Temperature w/o Set-Up	75
Nighttime Set-Up Temperature (Average)	82
Daytime Set-Up Temperature (Average)	82
Cooling System Type	None

****All temperatures are in degrees Fahrenheit. Setpoint is defined as the temperature setting for any given time period. Set-back temperature is defined as the lower setpoint temperature for the energy-savings periods during the heating season, generally nighttime and daytime. Set-up temperature is defined as the higher setpoint temperature for the energy-savings periods during the cooling season, generally nighttime and daytime.***

	24 Programmable Thermostat(s)	24 Manual Thermostat(s)	Savings
Annual Energy Costs			
Heating Energy Cost	$17,498	$18,184	$686
Heating Energy Consumption (MBTU)	*1,942*	*2,018*	*76*
Cooling Energy Cost	$0	$0	$0
Cooling Energy Consumption (MBTU)	*0.0*	*0.0*	*0*
Total	**$17,498**	**$18,184**	**$686**

DTE Energy Multifamily Program HVAC & Water Heat Specifications

HVAC (ELECTRIC) SPECIFICATIONS

Programmable Thermostat Setback/Setup (Air Conditioning)

Incentives are available for replacement programmable thermostats that meet ENERGY STAR® criteria and replace any non-programmable thermostat to automatically adjust the temperature at pre-selected times. To meet ENERGY STAR® standards, thermostats must be capable of maintaining two separate programs (to address the different comfort needs of weekdays and weekends) and up to four temperature settings for each program. A current list of ENERGY STAR® qualified thermostats may be found at http://downloads.energystar.gov/bi/qplist/prog_thermostat_prod_list.pdf. Incentive is per thermostat.

GAS SPECIFICATIONS

All final applications must include manufacturers' equipment specification sheets

General Clause for Heating Measures

Prescriptive incentives are available only for retrofit projects using natural gas as the primary fuel source. If a dual-fuel system is used, or if natural gas is the back-up or redundant fuel, the custom incentive application must be used. The incentives for boilers are only available for equipment used in space heating conditions, except for steam traps. Equipment for process load may be eligible for custom incentives.

Steam Trap Repair/Replacement

Incentives are available for the repair or replacement of steam traps that have failed open and that are leaking steam. Incentive is not available for traps that have failed closed or that are plugged. Replacement with an orifice trap is not eligible. Incentive is available once per 24 month period, per facility. Steam trap repair work must be recorded and the service report must be attached to the incentive application. Incentive is per repaired or replaced trap. The report must contain:

- Name of Survey/Repair Technician
- Survey/Repair Date
- System nominal steam pressure
- Annual hours of operation
- Number of steam traps serviced
- Per steam trap:
  - ID tag number, location and type of trap
  - If repair or replaced:
    - Orifice Size
    - Pre-and Post Conditions (e.g., Functioning/Not Functioning, Leaking/Not Leaking)

Pipe Wrap - Steam Boiler

Incentives are available for insulation applied to bare steam boiler piping. Insulation must have an applied thickness of 1 inch and an thermal resistance of R-4. A minimum of 10 linear feet of pipe must be insulated. The bare pipe size must be ½ inch or larger. Incentive is per linear foot of insulation.

Pipe Wrap - Hot Water Boiler

Incentives are available for insulation applied to bare hot water boiler piping. Insulation must have an applied thickness of 1 inch and an thermal resistance of R-4. A minimum of 10 linear feet of pipe must be insulated. The bare pipe size must be ½ inch or larger. Incentive is per linear foot of insulation.

Programmable Thermostat Setback/Setup (Gas Heat)

Incentives are available for new programmable thermostats that meet ENERGY STAR® criteria and replace any non-programmable thermostat to automatically adjust the temperature at pre-selected times. To meet ENERGY STAR® criteria, thermostats must be capable of maintaining two separate programs (to address the different comfort needs of weekdays and weekends) and up to four temperature settings for each program. A current list of ENERGY STAR® qualified thermostats may be found at http://downloads.energystar.gov/bi/qplist/prog_thermostat_prod_list.pdf. Incentive is per thermostat.

