Peekskill Housing Authority

P. Holden Croslan – Executive Director

Energy Audit Report

July 2021

Prepared By:

The Nelrod Company®

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P. Holden Croslan
Executive Director
Peekskill Housing Authority
807 Main Street
Peekskill, NY 10566

Dear P. Holden Croslan:

Thank you for the opportunity to provide your housing authority with a Qualified Energy Audit. I enjoyed working with you and your staff in the preparation of this report.

Enclosed is the Energy Audit Report developed for the Peekskill Housing Authority. This report includes a summary of recommended Energy Conservation Measures (ECMs) and cost benefit analysis for your developments. Additionally, we have prepared ECM recommendations in the front section of each developments report.

If you have any questions or would like to discuss the reports, please feel free to call me at 817-922-9000 x 141 or by email at johnnie@nelrod.com.

I appreciate your continued support.

Sincerely,

Johnnie Watson

Johnnie Watson,
QEA Director

NATIONAL MORTGAGE INDUSTRY HERS ACCREDITATION REGISTRY No. 1998-046

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STATEMENT OF AUDIT GOALS AND OBJECTIVES

Due to the rising cost and the environmental restraints of producing energy, Federal regulations require all public housing authorities develop and implement energy conservation measures. Energy audits were conceived and developed to provide the housing authorities a means of measuring their consumption and evaluate the effectiveness of the energy conservation measures.

Section 14 of the United States Housing Act of 1937, as amended by the Quality Housing Act of 1998, restructured the Public Housing Modernization Program into the Capital Fund Program. Under this program, HUD is required to provide financial assistance to Public Housing Authorities to improve the condition of existing public housing developments. An important aspect of these improvements is energy conservation in the buildings, equipment, operation and maintenance of housing authority structures. HUD requires Housing Authorities to conduct energy audits every 5 years.

The Peekskill Housing Authority has **273** dwelling units in its public housing stock. The Peekskill Housing Authority manages the maintenance and operation of all the dwelling units along with the executive offices, maintenance shops and community buildings. The Nelrod Company conducted this energy audit for the Peekskill Housing Authority under the direction of P. Holden Croslan, Executive Director.

The Nelrod Company conducted this Energy Audit in accordance with the methodology presented in HUD publications "HUD Rehabilitation Energy Guidelines for Multi-Family Dwellings" (1996), "HUD Rehabilitation Energy Guidelines for One to Four Family" (Sept. 1996), and "Energy Conservation for Housing: A Workbook (1998). The guidelines set forth in the publications have enabled us to identify the Peekskill Housing Authority consumption and cost patterns, and to recommend Energy Conservation Measures (ECMs) for the specific heating degree zone in the county of Westchester County, NY. (Zone 2.96).

AUDIT TASKS AND OVERVIEW OF FINDINGS

This Energy Audit is intended for use as an evaluation of current energy consumption, present energy conservation measures, as well as to, identify all available conservation opportunities, and implement future conservation activities. The audit was conducted in four phases.

Phase 1 (Review Phase)
The first phase was the review phase in which historical information and other characteristic information pertaining to the Housing Authority and its inventory were evaluated in compliance to present mandates for Energy-Conservation.

Phase 2 (Survey Phase)
The second phase was the survey or the information-gathering phase. The Nelrod Company Staff visited the Housing Authority, inspecting the physical condition of 10% of the units in each development. They inspected equipment and collected information on present and past expenditures for utilities. Utilizing Development Walkthrough Survey forms, energy conservation opportunities were identified and noted. In this phase, the Qualified Energy Auditor also estimated the cost of the modifications identified. These estimates were used for the third and fourth phases of the audit.

Phase 3 (Data Calculation Phase)
The third phase calculates the information into a cost/benefit analysis that ranks the simple payback period for the construction of all the opportunities identified in Phases 1 and 2.

Phase 4 (Execution Phase)
The final phase executes or, starts the activities. Recommendations herein suggest to the management of the Housing Authority on what actions to take. The funds must be allocated if not readily available. Construction schedules based upon rank, identified funding sources, and logical order of sequence should be incorporated into Five Year Comprehensive Plan for Modernization.

The Utility companies failed to provide any historical information on Energy expenditures in time for the report, so Nelrod engineered these costs using calculations from the following software program:

REM/RATE™ SOFTWARE PROGRAM

1. REM/Rate™ Software Design Objective

REM/Rate – Residential Energy Analysis and Rating Software Program is a sophisticated, residential energy analysis, code compliance and rating software program. REM/Rate calculates heating, cooling, hot water, lighting, and appliance energy loads, consumption and costs for new and existing single and multi-family homes.

REM/Rate operates in Windows and has many unique features, including a simplified input procedure, extensive component libraries, automated energy efficient improvement analysis, duct conduction and leakage analysis, latent and sensible cooling analysis, lighting and appliance audit, and active and passive solar analysis.

A home energy rating is calculated based on the proposed Department of Energy (DOE) Home Energy Rating System (HERS) guidelines (10 CFR 437) as modified by the RESNET/NASEO (Residential Energy Service Network/National Association of State Energy Officials) HERS Technical Committee. REM/Rate also creates value added information including energy appraisal addendum, energy code compliance (Model Energy Code (MEC) and American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)), improvement analysis (existing homes), design optimization (new homes), heating and cooling equipment sizing and U.S. Environmental Protection Agency (EPA) Energy Star Home analysis.

2. Use of REM/Rate for Utility Consumption Development

REM/Rate utilizes an Engineering approach to calculate the consumption allowance for various types of new and existing homes. The REM/Rate software program is recognized and approved by EPA, DOE and HUD.

The Nelrod Company is accredited and licensed by HERS/RESNET and a certified and licensed REM/Rate provider and user. Over the last year we successfully conducted energy home rating and energy audits using this software for over 10,400 reports. The information from our experience and these reports is used to

develop models for the most common building types and bedroom sizes, which in turn are utilized in developing average monthly utility consumptions.

3. Basic Procedures

The data needed for this program is collected either from the building/site plans provided and/or from a site visit. Building type models are developed for the most common building types (Single-Family Detached House, Semi-Detached/Duplex, Row/Townhouse, Multi-Family Walk-Up, and Manufactured Homes) and bedroom sizes. The program calculates heating, cooling, hot water, lighting and appliances energy load, consumption and cost based on home's design and construction features as well as climate and energy cost data.

The calculations are conducted following the Residential Energy Services Network (RESNET) Home Energy Rating System (HERS) technical guidelines, developed in cooperation with, US DOE, US Department of Veterans Affairs (USVA), HUD, and the National Association of State Energy Officials (NASEO) as the rating system used to determine energy usage in new and existing construction. The guidelines were established as the only national standard for determining energy savings based on construction types and local (community-wide) geographical locations. It estimates the annual energy quantity a home will require, and the cost of that energy based on local utility rates. The guidelines make assumptions about the size and lifestyle of the family who will occupy the home. These assumptions are based on nationally accepted standards developed by the US DOE, American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) and US EPA. Such assumptions include occupancy rates of 2 persons for the first bedroom and one additional person for each additional bedroom; thermostat setting of 68° Fahrenheit for heating and 78° Fahrenheit for cooling, which is the recommended setting for an energy conserving household. To determine water heater energy usage, tap water temperatures are adjusted for local geographical locations and 120° thermostat settings are used, which is considered energy conservative. In addition, architectural components are considered such as square footages, number of stories, insulation R-values, wall materials, mechanical equipment types and efficiencies.

The REM/Rate software utilizes default standards based on national trends. (See details following this introduction.) If there are no local surveys available regarding residential lifestyles, a residential rental market study can be conducted to gather data on the most common household amenities, such as, dishwashers, clothes washers and dryers, microwaves, and size of refrigerators.

Additionally, the Agency can provide architectural characteristics concerning common foundation types, exterior siding, and other structure features for their area. This information will be used to further adjust the building type models.

4. Input Values and Determination

REM/Rate provides two levels of inputs: simplified and detailed. Simplified inputs use general design characteristics and built–in algorithms to determine the results. We use detailed inputs which provide the user greater control over calculational values and development of common building type models.

The various input parameters are as follows:

- Location – List of US and Canadian locations;
- Energy costs – create or modify various utility rates based on the existing market;
- Building Component data – Foundation type, Opaque wall constructional details, window/skylights conduction and solar gain values, type of ceilings and doors, heating equipment, cooling equipment, water heating equipment, various types of lights and appliances used.

These values are determined either from verified conditions/site visits or from the building plans. A Certified IECC (International Energy Conservation Code) Inspector/HERS/RESNET (Home Energy Rating Systems/Residential Energy Services Network) Rater inputs characteristics from building plans and/or from documentation gathered from an on-site inspection of the physical, structural and mechanical details. We use the criteria from our experience to develop models for common building types and bedroom sizes.

Climate data is available for cities and towns throughout North America. This data is updated periodically with new versions of the REM/Rate software program.

Extensive utility libraries can be created and maintained for specific utility company rates and charges and are available to apply to consumption data.

5. Output Values, Interpretation and Use for Utility Consumptions

Fifty-six preformatted reports are available for viewing on screen or printing. Reports include energy use, energy cost, design loads, rating, quick report,

improvement analysis, code compliance, and economic analysis of energy upgrades.

Reports are generated from the building type models in the REM/Rate software program and analyzed for consumption usage totals by energy end-use categories. (Fuel Summary and Lights & Appliance Summary.)

REM/Rate Software Default Audit

Lighting and Appliance Algorithms

REM/Rate Software uses the energy consumption of basic home appliances for the Default Loads. The appliances for the **Default Loads** are:

Lighting (permanent and non-permanent)
Plug Loads
Refrigerator/Freezer
Clothes Washer
Clothes Dryer
Oven/Range

The consumption in MMBtu is dependent on what the days of the heating and cooling seasons are.

Number of Occupants = Number of Bedrooms

Lighting (Watt h / Day) = $[HR_c + (Area/HR_{area}) + (HR_{occ} \times Occupants)] \times Watts / Fixture$

Where:

HR_c	constant number of fixture (or bulb) hours
HR_{area}	number of square feet per fixture (or bulb) hours
HR_{occ}	number of fixture (or bulb) hours per occupant
Area	conditioned area
Occupants	number of occupants in the structure

Permanently Installed Lighting:

	Heating Season	Cooling Season
HR_c	8	7
HR_{area}	500	800

HR_{occ}	2	1
Watts/Fixture Incandescent	100	100
Watts/Fixture Fluorescent	30	30

Non-Permanently Installed Lighting:

	Heating Season	Cooling Season
HR_c	14	10
HR_{area}	350	600
HR_{occ}	2.5	1
Watts/Fixture Incandescent	70	70
Watts/Fixture Fluorescent	25	25

Appliance Load

Lighting: The lighting usage is described in terms of fixture-hours and bulb-hours, (e.g. three fixture hours would be present if one fixture is on for 3 hours, or 3 fixtures are on for one hour). The lighting usage can then be determined by multiplying the number of lamp hours by the wattage per lamp, which would be determined by the percentage of fluorescent lamps.

Three terms exist in the determination of the number of fixture hours: a constant, a ratio by area, and a ratio by number of occupants (e.g. bedrooms). HR_c fixture hours/day are assumed as a base load. Added to this is one fixture hour/day for every HR_{area} square foot of conditioned area, and HR_{occ} fixture hours/day for each occupant (four non-permanently installed lights, substitute bulb hours in place of fixture hours.)

100 watts/fixture is assumed for the average permanently installed incandescent fixture, and 30 watts/fixture for the average permanently installed fluorescent fixture. The actual wattage assumed is ratioed by the percentage of fluorescent fixtures. If no information is input, a ratio of 10% fluorescent fixtures is assumed.

70 watts/bulb is assumed for the average non-permanently installed incandescent bulb, and 25 watts/bulb for the average non-permanently installed fluorescent bulb. Again, the actual wattage is dependent upon the percentage of fluorescent bulbs, and a value of 10% is used if no information is input on non-permanently installed lighting.

Refrigerator: Vary refrigerators' consumption by year, type and size, based on the data provided by VEIC (Vermont Energy Investment Corporation). The load due to year shall be interpolated, and the load due to size shall stay in the batch mode, (e.g. the program will pick which data to use by type and size, and then interpolate the data for the year).

Range/Oven:

Electric: 1.5 kwh/day (550 kwh/yr)
Gas: 12,000 Btu/day (4.4 MMBtu/yr)

Clothes Washer:
30 kwh/yr/person

Clothes Dryer:
Electric: 300 kwh/yr/person = 2 people for 1st bedroom + 1 for each additional = 3.5 persons x 25 kwh = 87.50 kwh
Gas 1.5 MMBtu/yr/person + 35 kwh (Electric)/yr/person

Plug Loads: 1.25 kwh/day + 1.75 kwh/day/person

Detailed Audit

REM/Rate also allows the user to enter the details of the Lights and Appliances by choosing the Perform Detailed Audit ratio button. By selecting this option, the user can enter the exact internal loads of the residential building.

The following table describes a detailed audit performed on an example building:

Name	Type	Location	Qty	Fuel	Rate	Use	Efficiency
Ceiling Fan	Miscellaneous	Conditioned Area	1	Electricity	220.0 kwh/ use	1.0 Uses/ Year	Standard
Dishwasher	Dishwasher	Conditioned Area	1	Electricity	290.0 kwh/ use	1.0 Uses/ Year	Standard
Clothes Dryer	Clothes Dryer	Conditioned Area	1	Electricity	880.0 kwh/ use	1.0 Uses/ Year	Standard
Lights	Light Fixture(s)	Conditioned Area	1	Electricity	940.0 kwh/ use	1.0 Uses/ Year	Standard
Microwave	Microwave	Conditioned Area	1	Electricity	190.0 kwh/ use	1.0 Uses/ Year	Standard
Plug Loads	Plug Load(s)	Conditioned Area	1	Electricity	500.0 kwh/ use	1.0 Uses/ Year	Standard
Range/Oven	Range/Oven	Conditioned Area	1	Electricity	450.0 kwh/ use	1.0 Uses/ Year	Standard
Refrigerator	Refrigerator	Conditioned Area	1	Electricity	1150.0 kwh/ use	1.0 Uses/ Year	Standard
Television	Miscellaneous	Conditioned Area	1	Electricity	720.0 kwh/ use	1.0 Uses/ Year	Standard
Washer	Clothes Washer	Conditioned Area	1	Electricity	100.0 kwh/ use	1.0 Uses/ Year	Standard

Washer	Clothes Washer	Conditioned Area	1	Water	5.0 gallons/ use	2.0 Uses/ week	Standard
Shower	Shower/Bath	Conditioned Area	1	Water	10.0 gallons/ use	3.0 Uses/ day	Standard

Internal Gains in (Rating) Load:
The internal gains will include the heat from the refrigerator, the oven/range, the clothes washer, and the plug loads. Heat from the dryer is assumed to be vented out of the conditioned space.

Domestic Hot Water (DHW)
The assumption currently used for DHW is 30 gallons + 10 gallons/occupant and will not be changed with the presence or absence of dish or clothes washers. Reasons for this include: the 30 gallons + 10 gallons/occupant average includes the averaged use of dishwashers and clothes washers. People will use some water to wash dishes if they do not have a dishwasher, but it is not clear whether the amount of water they use could approach the amount used by a dishwasher. A clothes washer is assumed to exist, as 75 percent of all households contain a clothes washer. Therefore, no adjustment is needed.

REM/Rate Internal Gains Data
Daily internal gains (Btu/day) are assumed to be:

	Heating	**Cooling**
Lighting	2,100/occ	1,200/occ
Appliance	3,000/occ + 15,000	3,000/occ + 15,000
Occupant	4,800/occ	4,800/occ
Total (Btu/day)	9,900/occ + 15,000	9,900/occ + 15,000
(Btu/hr)	413/occ + 625	375/occ + 625

If the DHW type is Heat Pump, the internal gains are further adjusted:

	Heating	**Cooling**
Heat Pump DHW	7,000/occ	8,000/occ

The number of occupants is assumed to be equal to the number of bedrooms in the home.

The REM method assumes that the gains are constant over the day and thus half occur during the daytime, coincident with the solar gains, and half at night when no solar gains are present. The internal gains during these two time periods are treated separately when the heating and cooling loads are calculated.

OBSERVATIONS

Many efforts to reduce the consumption of energy and water have been made by the Peekskill Housing Authority. Overall, the units are in fair condition. Improvements already or partially completed include the following:

- Replacement of older refrigerators with new energy efficient refrigerators
- Replacement of some of the incandescent lightbulbs
- Installation of new efficient water heaters
- Installation of 1.6 gallon per flush toilets
- Installation of 1.5 gallon per minute shower heads

Some energy conservation opportunities not being used were identified during the walkthrough inspections. These opportunities include:

- Replace any remaining incandescent light bulbs
- Replace non-programmable type thermostats with ENERGY STAR programmable setback type thermostats
- Replace any remaining 2.5 gallon per minute shower heads with lower flow shower heads of at least 1.5 gallon per minute. Ensure that all new shower heads have the EPAs Water Sense label
- Replace any damaged refrigerator door seals as necessary. When selecting the replacement refrigerators, it is recommended that ENERGY STAR refrigerators be selected

Energy savings are evident in both the Peekskill Housing Authority, and resident controlled measures. While measures such as upgrading the building envelopes, using energy efficient lighting, and the equipment's efficiency are strongly recommended, educating the residents on using the dwellings efficiently will produce the potential for more energy savings.

Based upon the audit, the Peekskill Housing Authority should implement the Operating and Maintenance ECM recommendations immediately while the Physical Improvements ECM will require available funds. A Summary of the recommendations is contained in each development section of this report.

OVERVIEW OF RECOMMENDATIONS

An overview of all Energy Conservation Measures (ECM) can be viewed below. These recommendations are summed up in 5 different categories. A detailed explanation of these energy & water saving strategies are discussed following this summary.

A. Air Infiltration ECMs

- Exterior doors need to have weather stripping installed
- Interior mechanical closet doors need to be sealed by using weather stripping and raised thresholds
- Inspect ducts for leakage

B. Lighting Systems ECMs

- Replace any remaining Incandescent lamps with CFLs or LED lamps
- Replace the remaining T-12 lamps with energy efficient T-8 or T-5 Fluorescent lamps
- Install lighting controls

C. Heating and Cooling ECMs

- Install setback thermostats and maintain settings of 68° - 75° heating and 78°-82° for cooling
- Include filter replacement as part of the preventive maintenance plan at developments with forced air furnaces
- Replace old domestic water heaters with newer units with Energy Factors (EF) of 0.67, and consider installing "On Demand" tankless domestic water heaters with EF of .90 in the office area restrooms and community rooms

D. Architectural ECMs

- Install attic insulation
- Seal attic access

E. Miscellaneous

- Replace any remaining 3.0 GPF toilets with 1.6 GPF
- Install low flow showerheads
- Replace the seals on the refrigerators where necessary

Note: Each Development Report contains specific recommendations on the Energy Conservation Measures (ECM) Summary Page located in the development sections of this report. Other recommendations include:

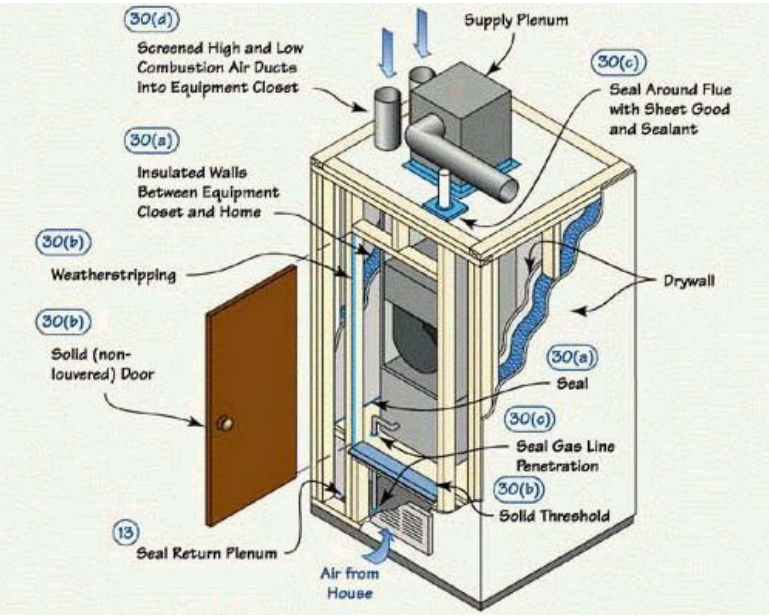
MECHANICAL CLOSET

DESCRIPTION

Units had the hot water and/or furnace in the mechanical closets located within the interior of the units.

RECOMMENDATIONS/COMMENTS

- Currently the mechanical closet doors have no weather-stripping or thresholds installed. This allows the conditioned air to escape or unconditioned air to be drawn into the units.
- The mechanical closets should have solid door installed, which include weather stripping and thresholds.
- Combustion air should be added to the closets when adding the door and weather stripping. Combustion air openings should be sized to allow 1 square inch per 4000 BTUH of input.



HVAC DUCTING

DESCRIPTION

The HVAC ducting is standard flexible ducting with R-2 insulation. No mastic was observed.

RECOMMENDATIONS/COMMENTS

- A mechanical contractor should smoke the duct systems and attempt to locate the areas of leakage that are readily accessible.
- Duct sealing can be accomplished using water-based mastic and mesh at all seams, joints and connections.
- All HVAC systems should be inspected, and all seams, cracks, joints and connections sealed with UL 181b water-based mastic, applied at a 20mil thickness (1/16''-1/8'').
- Special attention should be given to sealing the old air returns under the cabinets if applicable.

LIGHT BULBS

DESCRIPTION

Dwelling units and/or common areas were observed to have incandescent bulbs installed.

RECOMMENDATIONS/COMMENTS

- Recommended replacing bulbs with Light Emitting Diode (LED) lamps.
- LED bulbs can last up to 21 times longer, uses approximately 80% less energy.
- LED bulbs have a greater initial cost; however, they should be considered due to the lower cost over their life cycle.

	Incandescent	Compact Fluorescent (CFL)	Light Emitting Diode (LED)
Approximate cost per bulb	$1.39	$1.99	$1.99
Average Lifespan (hours)	4,000	10,000	15,000
Watts used	60	14	9
Number of bulbs needed for 20 years of use	44	3	2
Total purchase price of bulbs over 20 years	$61.16	$5.97	$3.98
Total cost of electricity ($.12 per kWh)	$1,261.44	$294.34	$189.22
Total operational cost over 23 years	$1,322.60	$300.31	$193.20

FLUORESCENT LIGHT FIXTURES

DESCRIPTION

Dwelling units and/or common areas had older 32W T8 fluorescent lights.

RECOMMENDATIONS/COMMENTS

- Recommended replacing fluorescent fixtures with or LED fixtures.
- Areas which are lit with multi-lamp fixtures may be providing higher than recommended light levels in the space. If this is observed, removal of T8 lamps from within the fixture itself can lower lighting power and energy consumption. Lighting levels should be verified to maintain proper design standards, typically between 40- and 75-foot candles.

COMMON AREA LIGHTING CONTROLS

DESCRIPTION

Currently the common areas do not have any form of passive electronic sensor controls for the lighting.

RECOMMENDATIONS/COMMENTS

- It is recommended that the Housing Agency install passive electronic sensors to automatically activate and deactivate common space lighting circuits based on occupancy.
- There are two commonly used sensors:
  - Infrared sensors detect occupants by sensing changes in heat patterns as they move.
  - Ultrasonic sensors detect physical movement.
- The type and location of each sensor must be carefully selected for each individual room layout and expected activity. In many instances, a simple wall switch replacement is adequate. In other cases, a ceiling mount or wall mount sensor may provide better coverage.
- Install wall switch lighting occupancy sensors in the offices. This measure will not reduce peak demand but will reduce annual energy consumption.

EXTERIOR LIGHTING

DESCRIPTION

The exterior lighting is comprised of wither Metal Halide or LED lamps mounted on poles or on the buildings. The fixtures have photocell or timer controls.

RECOMMENDATIONS/COMMENTS

- Recommend replacing remaining exterior Metal Halide with LED lamps of equivalent light output.
- The LED lamp is estimated to have a power rating of 213W per lamp verses the typical Metal Halide lamp of 400W and the High-Pressure Sodium lamp of 250W.
- Full fixture retrofits should be specified to have integrated photocell controls, and lamps that produce close to the same amount of light while consuming less energy.
- LEDs have additional benefits of significantly longer lamp life compared to standard lamps, typically around 50,000 hours, which translates to lower operating and maintenance costs.

High Pressure Sodium

Light Emitting Diode (LED)

THERMOSTATS

DESCRIPTION

Some dwelling units that were observed had non-setback type non-programmable thermostats installed.

RECOMMENDATIONS/COMMENTS

- Programmable thermostats should be installed in all conditioned areas.
- The Housing Authority should educate the staff and residents on using the programmable thermostats, this could reduce energy consumption up to 30% by reducing or increasing temperatures during periods of non-occupancy and when sleeping. Include education of the residents on the use and to optimize the efficiency of the thermostats.
- They should be installed in the offices and the community rooms to control energy use due to individuals forgetting to reset the temperature to 68°F-72°F for heating and 78°F-82°F for cooling.
- In addition, thermostats in community areas should have locking covers to reduce the potential for tampering.

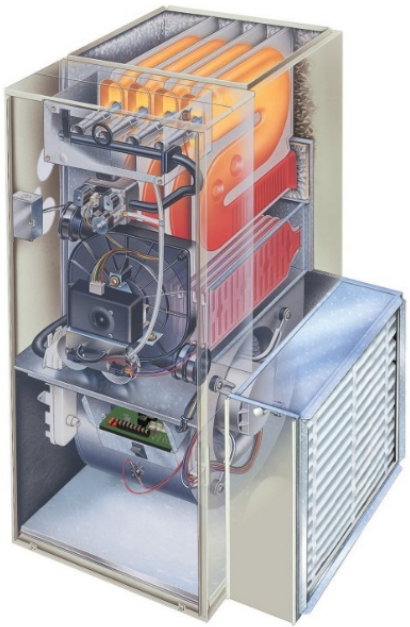
FURNACE

DESCRIPTION

The units were equipped with natural gas fueled forced air furnace.

RECOMMENDATIONS/COMMENTS

- The average life expectancy for a gas furnace is about 15 years.
- Older inefficient furnaces should be replaced with new efficient ones with greater than 90% Annual Fuel Utilization Efficiency (AFUE) in the U.S. South.
  - U.S. South states include Alabama, American Samoa, Arizona, Arkansas, California, Delaware, District of Columbia, Florida, Georgia, Guam, Hawaii, Kentucky, Louisiana, Maryland, Mississippi, Nevada, New Mexico, North Carolina, Oklahoma, Puerto Rico, South Carolina, Tennessee, Texas and Virginia.
- Older inefficient furnaces should be replaced with new efficient ones with greater than 95% Annual Fuel Utilization Efficiency (AFUE) in the U.S. North.
  - U.S. North states include Alaska, Colorado, Connecticut, Idaho, Illinois, Indiana, Iowa, Kansas, Maine, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, New Hampshire, New Jersey, New York, North Dakota, Ohio, Oregon, Pennsylvania, Rhode Island, South Dakota, Utah, Vermont, Washington, West Virginia, Wisconsin and Wyoming.



DOMESTIC WATER HEATERS

DESCRIPTION

The units were equipped with natural gas fueled domestic water heaters.

RECOMMENDATIONS/COMMENTS

- The average life expectancy for a hot water heater is about 15 years.
  - Ensure that a minimum EF (Energy Factor) of .67 for gas domestic water heaters, .90 for gas instantaneous domestic water heaters, and 2.0 for electric domestic water heaters when procuring replacements for the existing heaters.
  - Domestic Water heaters and boilers should be flushed at a minimum of once a year to remove sedimentary build up, which reduce the efficiency of the domestic water heater.

