Massachusetts Department
of Energy Resources

Energy Conservation
Improvement Program
Energy Audit

The Town of Tewksbury

1960 Parks & Recreation Building
Tewksbury, MA

March 17, 2009

Prepared by

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TABLE OF CONTENTS

SECTION 1: EXECUTIVE SUMMARY 1
Introduction 3
SECTION 2: FACILITY OVERVIEW 4
Building Description 4
Energy Profile 6
Clean Energy Opportunities 7
Solar Energy 7
Wind and Hydroelectric 7
Wood Pellet Fueled Heating 8
SECTION 3: ENERGY CONSERVATION MEASURES 9
Recommended Measures 14
ECM 87: Use High-Efficiency Fluorescent Lighting 14
ECM 102: Install Temperature Setup/Setback Control System 14
Measures Considered But Not Recommended 15
Window Replacement 15

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SECTION 1: EXECUTIVE SUMMARY

American Development Institute (ADI) has been retained by the Department of Energy Resources (MA – DOER) to prepare a scoping energy audit for a number of municipal buildings and school department buildings for the Town of Tewksbury, Massachusetts.

This energy study for the 1960 Parks & Recreation Building was commissioned in order to identify cost-effective energy conservation measures (ECMs) that would qualify for funding under the Energy Conservation Improvement Program (ECIP). The ECIP may fund a portion of this project.

The ECMs recommended in this study, if implemented, will yield annual energy savings of approximately $778, or 295 kWh and 9 MMBTU. These savings represent 10.4% of the present annual energy costs of $4,052. With a total installed cost of approximately $2,490, the overall project payback is 5.9 years; potential utility incentives could reduce the payback to 5.5 years. As part of the proposed setback thermostat measure, ADI recommends the facility implement retro-commissioning to optimize the operational efficiency of the building heating system.

Savings are summarized in Table 1.1 below.

Acknowledgements

The cooperation and assistance of Scott Durkee of the Massachusetts DOER and Ed Johnson of the Town of Tewksbury is greatly appreciated in making this study possible.

Table 1.1: Summary of Energy Efficiency Measures

ECM #	ECM Description	Annual Savings			Installed Cost ($)	Simple Payback (years)	Utility Funding ($)	Net Cost $	Net Payback yrs
		Electricity (kWh)	Fuel (MMBTU)	Total Savings ($)					
ECM 87	Use High-Efficiency Fluorescent Lighting	295		$ 66	$ 1,290	19.4	$ 160	$ 1,130	17.0
ECM 102	Install Setback Thermostat		9	$ 356	$ 1,200	3.4		$ 1,200	3.4
Totals		**295**	**9**	**$ 422**	**$ 2,490**	**5.9**	**$ 160**	**$ 2,330**	**5.5**

Introduction

Through the Energy Audit Program (EAP) offered by the Commonwealth of Massachusetts, Department of Energy Resources (DOER), technical assistance is provided for all buildings owned and operated by cities, towns, regional school districts and wastewater districts to identify capital improvements to reduce energy costs. The technical assistance provided by DOER includes an initial benchmarking of buildings and structures included in the application. Based on the results of the benchmarking, a detailed energy audit may be performed as well as a variety of feasibility studies to evaluate the potential to incorporate renewable energy sources. This comprehensive assistance provides communities with the knowledge needed to reduce energy consumption and associated financial resources.

The purpose of this audit report is to provide the program participant with a list of energy conservation projects, their costs and estimated energy savings. This information may be used to support a future application to DOER's Energy Conservation Improvement Program (ECIP), support performance contracting or justify a municipal bond funded improvement program. ECIP is a state funded grant program that provides funds for energy conserving capital improvements.

The approach taken in this audit included a thorough walk-through of the building(s) and associated systems and equipment, including both process systems and building systems. The major areas covered in the audit included the building envelope, process systems, electrical systems, HVAC systems, lighting systems and operational and maintenance procedures. A major element of the audit also included an initial interview and ongoing consultation with operational and maintenance personnel, as well as building occupants. This approach is critical to the quality of the audit process, since the input of building personnel is invaluable to the effort to obtain accurate information required for the audit.