GAS SPECIFICATIONS

All final applications must include manufacturers' equipment specification sheets

Boiler Tune-up (Space Heating Boilers Only)

Incentives are available for tune-ups to natural gas fired, space heating boilers. Burners must be adjusted to improve combustion efficiency as needed. The incentive is available once in a 24 month period. Boiler size must be 110 MBH or greater. The service provider must perform before and after combustion analyses and attach the tune-up report to the Final Application. Incentive is per boiler. Tune-up report must contain the following information:

- Name of the technician performing tune-up
- Date of tune-up
- Boiler type (hot water, low pressure steam, high pressure steam)
- Boiler nameplate information (make, model, capacity)
- Annual hours of operation
- Pre-and Post combustion analysis results (an electronic flue gas analyzer must be used) including
    - Combustion efficiency
    - Stack temperature
    - Flue gas levels of O2, CO2 and CO
- Statement that the following were performed:
    - Check and adjust combustion air flow and air intake as needed
    - Check burner and gas input
    - Check draft control dampers
    - Clean burners, nozzles, combustion chamber and heat exchanger surface (when weather or operating schedule permits
    - Check combustion chamber seals
    - Check for proper venting
    - Complete visual inspection of system piping and installation
    - Check safety controls

Boiler Water Reset Control

Incentives are available for boiler water reset controls added to existing boilers operating with a constant supply temperature. Incentives are for existing space heating boilers only. A replacement boiler with boiler reset controls is not eligible. The system must be set so that the minimum temperature is not more than 10°F above manufacturer's recommended minimum return temperature. For controls on multiple boilers to be eligible, control strategy must stage the lag boiler(s) only after the lead boiler fails to maintain the desired boiler water temperature. Incentive is per boiler.

YOUR ENERGY SAVINGS

YourEnergySavings.com

DTE Energy

DTE Energy
Multifamily Program

DTE Multifamily Program Application

Required Site Information

SITE NAME		FEDERAL TAX ID
SITE ADDRESS		
CITY	STATE	ZIP CODE
SITE REPRESENTATIVE NAME	SITE REPRESENTATIVE PHONE #	
SITE REPRESENTATIVE EMAIL ADDRESS	SITE REPRESENTATIVE FAX #	
SECONDARY REPRESENTATIVE NAME	SECONDARY REPRESENTATIVE PHONE #	

Required Management Company/Owner Information

MANAGEMENT COMPANY NAME		FEDERAL TAX ID
MAILING ADDRESS		
CITY	STATE	ZIP CODE
MANAGEMENT COMPANY REPRESENTATIVE NAME	MANAGEMENT REPRESENTATIVE PHONE #	
MANAGEMENT COMPANY EMAIL ADDRESS	MANAGEMENT COMPANY FAX #	
SECONDARY REPRESENTATIVE NAME	SECONDARY REPRESENTATIVE PHONE #	

Required Site Information

ELECTRICITY PROVIDER	ELECTRIC ACCOUNT NUMBER	GAS PROVIDER	GAS ACCOUNT NUMBER
YEAR BUILT	TOTAL # OF UNITS	TOTAL # OF BUILDINGS	TOTAL # OF VACANT UNITS

TOTAL NUMBER OF FLOORS	DOES BUILDING HAVE BASEMENTS?	MAX # OF BATHROOMS PER UNIT
MAX # OF SHOWERS PER UNIT	MAX # OF SINKS PER BATHROOM	AVERAGE SQUARE FOOTAGE OF UNITS

Optional Site Information

TOTAL # OF SHOWERS ON PROPERTY	TOTAL # OF SINKS ON PROPERTY	ARE WATER HEATERS IN UNITS?