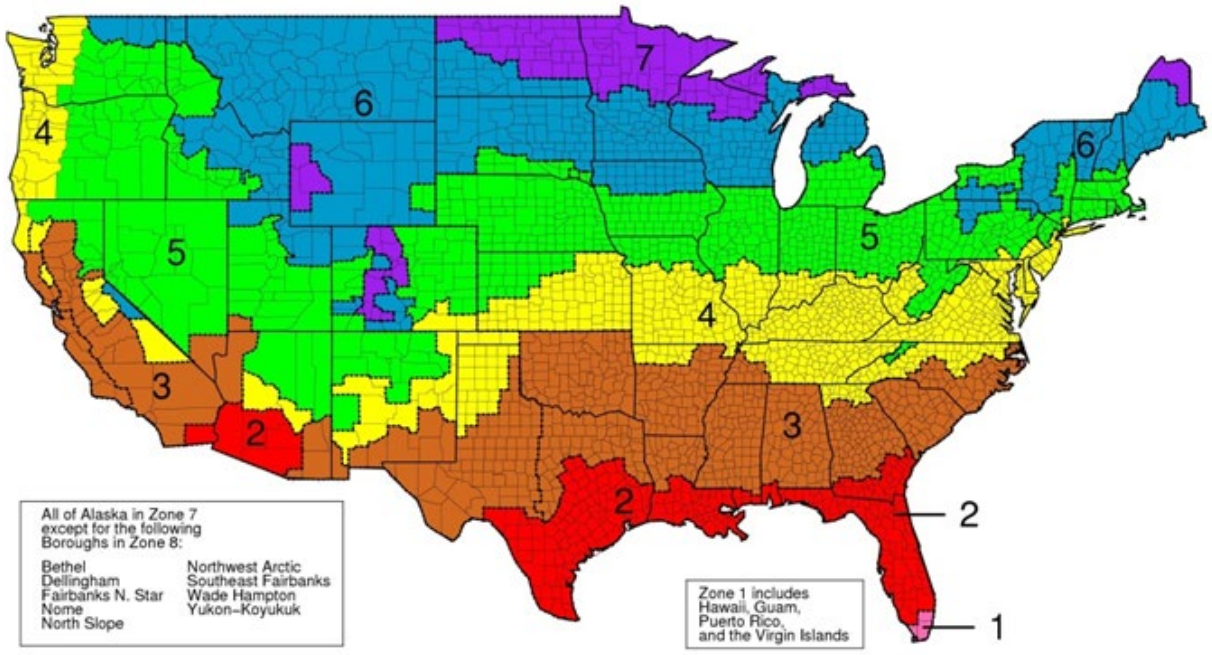
INSULATION

DESCRIPTION

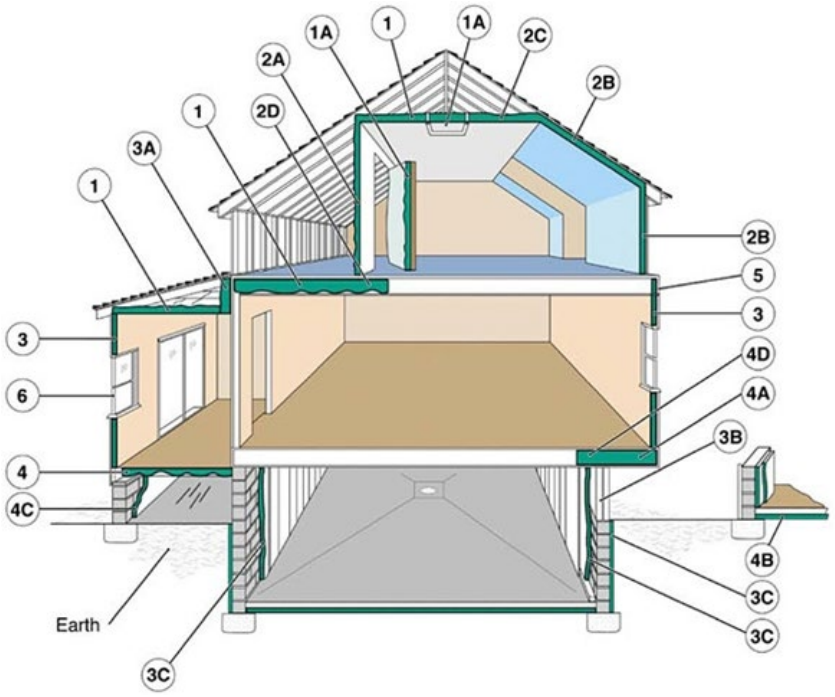
Some of the multifamily attics were noted to be under-insulated based on current International Energy Conservation Code (IECC) standards.

RECOMMENDATIONS/COMMENTS

- Attic insulation should be increased to a level of 16 inches or R-49 per International Energy Conservation Code 2015 (IECC) for climate zone 5.



2015 IECC RESIDENTIAL ENERGY CODE INSULATION LEVELS					
CLIMATE ZONE	*CEILING R-VALUE*	*WOOD FRAMED WALL R-VALUE*	*FLOOR R-VALUE*	*BASEMENT WALL R-VALUE*	*CRAWL SPACE WALL R-VALUE*
1	*30*	*13*	*13*	*0*	*0*
2	*38*	*13*	*13*	*0*	*0*
3	*38*	*20*	*19*	*5/13*	*5/13*
4	*49*	*20*	*19*	*10/13*	*10/13*
5	*49*	*20*	*30*	*15/19*	*15/19*
6	*49*	*20 + 5*	*30*	*15/19*	*15/19*
7 & 8	*49*	*20 + 5*	*38*	*15/19*	*15/19*



1. In unfinished attic spaces, insulate between and over the floor joists to seal off living spaces below. If the air distribution is in the attic space, then consider insulating the rafters to move the distribution into the conditioned space.
   (1A) attic access door
2. In finished attic rooms with or without dormer, insulate
   (2A) between the studs of "knee" walls,
   (2B) between the studs and rafters of exterior walls and roof,
   (2C) and ceilings with cold spaces above.
   (2D) Extend insulation into joist space to reduce air flows.
3. All exterior walls, including
   (3A) walls between living spaces and unheated garages, shed roofs, or storage areas;
   (3B) foundation walls above ground level;
   (3C) foundation walls in heated basements, full wall either interior or exterior.
4. Floors above cold spaces, such as vented crawl spaces and unheated garages. Also insulate
   (4A) any portion of the floor in a room that is cantilevered beyond the exterior wall below;
   (4B) slab floors built directly on the ground;
   (4C) as an alternative to floor insulation, foundation walls of unvented crawl spaces.
   (4D) Extend insulation into joist space to reduce air flows.
5. Band joists.
6. Replacement or storm windows and caulk and seal around all windows and doors.

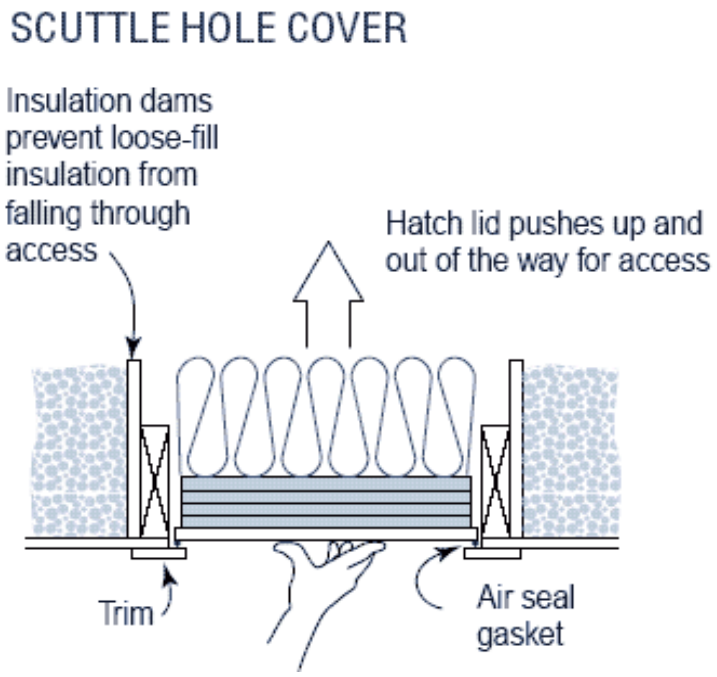
ATTIC SCUTTLE HOLE ACCESS COVER

DESCRIPTION

Some of the multifamily dwelling units had at least ¼ inch gap around the perimeter of the attic access.

RECOMMENDATIONS/COMMENTS

- For air sealing, weather stripping can be installed either on the hatch itself or on the inside of the trim or base where the hatch rests.
- Adding a latch bolt will help ensure a tighter seal.
- After the trim of base is aligned to seal properly, insulation should be added to the attic side of the hatch. Rigid insulated sheathing is recommended.
- Cut the insulated sheathing ¼ inch smaller than the hatch size to allow for clearance when moving the access panel.
- Apply 3 or 4 inches of insulation to the hatch with construction adhesive and screws.



SHOWERHEADS

DESCRIPTION

Showerheads observed were 2.2 gallon per minute (GPM) type in various styles.

RECOMMENDATIONS/COMMENTS

- It is recommended that EPA Water Sense showerheads with a maximum flow rate of 1.5 GPM be installed. Which represents a 40% savings in water usage over standard 2.5 GPM showerheads.
- The lower flow rated showerheads reduce water heating costs as well.
- To ensure performance and user satisfaction under a variety of household conditions, EPA Water Sense has established minimum flow rates at 80, 45 and 20 pounds per square inch (PSI) of pressure.

REFRIGERATORS

DESCRIPTION

Most of the refrigerators are 16 cubic feet.

RECOMMENDATIONS/COMMENTS

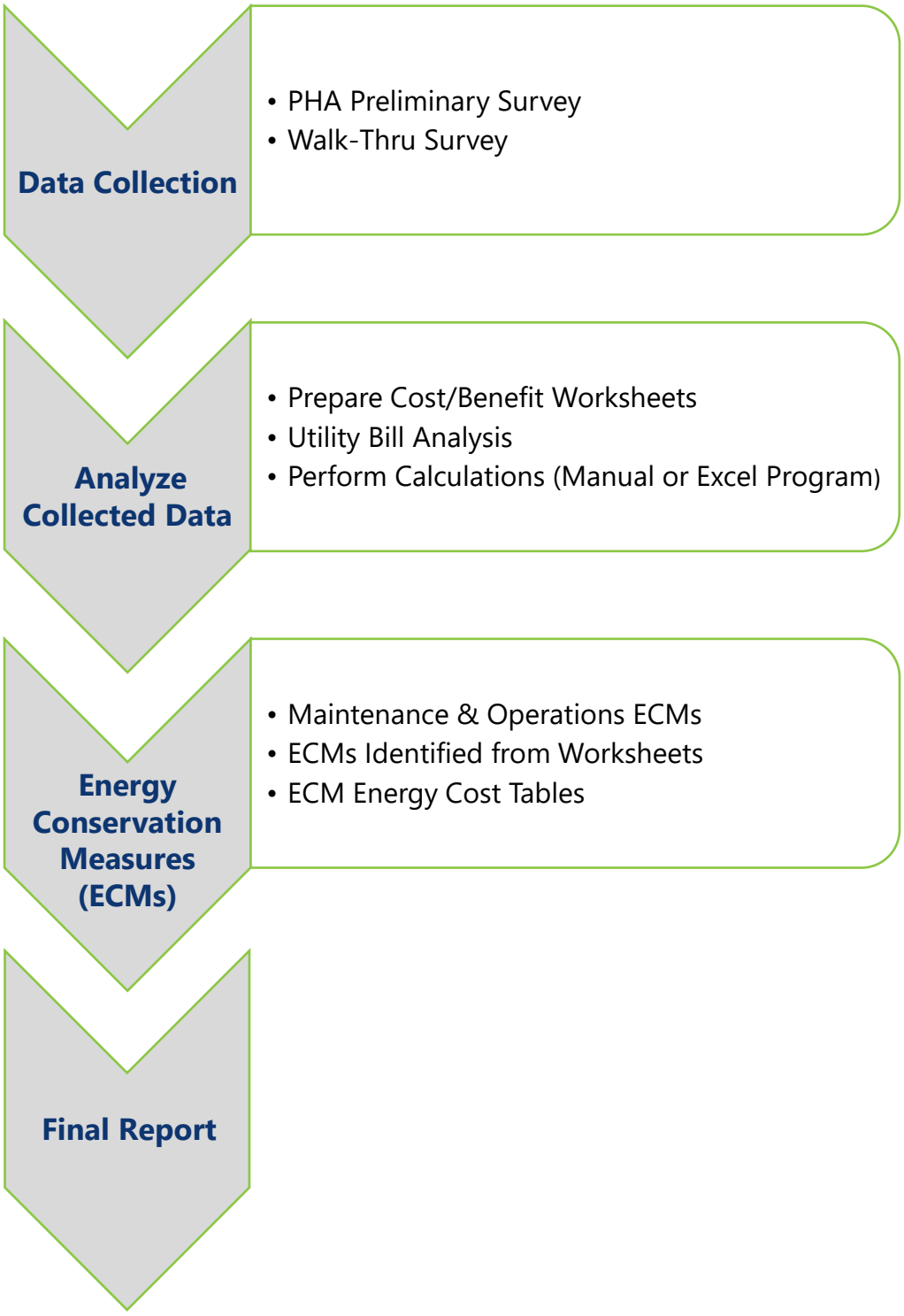
- The average life expectancy of refrigerators is 15 years.
- When replacing refrigerators, it is recommended that Energy Star labeled appliances should be used.
- Until new refrigerators are procured it is recommended that the Housing Agency maintain the existing refrigerators by changing door gaskets as needed.

Executing the recommended Energy Conservation Measures will reduce the cost of maintaining the dwelling units. Making the changes that are identified, including them in the modernization plan and the cost/benefit savings will shorten the payback rate much sooner than calculated in this Cost Benefit Analysis.

In summary, a successful energy conservation program takes cooperation from HUD, the PHAS and residents. HUD's commitment to funding improvements to conserve energy must be accompanied by the PHA's oversight and maintenance of improvements. The PHA must encourage tenants to conserve energy, as well as provide guidance.

Note: An ECM – related Maintenance and Operations Checklist is provided at the end of this section to assist the Housing Authority in its energy management plan.

Energy Audit Process Chart



BOHLMANN TOWERS

Showerheads

Recommend replacing current showerheads with 1.6 gpm low-flow shower heads.

Refrigerator Gasket

Recommend worn and damaged door gaskets in the refridgerators

Toilets

Recommend replacing any remaining non-low flush toilets with 1.6 gal flush toilets.

DUNBAR HEIGHTS

Bathroom Lights

Recommend replacing incandescent lights with LED.

Showerheads

Recommend replacing 2 gpm showerheads with 1.6 low flow showerheads.

Entry doors

Recommend refitting loose entry doors.

TURNKEY

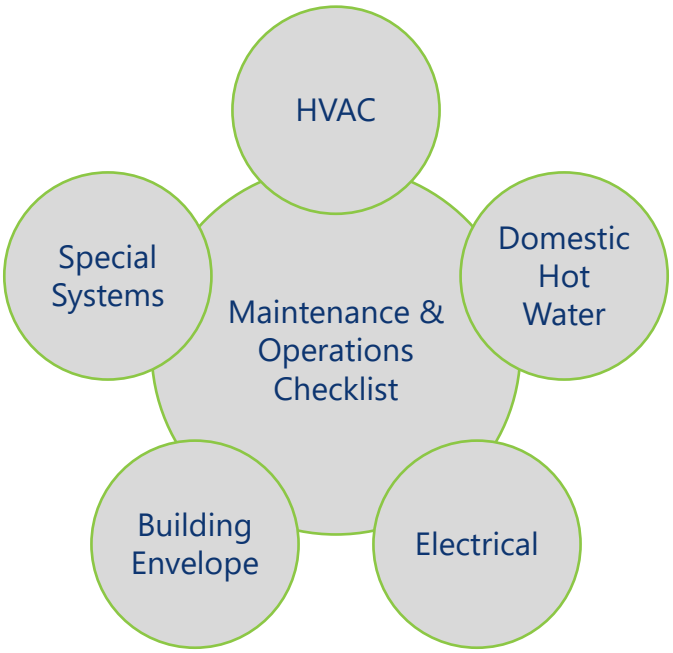
Building lights

Recommend cleaning light sensors on exterior building lights.

Bathroom lights

Recommend replacing florescent lights with LED

Recommended ECM - Related Maintenance & Operations Checklist



OBJECTIVE

PHAs should seek to establish a monitoring/maintenance system which:

- Detects deteriorating conditions
- Contains maintenance records for every piece (type) of equipment:
  - Maintenance procedures and schedules
  - Manufacturer's instructions and specifications
  - Maintenance records and warranty information
  - Bearing numbers, equipment serial numbers, fan belt sizes and serial numbers, other information
  - Maintenance tool inventory list
- Analyzes maintenance records and identifies the need for spare parts
- Supports systematic repair/replace/upgrade review and decisions
- Supports systematic decisions for in-house versus vendor repairs/replace or upgrade
- Supports systematic evaluation of maintenance intervals for each piece of equipment or system

INSTRUCTIONS

This energy-related checklist should be compared with the PHA's Routine and Preventive Maintenance Checklist. Measures from this checklist should be added to the PHA's Routine and Preventative Checklist as appropriate.

HVAC IMPROVE SPACE HEATING M & O

- ☐ Establish a regular schedule to inspect and service all space heaters in resident's apartment in advance of the heating season, replacing all filters, belts, nozzles, and worn parts as needed.
- ☐ Consider the replacement of pilot lights with electronic ignition systems.
- ☐ Purchase only high-efficiency space heaters with electronic ignition as replacements. (e.g. Energy Star® labeled products)
- ☐ Inspect air flow vents, (including cold air return vents) and ensure they are sealed properly and are not blocked.
- ☐ Check that heat pumps have been switched from summer cooling to winter heating.
- ☐ Check steam or hot water radiators and pipes for leaks, and control valves and air release valves are working properly.
- ☐ Check thermostat operation and settings.
- ☐ Advise residents of the dangers of using kitchen ovens as a source of heat.

HVAC IMPROVE CENTRAL HEATING M & O

- ☐ Check central furnace operation for conformity with manufacturer's specifications.
- ☐ Check for proper combustion temperature, steam or water temperature, and flue gas composition.
- ☐ Check oil burners for excessive smoke and soot.
- ☐ Check thermostats and temperature limit switches for proper operation.
- ☐ Check steam or hot water temperature at point of use, and adjust boiler operating to bring temperature into conformity with manufacturer's specifications.
- ☐ Establish a regular schedule for checking and adjusting all steam traps.

- ☐ Provide water treatment for boilers to reduce scale deposits.
- ☐ Ensure all gauges and safety devices are operating properly.
- ☐ Check all time clocks and other control equipment for proper operation, and for proper on-off points.

HVAC IMPROVE CENTRAL DISTRIBUTION M & O

- ☐ Establish a regular schedule for checking steam or hot water distribution systems for leaks.
- ☐ Repair or replace steam, condensate, and water pipe insulation.
- ☐ Check cathodic protection systems for steam and hot water distribution piping.
- ☐ Check and service all pneumatic control system lines to ensure proper operation.

HVAC IMPROVE VENTILATION/AC M & O

- ☐ Establish a regular schedule for cleaning both heating and cooling coils.
- ☐ Ensure damper controls and motors are operating properly, and the proper mixture of outdoor air is being provided.
- ☐ Check and repair all duct work leak(s).
- ☐ Establish a regular schedule for cleaning or changing air filters.
- ☐ Establish a regular schedule for cleaning the insides of ducts, plenum chambers, and air-handler units.
- ☐ Establish a regular schedule for checking and balancing all fans, oiling bearings, and adjusting and aligning drive belts.
- ☐ Establish a regular schedule for checking, cleaning, and adjusting all outlet registers and air return vents.
- ☐ Check and service all pneumatic control system lines to ensure proper operation.

IMPROVE DOMESTIC HOT WATER M & O

- ☐ Check temperature setting on domestic hot water heaters and adjust to at-tap hot water temperature of 120º F, except in homes with infants, which are bottle fed. The residents should be warned of the potential scalding hazard of the 140º temperature.
- ☐ Install devices preventing changes to hot water temperature settings.
- ☐ Establish a regular annual schedule for changing all faucet washers and toilet flapper valves, and ensuring all showers have low flow heads. (1.5 GPM)
- ☐ Check outside pipes have adequate insulation and replace when insulation has deteriorated.

IMPROVE ELECTRICAL/LIGHTING M & O

- ☐ Establish a regular schedule for checking and cleaning lamps (bulbs, lenses, and fixtures) in all site, office, and common areas.
- ☐ Replace obsolete fixtures with new ones which accept high-efficiency lamps or bulbs.
- ☐ Replace exterior incandescent lamps with high pressure sodium or metal halide systems.
- ☐ Replace all lenses or diffusers which are clouded, yellowed, or cracked.
- ☐ Establish a schedule for the replacement for all bulbs based on manufacturer's estimates of average bulb life.
- ☐ Bulk purchase lamps and fixtures to reduce purchase costs.
- ☐ Purchase energy-efficient fluorescent lamps and ballasts as replacements.
- ☐ Identify over-lighted areas and consider removing some lamps in common areas not otherwise impacted by security and surveillance needs.
- ☐ Check and trim back trees or other plants growth which are blocking light fixtures.

- ☐ Re-paint interior office and common area walls with washable, light-reflecting colors.
- ☐ Utilize timers or similar control devices to control site lighting.
- ☐ Utilize occupant sensors to control lights in meeting rooms and common areas.
- ☐ Develop a list of all the electrical motors used by the PHA, and determine which motors are high-efficiency and which are standard.
- ☐ Replace all motors which are standard, with high-efficiency models.
- ☐ Replace all oversized motors with smaller, high-efficiency models.
- ☐ Establish a regular schedule for checking electrical motors, and where appropriate oiling bearings, and adjusting and realigning power transmission belts.
- ☐ Use an industrial stethoscope to check motor and bearings on related devices, replace as needed.
- ☐ Clean all fans and fan housings.
- ☐ Re-wire toilet exhaust vents to bathroom light switches.
- ☐ Establish a regular schedule for checking motors, adjustable-speed drives, and related electrical starting and running loads.

IMPROVE BUILDING ENVELOP M & O

- ☐ Check the caulking around the exterior windows and doors, and repair as needed.
- ☐ Check the weather seals on all windows and doors, and repair as needed.
- ☐ Check all windows and doors for proper opening and closing.
- ☐ Check storm/screen doors and repair as needed.
- ☐ Ensure storm doors and storm windows are in place at the start of the heating season.

- ☐ Ensure screen doors and windows are in place at the end of the heating season.
- ☐ Check operation of kitchen and bathroom ventilation fans and related doors and flaps.
- ☐ Check all vents for blockage or build-up of soot or grease.
- ☐ Repair loose, cracked, or broken windows.
- ☐ Identify and repair any wall or plaster damage caused by water leaks through exterior walls.
- ☐ Ensure door-closing devices on entrance doors are working properly.

IMPROVE SPECIAL SYSTEMS M & O - (ADD TO OR EMPHASIZE THE ITEMS BELOW ON THE HQS INSPECTION LIST)

- ☐ Check refrigerator/freezer gaskets for tight fits & adjust or replace as needed.
- ☐ Check operation of kitchen and bathroom ventilation fans and related doors and flaps.
- ☐ Check for installation of curtains and carpets by residents.
- ☐ Check for use of additional space heaters (electrical/kerosene) by residents.
- ☐ Check for use of kitchen ovens as a winter heating source.
- ☐ Check resident installed window air conditioner and determine age, effectiveness, and efficiency.
- ☐ Check garbage disposals for proper operation and absence of fibrous material.
- ☐ Install Energy Conservation Reminders on all light switches in the units.
- ☐ Distribute energy and water conservation literature to residents at least twice a year, preferably fall and spring.
- ☐ Participate in meetings of the Resident Councils and discuss energy consumption and conservation.

- ☐ Distribute energy-saving fluorescent lamps to residents to replace incandescent bulbs. (some local utility companies support free or reduced cost distribution of these types of lamps)

  Note: Not recommended for enclosed fixtures where theft of expensive fluorescent bulbs can be prevented.

- ☐ Endorsement of an energy conservation policy by the PHA Board of Commissioners.

- ☐ Identification of one employee designated with overall responsibility for coordinating the energy management program.

- ☐ Establish annual energy conservation goals and objectives for the PHA which are achievable, measurable, and specific.

- ☐ Preparation on energy costs to the residents through metering or other methods so the end users of the energy have information about and are responsible for their energy consumption.

On-going training for the designated energy manager, to keep up with technology

Tab

Energy Conservation for Housing
Summary of Results

Development Information		
4-1.	Development ID Number:	NY082000001
4-2.	Development Name:	Bohlmann Towers
4-3.	Development/Unit Address:	807 Main Street

ECM Summary

ECM No.	ECM	N/A	Total Cost ($)	Annual Savings		Payback Period
				$	Energy	
Architectural ECMs						
1	Install Storm Windows	☐	213,010.89	24,271.40	242,714.03	8.78
2	Install Replacement Windows	■				
3a	Install Window Sun Shades: South-Facing Windows	■				
3b	Install Window Sun Shades - East and West Facing Windows	■				
4	Install Storm Doors	■				
5	Install/Increase Attic Insulation - R13	■				
5	Install/Increase Attic Insulation - R30	■				
5	Install/Increase Attic Insulation - R42	■				
6	Install Roof Insulation - R10	■				
6	Install Roof Insulation - R20	■				
7	Install Wall Insulation	■				
8	Control Air Leakage	☐	58,970.18	16,063.63	160,636.33	3.67
Heating and Cooling ECMs						
9	Install Vent Dampers	■				
10	Convert to Electronic Ignition	■				
11	Install Boiler Controls	■				
12	Replace Inefficient Heating Plant	■				
13	Install Setback Thermostats	☐	25,567.20	2,982.17	29,821.74	8.57
14	Install Radiator Controls	■				
15	Insulate Hot Water or Steam Pipes	■				
16	Convert Steam Heating to Hot Water Distribution	■				
17	Seal and Insulate Ducts	■				
18	Install Geothermal Heat Pumps	■				
19	Replace Inefficient Air Conditioners	■				
20	Install Swamp Coolers	■				
Domestic Hot Water System ECMs						
21	Install Water-Efficient Showerheads and Faucet Aerators	☐	9,069.12	8,239.35	82,393.50	1.10
22	Insulate Hot Water Tank	■				
23	Install DHW Off-Peak Controls	■				
24	Convert Laundry to Cold Rinse	■				
25	Replace Inefficient Hot Water Heater	■				

Energy Conservation for Housing
Summary of Results

ECM Summary - continued						
ECM No.	ECM	N/A	Total Cost ($)	Annual Savings		Payback Period
				$	Energy	
Lighting System ECMs						
26	Replace Incandescent Lighting with Compact Fluorescent Lamps in Dwelling Units	■				
27	Replace Incandescent Lighting with Fluorescent Lighting in Common Areas	■				
28	Replace Older Fluorescent Lamps with Energy-Saving Lamps in Common Areas	■				
29	Replace Older Fluorescent Lamps and Ballast in Common Areas	■				
30	Install Lighting Controls in Common Areas	■				
31	Convert Exterior Lighting Fixtures	■				
32	Install Photo-Controls for Exterior Lighting	■				
Miscellaneous ECMs						
33	Replace Older Refrigerators with High-Efficiency Units	■				
34a	Upgrade or Replace Inefficient Motors - Elevator	■				
34b	Upgrade or Replace Inefficient Motors - Ventilation System	■				
34c	Upgrade or Replace Inefficient Motors - Hydronic Heating or Cooling System	■				
35	Install Water-Saving Toilets	■				
36	Convert Water Supply Pumps	■				
37a	Install Checkmetering or Individual Metering - Natural Gas	■				
37b	Install Checkmetering or Individual Metering - Electricity	■				

Energy Conservation for Housing
Walkthrough Survey / Development Report

General Development Data			
Development Information			
4-1.	Development ID Number:	NY082000001	
4-2.	Development Name:	Bohlmann Towers	
4-3.	Development Address:	807 Main Street	
4-4.	Name of person responsible for completing this survey:	Jerry Fenchel	
4-5.	Contact person's telephone number:	817-922-9000	
Location and Climate			
4-6.	City:	Peekskill	
4-7:	State:	New York	
Complete questions 4-8 and 4-9 with information from Appendix A, Climate Data. If your development's specific location is not listed, use data for the closest city listed.			
4-8.	Heating Degree Day Zone *[ECMs No. 1-8, 13]*:	2.96	
4-9.	Heating Season Hours *[ECM No. 14]*:	2892	
Building Types and Quantities			
4-10.	Residential building types (check off applicable building type, then answer all further questions under that type):		
	☐ Single or twin-family houses		
	Number of single-family houses:		
	Number of twin-family houses:		
	☐ Low-rise multifamily buildings (4 stores or less)		
	Number of buildings:		
	Number of stories:		
	■ High-rise multifamily buildings (5 stories or more)		
	Number of buildings:	1	
	Number of stories:	9	
4-11.	Non-residential building types (i.e., separate structures used as office spaces, community rooms, laundry facilities, mechanical room, etc.)		
	Number of buildings:		
	Number of stories:		
4-12.	Total number of buildings in your development:	1	
Development Size			
4-13.	Number of dwelling units in your development		
	Number of 0 bedroom units:	14	
	Number of 1 bedroom units:	39	
	Number of 2 bedroom units:	7	
	Number of 3 bedroom units:	56	
	Number of 4 bedroom units:	21	
	Number of 5 bedroom units:	7	
	Number of 6 bedroom units:		
	Total number of dwelling units *[ECMs No. 26, 33]*:	144	
4-14.	Total number of residents in development *[ECMs No. 21, 22, 23, 25]*:	399	
4-15.	Average number of residents per dwelling unit *[ECMs No. 4]*:	2.77	

Energy Conservation for Housing
Walkthrough Survey / Development Report

Architectural Data

Development Size

4-16. Total area of all floors in the development

Unit Size	Floor Area *(Base per Unit)*	Floor Area *(Total for Units)*	
0 Bedroom Units	304	4256	sq. ft.
1 Bedroom Units	570	22230	sq. ft.
2 Bedroom Units	756	5292	sq. ft.
3 Bedroom Units	1103	61768	sq. ft.
4 Bedroom Units	1155	24255	sq. ft.
5 Bedroom Units	1456	10192	sq. ft.
6 Bedroom Units			sq. ft.
Total for all units		127993	sq. ft.