The recommendations within this report are based on one year of submitted usage data, a site review and preliminary evaluation. The energy savings and energy production figures are projected estimates based on conceptual project upgrades, information gathered at the site, and from the historical utility information provided. The actual savings may vary from these estimates due to a variety of factors. The figures used for the cost of recommended upgrades are 'opinions of probable cost' and are intended to be used for feasibility purposes only. The recommended measures should proceed to detailed design and further re-evaluation followed by competitive bidding per the Massachusetts Procurement Guidelines. The resulting responses to the bid should be used for budget approval purposes. For more information see:

Office of the Inspector General, Municipal, County, District, and Local Authority Procurement of Supplies, Services, and Real Property, Publication No. CR-1520-170-200-09/06-IGO.

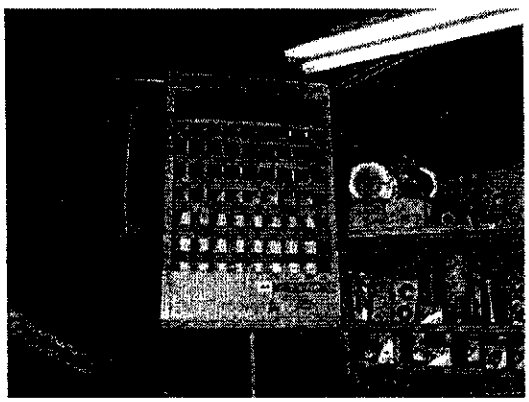
SECTION 2: FACILITY OVERVIEW

BUILDING DESCRIPTION

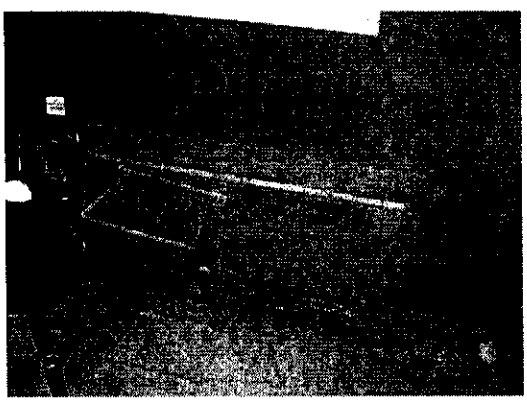
The 1960 Parks & Recreation Building building is seasonal building that comprises 4,000 ft^2 of floor space that is operated weekdays from about 8 am to 4 pm when the weather is warm enough. The exterior windows are double pane and are in fair condition. The primary lighting systems in the facility are fluorescent fixtures with T12 lamps.

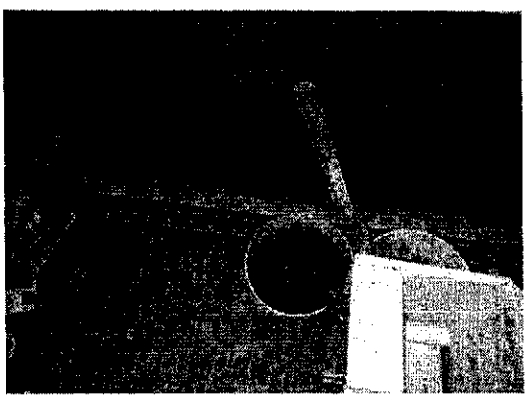
The building is primarily heated by a gas fired heating and ventilating unit. The second level of the facility has electric resistance heating baseboard radiation and cabinet heaters that are currently not operated. The H& V unit is controlled by a thermostat that operates the unit in occupied mode at all times. An electric resistance hot water heater provides domestic hot water.

The Annual Energy Index (AEI), as shown in the Facility Energy Profile presented below, based on end-use energy is 25,000 BTU/SF/Year. This value is relatively low for a building in New England, primarily due to it's not being in operation in the winter months.