4.0 Part 3: Utility Consumption Baseline

4.1 Acknowledgements of Part 3: Utility Consumption Baseline

The Consumption Narrative Report and Utility Consumption – Summary and Utility Consumption – Monthly worksheets in the RPCA Model were completed by Linnea Fraser and Henry McElvery of AKT Peerless. AKT Peerless certifies that the report preparers meet the qualifications identified in the RAD Physical Condition Assessment Statement of Work and Contractor Qualifications Part 3.2 (Version 2, December 2013).

Linnea Fraser, EIT
Senior Energy Analyst
AKT Peerless Environmental Services
Illinois Region
Phone: 312.564.8488
Fax: 312.564.8487

Henry McElvery
Technical Director of Energy Services
AKT Peerless Environmental Services
Illinois Region
Phone: 773.426.5454
Fax: 248.615.1334
Building Analyst Professional No. 5023902
Building Performance Institute

Date: February 21, 2014

Part 3 Consumption Narrative Report and Excel RPCA Model were Received and Reviewed by Owner:

Lori Harris
Norstar Development USA, LP
733 Broadway
Albany, NY 12207
Phone: 518-431-1051
Fax: 518-431-1053

Date: ___________________________

AKT PEERLESS

Rental Assistance Demonstration (RAD):

UTILITY CONSUMPTION BASELINE

1701-1747 Green Road, Ann Arbor, Michigan 48105

GREEN BAXTER

PREPARED FOR	Norstar Development USA, LP 733 Broadway Albany, NY 12207	**ON BEHALF OF**	The Ann Arbor Housing Commission 727 Miller Ave Ann Arbor, MI 48103
PROJECT #	8213E-3-90	**PIC #**	MI064
DATE	February 21, 2014		

Table of Contents

1.0 EXECUTIVE SUMMARY

1.1 Purpose and Scope of Work

The purpose of the Part 3: Utility Consumption Baseline is to establish a twelve-month consumption baseline for normalized heating, cooling, lighting, and other electric, gas and water usage (not cost) for the subject property as defined in the Rental Assistance Demonstration (RAD): Physical Condition Assessment (RPCA) statement of Work and Contractor Qualifications released by the Department of Housing and Urban Development (HUD) in December 2013 (Version 2).

This report contains data on all utility usage at the subject property, both tenant-paid and owner-paid (if applicable), and including all common areas for a full 12-month period. It establishes a baseline to allow for benchmarking, and for future measurement of consumption and costs. As such, the utility baseline creates a whole building consumption profile, addressing missing utility data, vacancies, and weather patterns, in achieving its aim of establishing that standard on which future consumption can be compared.

1.2 Subject Site Description

1.2.1 General Site Description

The subject property contains four (4) multi-family buildings with twenty-three (29) tenant units and one (1) community center unit. The subject buildings were constructed in 1969 and contain two (2) stories with a basement. The site contains eight (8) two bedroom/one bathroom units, eleven (11) three bedroom/one bathroom units, and four (4) four bedroom/one and half bathroom units. The subject complex is generally referred to as Green Baxter.

1.2.2 Site Utilities and Usage

Each unit at the subject property has an electric meter, a natural gas meter, and a water meter. One common meter for exterior lighting exists at the site. Therefore, there are a total of twenty-five (25) electric meters, twenty-four (24) natural gas meters, and four (4) water meters at the site.

1.3 Baseline Site Energy Consumption

The Actual Site Energy Use, Energy Use Intensity (EUI), Weather Normalized Site Energy Use and Weather Normalized EUI displayed below are consistent with the ASHRAE Procedures for Commercial Building Energy Audits. This methodology establishes the property's baseline use and cost conditions that are representative of the building's energy performance.

This statistical analysis removes the bias of independent variables such as historic weather, occupancy and operating hours. These calculations have been normalized to the mean values of the independent variables impacting the building's energy performance and represent the most probable performance under actual conditions accounting for weather, occupancy and operating hour variability.

As the subject site has been 100% occupied for the duration of the analysis period, no pro-forma adjustment factors to the consumption have been made.