4-17. Total development volume (total area in question 4-16 times floor-to-typical ceiling height, usually 8.0 feet) *[ECMs No. 1, 2, 8]*:

Floor-to-Ceiling Height:	8	ft.
Total Volume *[ECMs No. 1, 2, 8]*:	1023944	cu. ft.

Window Area

4-18. Window Area *[ECMs No. 1, 2]*:

Unit Size	Floor Area *(Base per Unit)*	Floor Area *(Total for Units)*	
0 Bedroom Units	49	686	sq. ft.
1 Bedroom Units	49	1911	sq. ft.
2 Bedroom Units	99	693	sq. ft.
3 Bedroom Units	115	6440	sq. ft.
4 Bedroom Units	148	3108	sq. ft.
5 Bedroom Units	181	1267	sq. ft.
6 Bedroom Units			sq. ft.
Total for all units		14105	sq. ft.

4-19. Window panes (typical or predominant type) *[ECM No. 2]*:

- ☐ Single-Pane
- ■ Double-Pane
- ☐ Triple-Pane
- ☐ N/A

4-20. Window frame material *[ECM No. 1]*:

- ☐ Wood
- ■ Metal
- ☐ Vinyl
- ☐ Fiberglass
- ☐ N/A

4-21. Typical window fit (check of predominant condition) *[ECMs No. 1, 2]*:

- ☐ Loose (frame rattles, large air gaps, large drafts)
- ■ Average (some looseness, no large gaps, no large drafts)
- ☐ Tight (no excessive frame movement of drafts)
- ☐ N/A

4-22. Are the windows equipped with storm windows? *[ECM No. 1]*:

☐ Yes ■ No ☐ N/A

Energy Conservation for Housing
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Window Area (continued)

4-23. Are the windows and/or storm windows weatherstripped adequately? *[ECM No. 1, 2]*:

■ Yes ☐ No ☐ N/A

4-24. Are office and community spaces in the development air-conditioned? *[ECM No. 3]*:

■ Yes ☐ No ☐ N/A

Complete questions 4-25 through 4-27 only for office and community spaces that are air-conditioned. Proceed to question 4-28 if there are no air-conditioned spaces in your development.

4-25. Window area (in air-conditioned office and community spaces only) *[ECM No. 3]*:

South-facing windows only:	0	sq. ft.
East and west-facing windows only:	227	sq. ft.

4-26. Are windows in office and community areas well shaded (i.e., 50% of summer daylight hours, 50% of their area) by trees or vegetation? *[ECM No. 3]*:

■ Yes ☐ No ☐ N/A

4-27. Area windows in office and community area equipped with exterior shades, interior blinds, or tinted glass? *[ECM No. 3]*:

☐ Yes ☐ No ■ N/A

If no, indicate desired replacement shading type *[ECM No. 3]*:

☐ Exterior Shading
☐ Tinted Film
☐ Interior Shades
■ N/A

Exterior Doors

4-28. Total number of exterior doors in your development: 148

4-29. Typical exterior door fit (check off predominant condition) *[ECM No. 4]*:

☐ Loose (large drafts)
☐ Average (no excessive drafts)
■ Tight (no drafts)
☐ N/A

4-30. Are exterior doors adequately weatherstripped? *[ECM No. 4]*:

■ Yes ☐ No ☐ N/A

4-31. Are exterior doors equipped with storm doors? *[ECM No. 4]*:

☐ Yes ☐ No ■ N/A

4-32. Predominant door type (inspect doors, door labels, or construction specifications) *[ECM No. 4]*:

■ Wood
☐ Metal (energy conserving type - insulated steel)
☐ Metal (standard type - hollow steel)
☐ Sliding Glass Patio Doors (metal, single pane)
☐ N/A

If Wood, specify door thickness:

☐ 1□ in.
■ 1¾ in
☐ N/A

Energy Conservation for Housing
Walkthrough Survey / Development Report

Attics and Flat Roofs

4-33. Does the development have attics or flat roofs on the buildings? *[ECMs No. 5, 6]*:

- ☐ Attics (i.e., roofs with crawl spaces or full attics underneath)
- ■ Flat Roofs (i.e., flat or nearly flat roofs with no attic or crawl space underneath)
- ☐ N/A

If you checked off "attics" answer questions 4-34 and 4-35. If you checked off "flat roofs" answer questions 4-36 and 4-37.

4-34. Area of attic (assume it is equal to the floor area of the top floor of the building) *[ECM No. 5]*:

_____ sq. ft

4-35. Attic insulation type and level, i.e., depth (measure typical insulation thickness and enter below; round off to nearest inch) *[ECM No. 5]*:

- ☐ Batt fiberglass
- ☐ Dry cellulose
- ☐ Loose fill fiberglass
- ☐ Spray foam
- ■ N/A

Insulation level _____ in.

4-36. Area of flat roof (assume it is equal to the floor area of the top floor of the building) *[ECM No. 6]*:

12572

4-37. Type of existing flat roof structure (check whether insulated or uninsulated) *[ECM No. 6]*:

- ■ Insulated
- ☐ Uninsulated
- ☐ N/A

If uninsulated, check structure type *[ECM No. 6]*:

- ☐ Wood structure
- ☐ Concrete structure
- ☐ Steel structure
- ■ N/A

Walls

4-38. Wall construction, size and insulation (check off whether insulated or uninsulated) *[ECM No. 7]*:

- ■ Insulated
- ☐ Uninsulated
- ☐ N/A

If uninsulated construction, check structure and siding type *[ECM No. 7]*:

- ☐ Wood frame with wood siding
- ☐ Wood frame with aluminum siding
- ☐ Wood frame with brick siding
- ☐ Wood frame with other siding
- ☐ Concrete block masonry wall
- ☐ Brick masonry wall
- ☐ Other masonry wall construction
- ■ N/A

Total area of all uninsulated exterior (not including windows and doors) *[ECM No. 7]*:

Energy Conservation for Housing
Walkthrough Survey / Development Report

Heating and Cooling Systems Data

Heating System & Fuel Type

4-39. Heating system type (check off applicable type):

- ☐ Individual heating systems
- ■ Central heating system
- ☐ N/A

If you checked off "Central heating system," check off system type:

- ■ Boiler
- ☐ Furnace
- ☐ Other (e.g., heat pump)
- ☐ N/A

4-40. Heating fuel type (check off applicable type):

- ☐ Electricity
- ■ Natural Gas
- ☐ Heating Oil
- ☐ Propane
- ☐ N/A

If you checked off "Individual heating systems" in question 4-39, answer questions 4-41 through 4-43.
If you checked off "Central heating system" above, answer questions 4-44 through 4-51.

Individual Heating Systems

4-41. Do the heaters have vent dampers or flue dampers (applies only to oil and gas furnaces and boilers)? *[ECMs No. 9, 10]*:

☐ Yes ☐ No ■ N/A

4-42. Do gas heaters have constant-burning pilot lights? *[ECM No. 10]*:

☐ Yes ☐ No ■ N/A

4-43. Are heaters controlled by thermostats? *[ECM No 13]*:

☐ Yes ☐ No ■ N/A

If yes, indicate type *[ECM No. 13]*:

- ☐ Non-setback
- ☐ Setback
- ■ N/A

Central Heating System

4-44. Does the system have flue dampers or vent dampers (question applies to oil and gas furnaces and boilers only)? *[ECMs No. 9, 10]*:

■ Yes ☐ No ☐ N/A

4-45. Heat distribution type of your central heating system *[ECM No. 16]*:

- ☐ Steam
- ■ Hot Water
- ☐ Forced Air
- ☐ N/A

4-46. Check off which of the following are used to control heating:

- ☐ Outdoor reset and cutout controls (boiler systems only) *[ECM No. 11]*:
- ■ Non-setback thermostats in the dwelling unit *[ECM No. 13]*:
- ☐ Setback thermostats in the dwelling unit *[ECM No. 13]*:
- ☐ Radiator controls in the dwelling unit (boiler systems only) *[ECM No. 14]*:
- ☐ N/A

Total number of radiators in your development: 393

Energy Conservation for Housing
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Central Heating System - continued

4-47. Are all or most hot water or steam distribution pipes insulated (question does not apply to forced air distribution systems) *[ECM No. 15]*:

☐ Yes ☐ No ■ N/A

If No, (i.e., pipes are no insulated), answer question 4-48.

4-48. Linear feet of uninsulated pipes (do not include pipes that are in heated areas such as dwelling units) *[ECM No. 15]*:

¾" diameter pipe	
1" diameter pipe	
1½" diameter pipe	
2" diameter pipe	
3" diameter pipe	
4" diameter pipe	
6" diameter pipe	

Combustion Efficiency Test for Central Boilers and Furnaces

To properly estimate energy savings for replacing a central heating system, a combustion efficiency test must be performed on the existing central boilers or furnaces. (Note: Combustion efficiency is not the same as Annual Fuel Usage efficiency, or AFUE. Please refer to the Glossary in Appendix B.) A combustion efficiency test determines how completely the fuel is burned in the boiler or furnace by measuring the oxygen or carbon dioxide concentration in the flue gas. Combustion efficiency tests should be performed only on large central boilers or furnaces, not on boilers or furnaces for individual units. A qualified technician, familiar with combustion efficiency test procedures should conduct the test. The test should be conducted during the heating season. If these tests are routinely conducted at your development, use the most recent test data (if not more than two years old) to answer the following question.

4-49. What is the existing combustion efficiency of your central boiler or furnace (enter as decimal fraction, e.g.,: 75% = .75) *[ECM No. 12]*:

82

4-50. Is your central boiler or furnace oversized (i.e., cycles often - as a rough guideline, this means that the boiler or furnace starts up more than two times per hour):

☐ Yes ■ No ☐ N/A

Air-Conditioning (AC) Systems

4-51. Do you have air-conditioning in your development to cool community and office areas? *[ECMs No. 19, 20]*:

■ Yes ☐ No ☐ N/A

4-52. Do you have air-conditioning in your development to cool residential units (do not included window or wall AC units if they are owned and installed by the residents)? *[ECMs No. 19, 20]*:

☐ Yes ■ No ☐ N/A

4-53. Does the HA pay for the fuel consumption for residential air conditioning?

■ Yes ☐ No ☐ N/A

If you answered Yes to question 4-53, proceed to question 4-54 through 4-56. If you answered No, proceed to 4-57.

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Air-Conditioning (AC) Systems - continued

4-54. Air-conditioning system type and number of units *[ECMs No. 19, 20]*:

■ Individual window or wall units		units
☐ Central system		units

4-55. Power requirement of typical existing unit or system (read equipment labels, literature, or engineering specification drawings) *[ECMs No. 19, 20]*:

Typical ranges:		
Window or wall AC units:	500-5,000	watts
Central AC unit:	2,000-10,000	watts
Chiller:	10,000-1,400,000	watts
Power requirement:	5000	watts

4-56. Cooling capacity of typical existing unit or system (read equipment labels, literature, or engineering specification drawings) (Note: One ton of cooling capacity = 12,000 Btu) *[ECMs No. 19, 20]*:

Typical ranges:		
Window or wall AC units:	5,000-30,000	Btu
Central AC unit:	20,000-60,000	Btu
Chiller:	60,000-12,000,000	Btu
Cooling capacity	8500	Btu

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Domestic Hot Water (DHW) System/Water Supply Systems Data	
Hot Water Heater Fuel and Type	
4-57.	Does the development have DHW tanks? *[ECMs No. 22, 23]*: ■ Yes ☐ No ☐ N/A
4-58.	Are the DHW tanks uninsulated? (Note: Most newer hot water heaters have adequate insulation built into the design, but may not look "wrapped.") *[ECMs No. 22, 23]*: ■ Yes ☐ No ☐ N/A
4-59.	Water heater type (check off applicable type) *[ECM No. 25]*: ☐ Individual tank water heater ■ Central DHW heater ☐ N/A If a replacement heater is considered, check off type *[ECM No. 25]*: ☐ Central, condensing ☐ Central, non-condensing ☐ Tank, condensing ☐ Tank, non-condensing ■ N/A
4-60.	Water heater fuel type: ☐ Electricity ■ Natural Gas ☐ Heating Oil ☐ Propane ☐ N/A
Hot Water Heater Fuel and Type	
4-61.	Do you have low-flow faucet aerators and shower heads installed on all or most faucets and showers? *[ECM No. 21]*: ☐ Yes ■ No ☐ N/A
4-62.	How is proper water pressure maintained in your development? *[ECM No. 36]*: ☐ Roof-mounted storage tank ■ From street mains (no tanks and no pumps) ☐ Pressurizing pump system (booster pumps) ☐ N/A Total horsepower of existing booster pumps *[ECM 36]:* _____ HP
4-63.	Have water-saving toilets been installed in your development? [ECM No. 35]: ■ Yes ☐ No ☐ N/A
Central Laundry Facilities	
4-64.	Do you have central public laundry facilities as part of your development? *[ECM No. 24]*: ■ Yes ☐ No ☐ N/A
4-65.	Total number of washing machines *[ECM No. 24]*: 12
4-66.	Are washing machines restricted to cold water rinse only? *[ECM No. 24]*: ■ Yes ☐ No ☐ N/A

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Lighting Systems Data	
Residential Unit Lighting	
4-67.	Type of lighting in residential units (check off predominant fixture type in each of the following spaces) *[ECM No. 26]*: Kitchen: ■ LED ☐ Fluorescent ☐ N/A Bathroom: ☐ LED ■ Fluorescent ☐ N/A Hallway/Foyer: ■ LED ☐ Fluorescent ☐ N/A
Common Area Lighting	
Common areas include offices, community rooms, lobbies, corridors, hallways and stairways in both public and basement floors. All questions refer to "general lighting" only; do not include "task lighting" such as desk lamps, etc.	
4-68.	Is there incandescent lighting in the common areas? *[ECMs No. 27, 28, 29, 30]*: ☐ Yes ■ No ☐ N/A
If you answered "Yes" to question 4-68, answer questions 4-69 and 4-70. If you answered "No" to question 4-68, proceed to question 4-71.	
4-69.	Total number of incandescent fixtures (common areas only *) *[ECM No. 27]*:
* To obtain the total number of incandescent fixtures in the common areas, select one building that is representative of the buildings on site and count the number of fixtures in the basement, at the ground floor, and at the typical floor. Multiply the number of fixtures at the typical floor by the number of floors in the building. Add this figure to the number of fixtures located in the basement and the ground floor to obtain the total number of fixtures in the building. Multiply this total building figure by the number of buildings on the site.	
4-70.	Average watts per incandescent lighting fixture (e.g., 50, 75, or 100 watts) *[ECM No. 27]*:
4-71.	Is there fluorescent lighting in the common areas? *[ECMs No. 27, 28, 29, 30]*: ■ Yes ☐ No ☐ N/A
If you answered "Yes" to question 4-71, answer questions 4-72 through 4-75. If you answered "No" to question 4-71, proceed to question 4-76.	

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Common Area Lighting - continued

4-72. Type of fixture (check off predominant type of fixture in common areas) *[ECMs No. 28, 29]*:

- ☐ 2 tubes/4 feet long
- ☐ 2 tubes/8 feet long
- ☐ 4 tubes/4 feet long
- ☐ 4 tubes/8 feet long
- ☐ 6 tubes/4 feet long
- ☐ 8 tubes/4 feet long
- ■ Other
- ☐ N/A

4-73. Are the fluorescent lamps "energy-conserving" lamps (e.g., General Electric's Watt-Miser, Osram Sylvania's SuperSaver, Philips Econ-o-Watts, and Duro-Test's Watt Saver)? *[ECM No. 28]*:

☐ Yes ☐ No ■ N/A

4-74. Are the ballasts electronic? (Note: As a general rule, if the lighting has not been updated, the ballasts are not electronic.) *[ECM No. 29]*:

☐ Yes ☐ No ■ N/A

4-75. Total number of fluorescent fixtures in the development (common areas only) *[ECMs No. 28, 29]*:

Complete the following questions (4-76 through 4-78) for office areas only. Do not answer the questions if there are no office or management spaces in your development or if the offices are windowless or all "general lighting" is incandescent.

4-76. Are lights located near the windows routinely turned off during the daytime hours?

☐ Yes ☐ No ■ N/A

4-77. Number of fluorescent fixtures within 10 feet of the windows (office areas only) *[ECM No. 30]*:

Type of window glass *[ECM No 30]*:

- ☐ Clear
- ☐ Tinted
- ■ N/A

Estimated percentage of exterior wall above desk height that is glass *[ECM No 30]*:

- ☐ 25-50%
- ☐ 50-75%
- ☐ 75-100%
- ■ N/A

Does the building have exterior overhangs projected at least two feet from the outside face of the glass near the top of the window? *[ECM No. 30]*:

■ Yes ☐ No ☐ N/A

Energy Conservation for Housing
Walkthrough Survey / Development Report

Common Area Lighting - continued

4-78. Type of predominant fluorescent fixture within 10 feet of windows in office areas *[ECM No. 30]*:

- ☐ 2 tubes/4 feet long
- ☐ 2 tubes/8 feet long
- ☐ 4 tubes/4 feet long
- ☐ 4 tubes/8 feet long
- ☐ 6 tubes/4 feet long
- ☐ 8 tubes/4 feet long
- ☐ Other
- ■ N/A

Exterior Lighting

4-79. Predominant type of exterior lighting fixture (check off applicable type) *[ECM No. 31]*:

- ☐ None (no exterior lighting)
- ☐ Sodium vapor lamps (high or low-pressure)
- ☐ Mercury vapor lamps
- ☐ Metal halide lamps
- ☐ Incandescent lamps
- ☐ Fluorescent lamps
- ☐ Halogen lamps
- ■ N/A

4-80. Number of exterior lighting fixtures *[ECMs No. 31, 32]*: ☐

4-81. Energy consumption (watts) per predominant exterior lighting fixture type (i.e., per fixture unit) *[ECMs No. 31, 32]*: ☐

4-82. Who pays for exterior lighting electricity? *[ECMs No. 31, 32]*:

- ☐ Housing Authority
- ☐ Local town or city government
- ■ N/A

4-83. Type of exterior lighting controllers (check off applicable type) *[ECM No. 32]*:

- ☐ Manual switching (no controls)
- ☐ Timers
- ☐ Photo-controls
- ■ N/A

If you checked "Manual Switching" or "Timers" on question 4-83, go to question 4-84. If you checked "Photo-controls", proceed to question 4-85.

4-84. Number of hours per year exterior lighting is turned on* *[ECM No. 32]*: ☐

* Estimate annual hours by multiplying average daily hours of use (hours between turning on and off) by 365 days. Adjust for weekend and season variations, if necessary.

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Miscellaneous Data		
4-85.	Average age of existing refrigerators (check off predominant age of existing refrigerators in your development) *[ECM No. 33]*:	
	☐ 1990s	
	☐ 2000s	
	■ 2010s	
	☐ 2020s	
	☐ N/A	
	Average size of existing refrigerators (check off predominant size of existing refrigerators in your development) *[ECM No. 33]*:	
	☐ 13 cubic feet or smaller	
	■ 14-15 cubic feet	
	☐ 16 cubic feet or large	
	☐ N/A	
4-86.	Type of motors that could be operation fans or pumps at your development (check off applicable types) *[ECM No. 34]*:	
	■ Elevator	
	■ Ventilation system	
	☐ Hydronic heating or cooling system	
4-87.	Predominant size of motor for each of the above systems (in horsepower) *[ECM No. 34]*:	
	Elevator	15
	Ventilation system	0
	Hydronic heating or cooling system	
4-88.	Number of motors of each type *[ECM No. 34]:*	
	Elevator	2
	Ventilation system	12
	Hydronic heating or cooling system	
4-89.	Average operation hours per year of each motor *[ECM No. 34]*:	
	Elevator	4380
	Ventilation system	8760
	Hydronic heating or cooling system	

Energy Conservation for Housing
Energy Consumption Survey

Energy Consumption Survey - Electricity				
5-1.	Electricity Consumption			
0 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			kWh/yr
	2019	4141.53	57981.42	kWh/yr
	2020			kWh/yr
	Total:		57981.42	kWh
	Average annual consumption:		57981.42	kWh/yr
	Average current price for electricity*:		0.1	$/kWh
	Average annual cost of electricity consumption:		5798.14	$/yr
1 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			kWh/yr
	2019	4142.12	161542.68	kWh/yr
	2020			kWh/yr
	Total:		161542.68	kWh
	Average annual consumption:		161542.68	kWh/yr
	Average current price for electricity*:		0.1	$/kWh
	Average annual cost of electricity consumption:		16154.27	$/yr
2 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			kWh/yr
	2019	4145.26	29016.82	kWh/yr
	2020			kWh/yr
	Total:		29016.82	kWh
	Average annual consumption:		29016.82	kWh/yr
	Average current price for electricity*:		0.1	$/kWh
	Average annual cost of electricity consumption:		2901.68	$/yr
3 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			kWh/yr
	2019	4142.06	231955.36	kWh/yr
	2020			kWh/yr
	Total:		231955.36	kWh
	Average annual consumption:		231955.36	kWh/yr
	Average current price for electricity*:		0.1	$/kWh
	Average annual cost of electricity consumption:		23195.54	$/yr

Energy Conservation for Housing
Energy Consumption Survey

5-1.	Electricity Consumption - continued			
4 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			kWh/yr
	2019	4140.55	86951.55	kWh/yr
	2020			kWh/yr
	Total:		86951.55	kWh
	Average annual consumption:		86951.55	kWh/yr
	Average current price for electricity*:		0.1	$/kWh
	Average annual cost of electricity consumption:		8695.16	$/yr
5 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			kWh/yr
	2019	4141	28987	kWh/yr
	2020			kWh/yr
	Total:		28987	kWh
	Average annual consumption:		28987	kWh/yr
	Average current price for electricity*:		0.1	$/kWh
	Average annual cost of electricity consumption:		2898.7	$/yr
6 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			kWh/yr
	2019			kWh/yr
	2020			kWh/yr
	Total:			kWh
	Average annual consumption:			kWh/yr
	Average current price for electricity*:			$/kWh
	Average annual cost of electricity consumption:			$/yr
Electricity Total				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			kWh/yr
	2019	24852.52	596434.83	kWh/yr
	2020			kWh/yr
	Total:		596434.83	kWh
	Average annual consumption:		596434.83	kWh/yr
	Average current price for electricity*:		0.1	$/kWh
	Average annual cost of electricity consumption:		59643.48	$/yr

* For the current price of electricity, refer to the development's current bills or contact the utility company. Also, when referring to the utility bills, remember that the price of electricity often changes seasonally and even hourly. The rates for these tables should represent the *current average annual rates*, including any surcharges.

Energy Conservation for Housing
Energy Consumption Survey

Rate Structure for Electricity

5-2. Demand charges (shown in terms of kW, not kWh):

- ■ No demand charges levied by utility
- ☐ Charges included in bill
- ☐ N/A

If you answered "Charges included in bill", please answer the following questions. If you answered "No demand charges levied by utility", proceed to question 5-3.

Average annual demand charge amount (above normal kWh charges): _____

Please describe demand structure:

5-3. Time-of-day or time-of-use charges, also known as "peak" and "off-peak" rates charges (i.e., different electricity rates at different times of day):

Are time-of-day meters installed in the developments?

☐ Yes ■ No ☐ N/A

If you answered "No" to the previous question, does your utility offer time-of-day charged?

☐ Yes ■ No ☐ N/A

5-4. If the answer to either question in 5-3 is "Yes", what are the time-of-day charges? *[ECM No. 25]*:

Lowest rate charged: _____ $/kWh

Highest rate charged: _____ $/kWh

Please describe the time-of-day charge structure (i.e., lowest and highest cost time periods, etc.):

5-5. Low power factor surcharges *[ECM No. 40]*:

- ■ No low power factor charges levied by utility
- ☐ Charges included in bill
- ☐ N/A

If you answered "Charges included in bill", please answer the following questions. If you answered "No demand charges levied by utility", proceed to question 5-6.

Average annual low power factor charge amount: _____ $/yr

Please describe low power factor charge structure:

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Energy Consumption Survey

Energy Consumption Survey - Natural Gas				
5-1.	Natural Gas Consumption			
0 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Therms/yr
	2019	210.67	2949.38	Therms/yr
	2020			Therms/yr
	Total:		2949.38	Therms
	Average annual consumption:		2949.38	Therms/yr
	Average current price for natural gas*:		18.71	$/Therm
	Average annual cost of natural gas consumption:		55182.9	$/yr
1 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Therms/yr
	2019	30340	1183260	Therms/yr
	2020			Therms/yr
	Total:		1183260	Therms
	Average annual consumption:		1183260	Therms/yr
	Average current price for natural gas*:		32336.71	$/Therm
	Average annual cost of natural gas consumption:		38262735475	$/yr
2 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Therms/yr
	2019	30340	212380	Therms/yr
	2020			Therms/yr
	Total:		212380	Therms
	Average annual consumption:		212380	Therms/yr
	Average current price for natural gas*:		32336.71	$/Therm
	Average annual cost of natural gas consumption:		6867670470	$/yr
3 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Therms/yr
	2019	30340	1699040	Therms/yr
	2020			Therms/yr
	Total:		1699040	Therms
	Average annual consumption:		1699040	Therms/yr
	Average current price for natural gas*:		32336.71	$/Therm
	Average annual cost of natural gas consumption:		54941363758	$/yr

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Energy Consumption Survey

5-1.	Natural Gas Consumption - continued			
4 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Therms/yr
	2019	30340	637140	Therms/yr
	2020			Therms/yr
	Total:		637140	Therms
	Average annual consumption:		637140	Therms/yr
	Average current price for natural gas*:		32336.71	$/Therm
	Average annual cost of natural gas consumption:		20603011409	$/yr
5 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Therms/yr
	2019	30340	212380	Therms/yr
	2020			Therms/yr
	Total:		212380	Therms
	Average annual consumption:		212380	Therms/yr
	Average current price for natural gas*:		32336.71	$/Therm
	Average annual cost of natural gas consumption:		6867670470	$/yr
6 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Therms/yr
	2019			Therms/yr
	2020			Therms/yr
	Total:			Therms
	Average annual consumption:			Therms/yr
	Average current price for natural gas*:			$/Therm
	Average annual cost of natural gas consumption:			$/yr
Natural Gas Total				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Therms/yr
	2019	151910.67	3947149.38	Therms/yr
	2020			Therms/yr
	Total:		3947149.38	Therms
	Average annual consumption:		3947149.38	Therms/yr
	Average current price for natural gas*:		26950.37667	$/Therm
	Average annual cost of natural gas consumption:		1.06377E+11	$/yr
* If the current price of natural gas is metered in cubic feet, divide by 100 to change to therms.				

Energy Conservation for Housing
Energy Consumption Survey

Energy Consumption Survey - Summary of Fuel Consumption				
5-8.	Summary of Fuel Consumption			
	Fuel Type	Average Annual Fuel Consumption	Current Cost per Fuel or Energy Unit	
	Electricity	596434.83	0.1	kWh
	Natural Gas	3947149.38	26950.37667	Therm
	Heating Oil			Gal
	Propane			Gal

Energy Conservation for Housing
Energy Consumption Survey

Energy Consumption Survey - Water Charges				
5-10.	Water Charges *[ECM No. 35]*:			
0 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019	2631.7	36843.8	$/yr
	2020			$/yr
	Total:		36843.8	$
	Average annual consumption:		36843.8	$
1 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019	2632.07	102650.73	$/yr
	2020			$/yr
	Total:		102650.73	$
	Average annual consumption:		102650.73	$
2 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019	2634.06	18438.42	$/yr
	2020			$/yr
	Total:		18438.42	$
	Average annual consumption:		18438.42	$
3 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019	2632.03	147393.68	$/yr
	2020			$/yr
	Total:		147393.68	$
	Average annual consumption:		147393.68	$

Energy Conservation for Housing
Energy Consumption Survey

5-10.	Water Charges *[ECM No. 35]* - continued:			
4 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019	2631.07	55252.47	$/yr
	2020			$/yr
	Total:		55252.47	$
	Average annual consumption:		55252.47	$
5 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019	2631.36	18419.52	$/yr
	2020			$/yr
	Total:		18419.52	$
	Average annual consumption:		18419.52	$
6 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019			$/yr
	2020			$/yr
	Total:			$
	Average annual consumption:			$
Water Total				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019	15792.29	378998.62	$/yr
	2020			$/yr
	Total:		378998.62	$
	Average annual consumption:		378998.62	$

Energy Conservation for Housing
Energy Consumption Survey

Energy Consumption Survey - Heating Consumption Calculation

Electrically Heated Developments Only

A. Transfer the following information that you have previously obtained in the Walkthrough and Energy Consumption Surveys:

Heating Degree Day Zone (4-8):	2.96	DDZ
Average annual kWh consumption (5-9):	596434.83	kWh/yr

B. Select the appropriate conversion factor for Heating Degree Day Zone in the table below:

Degree Day Zone (DDZ)	Conversion Factor
2 or less	0.35
2.1 - 4	0.50
4.1 - 6	0.65
6.1 - 8	0.75

C. Calculate total electricity used for heating in your development by multiplying the average annual kWh consumption by the appropriate conversion factor:

5-12.