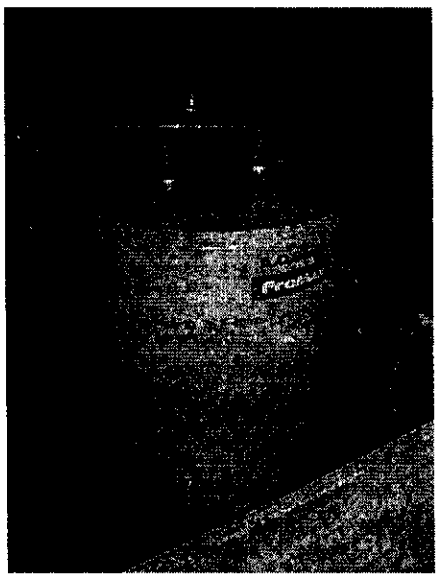


Heating & Ventilating Unit





Electric Heaters



Domestic Hot Water

ENERGY PROFILE

Based on the electric billing history for fiscal years 2007, the total electrical consumption for the facility was 1,719 kWh, with a total cost of $388. Electricity is provided by National Grid USA. The average blended rate for the facility is $0.43 per kWh.

The facility utilizes natural gas for heating, with an annual total usage of 915 ccf at $4,052. The average cost of fuel is $38.88/MMBtu.

Table 2.1: Profile of Annual Energy Use

	Electric	Fuel	Total
Total Energy Usage	1,719 kWh	94 MMBtu	100 MMBtu
Total Energy Cost	$ 388	$ 3,664	$ 4,052
Total Energy per sf	0.430 kWh per sf	0.024 MMBtu per sf	0.025 MMBtu per sf
Total Cost per unit	$ 0.23 $/kWh	$ 38.88 $/MMBtu	$ 40.47 $/MMBtu
Total Cost per sf	$ 0.10	$ 0.92	$ 1.01

CLEAN ENERGY OPPORTUNITIES

The Commonwealth of Massachusetts is dedicated to promoting clean energy as an alternative to traditional sources of energy. As such, the DOER and other agencies have developed a number of programs to promote the use of clean energy sources by potentially providing technical assistance and/or financial incentives based on project feasibility. A brief discussion of the various programs is provided below, along with specific projects that may be appropriate for the respective technologies.

Solar Energy

Through the Commonwealth Solar Program[1], rebates are offered to encourage the installation of solar photovoltaic (PV) power by homeowners, businesses and municipalities. The rebate program is designed to help defray the costs that are associated with the installation of eligible systems from 20% - 60%. Rebate applications have been available since January 23, 2008. Incentives are greater for projects on public buildings and those that incorporate products manufactured in Massachusetts. The rebates are available for systems that will be directly owned by the applicant, as well as those financed through a third-party ownership model that takes advantage of federal and state tax credits. A total of $68 million is available over the next four years. The following table provides the initial rebate levels:

Non-Residential Rebates for Incremental Capacity ($/Watt)				
Incremental Capacity	First: 1 to 25 kW	Next: > 25 to 100 kW	Next: > 100 kW to 200 kW	Next: > 200 kW to 500 kW
Base Incentive	$3.25	$2.50	$2.00	$1.50
Bonus Additions to Base Incentives				
Massachusetts Manufactured System	$0.25	$0.25	$0.25	$0.25
Public Building	$0.50	$0.50	$0.25	$0.25

Wind and Hydroelectric

The Massachusetts Technology Collaborative[2] (MTC) is a quasi-public agency and is the state's development agency for renewable energy. MTC offers a number of programs, including those that provide funding for wind and hydroelectric projects. The two primary programs are the Small Renewables Initiative (SRI) and the Large Onsite Renewables Initiative (LORI). The SRI provides rebates for the installation of wind and small hydroelectric projects that are up to 10 kW. Annual funding is approximately $3.6 million and is provided on a "first come – first served" basis.