1.3.1 Actual Site Energy Use and EUI

Actual Site Energy Use	Actual Site Energy Use Intensity (EUI)
2,302,198 kBtu/yr	59.85 kBtu/ ft^2/yr

1.3.2 Weather Normalized Site Energy Use and EUI

Weather Normalized Site Energy Use	Weather Normalized Site Energy Use Intensity (EUI)
2,414,598 kBtu/yr	62.77 kBtu/ft^2/yr

2.0 INTRODUCTION

2.1 Purpose

The purpose of the Part 3: Utility Consumption Baseline is to establish a twelve-month consumption baseline for normalized heating, cooling, lighting, and other electric, gas and water usage (not cost) for the subject property as defined in the Rental Assistance Demonstration (RAD): Physical Condition Assessment (RPCA) statement of Work and Contractor Qualifications released by the Department of Housing and Urban Development (HUD) in December 2013 (Version 2).

This report contains data on all utility usage at the subject property, both tenant-paid and owner-paid (if applicable), and including all common areas for a full 12-month period. It establishes a baseline to allow for benchmarking, and for future measurement of consumption and costs. As such, the utility baseline creates a whole building consumption profile, addressing missing utility data, vacancies, and weather patterns, in achieving its aim of establishing that standard on which future consumption can be compared.

2.2 Scope of Work

AKT Peerless' scope-of-services is based on its proposal PE-14248, dated January 9, 2013 and revised March 15, 2013 and authorized by Norstar Development USA, LP (the Client), and the terms and conditions of that agreement.

The purpose of the Part 3: Utility Consumption Baseline is to establish a twelve-month consumption baseline for normalized heating, cooling, lighting, and other electric, gas and water usage (not cost) for the subject property as defined in the Rental Assistance Demonstration (RAD): Physical Condition Assessment (RPCA) statement of Work and Contractor Qualifications released by the Department of Housing and Urban Development (HUD) in December 2013 (Version 2).

This report contains data on all utility usage at the subject property, both tenant-paid and owner-paid (if applicable), and including all common areas for a full 12-month period. It establishes a baseline to allow for benchmarking, and for future measurement of consumption and costs. As such, the utility baseline creates a whole building consumption profile, addressing missing utility data, vacancies, and weather patterns, in achieving its aim of establishing that standard on which future consumption can be compared.

3.0 SUBJECT SITE DESCRIPTION

3.1 General Site Description

The subject property contains four (4) multi-family buildings with twenty-three (23) tenant units and one (1) community center unit. The subject buildings were constructed in 1969 and contain two (2) stories with a basement. The site contains eight (8) two bedroom/one bathroom units, eleven (11) three bedroom/one bathroom units, and four (4) four bedroom/one and half bathroom units. The subject complex is generally referred to as Green Baxter.

3.2 Current/Planned Use of the Property

The subject property has been used as a multi-family structure and operated by the AAHC since its initial construction in 1969. AAHC is participating in HUD's Rental Assistance Demonstration pilot program and intends to continue operating the building as a multi-family residential facility.

4.0 ENERGY CONSUMPTION ANALYSIS

This section provides information on energy utilities associated with the subject property.

4.1 Electricity

The following figure (Figure 4.1) identifies monthly electrical consumption (kWh) in comparison to cooling degree days (CDD). Cooling Degree Days (CDD) are roughly proportional to the energy used for cooling a building, while Heating Degree Days, (HDD) are roughly proportional to the energy used for heating a building. In general, daily degree days are the difference between a base point temperature (65 degrees) and the average outside temperature.