Annual kWh Consumption		Conversion Factor		Total electricity used for heating:	
596434.83	x	0.5	=	298217.42	kWh/yr

Non-Electrically Heated Developments Only

If the fuel used for heating your development is gas, oil, or propane, and is used *only* for heating and not for other end-uses (e.g., domestic hot water, cooking, clothes dryers), then skip to the table in question 5-14. If the fuel used for heating your development is gas, oil, or propane, and is also used for other end uses, complete the items below.

A. Transfer the following information that you have previously obtained in the Walkthrough and Energy Consumption Surveys:

Number of dwelling unit (question 4-13):	144	
Average annual fuel consumption (question 5-9):		
Natural Gas:	3947149.38	Therms/yr
Heating Oil:		Gal/yr
Propane:		Gal/yr

B. Select the appropriate conversion factor for your heating fuel type in the table below:

Fuel Type	Conversion Factor	
Natural Gas	100	Therms
Heating Oil	43	Gal
Propane	66	Gal

C. Calculate total fuel used for non-heating uses by multiplying the number of dwelling units by the appropriate conversion factor:

Number of dwelling units		Conversion Factor		Total Fuel Used for Non-Heating	
Natural Gas					
144	x	100	=	14400	Therms/yr
Heating Oil					
144	x	43	=	6192	Gal/yr
Propane					
144	x	66	=	9504	Gal/yr

D. Calculate fuel consumed for heating only by subtracting the non-heating fuel use (step C above) from the average annual fuel consumption (step A above):

Energy Conservation for Housing
Energy Consumption Survey

Non-Electrically Heated Developments Only - continued

5-13.

Average Annual Consumption		Non-heating Use		Total Fuel Used for Heating	
Natural Gas					
3947149.38	-	14400	=	3932749.38	Therms/yr
Heating Oil					
	-	6192	=		Gal/yr
Propane					
	-	9504	=		Gal/yr

If the fuel used for heating your development is gas, oil, or propane, and is used only for heating, transfer the Average Annual Fuel Consumption from question 5-9 to the table below. Otherwise, transfer the information that you have previously calculated for question 5-12 and 5-13 (depending on whether your development is electrically or non-electrically heated) to the table. (Check off the fuel type used for heating and fill the annual quantity.)

Is the fuel used to heat your development gas, oil, or propane and also is used for other end-uses (e.g., domestic hot water, cooking, clothes dryers, etc.)?

■ Yes ☐ No ☐ N/A

If development needs either checkmetering or individual metering, please select type of metering to install *[ECM No. 37]*:

☐ Checkmetering
☐ Individual Metering
■ N/A

5-14. Summary of Heating Fuel Consumption

Heating Fuel Type	Annual Heating Fuel Consumption	
■ Electricity	298217.42	kWh/yr
☐ Natural Gas		Therms/yr
☐ Heating Oil		Gal/yr
☐ Propane		Gal/yr
☐ N/A		

Energy Conservation for Housing
ECM Cost/Benefit Worksheet

ECM No. 1 - Install Storm Windows					
Step 1	Obtain total cost of installing the type and quantity of storm windows needed.				
			213,010.89	$	
Step 2	Transfer the following information from the Survey				
4-8	**a.** Heating degree-day zone:		2.96	DDZ	
4-18	**b.** Total area of windows:		14105	sq. ft.	
4-17	**c.** Total volume of buildings in development:		1023944	cu. ft.	
4-20	**d.** Window frame material:		Metal		
4-21	**e.** Average window fit:		Average		
5-9	**f.** Cost of heating fuel:	Electricity:	0.1	$/kWh	
		Natural Gas:		$/Therm	
		Heating Oil:		$/Gal	
		Propane:		$/Gal	
Step 3	Obtain the following savings factors from Tables 1 and 2:				
Table 1	**a.** Conductance savings factor:		3.2		
Table 2	**b.** Infiltration savings factor:		0.036		
Step 4	Estimate annual energy savings due to conduction losses:				

2a		2b		3a			
2.96	x	14105	x	3.2	=	133,602.56	/yr

Step 5	Estimate annual energy savings due to infiltration losses:

2a		2c		3b			
2.96	x	1023944	x	0.036	=	109,111.47	/yr

Step 6	Estimate total annual energy savings:

4		5			
133,602.56	+	109,111.47	=	242,714.03	/yr

Step 7	Calculate annual cost savings:

6		2f			
242,714.03	x	0.1	=	24,271.40	$/yr

Step 8	Calculate payback period:

1		7			
213,010.89	/	24,271.40	=	8.78	yrs

Energy Conservation for Housing
ECM Cost/Benefit Worksheet

ECM No. 1 - Install Storm Windows

Table 1: Conductance Savings Factors

Instructions:

1. Find the frame material of the primary windows (see Step2d).
2. Find the fuel type.
3. Select the appropriate conductance savings factor and transfer it to Step 3.

Primary Window Frame Material	Fuel Type			
	Electricity	Natural Gas	Heating Oil	Propane
Wood	2.200	0.110	0.076	0.120
Metal	3.200	0.160	0.110	0.170

Table 2: Infiltration Savings Factors

Instructions:

1. Find the fit of the primary windows (see Step 2e).
2. Find the fuel type.
3. Select the appropriate infiltration savings factor and transfer it to Step 3.

Primary Window Fit	Fuel Type			
	Electricity	Natural Gas	Heating Oil	Propane
Loose	0.05300	0.00260	0.00190	0.00280
Average	0.03600	0.00170	0.00130	0.00190
Tight	0.01800	0.00087	0.00063	0.00095

Energy Conservation for Housing
ECM Cost/Benefit Worksheet

ECM No. 8 - Control Air Leakage										
Step 1	Obtain total cost of installing wall insulation:									
								58,970.18	$	
Step 2	Transfer the following information from the Survey									
4-8	**a.** Heating degree-day zone:							2.96	DDZ	
4-17	**b.** Total volume of buildings in development:							1023944	cu. ft.	
5-9	**c.** Cost of heating fuel:						Electricity:	0.1	$/kWh	
							Natural Gas:		$/Therm	
							Heating Oil:		$/Gal	
							Propane:		$/Gal	
Step 3	Obtain the following data from Table 1:									
Table 1	Infiltration savings factor:							0.053		
Step 4	Estimate annual energy savings:									
		2a		2b		3				
		2.96	x	1023944	x	0.053	=	160,636.33	/yr	
Step 5	Calculate annual cost savings:									
				4		2c				
				160,636.33	x	0.1	=	16,063.63	$/yr	
Step 6	Calculate payback period:									
				1		5				
				58,970.18	/	16,063.63	=	3.67	yrs	

Energy Conservation for Housing
ECM Cost/Benefit Worksheet

ECM No. 8 - Control Air Leakage

Table 1: Conductance Savings Factors

Instructions:

1. Find the fuel type.
2. Select the appropriate savings factor and transfer it to Step 3.

Fuel	Savings Factor
Electricity	0.0530
Natural Gas	0.0026
Heating Oil	0.0019
Propane	0.0028

Energy Conservation for Housing
ECM Cost/Benefit Worksheet

ECM No. 13 - Install Setback Thermostats								
Step 1	Obtain total cost of installing night setback thermostats:							
						25,567.20	$	
Step 2	Transfer the following information from the Survey:							
4-8	**a.** Heating degree-day zone:					2.96	DDZ	
5-14	**b.** Annual heating fuel consumption:	Natural Gas:					Therms/yr	
		Heating Oil:					Gal/yr	
		Propane:					Gal/yr	
5-9	**c.** Cost of heating fuel:	Natural Gas:					$/Therm	
		Heating Oil:					$/Gal	
		Propane:					$/Gal	
Step 3	Obtain the following savings factor from Table 1:							
Table 1	Savings factor:					0.1		
Step 4	Estimate annual energy savings:							
		3		2b				
		0.1	x	0	=	29,821.74	/yr	
Step 5	Calculate annual cost savings:							
		4		2c				
		29,821.74	x	0	=	2,982.17	$/yr	
Step 6	Calculate payback period:							
		1		5				
		25,567.20	/	2,982.17	=	8.57	yrs	

Energy Conservation for Housing
ECM Cost/Benefit Worksheet

ECM No. 13 - Install Setback Thermostats

Table 1: Savings Factors for Installing Setback Thermostats

Heating Energy Savings from Nightly Setback of 8 Degrees

Instructions:

1. Find the appropriate heating degree day zone (DDZ) (see Step 2).
2. Select the appropriate savings factor and transfer it to Step 3.

Heating DDZ	Savings Factor
2.50 or less	0.150
2.51 - 2.80	0.120
2.81 - 3.40	0.100
3.41 - 4.10	0.093
4.11 - 4.80	0.080
4.81 - 5.50	0.075
5.50 or more	0.072

Energy Conservation for Housing
ECM Cost/Benefit Worksheet

ECM No. 21 - Install Water-Efficient Showerheads and Faucet Aerators								
Step 1	Obtain total cost of replacing showerheads and aerators (typically one showerhead and two aerators per dwelling unit):							
						9,069.12	$	
Step 2	Transfer the following information from the Survey:							
4-14	**a.** Total number of residents in development:					399		
5-9	**b.** Cost of DHW heating fuel:			Electricity:		0.1	$/kWh	
				Natural Gas:			$/Therm	
				Heating Oil:			$/Gal	
				Propane:			$/Gal	
Step 3	Estimate annual energy savings:							
				2a				
	Electricity:	206.5	x	399	=	82,393.50	kWh/yr	
	Natural Gas:	10.0	x		=		Therms/yr	
	Heating Oil:	7.2	x		=		Gal/yr	
	Propane:	10.1	x		=		Gal/yr	
Step 4	Calculate annual cost savings:							
		3		2b				
		82,393.50	x	0.1	=	8,239.35	$/yr	
Step 5	Calculate payback period:							
		1		4				
		9,069.12	/	8,239.35	=	1.10	yrs	

Tab

Energy Conservation for Housing
Summary of Results

Development Information		
4-1.	Development ID Number:	NY082000002
4-2.	Development Name:	Dunbar Heights
4-3.	Development/Unit Address:	81 Highland

ECM Summary

ECM No.	ECM	N/A	Total Cost ($)	Annual Savings		Payback Period
				$	Energy	
Architectural ECMs						
1	Install Storm Windows	☐	101,906.95	19,112.00	136,514.25	5.33
2	Install Replacement Windows	■				
3a	Install Window Sun Shades: South-Facing Windows	■				
3b	Install Window Sun Shades - East and West Facing Windows	■				
4	Install Storm Doors	■				
5	Install/Increase Attic Insulation - R13	☐	30,995.81	2,196.69	15,690.66	14.11
5	Install/Increase Attic Insulation - R30	■				
5	Install/Increase Attic Insulation - R42	■				
6	Install Roof Insulation - R10	■				
6	Install Roof Insulation - R20	■				
7	Install Wall Insulation	■				
8	Control Air Leakage	☐	28,212.04	14,963.09	106,879.21	1.89
Heating and Cooling ECMs						
9	Install Vent Dampers	■				
10	Convert to Electronic Ignition	■				
11	Install Boiler Controls	■				
12	Replace Inefficient Heating Plant	■				
13	Install Setback Thermostats	■				
14	Install Radiator Controls	■				
15	Insulate Hot Water or Steam Pipes	■				
16	Convert Steam Heating to Hot Water Distribution	■				
17	Seal and Insulate Ducts	■				
18	Install Geothermal Heat Pumps	■				
19	Replace Inefficient Air Conditioners	■				
20	Install Swamp Coolers	■				
Domestic Hot Water System ECMs						
21	Install Water-Efficient Showerheads and Faucet Aerators	☐	6,046.08	6,013.28	42,952.00	1.01
22	Insulate Hot Water Tank	■				
23	Install DHW Off-Peak Controls	■				
24	Convert Laundry to Cold Rinse	■				
25	Replace Inefficient Hot Water Heater	■				

Energy Conservation for Housing
Summary of Results

ECM Summary - continued						
ECM No.	ECM	N/A	Total Cost ($)	Annual Savings		Payback Period
				$	Energy	
Lighting System ECMs						
26	Replace Incandescent Lighting with Compact Fluorescent Lamps in Dwelling Units	☐	1,214.36	2,016.00	14,400.00	0.60
27	Replace Incandescent Lighting with Fluorescent Lighting in Common Areas	■				
28	Replace Older Fluorescent Lamps with Energy-Saving Lamps in Common Areas	■				
29	Replace Older Fluorescent Lamps and Ballast in Common Areas	■				
30	Install Lighting Controls in Common Areas	■				
31	Convert Exterior Lighting Fixtures	■				
32	Install Photo-Controls for Exterior Lighting	■				
Miscellaneous ECMs						
33	Replace Older Refrigerators with High-Efficiency Units	■				
34a	Upgrade or Replace Inefficient Motors - Elevator	■				
34b	Upgrade or Replace Inefficient Motors - Ventilation System	■				
34c	Upgrade or Replace Inefficient Motors - Hydronic Heating or Cooling System	■				
35	Install Water-Saving Toilets	■				
36	Convert Water Supply Pumps	☐	496.34	2,146.20	15,330.00	0.23
37a	Install Checkmetering or Individual Metering - Natural Gas	■				
37b	Install Checkmetering or Individual Metering - Electricity	■				

Energy Conservation for Housing
Walkthrough Survey / Development Report

General Development Data			
Development Information			
4-1.	Development ID Number:	NY082000002	
4-2.	Development Name:	Dunbar Heights	
4-3.	Development Address:	81 Highland	
4-4.	Name of person responsible for completing this survey:	Jerry Fenchel	
4-5.	Contact person's telephone number:	817-922-9000	
Location and Climate			
4-6.	City:	Peekskill	
4-7:	State:	New York	
Complete questions 4-8 and 4-9 with information from Appendix A, Climate Data. If your development's specific location is not listed, use data for the closest city listed.			
4-8.	Heating Degree Day Zone *[ECMs No. 1-8, 13]*:	2.96	
4-9.	Heating Season Hours *[ECM No. 14]*:	2892	
Building Types and Quantities			
4-10.	Residential building types (check off applicable building type, then answer all further questions under that type):		
	☐ Single or twin-family houses		
	Number of single-family houses:		
	Number of twin-family houses:		
	■ Low-rise multifamily buildings (4 stores or less)		
	Number of buildings:	13	
	Number of stories:		
	☐ High-rise multifamily buildings (5 stories or more)		
	Number of buildings:		
	Number of stories:		
4-11.	Non-residential building types (i.e., separate structures used as office spaces, community rooms, laundry facilities, mechanical room, etc.)		
	Number of buildings:		
	Number of stories:		
4-12.	Total number of buildings in your development:	13	
Development Size			
4-13.	Number of dwelling units in your development		
	Number of 0 bedroom units:		
	Number of 1 bedroom units:	7	
	Number of 2 bedroom units:	72	
	Number of 3 bedroom units:	11	
	Number of 4 bedroom units:	6	
	Number of 5 bedroom units:		
	Number of 6 bedroom units:		
	Total number of dwelling units *[ECMs No. 26, 33]*:	96	
4-14.	Total number of residents in development *[ECMs No. 21, 22, 23, 25]*:	208	
4-15.	Average number of residents per dwelling unit *[ECMs No. 4]*:	2.17	

Energy Conservation for Housing
Walkthrough Survey / Development Report

Architectural Data

Development Size

4-16. Total area of all floors in the development

Unit Size	Floor Area *(Base per Unit)*	Floor Area *(Total for Units)*	
0 Bedroom Units			sq. ft.
1 Bedroom Units	840	5880	sq. ft.
2 Bedroom Units	850	61200	sq. ft.
3 Bedroom Units	910	10010	sq. ft.
4 Bedroom Units	1345	8070	sq. ft.
5 Bedroom Units			sq. ft.
6 Bedroom Units			sq. ft.
Total for all units		85160	sq. ft.

4-17. Total development volume (total area in question 4-16 times floor-to-typical ceiling height, usually 8.0 feet) *[ECMs No. 1, 2, 8]*:

Floor-to-Ceiling Height:	8	ft.
Total Volume *[ECMs No. 1, 2, 8]*:	681280	cu. ft.

Window Area

4-18. Window Area *[ECMs No. 1, 2]*:

Unit Size	Floor Area *(Base per Unit)*	Floor Area *(Total for Units)*	
0 Bedroom Units			sq. ft.
1 Bedroom Units	45	315	sq. ft.
2 Bedroom Units	66	4752	sq. ft.
3 Bedroom Units	89	979	sq. ft.
4 Bedroom Units	117	702	sq. ft.
5 Bedroom Units			sq. ft.
6 Bedroom Units			sq. ft.
Total for all units		6748	sq. ft.

4-19. Window panes (typical or predominant type) *[ECM No. 2]*:

- ☐ Single-Pane
- ■ Double-Pane
- ☐ Triple-Pane
- ☐ N/A

4-20. Window frame material *[ECM No. 1]*:

- ☐ Wood
- ■ Metal
- ☐ Vinyl
- ☐ Fiberglass
- ☐ N/A

4-21. Typical window fit (check of predominant condition) *[ECMs No. 1, 2]*:

- ☐ Loose (frame rattles, large air gaps, large drafts)
- ■ Average (some looseness, no large gaps, no large drafts)
- ☐ Tight (no excessive frame movement of drafts)
- ☐ N/A

4-22. Are the windows equipped with storm windows? *[ECM No. 1]*:

☐ Yes ■ No ☐ N/A

Energy Conservation for Housing
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Window Area (continued)

4-23. Are the windows and/or storm windows weatherstripped adequately? *[ECM No. 1, 2]*:

■ Yes ☐ No ☐ N/A

4-24. Are office and community spaces in the development air-conditioned? *[ECM No. 3]*:

■ Yes ☐ No ☐ N/A

Complete questions 4-25 through 4-27 only for office and community spaces that are air-conditioned. Proceed to question 4-28 if there are no air-conditioned spaces in your development.

4-25. Window area (in air-conditioned office and community spaces only) *[ECM No. 3]*:

South-facing windows only: _____ sq. ft.

East and west-facing windows only: _____ sq. ft.

4-26. Are windows in office and community areas well shaded (i.e., 50% of summer daylight hours, 50% of their area) by trees or vegetation? *[ECM No. 3]*:

☐ Yes ☐ No ■ N/A

4-27. Area windows in office and community area equipped with exterior shades, interior blinds, or tinted glass? *[ECM No. 3]*:

☐ Yes ☐ No ■ N/A

If no, indicate desired replacement shading type *[ECM No. 3]*:

☐ Exterior Shading
☐ Tinted Film
☐ Interior Shades
■ N/A

Exterior Doors

4-28. Total number of exterior doors in your development: 192

4-29. Typical exterior door fit (check off predominant condition) *[ECM No. 4]*:

☐ Loose (large drafts)
■ Average (no excessive drafts)
☐ Tight (no drafts)
☐ N/A

4-30. Are exterior doors adequately weatherstripped? *[ECM No. 4]*:

■ Yes ☐ No ☐ N/A

4-31. Are exterior doors equipped with storm doors? *[ECM No. 4]*:

■ Yes ☐ No ☐ N/A

4-32. Predominant door type (inspect doors, door labels, or construction specifications) *[ECM No. 4]*:

☐ Wood
■ Metal (energy conserving type - insulated steel)
☐ Metal (standard type - hollow steel)
☐ Sliding Glass Patio Doors (metal, single pane)
☐ N/A

If Wood, specify door thickness:

☐ 1□ in.
☐ 1¾ in
■ N/A

Energy Conservation for Housing
Walkthrough Survey / Development Report

Attics and Flat Roofs

4-33. Does the development have attics or flat roofs on the buildings? *[ECMs No. 5, 6]*:

- ■ Attics (i.e., roofs with crawl spaces or full attics underneath)
- ☐ Flat Roofs (i.e., flat or nearly flat roofs with no attic or crawl space underneath)
- ☐ N/A

If you checked off "attics" answer questions 4-34 and 4-35. If you checked off "flat roofs" answer questions 4-36 and 4-37.

4-34. Area of attic (assume it is equal to the floor area of the top floor of the building) *[ECM No. 5]*:

48190 sq. ft

4-35. Attic insulation type and level, i.e., depth (measure typical insulation thickness and enter below; round off to nearest inch) *[ECM No. 5]*:

- ☐ Batt fiberglass
- ☐ Dry cellulose
- ■ Loose fill fiberglass
- ☐ Spray foam
- ☐ N/A

Insulation level 8 in.

4-36. Area of flat roof (assume it is equal to the floor area of the top floor of the building) *[ECM No. 6]*:

4-37. Type of existing flat roof structure (check whether insulated or uninsulated) *[ECM No. 6]*:

- ☐ Insulated
- ☐ Uninsulated
- ■ N/A

If uninsulated, check structure type *[ECM No. 6]*:

- ☐ Wood structure
- ☐ Concrete structure
- ☐ Steel structure
- ■ N/A

Walls

4-38. Wall construction, size and insulation (check off whether insulated or uninsulated) *[ECM No. 7]*:

- ■ Insulated
- ☐ Uninsulated
- ☐ N/A

If uninsulated construction, check structure and siding type *[ECM No. 7]*:

- ☐ Wood frame with wood siding
- ☐ Wood frame with aluminum siding
- ☐ Wood frame with brick siding
- ☐ Wood frame with other siding
- ☐ Concrete block masonry wall
- ☐ Brick masonry wall
- ☐ Other masonry wall construction
- ■ N/A

Total area of all uninsulated exterior (not including windows and doors) *[ECM No. 7]*:

Energy Conservation for Housing
Walkthrough Survey / Development Report

Heating and Cooling Systems Data

Heating System & Fuel Type

4-39. Heating system type (check off applicable type):

- ☐ Individual heating systems
- ■ Central heating system
- ☐ N/A

If you checked off "Central heating system," check off system type:

- ■ Boiler
- ☐ Furnace
- ☐ Other (e.g., heat pump)
- ☐ N/A

4-40. Heating fuel type (check off applicable type):

- ☐ Electricity
- ☐ Natural Gas
- ■ Heating Oil
- ☐ Propane
- ☐ N/A

If you checked off "Individual heating systems" in question 4-39, answer questions 4-41 through 4-43.
If you checked off "Central heating system" above, answer questions 4-44 through 4-51.

Individual Heating Systems

4-41. Do the heaters have vent dampers or flue dampers (applies only to oil and gas furnaces and boilers)? *[ECMs No. 9, 10]*:

☐ Yes ☐ No ■ N/A

4-42. Do gas heaters have constant-burning pilot lights? *[ECM No. 10]*:

☐ Yes ☐ No ■ N/A

4-43. Are heaters controlled by thermostats? *[ECM No 13]*:

☐ Yes ☐ No ■ N/A

If yes, indicate type *[ECM No. 13]*:

- ☐ Non-setback
- ☐ Setback
- ■ N/A

Central Heating System

4-44. Does the system have flue dampers or vent dampers (question applies to oil and gas furnaces and boilers only)? *[ECMs No. 9, 10]*:

■ Yes ☐ No ☐ N/A

4-45. Heat distribution type of your central heating system *[ECM No. 16]*:

- ☐ Steam
- ■ Hot Water
- ☐ Forced Air
- ☐ N/A

4-46. Check off which of the following are used to control heating:

- ☐ Outdoor reset and cutout controls (boiler systems only) *[ECM No. 11]*:
- ☐ Non-setback thermostats in the dwelling unit *[ECM No. 13]*:
- ☐ Setback thermostats in the dwelling unit *[ECM No. 13]*:
- ■ Radiator controls in the dwelling unit (boiler systems only) *[ECM No. 14]*:
- ☐ N/A

Total number of radiators in your development: 526

Energy Conservation for Housing
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Central Heating System - continued

4-47. Are all or most hot water or steam distribution pipes insulated (question does not apply to forced air distribution systems) *[ECM No. 15]*:

☐ Yes ☐ No ■ N/A

If No, (i.e., pipes are no insulated), answer question 4-48.

4-48. Linear feet of uninsulated pipes (do not include pipes that are in heated areas such as dwelling units) *[ECM No. 15]*:

¾" diameter pipe	
1" diameter pipe	
1½" diameter pipe	
2" diameter pipe	
3" diameter pipe	
4" diameter pipe	
6" diameter pipe	

Combustion Efficiency Test for Central Boilers and Furnaces

To properly estimate energy savings for replacing a central heating system, a combustion efficiency test must be performed on the existing central boilers or furnaces. (Note: Combustion efficiency is not the same as Annual Fuel Usage efficiency, or AFUE. Please refer to the Glossary in Appendix B.) A combustion efficiency test determines how completely the fuel is burned in the boiler or furnace by measuring the oxygen or carbon dioxide concentration in the flue gas. Combustion efficiency tests should be performed only on large central boilers or furnaces, not on boilers or furnaces for individual units. A qualified technician, familiar with combustion efficiency test procedures should conduct the test. The test should be conducted during the heating season. If these tests are routinely conducted at your development, use the most recent test data (if not more than two years old) to answer the following question.

4-49. What is the existing combustion efficiency of your central boiler or furnace (enter as decimal fraction, e.g.,: 75% = .75) *[ECM No. 12]*:

75

4-50. Is your central boiler or furnace oversized (i.e., cycles often - as a rough guideline, this means that the boiler or furnace starts up more than two times per hour):

☐ Yes ☐ No ■ N/A

Air-Conditioning (AC) Systems

4-51. Do you have air-conditioning in your development to cool community and office areas? *[ECMs No. 19, 20]*:

☐ Yes ☐ No ■ N/A

4-52. Do you have air-conditioning in your development to cool residential units (do not included window or wall AC units if they are owned and installed by the residents)? *[ECMs No. 19, 20]*:

☐ Yes ■ No ☐ N/A

4-53. Does the HA pay for the fuel consumption for residential air conditioning?

☐ Yes ☐ No ■ N/A

If you answered Yes to question 4-53, proceed to question 4-54 through 4-56. If you answered No, proceed to 4-57.

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Air-Conditioning (AC) Systems - continued

4-54. Air-conditioning system type and number of units *[ECMs No. 19, 20]*:

☐ Individual window or wall units		units
☐ Central system		units

4-55. Power requirement of typical existing unit or system (read equipment labels, literature, or engineering specification drawings) *[ECMs No. 19, 20]*:

Typical ranges:		
Window or wall AC units:	500-5,000	watts
Central AC unit:	2,000-10,000	watts
Chiller:	10,000-1,400,000	watts
Power requirement:		watts

4-56. Cooling capacity of typical existing unit or system (read equipment labels, literature, or engineering specification drawings) (Note: One ton of cooling capacity = 12,000 Btu) *[ECMs No. 19, 20]*:

Typical ranges:		
Window or wall AC units:	5,000-30,000	Btu
Central AC unit:	20,000-60,000	Btu
Chiller:	60,000-12,000,000	Btu
Cooling capacity		Btu

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Domestic Hot Water (DHW) System/Water Supply Systems Data	
Hot Water Heater Fuel and Type	
4-57.	Does the development have DHW tanks? *[ECMs No. 22, 23]*: ■ Yes ☐ No ☐ N/A
4-58.	Are the DHW tanks uninsulated? (Note: Most newer hot water heaters have adequate insulation built into the design, but may not look "wrapped.") *[ECMs No. 22, 23]*: ■ Yes ☐ No ☐ N/A
4-59.	Water heater type (check off applicable type) *[ECM No. 25]*: ☐ Individual tank water heater ☐ Central DHW heater ■ N/A If a replacement heater is considered, check off type *[ECM No. 25]*: ☐ Central, condensing ☐ Central, non-condensing ☐ Tank, condensing ☐ Tank, non-condensing ■ N/A
4-60.	Water heater fuel type: ☐ Electricity ☐ Natural Gas ■ Heating Oil ☐ Propane ☐ N/A
Hot Water Heater Fuel and Type	
4-61.	Do you have low-flow faucet aerators and shower heads installed on all or most faucets and showers? *[ECM No. 21]*: ■ Yes ☐ No ☐ N/A
4-62.	How is proper water pressure maintained in your development? *[ECM No. 36]*: ☐ Roof-mounted storage tank ☐ From street mains (no tanks and no pumps) ■ Pressurizing pump system (booster pumps) ☐ N/A Total horsepower of existing booster pumps *[ECM 36]:* 7 HP
4-63.	Have water-saving toilets been installed in your development? [ECM No. 35]: ■ Yes ☐ No ☐ N/A
Central Laundry Facilities	
4-64.	Do you have central public laundry facilities as part of your development? *[ECM No. 24]*: ☐ Yes ■ No ☐ N/A
4-65.	Total number of washing machines *[ECM No. 24]*:
4-66.	Are washing machines restricted to cold water rinse only? *[ECM No. 24]*: ☐ Yes ☐ No ■ N/A

Energy Conservation for Housing
Walkthrough Survey / Development Report

Lighting Systems Data	
Residential Unit Lighting	
4-67.	Type of lighting in residential units (check off predominant fixture type in each of the following spaces) *[ECM No. 26]*: Kitchen: ■ LED ☐ Fluorescent ☐ N/A Bathroom: ☐ LED ■ Fluorescent ☐ N/A Hallway/Foyer: ■ LED ☐ Fluorescent ☐ N/A
Common Area Lighting	
Common areas include offices, community rooms, lobbies, corridors, hallways and stairways in both public and basement floors. All questions refer to "general lighting" only; do not include "task lighting" such as desk lamps, etc.	
4-68.	Is there incandescent lighting in the common areas? *[ECMs No. 27, 28, 29, 30]*: ☐ Yes ☐ No ■ N/A
If you answered "Yes" to question 4-68, answer questions 4-69 and 4-70. If you answered "No" to question 4-68, proceed to question 4-71.	
4-69.	Total number of incandescent fixtures (common areas only *) *[ECM No. 27]*:
* To obtain the total number of incandescent fixtures in the common areas, select one building that is representative of the buildings on site and count the number of fixtures in the basement, at the ground floor, and at the typical floor. Multiply the number of fixtures at the typical floor by the number of floors in the building. Add this figure to the number of fixtures located in the basement and the ground floor to obtain the total number of fixtures in the building. Multiply this total building figure by the number of buildings on the site.	
4-70.	Average watts per incandescent lighting fixture (e.g., 50, 75, or 100 watts) *[ECM No. 27]*:
4-71.	Is there fluorescent lighting in the common areas? *[ECMs No. 27, 28, 29, 30]*: ☐ Yes ☐ No ■ N/A
If you answered "Yes" to question 4-71, answer questions 4-72 through 4-75. If you answered "No" to question 4-71, proceed to question 4-76.	