The LORI awards grants for feasibility studies and design and construction projects for projects that are greater than 10 kW. Feasibility grants are capped at $40,000 with an applicant cost share of 15%. Design grants are capped at the lesser of $125,000 or 75% of actual cost and construction grants are capped at the lesser of $275,000 or 75% of actual costs.

[1] Web site: www.commonwealthsolar.org
[2] Web site: www.masstech.org

Wood Pellet Fueled Heating

On a periodic basis, the DOER accepts grant applications for wood pellet fueled heating systems[3], which burn pellets made from renewable sources of energy such as compacted sawdust, wood chips, bark and agricultural crop waste. Funding is available to cities, towns, regional school districts, as well as water and wastewater districts. A maximum of $50,000 per project is available for installation; however, applicants may propose greater grant requests, which will be considered based on the merits of the project and available funding. A total of $525,000 is available for this program. The grantee is responsible for repaying 30% of the funds granted within one year of the completed installation.

Clean Energy Projects for the Town of Tewksbury

Based on the walkthrough that was performed as part of this audit, the Town of Tewksbury does not have *Clean Energy* opportunities at the 1960 Parks & Recreation Building that could be pursued further. If a decision is made in the future to move forward on any *Clean Energy* opportunities, then the granting authority should be contacted for the respective program, as previously described. The typical process requires the submittal of an initial application. Once a preliminary approval is obtained, a more detailed technical assessment is performed to determine the specific costs and potential payback of the project. Often times, the granting authority will provide some level of funding to support this phase of the project. If there are any questions or further guidance required, please contact Scott Durkee at DOER, phone number (617) 727-4732 ext. 40156.

[3] http://www.mass.gov/Eoca/docs/doer/pub_info/doer_pellet_guidebook.pdf

SECTION 3: ENERGY CONSERVATION MEASURES

This section describes all the ECMs that are recommended for inclusion in the ECIP. The selected measures meet the cost-effectiveness criteria of the program, and are eligible for funding under the ECIP.

The following measures were considered in our evaluation:

Table 3.1: Energy Conservation Measures Evaluated

Building System	Category	ECM#	ECM Name	Y/N
BUILDING EQUIPMENT OPERATION	*Reduce Operating Hours*	ECM 1	Reduce Operating Hours for Space Heating and Cooling Systems	NO
		ECM 2	Reduce Operating Hours for Ventilation Systems	NO
		ECM 3	Reduce Operating Hours for Water Heating Systems	NO
		ECM 4	Reduce Operating Hours for Lighting Systems	NO
		ECM 5	Reduce Operating Hours for Escalators and Elevators	NO
		ECM 6	Reduce Operating Hours for Equipment and Machines	NO
	Adjust Space Temperature and Humidity Setpoints	ECM 7	Maintain Heating and Coolers Cooling Temperature at recommended Setpoints	NO
		ECM 8	Maintain Humidification and Dehumidification at Setpoints	NO
		ECM 9	Adjust Heating and Cooling Setpoints When the Building Is Not Occupied	NO
BUILDING ENVELOPE	*Reduce Heat Conduction Through Ceilings and Roofs*	ECM 10	Insulate Ceilings and Roofs	NO
		ECM 11	Install Vapor Barriers in Ceilings and Roofs	NO
	Reduce Solar Heat Gain Through Roofs	ECM 12	Install Reflective Roof Services	NO
	Reduce Heat Conduction Through Walls	ECM 13	Insulate Walls	NO
		ECM 14	Install Vapor Barriers in Walls	NO
	Reduce Heat Conduction Through Floors	ECM 15	Insulate Floors	NO
	Reduce Heat Conduction and Long-Wave Radiation Through Glazing Areas	ECM 16	Install Storm Windows and Multiple-Glazed Windows	NO
		ECM 17	Insulate Movable Windows	NO
		ECM 18	Install Operable Windows	NO
	Control Solar Heat Gain Through Glazing Areas	ECM 19	Install Exterior Shading	NO
		ECM 20	Install Interior Shading	NO
		ECM 21	Use Tinted or Reflective Glazing or Films	NO
		ECM 22	Plant Shade Trees	NO
	Reduce Infiltration	ECM 23	Seal Vertical Shafts and Stairways	NO
		ECM 24	Caulk and Weatherstrip Doors and Windows	NO
		ECM 25	Install Revolving Doors or Construct Vestibules	NO