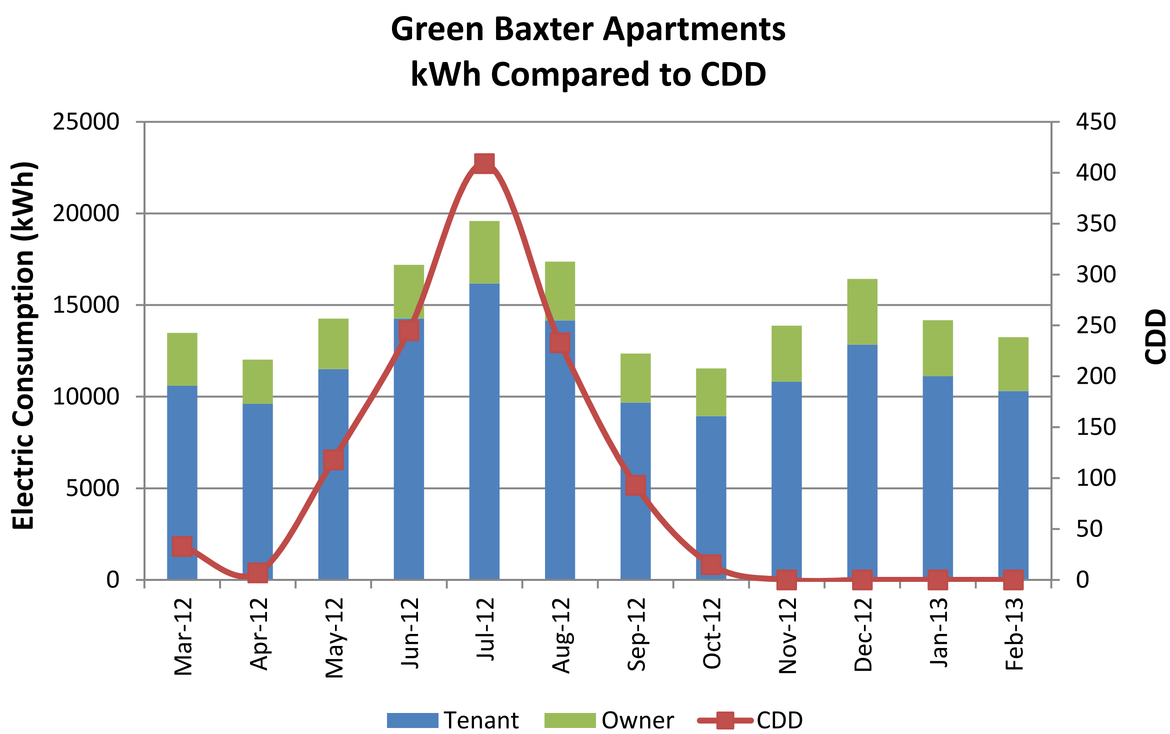


Figure 4.1 Electricity Consumption Graph

The following table (Table 4.1) identifies key information regarding the electric utility associated with the property.

Table 4.1 Annual Electricity Metrics

Vendor	DTE Energy
Meters on Site	Residential - Twenty-three (23) Non-Residential (Common) - Two (2)
Use for Residential	Lighting, electric appliances, tenant plug loads, tenant ac window units (if present), washing machines, furnace blower and control.
Use for Non-Residential	Exterior lighting, community center lighting, electric appliances, plug loads, ac units, furnace blower and control.
Responsible for Payment	Residential - Tenant Non-Residential - Owner
Rate	Residential - $0.157 / kWh Non-Residential - $0.144 / kWh
Site Consumption	175,534 kWh / year (599,098 kBtu / year)

Energy Use Intensity (EUI)	4.56 kWh / ft^2 (15.57 kBtu / ft^2)
Weather Normalized Site Consumption	170,368 kWh / year (581,466 kBtu / year)
Weather Normalized EUI	4.43 kWh / ft^2 (15.12 kBtu / ft^2)

AKT Peerless received tenant electric bill information in an electronic spreadsheet from the owner (AAHC) for the subject property. This spreadsheet included the following information for each individual unit at the subject property: meter read date, invoice amount ($), usage days per billing period, and net usage (kWh). For the subject property, Green Baxter, monthly electrical data was included from September 2011 to February 2013. The most current twelve (12) months of electrical data provided (March 2012 through February 2013) were used for this analysis and input into the RPCA model.