Energy Conservation for Housing
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Common Area Lighting - continued

4-72. Type of fixture (check off predominant type of fixture in common areas) *[ECMs No. 28, 29]*:

- ☐ 2 tubes/4 feet long
- ☐ 2 tubes/8 feet long
- ☐ 4 tubes/4 feet long
- ☐ 4 tubes/8 feet long
- ☐ 6 tubes/4 feet long
- ☐ 8 tubes/4 feet long
- ☐ Other
- ■ N/A

4-73. Are the fluorescent lamps "energy-conserving" lamps (e.g., General Electric's Watt-Miser, Osram Sylvania's SuperSaver, Philips Econ-o-Watts, and Duro-Test's Watt Saver)? *[ECM No. 28]*:

☐ Yes ☐ No ■ N/A

4-74. Are the ballasts electronic? (Note: As a general rule, if the lighting has not been updated, the ballasts are not electronic.) *[ECM No. 29]*:

☐ Yes ☐ No ■ N/A

4-75. Total number of fluorescent fixtures in the development (common areas only) *[ECMs No. 28, 29]*:

Complete the following questions (4-76 through 4-78) for office areas only. Do not answer the questions if there are no office or management spaces in your development or if the offices are windowless or all "general lighting" is incandescent.

4-76. Are lights located near the windows routinely turned off during the daytime hours?

☐ Yes ☐ No ■ N/A

4-77. Number of fluorescent fixtures within 10 feet of the windows (office areas only) *[ECM No. 30]*:

Type of window glass *[ECM No 30]*:

- ☐ Clear
- ☐ Tinted
- ■ N/A

Estimated percentage of exterior wall above desk height that is glass *[ECM No 30]*:

- ☐ 25-50%
- ☐ 50-75%
- ☐ 75-100%
- ■ N/A

Does the building have exterior overhangs projected at least two feet from the outside face of the glass near the top of the window? *[ECM No. 30]*:

■ Yes ☐ No ☐ N/A

Energy Conservation for Housing
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Common Area Lighting - continued

4-78. Type of predominant fluorescent fixture within 10 feet of windows in office areas *[ECM No. 30]*:

- ☐ 2 tubes/4 feet long
- ☐ 2 tubes/8 feet long
- ☐ 4 tubes/4 feet long
- ☐ 4 tubes/8 feet long
- ☐ 6 tubes/4 feet long
- ☐ 8 tubes/4 feet long
- ☐ Other
- ■ N/A

Exterior Lighting

4-79. Predominant type of exterior lighting fixture (check off applicable type) *[ECM No. 31]*:

- ☐ None (no exterior lighting)
- ☐ Sodium vapor lamps (high or low-pressure)
- ☐ Mercury vapor lamps
- ☐ Metal halide lamps
- ☐ Incandescent lamps
- ☐ Fluorescent lamps
- ☐ Halogen lamps
- ■ N/A

4-80. Number of exterior lighting fixtures *[ECMs No. 31, 32]*: ☐

4-81. Energy consumption (watts) per predominant exterior lighting fixture type (i.e., per fixture unit) *[ECMs No. 31, 32]*: ☐

4-82. Who pays for exterior lighting electricity? *[ECMs No. 31, 32]*:

- ☐ Housing Authority
- ☐ Local town or city government
- ■ N/A

4-83. Type of exterior lighting controllers (check off applicable type) *[ECM No. 32]*:

- ☐ Manual switching (no controls)
- ☐ Timers
- ☐ Photo-controls
- ■ N/A

If you checked "Manual Switching" or "Timers" on question 4-83, go to question 4-84. If you checked "Photo-controls", proceed to question 4-85.

4-84. Number of hours per year exterior lighting is turned on* *[ECM No. 32]*: ☐

* Estimate annual hours by multiplying average daily hours of use (hours between turning on and off) by 365 days. Adjust for weekend and season variations, if necessary.

Energy Conservation for Housing
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Miscellaneous Data	
4-85.	Average age of existing refrigerators (check off predominant age of existing refrigerators in your development) *[ECM No. 33]*: ☐ 1990s ☐ 2000s ■ 2010s ☐ 2020s ☐ N/A Average size of existing refrigerators (check off predominant size of existing refrigerators in your development) *[ECM No. 33]*: ☐ 13 cubic feet or smaller ■ 14-15 cubic feet ☐ 16 cubic feet or large ☐ N/A
4-86.	Type of motors that could be operation fans or pumps at your development (check off applicable types) *[ECM No. 34]*: ☐ Elevator ☐ Ventilation system ☐ Hydronic heating or cooling system
4-87.	Predominant size of motor for each of the above systems (in horsepower) *[ECM No. 34]*: Elevator Ventilation system Hydronic heating or cooling system
4-88.	Number of motors of each type *[ECM No. 34]:* Elevator Ventilation system Hydronic heating or cooling system
4-89.	Average operation hours per year of each motor *[ECM No. 34]*: Elevator Ventilation system Hydronic heating or cooling system

Energy Conservation for Housing
Energy Consumption Survey

Energy Consumption Survey - Electricity				
5-1.	Electricity Consumption			
0 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			kWh/yr
	2019			kWh/yr
	2020			kWh/yr
	Total:			kWh
	Average annual consumption:			kWh/yr
	Average current price for electricity*:			$/kWh
	Average annual cost of electricity consumption:			$/yr
1 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			kWh/yr
	2019	580	4060	kWh/yr
	2020	776	5432	kWh/yr
	Total:		9492	kWh
	Average annual consumption:		4746	kWh/yr
	Average current price for electricity*:		0.14	$/kWh
	Average annual cost of electricity consumption:		664.44	$/yr
2 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			kWh/yr
	2019	587	42264	kWh/yr
	2020	785	56520	kWh/yr
	Total:		98784	kWh
	Average annual consumption:		49392	kWh/yr
	Average current price for electricity*:		0.14	$/kWh
	Average annual cost of electricity consumption:		6914.88	$/yr
3 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			kWh/yr
	2019	629	6919	kWh/yr
	2020	841	9251	kWh/yr
	Total:		16170	kWh
	Average annual consumption:		8085	kWh/yr
	Average current price for electricity*:		0.14	$/kWh
	Average annual cost of electricity consumption:		1131.9	$/yr

Energy Conservation for Housing
Energy Consumption Survey

5-1. Electricity Consumption - continued

4 Bedroom

Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
2018			kWh/yr
2019	932	5592	kWh/yr
2020	1246	7476	kWh/yr
Total:		13068	kWh
Average annual consumption:		6534	kWh/yr
Average current price for electricity*:		0.14	$/kWh
Average annual cost of electricity consumption:		914.76	$/yr

5 Bedroom

Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
2018			kWh/yr
2019			kWh/yr
2020			kWh/yr
Total:			kWh
Average annual consumption:			kWh/yr
Average current price for electricity*:			$/kWh
Average annual cost of electricity consumption:			$/yr

6 Bedroom

Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
2018			kWh/yr
2019			kWh/yr
2020			kWh/yr
Total:			kWh
Average annual consumption:			kWh/yr
Average current price for electricity*:			$/kWh
Average annual cost of electricity consumption:			$/yr

Electricity Total

Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
2018			kWh/yr
2019	2728	58835	kWh/yr
2020	3648	78679	kWh/yr
Total:		137514	kWh
Average annual consumption:		68757	kWh/yr
Average current price for electricity*:		0.14	$/kWh
Average annual cost of electricity consumption:		9625.98	$/yr

* For the current price of electricity, refer to the development's current bills or contact the utility company. Also, when referring to the utility bills, remember that the price of electricity often changes seasonally and even hourly. The rates for these tables should represent the *current average annual rates*, including any surcharges.

Energy Conservation for Housing
Energy Consumption Survey

Rate Structure for Electricity

5-2. Demand charges (shown in terms of kW, not kWh):

- ■ No demand charges levied by utility
- ☐ Charges included in bill
- ☐ N/A

If you answered "Charges included in bill", please answer the following questions. If you answered "No demand charges levied by utility", proceed to question 5-3.

Average annual demand charge amount (above normal kWh charges): _____

Please describe demand structure:

5-3. Time-of-day or time-of-use charges, also known as "peak" and "off-peak" rates charges (i.e., different electricity rates at different times of day):

Are time-of-day meters installed in the developments?

☐ Yes ■ No ☐ N/A

If you answered "No" to the previous question, does your utility offer time-of-day charged?

☐ Yes ■ No ☐ N/A

5-4. If the answer to either question in 5-3 is "Yes", what are the time-of-day charges? *[ECM No. 25]*:

Lowest rate charged: _____ $/kWh

Highest rate charged: _____ $/kWh

Please describe the time-of-day charge structure (i.e., lowest and highest cost time periods, etc.):

5-5. Low power factor surcharges *[ECM No. 40]*:

- ■ No low power factor charges levied by utility
- ☐ Charges included in bill
- ☐ N/A

If you answered "Charges included in bill", please answer the following questions. If you answered "No demand charges levied by utility", proceed to question 5-6.

Average annual low power factor charge amount: _____ $/yr

Please describe low power factor charge structure:

Energy Conservation for Housing
Energy Consumption Survey

Energy Consumption Survey - Heating Oil				
5-1.	Heating Oil Consumption			
0 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Gal/yr
	2019			Gal/yr
	2020			Gal/yr
	Total:			Gal
	Average annual consumption:			Gal/yr
	Average current price for heating oil:			$/Gal
	Average annual cost of heating oil consumption:			$/yr
1 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Gal/yr
	2019			Gal/yr
	2020	8657.92	60605.44	Gal/yr
	Total:		60605.44	Gal
	Average annual consumption:		60605.44	Gal/yr
	Average current price for heating oil:		0.52	$/Gal
	Average annual cost of heating oil consumption:		31514.83	$/yr
2 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Gal/yr
	2019			Gal/yr
	2020	48368.42	3482526.24	Gal/yr
	Total:		3482526.24	Gal
	Average annual consumption:		3482526.24	Gal/yr
	Average current price for heating oil:		0.52	$/Gal
	Average annual cost of heating oil consumption:		1810913.64	$/yr
3 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Gal/yr
	2019			Gal/yr
	2020	8657.92	95237.12	Gal/yr
	Total:		95237.12	Gal
	Average annual consumption:		95237.12	Gal/yr
	Average current price for heating oil:		0.52	$/Gal
	Average annual cost of heating oil consumption:		49523.3	$/yr

Energy Conservation for Housing
Energy Consumption Survey

5-1.	Heating Oil Consumption - continued			
4 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Gal/yr
	2019			Gal/yr
	2020	7559.6	45357.6	Gal/yr
	Total:		45357.6	Gal
	Average annual consumption:		45357.6	Gal/yr
	Average current price for heating oil:		0.52	$/Gal
	Average annual cost of heating oil consumption:		23585.95	$/yr
5 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Gal/yr
	2019			Gal/yr
	2020			Gal/yr
	Total:			Gal
	Average annual consumption:			Gal/yr
	Average current price for heating oil:			$/Gal
	Average annual cost of heating oil consumption:			$/yr
6 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Gal/yr
	2019			Gal/yr
	2020			Gal/yr
	Total:			Gal
	Average annual consumption:			Gal/yr
	Average current price for heating oil:			$/Gal
	Average annual cost of heating oil consumption:			$/yr
Heating Oil Total				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Gal/yr
	2019			Gal/yr
	2020	73243.86	3683726.4	Gal/yr
	Total:		3683726.4	Gal
	Average annual consumption:		3683726.4	Gal/yr
	Average current price for heating oil:		0.52	$/Gal
	Average annual cost of heating oil consumption:		1915537.73	$/yr

Energy Conservation for Housing
Energy Consumption Survey

Energy Consumption Survey - Propane				
5-8.	Propane Consumption			
0 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Gal/yr
	2019			Gal/yr
	2020			Gal/yr
	Total:			Gal
	Average annual consumption:			Gal/yr
	Average current price for propane:			$/Gal
	Average annual cost of propane consumption:			$/yr
1 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Gal/yr
	2019			Gal/yr
	2020	28	196	Gal/yr
	Total:		196	Gal
	Average annual consumption:		196	Gal/yr
	Average current price for propane:		2.28	$/Gal
	Average annual cost of propane consumption:		446.88	$/yr
2 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Gal/yr
	2019			Gal/yr
	2020	29	2088	Gal/yr
	Total:		2088	Gal
	Average annual consumption:		2088	Gal/yr
	Average current price for propane:		2.28	$/Gal
	Average annual cost of propane consumption:		4760.64	$/yr
3 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Gal/yr
	2019			Gal/yr
	2020	31	341	Gal/yr
	Total:		341	Gal
	Average annual consumption:		341	Gal/yr
	Average current price for propane:		2.28	$/Gal
	Average annual cost of propane consumption:		777.48	$/yr

Energy Conservation for Housing
Energy Consumption Survey

5-8.	Propane Consumption - continued			
4 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Gal/yr
	2019			Gal/yr
	2020	46	276	Gal/yr
	Total:		276	Gal
	Average annual consumption:		276	Gal/yr
	Average current price for propane:		2.28	$/Gal
	Average annual cost of propane consumption:		629.28	$/yr
5 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Gal/yr
	2019			Gal/yr
	2020			Gal/yr
	Total:			Gal
	Average annual consumption:			Gal/yr
	Average current price for propane:			$/Gal
	Average annual cost of propane consumption:			$/yr
6 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Gal/yr
	2019			Gal/yr
	2020			Gal/yr
	Total:			Gal
	Average annual consumption:			Gal/yr
	Average current price for propane:			$/Gal
	Average annual cost of propane consumption:			$/yr
Propane Total				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Gal/yr
	2019			Gal/yr
	2020	134	2901	Gal/yr
	Total:		2901	Gal
	Average annual consumption:		2901	Gal/yr
	Average current price for propane:		2.28	$/Gal
	Average annual cost of propane consumption:		6614.28	$/yr

Energy Conservation for Housing
Energy Consumption Survey

Energy Consumption Survey - Summary of Fuel Consumption				
5-8.	Summary of Fuel Consumption			
	Fuel Type	Average Annual Fuel Consumption	Current Cost per Fuel or Energy Unit	
	Electricity	68757	0.14	kWh
	Natural Gas			Therm
	Heating Oil	3683726.4	0.52	Gal
	Propane	2901	2.28	Gal

Energy Conservation for Housing
Energy Consumption Survey

Energy Consumption Survey - Water Charges				
5-10.	Water Charges *[ECM No. 35]*:			
0 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019			$/yr
	2020			$/yr
	Total:			$
	Average annual consumption:			$
1 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019	265.1	1855.7	$/yr
	2020	295.41	2067.87	$/yr
	Total:		3923.57	$
	Average annual consumption:		1961.79	$
2 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019	268.26	19314.72	$/yr
	2020	298.93	21522.96	$/yr
	Total:		40837.68	$
	Average annual consumption:		20418.84	$
3 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019	287.19	3159.09	$/yr
	2020	320.03	3520.33	$/yr
	Total:		6679.42	$
	Average annual consumption:		3339.71	$

Energy Conservation for Housing
Energy Consumption Survey

5-10.	Water Charges *[ECM No. 35]* - continued:			
4 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019	425.74	2554.44	$/yr
	2020	474.41	2846.46	$/yr
	Total:		5400.9	$
	Average annual consumption:		2700.45	$
5 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019			$/yr
	2020			$/yr
	Total:			$
	Average annual consumption:			$
6 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019			$/yr
	2020			$/yr
	Total:			$
	Average annual consumption:			$
Water Total				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019	1246.29	26883.95	$/yr
	2020	1388.78	29957.62	$/yr
	Total:		56841.57	$
	Average annual consumption:		28420.79	$

Energy Conservation for Housing
Energy Consumption Survey

Energy Consumption Survey - Sewer Charges				
5-11.	Sewer Charges *[ECM No. 35]*:			
0 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019			$/yr
	2020			$/yr
	Total:			$
	Average annual consumption:			$
1 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019	60.96	426.72	$/yr
	2020	67.83	474.81	$/yr
	Total:		901.53	$
	Average annual consumption:		450.77	$
2 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019	61.69	4441.68	$/yr
	2020	68.63	4941.36	$/yr
	Total:		9383.04	$
	Average annual consumption:		4691.52	$
3 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019	66.04	726.44	$/yr
	2020	73.48	808.28	$/yr
	Total:		1534.72	$
	Average annual consumption:		767.36	$

Energy Conservation for Housing
Energy Consumption Survey

5-11.	Sewer Charges *[ECM No. 35]* - continued:			
4 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019	97.8	586.8	$/yr
	2020	108.93	653.58	$/yr
	Total:		1240.38	$
	Average annual consumption:		620.19	$
5 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019			$/yr
	2020			$/yr
	Total:			$
	Average annual consumption:			$
6 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019			$/yr
	2020			$/yr
	Total:			$
	Average annual consumption:			$
Sewer Total				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019	286.49	6181.64	$/yr
	2020	318.87	6878.03	$/yr
	Total:		13059.67	$
	Average annual consumption:		6529.84	$

Energy Conservation for Housing
Energy Consumption Survey

Energy Consumption Survey - Heating Consumption Calculation

Electrically Heated Developments Only

A. Transfer the following information that you have previously obtained in the Walkthrough and Energy Consumption Surveys:

Heating Degree Day Zone (4-8):	2.96	DDZ
Average annual kWh consumption (5-9):	68757	kWh/yr

B. Select the appropriate conversion factor for Heating Degree Day Zone in the table below:

Degree Day Zone (DDZ)	Conversion Factor
2 or less	0.35
2.1 - 4	0.50
4.1 - 6	0.65
6.1 - 8	0.75

C. Calculate total electricity used for heating in your development by multiplying the average annual kWh consumption by the appropriate conversion factor:

5-12.

Annual kWh Consumption		Conversion Factor		Total electricity used for heating:	
68757	x	0.5	=	34378.5	kWh/yr

Non-Electrically Heated Developments Only

If the fuel used for heating your development is gas, oil, or propane, and is used *only* for heating and not for other end-uses (e.g., domestic hot water, cooking, clothes dryers), then skip to the table in question 5-14. If the fuel used for heating your development is gas, oil, or propane, and is also used for other end uses, complete the items below.

A. Transfer the following information that you have previously obtained in the Walkthrough and Energy Consumption Surveys:

Number of dwelling unit (question 4-13):	96	
Average annual fuel consumption (question 5-9):		
Natural Gas:		Therms/yr
Heating Oil:	3683726.4	Gal/yr
Propane:	2901	Gal/yr

B. Select the appropriate conversion factor for your heating fuel type in the table below:

Fuel Type	Conversion Factor	
Natural Gas	100	Therms
Heating Oil	43	Gal
Propane	66	Gal

C. Calculate total fuel used for non-heating uses by multiplying the number of dwelling units by the appropriate conversion factor:

Number of dwelling units		Conversion Factor		Total Fuel Used for Non-Heating	
Natural Gas					
96	x	100	=	9600	Therms/yr
Heating Oil					
96	x	43	=	4128	Gal/yr
Propane					
96	x	66	=	6336	Gal/yr

D. Calculate fuel consumed for heating only by subtracting the non-heating fuel use (step C above) from the average annual fuel consumption (step A above):

Energy Conservation for Housing
Energy Consumption Survey

Non-Electrically Heated Developments Only - continued

5-13.

Average Annual Consumption		Non-heating Use		Total Fuel Used for Heating	
Natural Gas					
	-	9600	=		Therms/yr
Heating Oil					
3683726.4	-	4128	=	3679598.4	Gal/yr
Propane					
2901	-	6336	=	-3435	Gal/yr

If the fuel used for heating your development is gas, oil, or propane, and is used only for heating, transfer the Average Annual Fuel Consumption from question 5-9 to the table below. Otherwise, transfer the information that you have previously calculated for question 5-12 and 5-13 (depending on whether your development is electrically or non-electrically heated) to the table. (Check off the fuel type used for heating and fill the annual quantity.)

Is the fuel used to heat your development gas, oil, or propane and also is used for other end-uses (e.g., domestic hot water, cooking, clothes dryers, etc.)?

■ Yes ☐ No ☐ N/A

If development needs either checkmetering or individual metering, please select type of metering to install *[ECM No. 37]*:

☐ Checkmetering
☐ Individual Metering
■ N/A

5-14. Summary of Heating Fuel Consumption

Heating Fuel Type	Annual Heating Fuel Consumption	
■ Electricity	34378.5	kWh/yr
☐ Natural Gas		Therms/yr
☐ Heating Oil		Gal/yr
☐ Propane		Gal/yr
☐ N/A		

Energy Conservation for Housing
ECM Cost/Benefit Worksheet

ECM No. 1 - Install Storm Windows									
Step 1	Obtain total cost of installing the type and quantity of storm windows needed.								
							101,906.95	$	
Step 2	Transfer the following information from the Survey								
4-8	**a.** Heating degree-day zone:						2.96	DDZ	
4-18	**b.** Total area of windows:						6748	sq. ft.	
4-17	**c.** Total volume of buildings in development:						681280	cu. ft.	
4-20	**d.** Window frame material:						Metal		
4-21	**e.** Average window fit:						Average		
5-9	**f.** Cost of heating fuel:	Electricity:					0.14	$/kWh	
		Natural Gas:						$/Therm	
		Heating Oil:						$/Gal	
		Propane:						$/Gal	
Step 3	Obtain the following savings factors from Tables 1 and 2:								
Table 1	**a.** Conductance savings factor:						3.2		
Table 2	**b.** Infiltration savings factor:						0.036		
Step 4	Estimate annual energy savings due to conduction losses:								
		2a		2b		3a			
		2.96	x	6748	x	3.2	=	63,917.06	/yr
Step 5	Estimate annual energy savings due to infiltration losses:								
		2a		2c		3b			
		2.96	x	681280	x	0.036	=	72,597.20	/yr
Step 6	Estimate total annual energy savings:								
				4		5			
				63,917.06	+	72,597.20	=	136,514.25	/yr
Step 7	Calculate annual cost savings:								
				6		2f			
				136,514.25	x	0.14	=	19,112.00	$/yr
Step 8	Calculate payback period:								
				1		7			
				101,906.95	/	19,112.00	=	5.33	yrs

Energy Conservation for Housing
ECM Cost/Benefit Worksheet

ECM No. 1 - Install Storm Windows

Table 1: Conductance Savings Factors

Instructions:

1. Find the frame material of the primary windows (see Step2d).
2. Find the fuel type.
3. Select the appropriate conductance savings factor and transfer it to Step 3.

Primary Window Frame Material	Fuel Type			
	Electricity	Natural Gas	Heating Oil	Propane
Wood	2.200	0.110	0.076	0.120
Metal	3.200	0.160	0.110	0.170

Table 2: Infiltration Savings Factors

Instructions:

1. Find the fit of the primary windows (see Step 2e).
2. Find the fuel type.
3. Select the appropriate infiltration savings factor and transfer it to Step 3.

Primary Window Fit	Fuel Type			
	Electricity	Natural Gas	Heating Oil	Propane
Loose	0.05300	0.00260	0.00190	0.00280
Average	0.03600	0.00170	0.00130	0.00190
Tight	0.01800	0.00087	0.00063	0.00095

Energy Conservation for Housing
ECM Cost/Benefit Worksheet

ECM No. 5 - Install/Increase Attic Insulation

Step 1 Obtain total cost of installing selected type of insulation:

	a.	R-13 additional insulation (total labor and material cost):						30,995.81	$
	b.	R-30 additional insulation (total labor and material cost):						38,099.01	$
	c.	R-42 additional insulation (total labor and material cost):						98,799.14	$
	d.	Incremental cost of adding R-30 insulation vs. R-13 insulation:	1b: 38,099.01	-	1a: 30,995.81	=	7,103.20	$
	a.	Incremental cost of adding R-42 insulation vs. R-30 insulation:	1c: 98,799.14	-	1b: 38,099.01	=	60,700.13	$

Step 2 Transfer the following information from the Survey

4-8	**a.**	Heating degree-day zone:		2.96	DDZ
4-34	**b.**	Attic area:		48190	sq. ft.
4-35	**c.**	Existing insulation level:		8	Inches
4-35	**d.**	Existing insulation type:		Loose Fill Fiberg	
Table 1	**e.**	Existing insulation R-value:		20	R
5-9	**f.**	Cost of heating fuel:	Electricity:	0.14	$/kWh
			Natural Gas:		$/Therm
			Heating Oil:		$/Gal
			Propane:		$/Gal

Step 3 Obtain the following savings factors from Table 2:

Table 2	**a.**	R-13 additional insulation:	0.11	
Table 2	**b.**	R-30 additional insulation:	0.05	
Table 2	**c.**	R-42 additional insulation:	0.02	

Step 4 Estimate annual energy savings:

a. R-13 additional insulation:

2a		2b		3a			
2.96	x	48190	x	0.11	=	15,690.66	/yr

b. R-30 additional insulation:

2a		2b		3b			
2.96	x	48190	x	0.05	=	7,132.12	/yr

c. R-42 additional insulation:

2a		2b		3c			
2.96	x	48190	x	0.02	=	2,852.85	/yr

Step 5 Calculate annual cost savings:

a.	R-13 additional insulation:	4a: 15,690.66	x	2f: 0.14	=	2,196.69	$/yr
b.	R-30 additional insulation:	4b: 7,132.12	x	2f: 0.14	=	998.50	$/yr
c.	R-42 additional insulation:	4c: 2,852.85	x	2f: 0.14	=	399.40	$/yr

Step 6 Calculate payback period:

a.	R-13 additional insulation:	1a: 30,995.81	/	5a: 2,196.69	=	14.11	yrs
b.	R-30 additional insulation:	1b: 38,099.01	/	5b: 998.50	=	38.16	yrs
c.	R-42 additional insulation:	1c: 98,799.14	/	5c: 399.40	=	247.37	yrs

Energy Conservation for Housing
ECM Cost/Benefit Worksheet

ECM No. 5 - Install/Increase Attic Insulation

Table 1: R-value vs. Thickness for Typical Attic Insulation Materials

Instructions:

1. Find existing level of insulation in inches (see Step 2c).
2. Find type of existing insulation (see Step 2d).
3. Select the appropriate R-value and transfer it to Step 3.

Thickness (inches)	R-Value		
	Batt Fiberglass	Dry Cellulose	Loose Fill Fiberglass
0	1.6	1.6	1.6
1	3	4	3
2	7	7	5
3	10	11	8
4	13	14	10
5	17	18	13
6	19	21	15
7	23	25	18
8	26	28	20
9	30	32	23
10	33	35	25
11	36	39	28
12	40	42	30

Table 2: Savings Factors for Increasing Attic Insulation

Instructions:

1. Find heating fuel type.
2. Find R-value of existing attic insulation (see Step 2e or Table 1).
3. Select the appropriate savings factor for each level of additional insulation and transfer it to Step 3.

Fuel Type	Existing R-Value [1]	Added R-value			Fuel Type	Existing R-Value [1]	Added R-value		
		13	30	42			13	30	42
Electricity	None	2.740	0.180	0.040	Heating Oil	None	0.095	0.006	0.001
	7	0.460	0.110	0.030		7	0.016	0.004	0.001
	13	0.190	0.070	0.020		13	0.007	0.003	0.001
	19	0.110	0.050	0.020		19	0.004	0.002	0.001
	26	0.060	0.040	0.020		26	0.002	0.001	0.001
	33	0.040	0.030	[2]		33	0.001	0.001	[2]
	40	0.030	0.020	[2]		40	0.001	[2]	[2]
Natural Gas	None	0.134	0.009	0.002	Propane	None	0.146	0.010	0.002
	7	0.022	0.006	0.002		7	0.024	0.007	0.002
	13	0.009	0.004	0.001		13	0.010	0.004	0.001
	19	0.005	0.003	[2]		19	0.005	0.003	[2]
	26	0.003	0.002	[2]		26	0.003	0.002	[2]
	33	0.002	[2]	[2]		33	0.002	[2]	[2]
	40	[2]	[2]	[2]		40	[2]	[2]	[2]

[1] See Table 1.

[2] Additional insulation is not cost-effective; do not complete calculations for these thicknesses.