Building System	Category	ECM#	ECM Name	Y/N
HEATING, VENTILATION AND AIR-CONDITIONING (HVAC) SYSTEMS	*Electric to Fossil Fuel Conversions*	ECM 26	Convert Existing Electric Domestic Hot Water System to Fossil Fuel or Heat Pump	NO
		ECM 27	Convert Existing Heating System from Electric to Domestic Hot Water	NO
	Reduce Ventilation	ECM 28	Reduce Ventilation Rates Without Affecting Indoor Air Quality	NO
		ECM 29	Reduce the Generation of Indoor Pollutants	NO
		ECM 30	Install Air-to-Air Heat Exchangers	NO
		ECM 31	Install Air Cleaners	NO
		ECM 32	Install Local Ventilation Systems	NO
	Improve Chiller Efficiency	ECM 33	Clean Evaporator and Condenser Surfaces of Fouling	NO
		ECM 34	Raise Evaporator or Lower Condenser Water Temperature	NO
		ECM 35	Isolate Off-Line Chillers and Cooling Towers	NO
		ECM 36	Install Evaporation-Cooled or Water-Cooled Condensers	NO
	Improve Boiler or Furnace Efficiency	ECM 37	Clean Boiler Surfaces of Fouling	NO
		ECM 38	Check Flue for Improper Draft and repair if necessary	NO
		ECM 39	Check for Air Leaks and repair if necessary	NO
		ECM 40	Install Flue Gas Analyzers for Boilers	NO
		ECM 41	Preheat Combustion Air, Feed Water or Fuel Oil with Reclaimed Waste Heat	NO
		ECM 42	Isolate Off-Line Boilers	NO
		ECM 43	Install Automatic Vent Dampers	NO
		ECM 44	Install Automatic Boiler Blow-Down Control	NO
		ECM 45A	Replace Boiler/Furnace	NO
		ECM 45B	Install Pulse or Condensing Boilers/Furnaces	NO
		ECM 46	Install Air-Atomizing Burners (for Oil-Fired Systems)	NO
		ECM 47	Install Low-Excess-Air Burners (for Oil-Fired Systems)	NO
		ECM 48	Install Modular Units	NO
	Improve Air-Conditioner or Heat Pump Efficiency	ECM 49	Clean Air Filters	NO
		ECM 50	Install Add-On Heat Pumps	NO
		ECM 51	Install Ground or Ground-Water Source Heat Pump	NO
	Reduce Energy Used for Tempering Supply Air	ECM 52	Install Variable Air Volume Systems	NO
		ECM 53	Reset Supply Air Temperatures	NO
		ECM 54	Reset Hot/Chilled Water Temperatures	NO
	Use Energy-Efficient Cooling Systems	ECM 55	Install Economizer Cooling Systems	NO
		ECM 56	Install Evaporative Cooling Systems	NO
		ECM 57	Install Desiccant Cooling Systems	NO
		ECM 58	Install Cooling Tower Cooling Systems	NO
		ECM 59	Install Roof-Spray Cooling Systems	NO
		ECM 60	Create Air Movement with Fans	NO
		ECM 61	Exhaust Hot Air From Attics	NO