The actual electric consumption was adjusted to produce a weather-normalized summary of electric consumption. This process involved the following steps:

- CDD for the base year billing periods were calculated. Source for CDD is www.degreedays.net (using temperature data from www.wunderground.com) at weather station ANN ARBOR MUNICIPAL AIRPORT, MI, US (83.74W,42.22N), Station ID: KARB.
- Base year billing consumption (kWh) and CDD were normalized by number of days in each billing period.
- Relationship between usage (kWh/day) and weather (CDD/day) was established by using spreadsheet software (Excel) to determine the "best fit" linear regression trend line and R^2 value. The R^2 value is a statistical indicator that represents goodness of fit of the tread line, with $R^2 > 0.75$ considered an acceptable fit.
- Weather Normalized Site Consumption was calculated using the linear regression equation and the 10 year average CDD per month.

4.2 Natural Gas

The following figure (Figure 4.2) identifies monthly natural gas consumption (therms) in comparison to heating degree days (HDD). HDD are roughly proportional to the energy used for heating a building. In general, daily degree days are the difference between a base point temperature (65 degrees) and the average outside temperature.

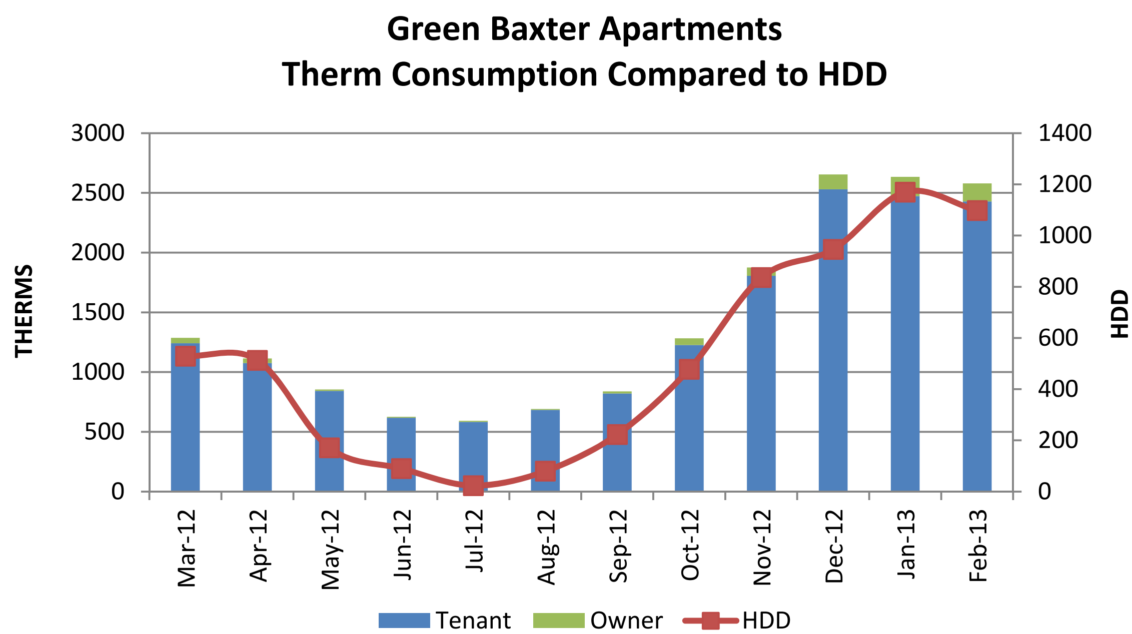


Figure 4.2 Natural Gas Consumption Graph

The following table (Table 4.2) identifies key information regarding the natural gas utility associated with the property.