Energy Conservation for Housing
ECM Cost/Benefit Worksheet

ECM No. 8 - Control Air Leakage					
Step 1	Obtain total cost of installing wall insulation:				
				28,212.04	$
Step 2	Transfer the following information from the Survey				
4-8	**a.** Heating degree-day zone:			2.96	DDZ
4-17	**b.** Total volume of buildings in development:			681280	cu. ft.
5-9	**c.** Cost of heating fuel:	Electricity:		0.14	$/kWh
		Natural Gas:			$/Therm
		Heating Oil:			$/Gal
		Propane:			$/Gal
Step 3	Obtain the following data from Table 1:				
Table 1	Infiltration savings factor:			0.053	
Step 4	Estimate annual energy savings:				
	2a	2b	3		
	2.96 x	681280 x	0.053 =	106,879.21	/yr
Step 5	Calculate annual cost savings:				
	4	2c			
	106,879.21 x	0.14 =		14,963.09	$/yr
Step 6	Calculate payback period:				
	1	5			
	28,212.04 /	14,963.09 =		1.89	yrs

Energy Conservation for Housing
ECM Cost/Benefit Worksheet

ECM No. 8 - Control Air Leakage

Table 1: Conductance Savings Factors

Instructions:

1. Find the fuel type.
2. Select the appropriate savings factor and transfer it to Step 3.

Fuel	Savings Factor
Electricity	0.0530
Natural Gas	0.0026
Heating Oil	0.0019
Propane	0.0028

Energy Conservation for Housing
ECM Cost/Benefit Worksheet

ECM No. 21 - Install Water-Efficient Showerheads and Faucet Aerators								
Step 1	Obtain total cost of replacing showerheads and aerators (typically one showerhead and two aerators per dwelling unit):							
						6,046.08	$	
Step 2	Transfer the following information from the Survey:							
4-14	**a.** Total number of residents in development:					208		
5-9	**b.** Cost of DHW heating fuel:			Electricity:		0.14	$/kWh	
				Natural Gas:			$/Therm	
				Heating Oil:			$/Gal	
				Propane:			$/Gal	
Step 3	Estimate annual energy savings:							
				2a				
	Electricity:	206.5	x	208	=	42,952.00	kWh/yr	
	Natural Gas:	10.0	x		=		Therms/yr	
	Heating Oil:	7.2	x		=		Gal/yr	
	Propane:	10.1	x		=		Gal/yr	
Step 4	Calculate annual cost savings:							
		3		2b				
		42,952.00	x	0.14	=	6,013.28	$/yr	
Step 5	Calculate payback period:							
		1		4				
		6,046.08	/	6,013.28	=	1.01	yrs	

Energy Conservation for Housing
ECM Cost/Benefit Worksheet

ECM No. 26 - Replace Incandescent Lighting with Compact Fluorescent Lamps in Dwelling Units							
Step 1	Obtain total cost of installing CFLs in dwelling units (one, two, or three per dwelling):						
						1,214.36	$
Step 2	Transfer the following information from the Survey:						
4-13	**a.** Number of dwellling units:					96	
5-9	**b.** Cost of electricity:					0.14	$/kWh
4-67	**c.** Number of bulbs or fixtures to be replaced:					1	
Step 3	Obtain the following value from Table 1:						
Table 1	kWh saved per year					150	kWh/yr
Step 4	Estimate annual energy savings:						
		2a		3			
		96	x	150	=	14,400.00	kWh/yr
Step 5	Calculate annual cost savings:						
		4		2b			
		14,400.00	x	0.14	=	2,016.00	$/yr
Step 6	Calculate payback period:						
		1		5			
		1,214.36	/	2,016.00	=	0.60	yrs

Energy Conservation for Housing
ECM Cost/Benefit Worksheet

ECM No. 26 - Replace Incandescent Lighting with Compact Fluorescent Lamps in Dwelling Units

Table 1: Annual Electricity Savings from Replacing Incandescent Lamps

Instructions:

1. Find the average number of builds or fixtures that would be replaced per unit (See Step 2c).
2 Select the savings for that number of fixtures and transfer to Step 3.

Fixtures per Unit	Savings (kWh)
One fixture (kitchen only)	150
Two fixtures (kitchen and bath)	210
Three fixtures (kitchen, bath, and hall)	250

This table assumes average usage of lights by reidents in the indicated locations; savings may vary substantially between individual developments.

Energy Conservation for Housing
ECM Cost/Benefit Worksheet

ECM No. 36 - Convert Water Supply								
Step 1	Obtain total cost of installing installing hydro-pneumatic water pressure systems:							
						496.34	$	
Step 2	Transfer the following information from the Survey:							
4-62	**a.** Total horsepower of existing booster pumps:					7	HP	
5-9	**b.** Cost of electricity:					0.14	$/kWh	
Step 3	Estimate annual energy savings:							
		2a						
		7	x	2190	=	15,330.00	kWh/yr	
Step 4	Calculate annual cost savings:							
		3		2b				
		15,330.00	x	0.14	=	2,146.20	$/yr	
Step 5	Calculate payback period:							
		1		4				
		496.34	/	2,146.20	=	0.23	yrs	

Tab

Energy Conservation for Housing
Summary of Results

Development Information		
4-1.	Development ID Number:	NY082000002
4-2.	Development Name:	Turnkey
4-3.	Development/Unit Address:	Scattered

ECM Summary

ECM No.	ECM	N/A	Total Cost ($)	Annual Savings		Payback Period
				$	Energy	
Architectural ECMs						
1	Install Storm Windows	■				
2	Install Replacement Windows	■				
3a	Install Window Sun Shades: South-Facing Windows	■				
3b	Install Window Sun Shades - East and West Facing Windows	■				
4	Install Storm Doors	■				
5	Install/Increase Attic Insulation - R13	■				
5	Install/Increase Attic Insulation - R30	■				
5	Install/Increase Attic Insulation - R42	■				
6	Install Roof Insulation - R10	■				
6	Install Roof Insulation - R20	■				
7	Install Wall Insulation	■				
8	Control Air Leakage	□	13,136.07	2,618.42	2,296.86	5.02
Heating and Cooling ECMs						
9	Install Vent Dampers	■				
10	Convert to Electronic Ignition	■				
11	Install Boiler Controls	□	10,024.67	664.67	583.04	15.08
12	Replace Inefficient Heating Plant	■				
13	Install Setback Thermostats	□	5,859.15	830.83	728.80	7.05
14	Install Radiator Controls	■				
15	Insulate Hot Water or Steam Pipes	■				
16	Convert Steam Heating to Hot Water Distribution	■				
17	Seal and Insulate Ducts	■				
18	Install Geothermal Heat Pumps	■				
19	Replace Inefficient Air Conditioners	■				
20	Install Swamp Coolers	■				
Domestic Hot Water System ECMs						
21	Install Water-Efficient Showerheads and Faucet Aerators	□	2,078.34	1,128.60	990.00	1.84
22	Insulate Hot Water Tank	■				
23	Install DHW Off-Peak Controls	■				
24	Convert Laundry to Cold Rinse	■				
25	Replace Inefficient Hot Water Heater	■				

Energy Conservation for Housing
Summary of Results

ECM Summary - continued						
ECM No.	ECM	N/A	Total Cost ($)	Annual Savings		Payback Period
				$	Energy	
Lighting System ECMs						
26	Replace Incandescent Lighting with Compact Fluorescent Lamps in Dwelling Units	■				
27	Replace Incandescent Lighting with Fluorescent Lighting in Common Areas	■				
28	Replace Older Fluorescent Lamps with Energy-Saving Lamps in Common Areas	■				
29	Replace Older Fluorescent Lamps and Ballast in Common Areas	■				
30	Install Lighting Controls in Common Areas	■				
31	Convert Exterior Lighting Fixtures	■				
32	Install Photo-Controls for Exterior Lighting	■				
Miscellaneous ECMs						
33	Replace Older Refrigerators with High-Efficiency Units	■				
34a	Upgrade or Replace Inefficient Motors - Elevator	■				
34b	Upgrade or Replace Inefficient Motors - Ventilation System	■				
34c	Upgrade or Replace Inefficient Motors - Hydronic Heating or Cooling System	■				
35	Install Water-Saving Toilets	■				
36	Convert Water Supply Pumps	■				
37a	Install Checkmetering or Individual Metering - Natural Gas	■				
37b	Install Checkmetering or Individual Metering - Electricity	■				

Energy Conservation for Housing
Walkthrough Survey / Development Report

General Development Data			
Development Information			
4-1.	Development ID Number:	NY082000002	
4-2.	Development Name:	Turnkey	
4-3.	Development Address:	Scattered	
4-4.	Name of person responsible for completing this survey:	Jerry Fenchel	
4-5.	Contact person's telephone number:	817-922-9000	
Location and Climate			
4-6.	City:	Peekskill	
4-7:	State:	New York	
Complete questions 4-8 and 4-9 with information from Appendix A, Climate Data. If your development's specific location is not listed, use data for the closest city listed.			
4-8.	Heating Degree Day Zone *[ECMs No. 1-8, 13]*:	2.96	
4-9.	Heating Season Hours *[ECM No. 14]*:	2892	
Building Types and Quantities			
4-10.	Residential building types (check off applicable building type, then answer all further questions under that type):		
	■ Single or twin-family houses		
	Number of single-family houses:		
	Number of twin-family houses:	5	
	☐ Low-rise multifamily buildings (4 stores or less)		
	Number of buildings:		
	Number of stories:		
	☐ High-rise multifamily buildings (5 stories or more)		
	Number of buildings:		
	Number of stories:		
4-11.	Non-residential building types (i.e., separate structures used as office spaces, community rooms, laundry facilities, mechanical room, etc.)		
	Number of buildings:		
	Number of stories:		
4-12.	Total number of buildings in your development:	5	
Development Size			
4-13.	Number of dwelling units in your development		
	Number of 0 bedroom units:		
	Number of 1 bedroom units:	4	
	Number of 2 bedroom units:		
	Number of 3 bedroom units:	21	
	Number of 4 bedroom units:	8	
	Number of 5 bedroom units:		
	Number of 6 bedroom units:		
	Total number of dwelling units *[ECMs No. 26, 33]*:	33	
4-14.	Total number of residents in development *[ECMs No. 21, 22, 23, 25]*:	99	
4-15.	Average number of residents per dwelling unit *[ECMs No. 4]*:	3	

Energy Conservation for Housing
Walkthrough Survey / Development Report

Architectural Data

Development Size

4-16. Total area of all floors in the development

Unit Size	Floor Area *(Base per Unit)*	Floor Area *(Total for Units)*	
0 Bedroom Units			sq. ft.
1 Bedroom Units	768	3072	sq. ft.
2 Bedroom Units			sq. ft.
3 Bedroom Units	1170	24570	sq. ft.
4 Bedroom Units	1208	9664	sq. ft.
5 Bedroom Units			sq. ft.
6 Bedroom Units			sq. ft.
Total for all units		37306	sq. ft.

4-17. Total development volume (total area in question 4-16 times floor-to-typical ceiling height, usually 8.0 feet) *[ECMs No. 1, 2, 8]*:

Floor-to-Ceiling Height:	8	ft.
Total Volume *[ECMs No. 1, 2, 8]*:	298448	cu. ft.

Window Area

4-18. Window Area *[ECMs No. 1, 2]*:

Unit Size	Floor Area *(Base per Unit)*	Floor Area *(Total for Units)*	
0 Bedroom Units			sq. ft.
1 Bedroom Units	65	260	sq. ft.
2 Bedroom Units			sq. ft.
3 Bedroom Units	90	1890	sq. ft.
4 Bedroom Units	124	992	sq. ft.
5 Bedroom Units			sq. ft.
6 Bedroom Units			sq. ft.
Total for all units		3142	sq. ft.

4-19. Window panes (typical or predominant type) *[ECM No. 2]*:

- ☐ Single-Pane
- ■ Double-Pane
- ☐ Triple-Pane
- ☐ N/A

4-20. Window frame material *[ECM No. 1]*:

- ☐ Wood
- ☐ Metal
- ☐ Vinyl
- ☐ Fiberglass
- ■ N/A

4-21. Typical window fit (check of predominant condition) *[ECMs No. 1, 2]*:

- ☐ Loose (frame rattles, large air gaps, large drafts)
- ■ Average (some looseness, no large gaps, no large drafts)
- ☐ Tight (no excessive frame movement of drafts)
- ☐ N/A

4-22. Are the windows equipped with storm windows? *[ECM No. 1]*:

☐ Yes ■ No ☐ N/A

Energy Conservation for Housing
Walkthrough Survey / Development Report

Window Area (continued)

4-23. Are the windows and/or storm windows weatherstripped adequately? *[ECM No. 1, 2]*:

■ Yes ☐ No ☐ N/A

4-24. Are office and community spaces in the development air-conditioned? *[ECM No. 3]*:

☐ Yes ☐ No ■ N/A

Complete questions 4-25 through 4-27 only for office and community spaces that are air-conditioned. Proceed to question 4-28 if there are no air-conditioned spaces in your development.

4-25. Window area (in air-conditioned office and community spaces only) *[ECM No. 3]*:

South-facing windows only: _____ sq. ft.

East and west-facing windows only: _____ sq. ft.

4-26. Are windows in office and community areas well shaded (i.e., 50% of summer daylight hours, 50% of their area) by trees or vegetation? *[ECM No. 3]*:

☐ Yes ☐ No ■ N/A

4-27. Area windows in office and community area equipped with exterior shades, interior blinds, or tinted glass? *[ECM No. 3]*:

☐ Yes ☐ No ■ N/A

If no, indicate desired replacement shading type *[ECM No. 3]*:

☐ Exterior Shading
☐ Tinted Film
☐ Interior Shades
■ N/A

Exterior Doors

4-28. Total number of exterior doors in your development: 33

4-29. Typical exterior door fit (check off predominant condition) *[ECM No. 4]*:

☐ Loose (large drafts)
■ Average (no excessive drafts)
☐ Tight (no drafts)
☐ N/A

4-30. Are exterior doors adequately weatherstripped? *[ECM No. 4]*:

■ Yes ☐ No ☐ N/A

4-31. Are exterior doors equipped with storm doors? *[ECM No. 4]*:

■ Yes ☐ No ☐ N/A

4-32. Predominant door type (inspect doors, door labels, or construction specifications) *[ECM No. 4]*:

☐ Wood
■ Metal (energy conserving type - insulated steel)
☐ Metal (standard type - hollow steel)
☐ Sliding Glass Patio Doors (metal, single pane)
☐ N/A

If Wood, specify door thickness:

☐ 1□ in.
☐ 1¾ in
■ N/A

Energy Conservation for Housing
Walkthrough Survey / Development Report

Attics and Flat Roofs

4-33. Does the development have attics or flat roofs on the buildings? *[ECMs No. 5, 6]*:

- ■ Attics (i.e., roofs with crawl spaces or full attics underneath)
- ☐ Flat Roofs (i.e., flat or nearly flat roofs with no attic or crawl space underneath)
- ☐ N/A

If you checked off "attics" answer questions 4-34 and 4-35. If you checked off "flat roofs" answer questions 4-36 and 4-37.

4-34. Area of attic (assume it is equal to the floor area of the top floor of the building) *[ECM No. 5]*:

18153 sq. ft

4-35. Attic insulation type and level, i.e., depth (measure typical insulation thickness and enter below; round off to nearest inch) *[ECM No. 5]*:

- ☐ Batt fiberglass
- ☐ Dry cellulose
- ☐ Loose fill fiberglass
- ☐ Spray foam
- ■ N/A

Insulation level _____ in.

4-36. Area of flat roof (assume it is equal to the floor area of the top floor of the building) *[ECM No. 6]*:

_____

4-37. Type of existing flat roof structure (check whether insulated or uninsulated) *[ECM No. 6]*:

- ☐ Insulated
- ☐ Uninsulated
- ■ N/A

If uninsulated, check structure type *[ECM No. 6]*:

- ☐ Wood structure
- ☐ Concrete structure
- ☐ Steel structure
- ■ N/A

Walls

4-38. Wall construction, size and insulation (check off whether insulated or uninsulated) *[ECM No. 7]*:

- ■ Insulated
- ☐ Uninsulated
- ☐ N/A

If uninsulated construction, check structure and siding type *[ECM No. 7]*:

- ☐ Wood frame with wood siding
- ☐ Wood frame with aluminum siding
- ☐ Wood frame with brick siding
- ☐ Wood frame with other siding
- ☐ Concrete block masonry wall
- ☐ Brick masonry wall
- ☐ Other masonry wall construction
- ■ N/A

Total area of all uninsulated exterior (not including windows and doors) *[ECM No. 7]*:

_____

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Heating and Cooling Systems Data

Heating System & Fuel Type

4-39. Heating system type (check off applicable type):

- ☐ Individual heating systems
- ■ Central heating system
- ☐ N/A

If you checked off "Central heating system," check off system type:

- ■ Boiler
- ☐ Furnace
- ☐ Other (e.g., heat pump)
- ☐ N/A

4-40. Heating fuel type (check off applicable type):

- ☐ Electricity
- ■ Natural Gas
- ☐ Heating Oil
- ☐ Propane
- ☐ N/A

If you checked off "Individual heating systems" in question 4-39, answer questions 4-41 through 4-43.
If you checked off "Central heating system" above, answer questions 4-44 through 4-51.

Individual Heating Systems

4-41. Do the heaters have vent dampers or flue dampers (applies only to oil and gas furnaces and boilers)? *[ECMs No. 9, 10]*:

☐ Yes ☐ No ■ N/A

4-42. Do gas heaters have constant-burning pilot lights? *[ECM No. 10]*:

☐ Yes ☐ No ■ N/A

4-43. Are heaters controlled by thermostats? *[ECM No 13]*:

☐ Yes ☐ No ■ N/A

If yes, indicate type *[ECM No. 13]*:

- ☐ Non-setback
- ☐ Setback
- ■ N/A

Central Heating System

4-44. Does the system have flue dampers or vent dampers (question applies to oil and gas furnaces and boilers only)? *[ECMs No. 9, 10]*:

■ Yes ☐ No ☐ N/A

4-45. Heat distribution type of your central heating system *[ECM No. 16]*:

- ☐ Steam
- ■ Hot Water
- ☐ Forced Air
- ☐ N/A

4-46. Check off which of the following are used to control heating:

- ☐ Outdoor reset and cutout controls (boiler systems only) *[ECM No. 11]*:
- ☐ Non-setback thermostats in the dwelling unit *[ECM No. 13]*:
- ☐ Setback thermostats in the dwelling unit *[ECM No. 13]*:
- ■ Radiator controls in the dwelling unit (boiler systems only) *[ECM No. 14]*:
- ☐ N/A

Total number of radiators in your development: 175

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Central Heating System - continued

4-47. Are all or most hot water or steam distribution pipes insulated (question does not apply to forced air distribution systems) *[ECM No. 15]*:

■ Yes ☐ No ☐ N/A

If No, (i.e., pipes are no insulated), answer question 4-48.

4-48. Linear feet of uninsulated pipes (do not include pipes that are in heated areas such as dwelling units) *[ECM No. 15]*:

¾" diameter pipe	
1" diameter pipe	
1½" diameter pipe	
2" diameter pipe	
3" diameter pipe	
4" diameter pipe	
6" diameter pipe	

Combustion Efficiency Test for Central Boilers and Furnaces

To properly estimate energy savings for replacing a central heating system, a combustion efficiency test must be performed on the existing central boilers or furnaces. (Note: Combustion efficiency is not the same as Annual Fuel Usage efficiency, or AFUE. Please refer to the Glossary in Appendix B.) A combustion efficiency test determines how completely the fuel is burned in the boiler or furnace by measuring the oxygen or carbon dioxide concentration in the flue gas. Combustion efficiency tests should be performed only on large central boilers or furnaces, not on boilers or furnaces for individual units. A qualified technician, familiar with combustion efficiency test procedures should conduct the test. The test should be conducted during the heating season. If these tests are routinely conducted at your development, use the most recent test data (if not more than two years old) to answer the following question.

4-49. What is the existing combustion efficiency of your central boiler or furnace (enter as decimal fraction, e.g.,: 75% = .75) *[ECM No. 12]*:

0.95

4-50. Is your central boiler or furnace oversized (i.e., cycles often - as a rough guideline, this means that the boiler or furnace starts up more than two times per hour):

☐ Yes ■ No ☐ N/A

Air-Conditioning (AC) Systems

4-51. Do you have air-conditioning in your development to cool community and office areas? *[ECMs No. 19, 20]*:

☐ Yes ☐ No ■ N/A

4-52. Do you have air-conditioning in your development to cool residential units (do not included window or wall AC units if they are owned and installed by the residents)? *[ECMs No. 19, 20]*:

☐ Yes ☐ No ■ N/A

4-53. Does the HA pay for the fuel consumption for residential air conditioning?

☐ Yes ☐ No ■ N/A

If you answered Yes to question 4-53, proceed to question 4-54 through 4-56. If you answered No, proceed to 4-57.

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Air-Conditioning (AC) Systems - continued

4-54. Air-conditioning system type and number of units *[ECMs No. 19, 20]*:

☐ Individual window or wall units		units
☐ Central system		units

4-55. Power requirement of typical existing unit or system (read equipment labels, literature, or engineering specification drawings) *[ECMs No. 19, 20]*:

Typical ranges:		
Window or wall AC units:	500-5,000	watts
Central AC unit:	2,000-10,000	watts
Chiller:	10,000-1,400,000	watts
Power requirement:		watts

4-56. Cooling capacity of typical existing unit or system (read equipment labels, literature, or engineering specification drawings) (Note: One ton of cooling capacity = 12,000 Btu) *[ECMs No. 19, 20]*:

Typical ranges:		
Window or wall AC units:	5,000-30,000	Btu
Central AC unit:	20,000-60,000	Btu
Chiller:	60,000-12,000,000	Btu
Cooling capacity		Btu

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Domestic Hot Water (DHW) System/Water Supply Systems Data	
Hot Water Heater Fuel and Type	
4-57.	Does the development have DHW tanks? *[ECMs No. 22, 23]*: ■ Yes ☐ No ☐ N/A
4-58.	Are the DHW tanks uninsulated? (Note: Most newer hot water heaters have adequate insulation built into the design, but may not look "wrapped.") *[ECMs No. 22, 23]*: ■ Yes ☐ No ☐ N/A
4-59.	Water heater type (check off applicable type) *[ECM No. 25]*: ☐ Individual tank water heater ■ Central DHW heater ☐ N/A If a replacement heater is considered, check off type *[ECM No. 25]*: ☐ Central, condensing ☐ Central, non-condensing ☐ Tank, condensing ☐ Tank, non-condensing ■ N/A
4-60.	Water heater fuel type: ☐ Electricity ■ Natural Gas ☐ Heating Oil ☐ Propane ☐ N/A
Hot Water Heater Fuel and Type	
4-61.	Do you have low-flow faucet aerators and shower heads installed on all or most faucets and showers? *[ECM No. 21]*: ■ Yes ☐ No ☐ N/A
4-62.	How is proper water pressure maintained in your development? *[ECM No. 36]*: ☐ Roof-mounted storage tank ■ From street mains (no tanks and no pumps) ☐ Pressurizing pump system (booster pumps) ☐ N/A Total horsepower of existing booster pumps *[ECM 36]:* _____ HP
4-63.	Have water-saving toilets been installed in your development? [ECM No. 35]: ■ Yes ☐ No ☐ N/A
Central Laundry Facilities	
4-64.	Do you have central public laundry facilities as part of your development? *[ECM No. 24]*: ■ Yes ☐ No ☐ N/A
4-65.	Total number of washing machines *[ECM No. 24]*: 4
4-66.	Are washing machines restricted to cold water rinse only? *[ECM No. 24]*: ■ Yes ☐ No ☐ N/A

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Lighting Systems Data	
Residential Unit Lighting	
4-67.	Type of lighting in residential units (check off predominant fixture type in each of the following spaces) *[ECM No. 26]*: Kitchen: ☐ LED ■ Fluorescent ☐ N/A Bathroom: ☐ LED ■ Fluorescent ☐ N/A Hallway/Foyer: ☐ LED ■ Fluorescent ☐ N/A
Common Area Lighting	
Common areas include offices, community rooms, lobbies, corridors, hallways and stairways in both public and basement floors. All questions refer to "general lighting" only; do not include "task lighting" such as desk lamps, etc.	
4-68.	Is there incandescent lighting in the common areas? *[ECMs No. 27, 28, 29, 30]*: ☐ Yes ☐ No ■ N/A
If you answered "Yes" to question 4-68, answer questions 4-69 and 4-70. If you answered "No" to question 4-68, proceed to question 4-71.	
4-69.	Total number of incandescent fixtures (common areas only *) *[ECM No. 27]*:
* To obtain the total number of incandescent fixtures in the common areas, select one building that is representative of the buildings on site and count the number of fixtures in the basement, at the ground floor, and at the typical floor. Multiply the number of fixtures at the typical floor by the number of floors in the building. Add this figure to the number of fixtures located in the basement and the ground floor to obtain the total number of fixtures in the building. Multiply this total building figure by the number of buildings on the site.	
4-70.	Average watts per incandescent lighting fixture (e.g., 50, 75, or 100 watts) *[ECM No. 27]*:
4-71.	Is there fluorescent lighting in the common areas? *[ECMs No. 27, 28, 29, 30]*: ☐ Yes ☐ No ■ N/A
If you answered "Yes" to question 4-71, answer questions 4-72 through 4-75. If you answered "No" to question 4-71, proceed to question 4-76.	

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Common Area Lighting - continued

4-72. Type of fixture (check off predominant type of fixture in common areas) *[ECMs No. 28, 29]*:

- ☐ 2 tubes/4 feet long
- ☐ 2 tubes/8 feet long
- ☐ 4 tubes/4 feet long
- ☐ 4 tubes/8 feet long
- ☐ 6 tubes/4 feet long
- ☐ 8 tubes/4 feet long
- ☐ Other
- ■ N/A

4-73. Are the fluorescent lamps "energy-conserving" lamps (e.g., General Electric's Watt-Miser, Osram Sylvania's SuperSaver, Philips Econ-o-Watts, and Duro-Test's Watt Saver)? *[ECM No. 28]*:

☐ Yes ☐ No ■ N/A

4-74. Are the ballasts electronic? (Note: As a general rule, if the lighting has not been updated, the ballasts are not electronic.) *[ECM No. 29]*:

☐ Yes ☐ No ■ N/A

4-75. Total number of fluorescent fixtures in the development (common areas only) *[ECMs No. 28, 29]*:

Complete the following questions (4-76 through 4-78) for office areas only. Do not answer the questions if there are no office or management spaces in your development or if the offices are windowless or all "general lighting" is incandescent.

4-76. Are lights located near the windows routinely turned off during the daytime hours?

☐ Yes ☐ No ■ N/A

4-77. Number of fluorescent fixtures within 10 feet of the windows (office areas only) *[ECM No. 30]*:

Type of window glass *[ECM No 30]*:

- ☐ Clear
- ☐ Tinted
- ■ N/A

Estimated percentage of exterior wall above desk height that is glass *[ECM No 30]*:

- ☐ 25-50%
- ☐ 50-75%
- ☐ 75-100%
- ■ N/A

Does the building have exterior overhangs projected at least two feet from the outside face of the glass near the top of the window? *[ECM No. 30]*:

■ Yes ☐ No ☐ N/A

Energy Conservation for Housing
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Common Area Lighting - continued

4-78. Type of predominant fluorescent fixture within 10 feet of windows in office areas *[ECM No. 30]*:

- ☐ 2 tubes/4 feet long
- ☐ 2 tubes/8 feet long
- ☐ 4 tubes/4 feet long
- ☐ 4 tubes/8 feet long
- ☐ 6 tubes/4 feet long
- ☐ 8 tubes/4 feet long
- ☐ Other
- ■ N/A

Exterior Lighting

4-79. Predominant type of exterior lighting fixture (check off applicable type) *[ECM No. 31]*:

- ☐ None (no exterior lighting)
- ☐ Sodium vapor lamps (high or low-pressure)
- ☐ Mercury vapor lamps
- ☐ Metal halide lamps
- ☐ Incandescent lamps
- ☐ Fluorescent lamps
- ☐ Halogen lamps
- ■ N/A

4-80. Number of exterior lighting fixtures *[ECMs No. 31, 32]*: ☐

4-81. Energy consumption (watts) per predominant exterior lighting fixture type (i.e., per fixture unit) *[ECMs No. 31, 32]*: ☐

4-82. Who pays for exterior lighting electricity? *[ECMs No. 31, 32]*:

- ☐ Housing Authority
- ☐ Local town or city government
- ■ N/A

4-83. Type of exterior lighting controllers (check off applicable type) *[ECM No. 32]*:

- ☐ Manual switching (no controls)
- ☐ Timers
- ☐ Photo-controls
- ■ N/A

If you checked "Manual Switching" or "Timers" on question 4-83, go to question 4-84. If you checked "Photo-controls", proceed to question 4-85.

4-84. Number of hours per year exterior lighting is turned on* *[ECM No. 32]*: ☐

* Estimate annual hours by multiplying average daily hours of use (hours between turning on and off) by 365 days. Adjust for weekend and season variations, if necessary.

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Miscellaneous Data	
4-85.	Average age of existing refrigerators (check off predominant age of existing refrigerators in your development) *[ECM No. 33]*: ☐ 1990s ☐ 2000s ■ 2010s ☐ 2020s ☐ N/A Average size of existing refrigerators (check off predominant size of existing refrigerators in your development) *[ECM No. 33]*: ☐ 13 cubic feet or smaller ■ 14-15 cubic feet ☐ 16 cubic feet or large ☐ N/A
4-86.	Type of motors that could be operation fans or pumps at your development (check off applicable types) *[ECM No. 34]*: ☐ Elevator ☐ Ventilation system ☐ Hydronic heating or cooling system
4-87.	Predominant size of motor for each of the above systems (in horsepower) *[ECM No. 34]*: Elevator Ventilation system Hydronic heating or cooling system
4-88.	Number of motors of each type *[ECM No. 34]:* Elevator Ventilation system Hydronic heating or cooling system
4-89.	Average operation hours per year of each motor *[ECM No. 34]*: Elevator Ventilation system Hydronic heating or cooling system

Energy Conservation for Housing
Energy Consumption Survey

Energy Consumption Survey - Electricity				
5-1.	Electricity Consumption			
0 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			kWh/yr
	2019			kWh/yr
	2020			kWh/yr
	Total:			kWh
	Average annual consumption:			kWh/yr
	Average current price for electricity*:			$/kWh
	Average annual cost of electricity consumption:			$/yr
1 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			kWh/yr
	2019	1240	4960	kWh/yr
	2020	1658	6632	kWh/yr
	Total:		11592	kWh
	Average annual consumption:		5796	kWh/yr
	Average current price for electricity*:		0.14	$/kWh
	Average annual cost of electricity consumption:		811.44	$/yr
2 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			kWh/yr
	2019			kWh/yr
	2020			kWh/yr
	Total:			kWh
	Average annual consumption:			kWh/yr
	Average current price for electricity*:			$/kWh
	Average annual cost of electricity consumption:			$/yr
3 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			kWh/yr
	2019	1889	39669	kWh/yr
	2020	2525	53025	kWh/yr
	Total:		92694	kWh
	Average annual consumption:		46347	kWh/yr
	Average current price for electricity*:		0.14	$/kWh
	Average annual cost of electricity consumption:		6488.58	$/yr

Energy Conservation for Housing
Energy Consumption Survey

5-1. Electricity Consumption - continued

4 Bedroom

Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
2018			kWh/yr
2019	1950	15600	kWh/yr
2020	2607	20856	kWh/yr
Total:		36456	kWh
Average annual consumption:		18228	kWh/yr
Average current price for electricity*:		0.14	$/kWh
Average annual cost of electricity consumption:		2551.92	$/yr

5 Bedroom

Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
2018			kWh/yr
2019			kWh/yr
2020			kWh/yr
Total:			kWh
Average annual consumption:			kWh/yr
Average current price for electricity*:			$/kWh
Average annual cost of electricity consumption:			$/yr

6 Bedroom

Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
2018			kWh/yr
2019			kWh/yr
2020			kWh/yr
Total:			kWh
Average annual consumption:			kWh/yr
Average current price for electricity*:			$/kWh
Average annual cost of electricity consumption:			$/yr

Electricity Total

Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
2018			kWh/yr
2019	5079	60229	kWh/yr
2020	6790	80513	kWh/yr
Total:		140742	kWh
Average annual consumption:		70371	kWh/yr
Average current price for electricity*:		0.14	$/kWh
Average annual cost of electricity consumption:		9851.94	$/yr

* For the current price of electricity, refer to the development's current bills or contact the utility company. Also, when referring to the utility bills, remember that the price of electricity often changes seasonally and even hourly. The rates for these tables should represent the *current average annual rates*, including any surcharges.

Energy Conservation for Housing
Energy Consumption Survey

Rate Structure for Electricity

5-2. Demand charges (shown in terms of kW, not kWh):

- ■ No demand charges levied by utility
- ☐ Charges included in bill
- ☐ N/A

If you answered "Charges included in bill", please answer the following questions. If you answered "No demand charges levied by utility", proceed to question 5-3.

Average annual demand charge amount (above normal kWh charges): _____

Please describe demand structure:

5-3. Time-of-day or time-of-use charges, also known as "peak" and "off-peak" rates charges (i.e., different electricity rates at different times of day):

Are time-of-day meters installed in the developments?

☐ Yes ■ No ☐ N/A

If you answered "No" to the previous question, does your utility offer time-of-day charged?

☐ Yes ■ No ☐ N/A

5-4. If the answer to either question in 5-3 is "Yes", what are the time-of-day charges? *[ECM No. 25]*:

Lowest rate charged: _____ $/kWh

Highest rate charged: _____ $/kWh

Please describe the time-of-day charge structure (i.e., lowest and highest cost time periods, etc.):

5-5. Low power factor surcharges *[ECM No. 40]*:

- ■ No low power factor charges levied by utility
- ☐ Charges included in bill
- ☐ N/A

If you answered "Charges included in bill", please answer the following questions. If you answered "No demand charges levied by utility", proceed to question 5-6.

Average annual low power factor charge amount: _____ $/yr

Please describe low power factor charge structure:

Energy Conservation for Housing
Energy Consumption Survey

Energy Consumption Survey - Natural Gas				
5-1.	Natural Gas Consumption			
0 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Therms/yr
	2019			Therms/yr
	2020			Therms/yr
	Total:			Therms
	Average annual consumption:			Therms/yr
	Average current price for natural gas*:			$/Therm
	Average annual cost of natural gas consumption:			$/yr
1 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Therms/yr
	2019	163	652	Therms/yr
	2020	273	1092	Therms/yr
	Total:		1744	Therms
	Average annual consumption:		872	Therms/yr
	Average current price for natural gas*:		1.14	$/Therm
	Average annual cost of natural gas consumption:		994.08	$/yr
2 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Therms/yr
	2019			Therms/yr
	2020			Therms/yr
	Total:			Therms
	Average annual consumption:			Therms/yr
	Average current price for natural gas*:			$/Therm
	Average annual cost of natural gas consumption:			$/yr
3 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Therms/yr
	2019	248	5208	Therms/yr
	2020	416	8736	Therms/yr
	Total:		13944	Therms
	Average annual consumption:		6972	Therms/yr
	Average current price for natural gas*:		1.14	$/Therm
	Average annual cost of natural gas consumption:		7948.08	$/yr

Energy Conservation for Housing
Energy Consumption Survey

5-1.	Natural Gas Consumption - continued			
4 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Therms/yr
	2019	256	2048	Therms/yr
	2020	430	3440	Therms/yr
	Total:		5488	Therms
	Average annual consumption:		2744	Therms/yr
	Average current price for natural gas*:		1.14	$/Therm
	Average annual cost of natural gas consumption:		3128.16	$/yr
5 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Therms/yr
	2019			Therms/yr
	2020			Therms/yr
	Total:			Therms
	Average annual consumption:			Therms/yr
	Average current price for natural gas*:			$/Therm
	Average annual cost of natural gas consumption:			$/yr
6 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Therms/yr
	2019			Therms/yr
	2020			Therms/yr
	Total:			Therms
	Average annual consumption:			Therms/yr
	Average current price for natural gas*:			$/Therm
	Average annual cost of natural gas consumption:			$/yr
Natural Gas Total				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			Therms/yr
	2019	667	7908	Therms/yr
	2020	1119	13268	Therms/yr
	Total:		21176	Therms
	Average annual consumption:		10588	Therms/yr
	Average current price for natural gas*:		1.14	$/Therm
	Average annual cost of natural gas consumption:		12070.32	$/yr
* If the current price of natural gas is metered in cubic feet, divide by 100 to change to therms.				

Energy Conservation for Housing
Energy Consumption Survey

Energy Consumption Survey - Summary of Fuel Consumption				
5-8.	Summary of Fuel Consumption			
	Fuel Type	Average Annual Fuel Consumption	Current Cost per Fuel or Energy Unit	
	Electricity	70371	0.14	kWh
	Natural Gas	10588	1.14	Therm
	Heating Oil			Gal
	Propane			Gal

Energy Conservation for Housing
Energy Consumption Survey

Energy Consumption Survey - Water Charges				
5-10.	Water Charges *[ECM No. 35]*:			
0 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019			$/yr
	2020			$/yr
	Total:			$
	Average annual consumption:			$
1 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019	422.99	1691.96	$/yr
	2020	630.88	2523.52	$/yr
	Total:		4215.48	$
	Average annual consumption:		2107.74	$
2 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019			$/yr
	2020			$/yr
	Total:			$
	Average annual consumption:			$
3 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019	644.4	13532.4	$/yr
	2020	961.1	20183.1	$/yr
	Total:		33715.5	$
	Average annual consumption:		16857.75	$

Energy Conservation for Housing
Energy Consumption Survey

5-10.	Water Charges *[ECM No. 35]* - continued:			
4 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019	665.33	5322.64	$/yr
	2020	992.32	7938.56	$/yr
	Total:		13261.2	$
	Average annual consumption:		6630.6	$
5 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019			$/yr
	2020			$/yr
	Total:			$
	Average annual consumption:			$
6 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019			$/yr
	2020			$/yr
	Total:			$
	Average annual consumption:			$
Water Total				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019	1732.72	20547	$/yr
	2020	2584.3	30645.18	$/yr
	Total:		51192.18	$
	Average annual consumption:		25596.09	$

Energy Conservation for Housing
Energy Consumption Survey

Energy Consumption Survey - Sewer Charges				
5-11.	Sewer Charges *[ECM No. 35]*:			
0 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019			$/yr
	2020			$/yr
	Total:			$
	Average annual consumption:			$
1 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019	97.12	388.48	$/yr
	2020	144.85	579.4	$/yr
	Total:		967.88	$
	Average annual consumption:		483.94	$
2 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019			$/yr
	2020			$/yr
	Total:			$
	Average annual consumption:			$
3 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019	147.96	3107.16	$/yr
	2020	220.67	4634.07	$/yr
	Total:		7741.23	$
	Average annual consumption:		3870.62	$

Energy Conservation for Housing
Energy Consumption Survey

5-11.	Sewer Charges *[ECM No. 35]* - continued:			
4 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019	152.76	1222.08	$/yr
	2020	227.84	1822.72	$/yr
	Total:		3044.8	$
	Average annual consumption:		1522.4	$
5 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019			$/yr
	2020			$/yr
	Total:			$
	Average annual consumption:			$
6 Bedroom				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019			$/yr
	2020			$/yr
	Total:			$
	Average annual consumption:			$
Sewer Total				
	Year (Most recent 3 years)	Annual Consumption (Base per unit)	Annual Consumption (Total for unit)	
	2018			$/yr
	2019	397.84	4717.72	$/yr
	2020	593.36	7036.19	$/yr
	Total:		11753.91	$
	Average annual consumption:		5876.96	$

Energy Conservation for Housing
Energy Consumption Survey

Energy Consumption Survey - Heating Consumption Calculation

Electrically Heated Developments Only

A. Transfer the following information that you have previously obtained in the Walkthrough and Energy Consumption Surveys:

Heating Degree Day Zone (4-8):	2.96	DDZ
Average annual kWh consumption (5-9):	70371	kWh/yr

B. Select the appropriate conversion factor for Heating Degree Day Zone in the table below:

Degree Day Zone (DDZ)	Conversion Factor
2 or less	0.35
2.1 - 4	0.50
4.1 - 6	0.65
6.1 - 8	0.75

C. Calculate total electricity used for heating in your development by multiplying the average annual kWh consumption by the appropriate conversion factor:

5-12.

Annual kWh Consumption		Conversion Factor		Total electricity used for heating:	
70371	x	0.5	=	35185.5	kWh/yr

Non-Electrically Heated Developments Only

If the fuel used for heating your development is gas, oil, or propane, and is used *only* for heating and not for other end-uses (e.g., domestic hot water, cooking, clothes dryers), then skip to the table in question 5-14. If the fuel used for heating your development is gas, oil, or propane, and is also used for other end uses, complete the items below.

A. Transfer the following information that you have previously obtained in the Walkthrough and Energy Consumption Surveys:

Number of dwelling unit (question 4-13):	33	
Average annual fuel consumption (question 5-9):		
Natural Gas:	10588	Therms/yr
Heating Oil:		Gal/yr
Propane:		Gal/yr

B. Select the appropriate conversion factor for your heating fuel type in the table below:

Fuel Type	Conversion Factor	
Natural Gas	100	Therms
Heating Oil	43	Gal
Propane	66	Gal

C. Calculate total fuel used for non-heating uses by multiplying the number of dwelling units by the appropriate conversion factor:

Number of dwelling units		Conversion Factor		Total Fuel Used for Non-Heating	
Natural Gas					
33	x	100	=	3300	Therms/yr
Heating Oil					
33	x	43	=	1419	Gal/yr
Propane					
33	x	66	=	2178	Gal/yr

D. Calculate fuel consumed for heating only by subtracting the non-heating fuel use (step C above) from the average annual fuel consumption (step A above):

Energy Conservation for Housing
Energy Consumption Survey

Non-Electrically Heated Developments Only - continued

5-13.

Average Annual Consumption		Non-heating Use		Total Fuel Used for Heating	
Natural Gas					
10588	-	3300	=	7288	Therms/yr
Heating Oil					
	-	1419	=		Gal/yr
Propane					
	-	2178	=		Gal/yr

If the fuel used for heating your development is gas, oil, or propane, and is used only for heating, transfer the Average Annual Fuel Consumption from question 5-9 to the table below. Otherwise, transfer the information that you have previously calculated for question 5-12 and 5-13 (depending on whether your development is electrically or non-electrically heated) to the table. (Check off the fuel type used for heating and fill the annual quantity.)

Is the fuel used to heat your development gas, oil, or propane and also is used for other end-uses (e.g., domestic hot water, cooking, clothes dryers, etc.)?

■ Yes ☐ No ☐ N/A

If development needs either checkmetering or individual metering, please select type of metering to install *[ECM No. 37]*:

☐ Checkmetering
☐ Individual Metering
■ N/A

5-14. Summary of Heating Fuel Consumption

Heating Fuel Type	Annual Heating Fuel Consumption	
☐ Electricity		kWh/yr
■ Natural Gas	7288	Therms/yr
☐ Heating Oil		Gal/yr
☐ Propane		Gal/yr
☐ N/A		

Energy Conservation for Housing
ECM Cost/Benefit Worksheet

ECM No. 8 - Control Air Leakage									
Step 1	Obtain total cost of installing wall insulation:								
							13,136.07	$	
Step 2	Transfer the following information from the Survey								
4-8	**a.** Heating degree-day zone:						2.96	DDZ	
4-17	**b.** Total volume of buildings in development:						298448	cu. ft.	
5-9	**c.** Cost of heating fuel:			Electricity:				$/kWh	
				Natural Gas:			1.14	$/Therm	
				Heating Oil:				$/Gal	
				Propane:				$/Gal	
Step 3	Obtain the following data from Table 1:								
Table 1	Infiltration savings factor:						0.0026		
Step 4	Estimate annual energy savings:								
		2a		2b		3			
		2.96	x	298448	x	0.0026	=	2,296.86	/yr
Step 5	Calculate annual cost savings:								
				4		2c			
				2,296.86	x	1.14	=	2,618.42	$/yr
Step 6	Calculate payback period:								
				1		5			
				13,136.07	/	2,618.42	=	5.02	yrs

Energy Conservation for Housing
ECM Cost/Benefit Worksheet

ECM No. 8 - Control Air Leakage

Table 1: Conductance Savings Factors

Instructions:

1. Find the fuel type.
2. Select the appropriate savings factor and transfer it to Step 3.

Fuel	Savings Factor
Electricity	0.0530
Natural Gas	0.0026
Heating Oil	0.0019
Propane	0.0028

Energy Conservation for Housing
ECM Cost/Benefit Worksheet

ECM No. 11 - Install Boiler Controls						
Step 1	Obtain total cost of installing boilers reset and cutout controls:					
				10,024.67	$	
Step 2	Transfer the following information from the Survey:					
5-14	**a.** Annual heating fuel consumption:	Natural Gas:		7288	Therms/yr	
		Heating Oil:			Gal/yr	
		Propane:			Gal/yr	
5-9	**b.** Cost of heating fuel:	Natural Gas:		1.14	$/Therm	
		Heating Oil:			$/Gal	
		Propane:			$/Gal	
Step 3	Estimate annual energy savings:					
			2a			
	0.08	x	7288	=	583.04	/yr
Step 4	Calculate annual cost savings:					
		3	2b			
	583.04	x	1.14	=	664.67	$/yr
Step 5	Calculate payback period:					
		1	4			
	10,024.67	/	664.67	=	15.08	yrs

Energy Conservation for Housing
ECM Cost/Benefit Worksheet

ECM No. 13 - Install Setback Thermostats								
Step 1	Obtain total cost of installing night setback thermostats:							
						5,859.15	$	
Step 2	Transfer the following information from the Survey:							
4-8	**a.** Heating degree-day zone:					2.96	DDZ	
5-14	**b.** Annual heating fuel consumption:	Natural Gas:				7288	Therms/yr	
		Heating Oil:					Gal/yr	
		Propane:					Gal/yr	
5-9	**c.** Cost of heating fuel:	Natural Gas:				1.14	$/Therm	
		Heating Oil:					$/Gal	
		Propane:					$/Gal	
Step 3	Obtain the following savings factor from Table 1:							
Table 1	Savings factor:					0.1		
Step 4	Estimate annual energy savings:							
		3		2b				
		0.1	x	7288	=	728.80	/yr	
Step 5	Calculate annual cost savings:							
		4		2c				
		728.80	x	1.14	=	830.83	$/yr	
Step 6	Calculate payback period:							
		1		5				
		5,859.15	/	830.83	=	7.05	yrs	

Energy Conservation for Housing
ECM Cost/Benefit Worksheet

ECM No. 13 - Install Setback Thermostats

Table 1: Savings Factors for Installing Setback Thermostats

Heating Energy Savings from Nightly Setback of 8 Degrees

Instructions:

1. Find the appropriate heating degree day zone (DDZ) (see Step 2).
2. Select the appropriate savings factor and transfer it to Step 3.

Heating DDZ	Savings Factor
2.50 or less	0.150
2.51 - 2.80	0.120
2.81 - 3.40	0.100
3.41 - 4.10	0.093
4.11 - 4.80	0.080
4.81 - 5.50	0.075
5.50 or more	0.072

Energy Conservation for Housing
ECM Cost/Benefit Worksheet

ECM No. 21 - Install Water-Efficient Showerheads and Faucet Aerators

Step 1 Obtain total cost of replacing showerheads and aerators (typically one showerhead and two aerators per dwelling unit):

	2,078.34	$	

Step 2 Transfer the following information from the Survey:

4-14	**a.** Total number of residents in development:	99		
5-9	**b.** Cost of DHW heating fuel: Electricity:		$/kWh	
	Natural Gas:	1.14	$/Therm	
	Heating Oil:		$/Gal	
	Propane:		$/Gal	

Step 3 Estimate annual energy savings:

				2a			
Electricity:	206.5	x		=		kWh/yr
Natural Gas:	10.0	x	99	=	990.00	Therms/yr
Heating Oil:	7.2	x		=		Gal/yr
Propane:	10.1	x		=		Gal/yr

Step 4 Calculate annual cost savings:

3		2b			
990.00	x	1.14	=	1,128.60	$/yr

Step 5 Calculate payback period:

1		4			
2,078.34	/	1,128.60	=	1.84	yrs

Tab

ECM No. 1

INSTALL STORM WINDOWS

Storm windows can save up to 10% on heating costs. The cost-effectiveness of this measure depends on the quality of the existing windows, the cost and type of the storm window, current energy costs, and climate. This ECM is most cost-effective in very cold climates.

APPLICABILITY

- Single-family and multifamily buildings with single-pane windows
- Buildings without storm windows

DESCRIPTION

A large amount of heat can be lost through single-pane windows in the winter, resulting in energy waste. A simple solution is to install storm windows. *Note: if the primary windows are in need of replacement, then energy-efficient replacement windows should be considered as an alternative to storm windows (see ECM No. 2).*

The purpose of storm windows is to save energy and to increase comfort. Storm windows save energy in two ways. First, they reduce air leakage through spaces around the window. Second, they reduce heat conduction through the window by creating an insulating air space between them and the primary window. In addition to saving on heating costs in the winter, storm windows can save on cooling costs in the summer.

Beyond saving energy, storm windows enhance the comfort of the residents, lower maintenance costs on existing windows, and reduce the amount of outside noise and pollutants that enter the dwelling unit.

TYPES

Storm windows can be installed on the exterior or interior of existing windows, depending on the type of storm window. They can be either glass or plastic and can be either fixed or operable. Operable storm windows can be opened and closed, while fixed units are not designed to be opened. Storm windows usually have a single pane, but in extremely cold climates, more expensive double-pane storm windows might be cost-effective. Storm windows with a plain aluminum finish will corrode relatively quickly, reducing the ease of operation and degrading the appearance. Selecting storm windows whose frames have been anodized (treated with a protective oxide coating) or that have a baked enamel finish will prevent this problem.

MAINTENANCE ISSUES

All storm windows. Maintenance staff should make sure storm windows are in place at the start of the heating (or cooling) season. Broken storm windows should be replaced.

Fixed storm windows. This type of storm window is not meant to be opened during the winter, and maintenance staff should make sure that residents do not remove them in the winter. If residents remove storm windows, the HA should try to determine if overheating is a problem.

Operable storm windows. The area around the storm window may need to be recaulked every few years to ensure a good seal, and the tracks should be cleaned occasionally to ensure proper operation. Maintenance staff should make sure that residents keep their storm windows closed when their heat is on.

IMPORTANT POINT TO CONSIDER

- Some windows (e.g., casements) cannot readily be equipped with storm windows.

Cost/Benefit Worksheet
ECM No. 1: Install Storm Windows

Step 1 Obtain total cost of installing the type and quantity of storm windows needed.

		$

Step 2 Transfer the following information from the Survey:

4-8	**a**	Heating degree-day zone:		DDZ
4-18	**b**	Total area of windows:		sq. ft.
4-17	**c**	Total volume of buildings in development:		cu. ft.
4-20	**d**	Window frame material:		
4-21	**e**	Average window fit:		
5-9	**f**	Cost of heating fuel: Gas:		$/therm
		Oil:		$/gal
		Electric:		$/kWh
		Propane:		$/gal

Step 3 Obtain the following savings factors from Tables 1 and 2:

Table 1	**a**	Conductance savings factor:	
Table 2	**b**	Infiltration savings factor:	

Step 4 Estimate annual energy savings due to conduction losses:

2a		2b		3a			
	x		x		=		/yr

Step 5 Estimate annual energy savings due to infiltration losses:

2a		2c		3b			
	x		x		=		/yr

Step 6 Estimate total annual energy savings:

4		5			
	+		=		/yr

Step 7 Calculate annual cost savings:

6		2f			
	x		=		$/yr

Step 8 Calculate payback period:

1		7			
	/		=		yrs

ECM No. 1: Install Storm Windows

Table 1: Conductance Savings Factors

Instructions:

1) Find the frame material of the primary windows (see Step 2d).
2) Find the fuel type.
3) Select the appropriate conductance savings factor and transfer it to Step 3.

Primary Window Frame Material	Fuel Type			
	Gas	Oil	Electric	Propane
Wood	0.11	0.076	2.2	0.12
Metal	0.16	0.11	3.20	0.17

Table 2: Infiltration Savings Factors

Instructions:

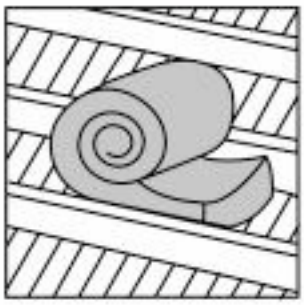
1) Find the fit of the primary windows (see Step 2e).
2) Find the fuel type.
3) Select the appropriate infiltration savings factor and transfer it to Step 3.

Primary Window Fit	Fuel Type			
	Gas	Oil	Electric	Propane
Loose	0.0026	0.0019	0.053	0.0028
Average	0.0017	0.0013	0.036	0.0019
Tight	0.00087	0.00063	0.018	0.00095

ECM No. 5

INSTALL/INCREASE ATTIC INSULATION

Because installing attic insulation is relatively easy and inexpensive, it is usually cost-effective. Even in mild climates where some attic insulation was already present, measured fuel savings from attic insulation range from 13% to 21%, according to a compilation of studies by Lawrence Berkeley Laboratory (Cohen et al. 1991).



APPLICABILITY

- Single-family and low-rise multifamily buildings with attics
- Attics that currently have less than 12 inches of insulation

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 (Krigger 1991).

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

TYPES

There are two basic types of insulation used for attics:

Batt insulation (also called rolls or blankets) is made of fiberglass or rock wool. It comes in standard widths to fit between rafters. One advantage of batt insulation is that it does not settle over time, as loose-fill insulation does. Settling can reduce the R-value.

Loose-fill insulation is typically made of fiberglass, rock wool, or cellulose. Cellulose loose-fill insulation is blown into the attic with a machine, while fiberglass and rock wool loose-fill insulation can either be poured or blown into the attic. If properly installed, loose-fill insulation can provide more complete coverage than batts, because the fibers can fill around wires, piping, and other obstacles (E Source 1996). Also, loose-fill insulation is more easily installed than batt insulation where access to the attic is constrained.

The best choice of insulation depends on economic factors, labor, material availability, and environmental concerns.

MAINTENANCE ISSUES

Attic insulation is a relatively maintenance-free energy conservation measure. However, there are several maintenance issues that should be addressed before and after adding insulation.

Before installation. The installation crew should make sure that any exposed wiring is in good condition and will not present a fire hazard. If the HA plans to reduce air leakage (see ECM No. 8), any air sealing in the attic should be performed before attic insulation is installed. Also, any ducts or pipes located in attics should be insulated to prevent freezing or excessive heat loss. Finally, attics with insulation must be ventilated.

After installation. If attic insulation gets soaked due to leakage through the roof, it should be removed, discarded, and replaced. Loose-fill insulation should be checked a year or so after installation for settling; if a significant amount of settling has occurred, it may be necessary to add more insulation.

IMPORTANT POINTS TO CONSIDER

- Insulation must be installed according to manufacturer's directions.
- Unless the attic is used as a habitable space, attic insulation should be installed between the rafters of the attic floor, rather than the attic ceiling.
- A vapor barrier must be present on the warm side of insulation to prevent moisture problems. If existing insulation has a vapor barrier, a second layer should not be added.
- Recessed lights or fans which protrude into the attic space should not be covered by insulation.
- Insulation should not obstruct vents or louvers.
- Installation crews should wear protective gloves and masks.
- Insulation must comply with local fire codes. Loose-fill cellulose insulation must be of fire-treated type.
- Although most insulation materials can have negative health effects when used inappropriately, some companies and organizations have used irresponsible scare tactics to get people to avoid or choose certain products. When possible, seek objective opinions by government research agencies or objective publications (E Source 1996).

Mini Case Study

In 1982, four low-rise developments of the San Francisco Housing Authority received attic insulation, along with a few other low-cost measures, including weatherstripping and caulking. For the most part, the attic insulation was installed where there had been none previously.

A research team measured the energy consumption before the installation and monitored the consumption for six years after the installation to analyze the level of energy savings achieved. The analysis adjusted for the effects of weather.

The savings at the four developments were 10%, 17%, 5%, and 20% the first year after installation. At each development, the level of savings persisted over the six-year period. According to the research team that analyzed the savings, most of the savings resulted from the installation of attic insulation (Ritschard & McAllister 1992).

Cost/Benefit Worksheet
ECM No. 5: Install or Increase Attic Insulation

This analysis is performed for three thicknesses of added insulation in order to assist in determining the maximum economical thickness level.

Step 1 Obtain total cost of installing selected type of insulation.

a R-13 additional insulation (total labor and material costs): [ ] $

b R-30 additional insulation (total labor and material costs): [ ] $

c R-42 additional insulation (total labor and material costs): [ ] $

d Incremental cost of adding R-30 insulation vs. R-13 insulation:

1b [ ] - 1a [ ] = [ ] $

e Incremental cost of adding R-42 insulation vs. R-30 insulation:

1c [ ] - 1b [ ] = [ ] $

Step 2 Transfer the following information from the Survey:

4-8	**a** Heating degree-day zone:		[ ]	DDZ
4-34	**b** Attic area:		[ ]	sq. ft.
4-35	**c** Existing insulation level:		[ ]	inches
4-35	**d** Existing insulation type:		[ ]	
	e Existing insulation R-value (use Table 1):		[ ]	R
5-9	**f** Cost of heating fuel:	Gas:	[ ]	$/therm
		Oil:	[ ]	$/gal
		Electric:	[ ]	$/kWh
		Propane:	[ ]	$/gal

Step 3 Obtain the following savings factors from Table 2:

Table 2	**a** R-13 additional insulation:	[ ]	
Table 2	**b** R-30 additional insulation:	[ ]	
Table 2	**c** R-42 additional insulation:	[ ]	

Step 4 Estimate annual energy savings:

a R-13 additional insulation:

2a [ ] x 2b [ ] x 3a [ ] = [ ] /yr

b R-30 additional insulation:

2a [ ] x 2b [ ] x 3b [ ] = [ ] /yr

c R-42 additional insulation:

2a [ ] x 2b [ ] x 3c [ ] = [ ] /yr

Step 5 Calculate annual cost savings:

a R-13 additional insulation: 4a [ ] x 2f [ ] = [ ] $/yr

b R-30 additional insulation: 4b [ ] x 2f [ ] = [ ] $/yr

c R-42 additional insulation: 4c [ ] x 2f [ ] = [ ] $/yr

Step 6 Calculate payback period:

a R-13 additional insulation: 1a [ ] / 5a [ ] = [ ] yrs

b R-30 additional insulation: 1d [ ] / 5b [ ] = [ ] yrs

c R-42 additional insulation: 1e [ ] / 5c [ ] = [ ] yrs

ECM No. 5: Install or Increase Attic Insulation

Table 1: R-value vs. Thickness for Typical Attic Insulation Materials

Instructions:
1) Find existing level of insulation in inches (see Step 2c).
2) Find type of existing insulation (see Step 2d).
3) Select the appropriate R-value and transfer it to Step 3.