Table 4.2 Annual Natural Gas Metrics

Vendor	DTE Energy
Meters on Site	Residential - Twenty-three (23) Non-Residential (Common) - One (1)
Use for Residential	Gas-fired furnaces for space heating, ranges for cooking, dryers for laundry.
Use for Non-Residential	Community center gas-fired furnace for space heating, ranges for cooking
Responsible for Payment	Residential - Tenant Non-Residential - Owner
Rate	Residential - \$0.978 / therm Non-Residential - \$1.030 / therm
Site Consumption	17,031 therms / year (1,703,100 kBtu / year)
Energy Use Intensity (EUI)	44.28 kBtu / ft^2
Weather Normalized Site Consumption	18,331 therms / year (1,833,132 kBtu / year)
Weather Normalized EUI	47.66 kBtu / ft^2

AKT Peerless received tenant natural gas bill information in an electronic spreadsheet from the owner (AAHC) for the subject property. This spreadsheet included the following information for each individual unit at the subject property: meter read date, invoice amount ($), usage days per billing period, and net usage (therms). For the subject property, Green Baxter, monthly natural gas data was included from September 2011 to February 2013. The most current twelve (12) months of natural gas data provided (March 2012 through February 2013) were used for this analysis and input into the RPCA model.

The actual natural gas consumption was adjusted to produce a weather-normalized summary of natural gas consumption. This process involved the following steps:

- HDD for the base year billing periods were calculated. Source for HDD is www.degreedays.net (using temperature data from www.wunderground.com) at weather station ANN ARBOR MUNICIPAL AIRPORT, MI, US (83.74W,42.22N), Station ID: KARB.
- Base year billing consumption (therms) and HDD were normalized by number of days in each billing period.
- Relationship between usage (therms/day) and weather (HDD/day) was established by using spreadsheet software (Excel) to determine the "best fit" linear regression trend line and R^2 value. The R^2 value is a statistical indicator that represents goodness of fit of the tread line, with $R^2 > 0.75$ considered an acceptable fit.
- Weather Normalized Site Consumption was calculated using the linear regression equation and the 10 year average HDD per month.

5.0 LIMITATIONS

5.1 Assumptions

The Ann Arbor Housing Commission (AAHC), the property owner, released utility information to AKT Peerless delivered directly from the utility provider(s), DTE Energy. It is assumed that this monthly usage and cost data is accurate and contains no data gaps or errors.

Information on how the utilities are utilized was generated from conversations with AAHC staff and results of the RPCA through the Energy Audit.

5.2 Limitations and Exceptions

AKT Peerless accepts responsibility for the competent performance of its duties in executing this assignment and preparing this report in accordance with the normal standards of the profession, but disclaims any responsibility for consequential damages. Although AKT Peerless believes the results contained herein are reliable, AKT Peerless cannot warrant or guarantee that the information provided is exhaustive, or that the information provided by the client, owner, third parties, or the secondary information sources cited in this report is complete or accurate.

AKT Peerless has not verified that the property owner/operator has reported all sources and records of energy consumed at the subject property. Potentially unreported information may include, but is not limited to, bills, meters, and types of energy consumed. Inaccurate information provided to AKT Peerless and information not reported to AKT Peerless may influence the findings of report.

AKT Peerless has not verified the accuracy of building floor area as reported by the owner.

Should additional information become available to the Client or Owner that differs significantly from our understanding of conditions presented in this report, AKT Peerless requests that such information be forwarded immediately to our attention so that we may reassess the conclusions provided herein and amend this project's scope of services as necessary and appropriate.

Nothing in this report constitutes a legal opinion or legal advice. For information regarding individual or organizational liability, AKT Peerless recommends consultation with independent legal counsel.

6.0 SIGNATURES

Report submitted by:

Linnea Fraser
Energy Analyst
AKT Peerless Environmental Services
Illinois Region
Phone: 773.426.5454
Fax: 248.615.1334

Henry McElvery
Technical Director of Energy Services
AKT Peerless Environmental Services
Illinois Region
Phone: 773.426.5454
Fax: 248.615.1334