Thickness (inches)	R-Value		
	Batt Fiberglass	Dry Cellu-lose	Loose Fill Fiberglass
0	1.6	1.6	1.6
1	3	4	3
2	7	7	5
3	10	11	8
4	13	14	10
5	17	18	13
6	19	21	15
7	23	25	18
8	26	28	20
9	30	32	23
10	33	35	25
11	36	39	28
12	40	42	30

Table 2: Savings Factors for Increasing Attic Insulation

Instructions:
1) Find heating fuel type.
2) Find R-value of existing attic insulation (see Step 2e or Table 1).
3) Select the appropriate savings factor for each level of additional insulation and transfer it to Step 3.

Fuel Type	Existing R-Value [1]	Added R-value		
		13	30	42
Gas	None	0.134	0.009	0.002
	7	0.022	0.006	0.002
	13	0.009	0.004	0.001
	19	0.005	0.003	[2]
	26	0.003	0.002	[2]
	33	0.002	[2]	[2]
	40	[2]	[2]	[2]
Oil	None	0.095	0.006	0.001
	7	0.016	0.004	0.001
	13	0.007	0.003	0.001
	19	0.004	0.002	0.001
	26	0.002	0.001	0.001
	33	0.001	0.001	[2]
	40	0.001	[2]	[2]
Electricity	None	2.74	0.18	0.04
	7	0.46	0.11	0.03
	13	0.19	0.07	0.02
	19	0.11	0.05	0.02
	26	0.06	0.04	0.02
	33	0.04	0.03	[2]
	40	0.03	0.02	[2]
Propane	None	0.146	0.010	0.002
	7	0.024	0.007	0.002
	13	0.010	0.004	0.001
	19	0.005	0.003	[2]
	26	0.003	0.002	[2]
	33	0.002	[2]	[2]
	40	[2]	[2]	[2]

[1] See Table 1.
[2] Additional insulation is not cost-effective; do not complete calculations for these thicknesses.

ECM No.
8

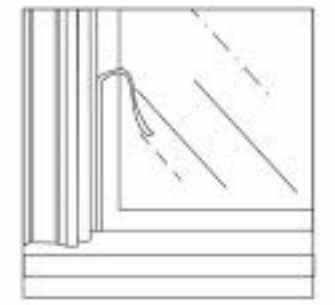
CONTROL AIR LEAKAGE

APPLICABILITY

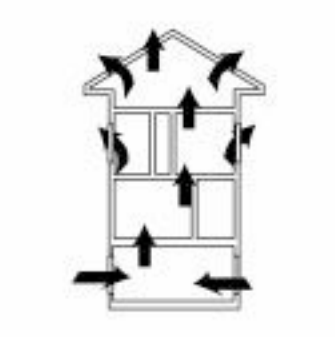
- Single-family and multifamily buildings

DESCRIPTION

Air sealing in single-family and small multifamiliy dwellings has been shown to reduce energy usage by an average of 153 therms or 1,330 kWh per year, depending on the type of heating (Brown et al. 1993).



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 weatherstripping and strategic sealing of these holes using caulk can significantly reduce the amount of heat lost to the outside, thus reducing the amount of energy needed to heat the dwelling unit. Insulation (see ECMs Nos. 5, 6, and 7) can also help reduce air leakage. In addition to saving energy, controlling air leakage can also 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.



Stack Effect

But reducing air leakage through air sealing techniques is more complicated than simply weatherstripping and caulking. Two important principles should 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 in temperature between inside and out, 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 any 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 parts of a building, where the pressure is negative from all the warm air moving upward (E Source 1996). 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 If a building does not have mechanical ventilation, it is recommended that a ventilation system be installed before any significant air leakage reduction is performed.

STRATEGIES

ventilation (E Source 1996). This risk is highest in buildings with significant sources of indoor air pollution, such as backdrafting from gas appliances or high occupancy levels.

Weatherstripping. Weatherstripping is a flexible strip that seals a gap between the stationary and movable parts of the door or window. The strip can be made of rubber, plastic, or metal and should be specifically suited to the window or door type. In general, all operable windows and doors leading to the outside should be weatherstripped. New energy-efficient windows may not need weatherstripping, and doors leading to common hallways do not need to be weatherstripped.

An effective air leakage reduction strategy requires an understanding of how air moves in a building. Cold air tends to enter a building from the basement or lower floors and exit from the top floors and through the roof. This is called the "stack effect" and can result in over-heating on top floors and inadequate heating on lower floors.

Air sealing. Air sealing is accomplished by strategically applying caulk to holes, gaps, cracks, penetrations, and electrical receptacles and around windows and door frames. By-pass leakage sites such as channels in stud cavities extending from the basement to the attic also need to be sealed. This process is best performed by an experienced technician equipped with appropriate diagnostic tools and trained to assess sources of indoor air quality problems. A good way to determine where to focus air sealing efforts is to measure how much air leakage is occurring and where it is occurring. The most common diagnostic tool used to measure air leakage is a "blower door", a large fan that the technician temporarily installs in a door or window to measure air tightness and identify sources of leakage. Because of the stack effect, a good strategy in some buildings is to focus air sealing efforts on the bottom and top of a building, where the pressure differential is greatest.

MAINTENANCE ISSUES

Weatherstripping windows and doors may require repairs to the doors and windows before or during the installation to ensure operability. Weatherstripping may need to be replaced occasionally, and sealed areas may need to be occasionally recaulked. In addition, maintenance staff should make sure that window air conditioners are removed during winter months; if they cannot be removed, they should be covered. Maintenance staff should also ensure that windows remain closed in the winter to minimize air leakage. If windows are routinely left open in the winter, maintenance should investigate any potential overheating or air quality problems. Finally, to ensure adequate air quality, the HA needs to make sure that mechanical ventilation systems are functioning.

IMPORTANT POINTS TO CONSIDER

- Air sealing should be performed in conjunction with an assessment of the building's ventilation system to ensure adequate air quality.
- Air leakage reduction is best performed by an experienced professional.
- Weatherstripping should be selected for quality and durability.
- The technician should check combustion appliances (such as gas-fired heaters and hot water heaters) before and after air sealing to ensure that they are venting properly.

Cost/Benefit Worksheet
ECM No. 8: Control Air Leakage

Step 1 Obtain total cost of air sealing:

			$

Step 2 Transfer the following information from the Survey:

4-8	**a** Heating degree-day zone:			DDZ
4-17	**b** Total volume of buildings in development:			cu. ft.
5-9	**c** Cost of heating fuel:	Gas:		$/therm
		Oil:		$/gal
		Electric:		$/kWh
		Propane:		$/gal

Step 3 Obtain the following savings factor from Table 1:

Table 1	Infiltration savings factor:		

Step 4 Estimate annual energy savings:

2a		2b		3			
	x		x		=		/yr

Step 5 Calculate annual cost savings:

4		2c			
	x		=		$/yr

Step 6 Calculate payback period:

1		5			
	/		=		yrs

Table 1: Infiltration Savings Factors

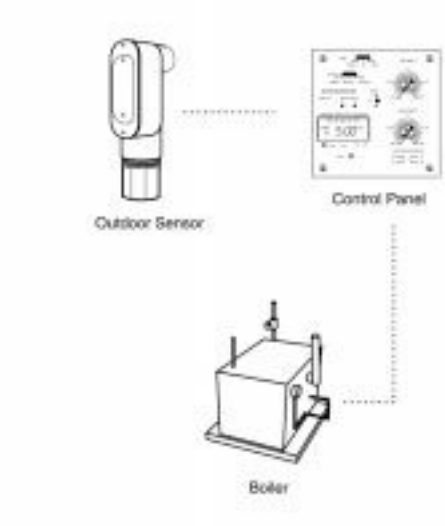
Instructions:

1) Find your fuel type.
2) Select the appropriate savings factor and transfer it to Step 3.

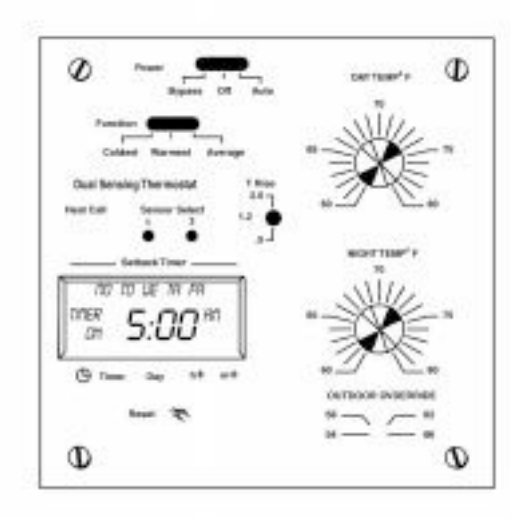
Fuel	Savings Factor
Gas	0.0026
Oil	0.0019
Electric	0.053
Propane	0.0028

ECM No. 11

INSTALL BOILER CONTROLS



Outdoor reset/cutout controls can save 7-9% of heating fuel use, with a payback of 1-2 years (DeCicco et al. 1995).



APPLICABILITY

- Multifamily buildings with central boilers
- Central boilers with no controls linked to outdoor temperature

DESCRIPTION

Boiler controls save energy by regulating the boiler so that it operates only when necessary. Some central boiler systems are totally uncontrolled, providing heat with no regard for how much is needed. In these developments, boilers are started up in the fall and remain on throughout the heating season until they are shut off in the spring. In other cases, the steam or hot water distribution system has apartment-level thermostatic controls, but the boiler runs constantly, even on warmer days when heat is not needed. Controls installed on the boilers can reduce energy waste by shutting off the boiler when the outdoor temperature reaches a specified temperature.

TYPES

The most basic type of boiler control is an outdoor reset/ cutout control system, which senses outdoor temperature and cycles the boiler as needed to maintain an appropriate temperature of the water in the boiler. It shuts off or "cuts out" boiler operation when outdoor temperature exceeds a specified temperature. More advanced controls link boiler run time, water temperature, or steam valve openings to outdoor temperature (DeCicco et al. 1995).

MAINTENANCE ISSUES

When controls are installed on boilers, maintenance staff need to be trained in their use and operation. The user's manual should be available to maintenance staff.

IMPORTANT POINT TO CONSIDER

- Other Heating System ECMs should be evaluated in conjunction with this one.

Mini Case Study

The Housing Authority of the City of Trenton, New Jersey, installed boiler controls at three low-rise developments in the mid-1980s. The developments, which consisted of sixteen buildings and 402 apartments, were built in the 1950s and had steam heat.

A research team measured the energy consumption before the installation and monitored the consumption for three years after the installation to analyze the level of energy savings achieved. The analysis adjusted for the effects of weather. During the first year, the savings at the three developments were 31%, 22%, and 5%, with an average of 19%.

In the second year, the savings dropped off at the first two developments to 27% and 12%, respectively, while the savings rose to 14% at the third development. The decrease in savings at the first two developments is attributed to poor maintenance of the heating system and its controls. Proper maintenance is particularly important when mechanical measures such as controls or new systems are installed (Ritschard & McAllister 1992).

Cost/Benefit Worksheet
ECM No. 11: Install Boiler Controls

Step 1 Obtain total cost of installing boiler reset and cutout controls:

		$

Step 2 Transfer the following information from the Survey:

5-14	**a** Annual heating fuel consumption:	Gas:		therms/yr
		Oil:		gal/yr
		Propane:		gal/yr
5-9	**b** Cost of heating fuel:	Gas:		$/therm
		Oil:		$/gal
		Propane:		$/gal

Step 3 Estimate annual energy savings:

		2a			
0.08	x		=		/yr

Step 4 Calculate annual cost savings:

3		2b			
	x		=		$/yr

Step 5 Calculate payback period:

1		4			
	/		=		yrs

ECM No.
13

INSTALL SETBACK THERMOSTATS

Daytime Setting

A 5-degree drop in thermostat setting over the whole winter can significantly lower the heating bill—often by as much as 15%.

Nighttime Setting

APPLICABILITY

- Single-family and multifamily buildings with non-setback thermostats

DESCRIPTION

Thermostats regulate temperature in a dwelling unit by controlling the heating system. A setback thermostat is a special type of wall-mounted thermostat that automatically lowers the temperature setting by 5-8 degrees at night, raising it back to the daytime setting in the morning. In addition to lowering the temperature at night, temperature-limiting setback thermostats limit daytime temperature to a predetermined setting (generally 72 degrees in family housing and 75 degrees in housing for the elderly). By lowering the temperature at night and limiting the daytime temperatures, setback thermostats save energy.

Resident energy education is crucial when replacing non-setback thermostats with temperature-limiting setback thermostats. At the time of installation, residents should be informed about why the thermostats were selected and how they operate. In buildings where heat had been unlimited, residents may find the lower temperatures uncomfortable at first, particularly if they are in the habit of keeping their windows open in the winter and wearing light clothing. A resident education program should stress the importance of keeping windows closed and should include information about how to dress appropriately at home in the winter.

TYPES

There are two main types of setback thermostats: clock and light-sensitive. Clock-based setback thermostats automatically go into setback mode at a certain time at night and return to the higher setting at a certain time in the morning. Light-sensitive thermostats go into setback mode when the room becomes dark at night, after residents turn out their lights. One disadvantage of clock thermostats is that they need to be programmed to establish the daytime and nighttime settings. They also need to be changed twice a year for Daylight Savings time, and their batteries need to be replaced occasionally. Light-sensitive thermostats do not need to be programmed and do not require batteries. However, one disadvantage of light-sensitive thermostats is that residents may keep lights on to keep temperatures higher.

MAINTENANCE ISSUES

To ensure comfort, HAs should consider installing insulation and other architectural measures such as air sealing before installing temperature-limiting thermostats. After installation, maintenance staff should make sure residents do not tamper with the thermostats in an attempt to raise the temperature limit. If clock thermostats are installed, maintenance will need to access units at least twice a year to adjust for Daylight

Savings time and to change batteries when necessary. Maintenance staff should be trained in programming and setting the thermostats.

IMPORTANT POINTS TO CONSIDER

- Setback thermostats should be of the temperature-limiting type.
- Thermostats in common areas and apartments should be tamper-proof. The electronic temperature-limiting type is more resistant to tampering than the mechanical type.
- Thermostats should be selected for ease of operation. For housing with elderly residents, thermostats with a large digital read-out should be selected (half-inch digits are best for elderly residents).
- Thermostats should be installed in a convenient, accessible location. They should be placed so that elderly residents do not have to bend down or reach up too far and disabled residents can access them readily. The standard location for thermostats is 54 inches from the floor.
- Thermostats in common areas should not be accessible to residents.
- HAs with heat pumps should make sure the thermostats selected are compatible with heat pump systems.

Cost/Benefit Worksheet
ECM No. 13: Install Setback Thermostats

Step 1	Obtain total cost of installing night setback thermostats.			
				$
Step 2	Transfer the following information from the Survey:			
4-8	**a** Heating degree-day zone:			DDZ
5-14	**b** Annual heating fuel consumption:	Gas:		therms/yr
		Oil:		gal/yr
		Electric:		kWh/yr
		Propane:		gal/yr
5-9	**c** Cost of heating fuel:	Gas:		$/therm
		Oil:		$/gal
		Electric:		$/kWh
		Propane:		$/gal
Step 3	Obtain the following savings factor from Table 1:			
Table 1	Savings factor:			

Step 4 Estimate annual energy savings:

3		2b			
	x		=		/yr

Step 5 Calculate annual cost savings:

4		2c			
	x		=		$/yr

Step 6 Calculate payback period:

1		5			
	/		=		yrs

ECM No. 13: Install Setback Thermostats

Table 1: Savings Factors for Installing Setback Thermostats
Heating Energy Savings from Nightly Setback of 8 Degrees

Instructions:

1) Find the appropriate heating degree day zone (DDZ) (see Step 2).
3) Select the appropriate savings factor and transfer it to Step 3.

Heating DDZ	Savings Factor
2.50 or less	.15
2.51-2.80	.12
2.81-3.40	.10
3.41-4.10	.093
4.11-4.80	.08
4.81-5.50	.075
5.51 or more	.072

ECM No. 21

INSTALL WATER-EFFICIENT SHOWERHEADS AND FAUCET AERATORS

Water-efficient showerheads can reduce hot-water consumption for bathing by 30%, while still providing satisfactory water pressure. A high-quality low-flow showerhead costs $10 to $20 and will pay for itself in energy savings in less than a year (National Renewable Energy Laboratory 1995).

APPLICABILITY

- Single-family and multifamily buildings that do not have water-efficient showerheads and faucet aerators

DESCRIPTION

About half the hot water consumed in a typical household is for bathing, and another 7% to 14% is used in the sink (E Source 1991). By reducing the flow of water coming from the shower and faucets, water-efficient showerheads and faucet aerators can generate significant energy savings at low cost and with easy installation. In addition to saving energy, showerheads and aerators save on water and sewer costs, which are rising in many areas.

Older showerheads deliver as much as 5 to 10 gallons per minute. New showerheads are required to be water-efficient, delivering 2.5 gallons per minute or less at a standard water pressure. Water-efficient, or low-flow, showerheads are designed to provide an acceptable shower at a greatly reduced flow rate. Most are equipped with a button to switch the water off at the showerhead, to save water while shaving or lathering. Water-efficient showerheads should not be confused with the *flow restrictors* used in the 1970s and early 1980s, which simply reduced the flow rate far below design level, often resulting in an unacceptable shower (E Source 1991).

The average faucet has a flow rate of about 3 to 5 gallons per minute. Adding a screw-in faucet aerator reduces the flow to 0.5 to 1.0 gallons per minute in the bathroom and 1.5 to 2.0 gallons per minute in the kitchen. In addition to saving energy and water, the "foamier" water that comes from faucet aerators wets objects (hands, food, dishes) better than water from a faucet with no aerator, which tends to bounce off the object rather than thoroughly wetting it (E Source 1991).

MAINTENANCE ISSUES

Water-efficient showerheads and faucet aerators can be easily installed by maintenance staff. Once installed, wire mesh screens in faucet aerators may need to be cleaned periodically, depending on the quality of the tap water. Maintenance staff should periodically check for faucet leaks, particularly on the hot water side, and residents

should be strongly encouraged to report such leaks. In addition, maintenance staff should make sure residents do not remove showerheads or faucet aerators.

IMPORTANT POINTS TO CONSIDER

- High-quality showerheads should be selected, as lower quality showerheads may simply restrict water flow, resulting in poor performance.
- When water-efficient showerheads are installed, the old showerheads should be removed from the household to discourage re-installation of the old units.
- Where vandalism is a problem, vandal-resistant aerators and showerheads should be selected.
- "Mist" type showerheads provide a poor-quality shower and can increase apartment humidity more than other showerheads, exacerbating any existing moisture problems.
- Residents should be informed about the button on low-flow showerheads that enables them to shut the water off to save water while shaving or lathering.

Cost/Benefit Worksheet
ECM No. 21: Install Water-Efficient Showerheads and Faucet Aerators

Step 1 Obtain total cost of replacing showerheads and aerators (typically one showerhead and two aerators per dwelling unit):

		$

Step 2 Transfer the following information from the Survey:

4-14	**a** Total number of residents in development:			
5-9	**b** Cost of DHW heating fuel:	Gas:		$/therm
		Oil:		$/gal
		Electric:		$/kWh
		Propane:		$/gal

Step 3 Estimate annual energy savings:

		2a			
Gas:	10.0 x		=		therms/yr
Oil:	7.2 x		=		gals/yr
Electric:	206.5 x		=		kWh/yr
Propane:	10.1 x		=		gal/yr

Step 4 Calculate annual cost savings:

3		2b			
	x		=		$/yr

Step 5 Calculate payback period:

1		4			
	/		=		yrs

ECM No. 26

REPLACE INCANDESCENT LIGHTING WITH COMPACT FLUORESCENT LAMPS IN DWELLING UNITS

Replacing a 75-watt incandescent bulb with a 20-watt CFL that costs $18 will generate enough savings to pay for the CFL in about three years, assuming the lamp is on for 3 hours per day. In addition, because the CFL will last up to ten times longer than the incandescent lamp, the HA will save on maintenance costs for replacing lamps.

APPLICABILITY

- Single-family homes and apartments in multifamily buildings
- Dwelling units that do not have fluorescent lamps

DESCRIPTION

Standard incandescent light bulbs, typically used in public housing dwelling units, use three to four times more electricity than fluorescent lamps. Replacing incandescent bulbs with fluorescent lamps will save up to 75% of the electricity costs per lamp. In addition, because fluorescent lamps last longer than incandescent bulbs, the HA saves on replacement and maintenance costs. The most appropriate type of fluorescent lighting for dwelling units is a compact fluorescent lamp (CFL). Advances in technology over the past few years have brought great improvements to CFLs in terms of light quality and appearance, and CFLs now come in a variety of shapes and sizes.

Although the initial cost of CFLs is high relative to incandescent lamps, the energy savings and reduced time and expense from lamp replacement make CFLs a cost-effective energy conservation measure for many applications. Because the energy savings from a CFL depend on the number of hours the lamp is on, CFLs should be installed in areas with the heaviest use, such as the kitchen, bathroom, and hallways. To avoid insufficient light levels, the wattage of the CFL should generally be one-third to one-fourth that of the incandescent it is replacing, unless the room was previously overlit.

TYPES

There are two basic types of CFL lamps: screw-in and hard-wired systems.

Screw-in lamps. Screw-in lamps (also called "integral units") fit into existing lamp fixtures, just as incandescent bulbs do. They are available in various shapes and sizes, ranging from 5 to 28 watts (E Source 1994). The best places for screw-in CFLs are in table and standing lamps and ceiling and wall fixtures. Because this type of CFL is removable, special care should be taken to ensure adequate light levels to prevent removal by dissatisfied residents. At $10

to $30 per lamp (E Source 1994), screw-in lamps are less expensive and easier to install than hard-wire fixtures. However, if theft is a concern, hard-wired fixtures may be preferable.

Hard-wired fixtures. Hard-wired fixtures consist of a ballast and a lamp socket that are permanently wired into a fixture. Hard-wired fixtures come in various wattages up to a maximum of 55 watts (E Source 1994). Although hard-wired fixtures are more expensive than screw-in CFLs, they are particularly appropriate where vandalism or theft is a concern because they are not removable. The most appropriate places for hard-wired fixtures are in the kitchen, bathroom, and frequently used incandescent ceiling fixtures.

Another type of CFL lamp is specially designed to replace halogen torchiere lamps. Halogen torchiere lamps are very popular because they are inexpensive, but they are energy hogs, and they pose a serious fire hazard. By contrast, CFL torchieres are six times more efficient than halogen torchieres, and they pose no fire hazard (E Source 1996b).

MAINTENANCE ISSUES

Because compact fluorescent lamps last up to ten times longer than incandescent bulbs, the amount of maintenance staff time required to replace bulbs decreases dramatically. Maintenance staff should watch for removal of screw-in CFLs by residents.

IMPORTANT POINTS TO CONSIDER

- Care should be taken to ensure the light output of a CFL, measured in lumens, is adequate for a particular location. To avoid insufficient light levels, a good rule of thumb is that the wattage of the CFL should generally be one-third to one-fourth that of the incandescent it is replacing.
- CFLs should be selected in appropriate sizes and shapes. For example, some CFLs are too bulky or too long to fit in some fixtures intended for incandescent bulbs.
- Elderly residents often require higher light levels than younger people due to reduced vision capabilities.
- The light output of some CFLs can decrease over time.
- Where theft is a problem, hard-wired CFLs should be selected.
- CFLs are not compatible with dimming switches, unless they come with a special dimming ballast.
- Generally, replacement of fixtures should be done by qualified contractors.
- Because of the high cost of CFLs relative to incandescent bulbs, the HA, not the residents, should consider being responsible for replacing them when they burn out.

Cost/Benefit Worksheet
ECM No. 26: Replace Incandescent Lighting with Compact Fluorescent Lamps in Dwelling Units

This analysis can be done for either one, two, or all of the following dwelling unit light fixtures: kitchen, bathroom, and hallway/foyer. Choose the number of fixtures that applies to your development.

Step 1 Obtain total cost of installing CFLs in dwelling units (one, two, or three per dwelling):

[ ] $

Step 2 Transfer the following information from the Survey:

4-13 **a** Number of dwelling units [ ]

5-9 **b** Cost of electricity: [ ] $/kWh

Step 3 Obtain the following value from Table 1:

Table 1 kWh saved per year: [ ] kWh/yr

Step 4 Estimate annual energy savings:

2a		3			
[ ]	x	[ ]	=	[ ]	kWh/yr

Step 5 Calculate annual cost savings:

4		2b			
[ ]	x	[ ]	=	[ ]	$/yr

Step 6 Calculate payback period:

1		5			
[ ]	/	[ ]	=	[ ]	yrs

ECM No. 26: Replace Incandescent Lighting with Compact Fluorescent Lamps in Dwelling Units

Table 1: Annual Electricity Savings from Replacing Incandescent Lamps

Instructions:

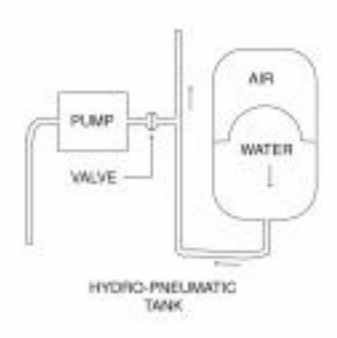
1) Find the average number of bulbs or fixtures that would be replaced per unit. (See question 4-67.)
2) Select the savings for that number of fixtures and transfer to Step 3.

Fixtures per Unit	Savings (kWh)
One fixture (kitchen only)	150
Two fixtures (kitchen and bath)	210
Three fixtures (kitchen, bath, hall)	250

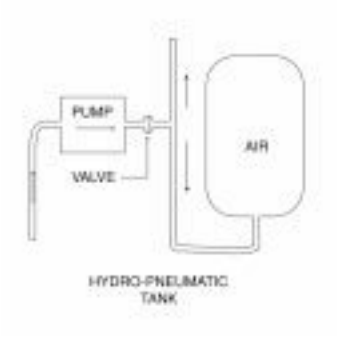
This table assumes average usage of lights by residents in the indicated locations; savings may vary substantially between individual dwelling units.

ECM No. 36

CONVERT WATER SUPPLY PUMPS



No demand:
- pump off
- valve closed
- hydro-pneumatic tank maintains water pressure



Demand:
- tank empties
- valve opens
- pump starts supplying water to building and refilling tank

APPLICABILITY

- High-rise multifamily buildings without roof-mounted water tanks

DESCRIPTION

In high-rise buildings that do not have water tanks on the roof, pumps are used to maintain adequate water pressure in the domestic water system. These pumps must operate continuously to provide adequate water pressure, even when there is no water demand. Converting water supply pumps to a system called a "hydro-pneumatic" system will keep adequate pressure levels without continuous pump operation, resulting in electricity savings.

During those periods when domestic water is not required, pressure is maintained by a hydro-pneumatic tank that contains air and water separated by a flexible membrane. When demand occurs for water, the imbalance of pressure causes the water stored in the tank to be provided to the building. When the tank is emptied, the pumps are activated and the water is supplied directly to the building. When demand ceases, water is pumped into the tank until adequate pressure can be maintained by the system and the pumps shut down.

The savings assumed for this ECM are 33% of the total pumping energy used for water supply. This level of savings is based on the assumption that water demand is minimal between 11 pm and 7 am.

MAINTENANCE ISSUES

Maintenance staff should be aware of a planned course of action in case the system ceases to function properly.

IMPORTANT POINTS TO CONSIDER

- System pumps and tank must be properly sized to provide adequate amounts of water for the entire building or project.
- The entire system must be located in a readily accessible space for maintenance purposes.
- The tank must be located in an area that can support its weight structurally. If such a space is not readily available, structural modifications may be required.

Cost/Benefit Worksheet
ECM No. 36: Convert Water Supply Pumps

Step 1 Obtain total cost of installing hydro-pneumatic water pressure systems:

		$

Step 2 Transfer the following information from the Survey:

4-62	**a** Total horsepower of existing booster pumps:		HP
5-9	**b** Cost of electricity:		$/kWh

Step 3 Estimate annual energy savings:

2a					
	x	2190	=		kWh/yr

Step 4 Calculate annual cost savings:

3		2b			
	x		=		$/yr

Step 5 Calculate payback period:

1		4			
	/		=		yrs