Building System	Category	ECM#	ECM Name	Y/N
HVAC DISTRIBUTION SYSTEMS	*Reduce Distribution System Energy Losses*	ECM 62	Repair Ducting and Piping Leaks	NO
		ECM 63	Maintain Steam Traps	NO
		ECM 64	Insulate Ducts	NO
		ECM 65	Insulate HVAC System Pipes	NO
	Reduce System Flow Rates	ECM 66	Reduce System Air Flow Rates	NO
		ECM 67	Reduce Heating/Cooling Water or Steam Flow Rates	NO
	Reduce Steam Resistance	ECM 68	Clean Air Filters in Ducts	NO
		ECM 69	Remove Scale from Water and Steam Pipes	NO
		ECM 70	Rebalance Piping Systems	NO
		ECM 71	Rebalance Ducting Systems	NO
		ECM 72	Design Ducting Systems to Reduce Flow Resistance	NO
		ECM 73	Install Booster Pumps	NO
WATER HEATING SYSTEMS	*Reduce Hot Water Loads*	ECM 74	Reduce Hot Water Consumption	NO
		ECM 75	Lower Hot Water Temperatures	NO
		ECM 76	Preheat Feedwater With Reclaimed Waste Heat	NO
	Reduce Hot Water Heating System Losses	ECM 77	Insulate Hot Water Pipes	NO
		ECM 78	Insulate Water Storage Tanks	NO
	Use Energy-Efficient Water Heating Systems	ECM 79	Install Decentralized Water Heaters	NO
		ECM 80	Use Smaller Water Heaters for Seasonal Requirements	NO
		ECM 81	Use Heat Pump Water Heaters	NO
		ECM 82	Heat Water with Solar Energy	NO
LIGHTING	*Reduce Illumination Requirements*	ECM 83	Clean and Maintain Systems	NO
		ECM 84	Reduce Illumination to recommended levels	NO
		ECM 85	Reduce Time of Operations	NO
		ECM 86	Use Task Lighting	NO
	Install Energy-Efficient Lighting Systems	ECM 87	Use High-Efficiency Fluorescent Lighting	YES
		ECM 88	Use High-Pressure Sodium Lighting in Selected Areas	NO
		ECM 89	Install Pulse Start Metal Halide Lighting in Selected Areas	NO
		ECM 90	Install High-Efficiency Ballasts	NO
		ECM 91	Install Occupancy Sensors	NO
	Use Daylight	ECM 92	Install Dimming Controls with Windows	NO
		ECM 93	Install Dimming Controls with Skylights	NO
POWER SYSTEMS	*Reduce Power System Losses*	ECM 94	Correct Power Factors	NO
		ECM 95	Install Energy-Efficient Transformers	NO
	Install Energy Efficient Motors	ECM 96	Replace Oversized Motors	NO
		ECM 97	Use High-Efficiency Motors	NO
		ECM 98	Use Variable Speed Motors	NO
	Reduce Peak Power Demand	ECM 99	Use Load-Shedding	NO
		ECM 100	Install a Cogeneration System	NO
		ECM 101	Install a Cool Storage System	NO

Building Systems	Category	ECM#	ECM Name	Y/N
ENERGY MANAGEMENT SYSTEMS	*Use Energy Management and Control Systems*	ECM 102	Install Temperature Setup/Setback Control System	YES
		ECM 103	Install Time-of-Day Control System	NO
		ECM 104	Install Duty-Cycling Control System	NO
		ECM 105	Install Supply Air Temperature Reset Control System	NO
		ECM 106	Install Hot/Chilled Water Supply Temperature Reset Control System	NO
		ECM 107	Install Ventilation Purging Control System	NO
		ECM 108	Install Economizer Cooling Control System	NO
		ECM 109	Install Demand Limiting Control System	NO
MISC.	*Heat Reclaim Systems*	ECM 110	Install Double-Bundle Chillers	NO
		ECM 111	Reclaim Heat from Boiler Blowdown	NO
		ECM 112	Reclaim Incinerator Heat	NO
		ECM 113	Reclaim Heat from Composition System Flue	NO
		ECM 114	Install Water-Loop Heat Pump System	NO
		ECM 115	Reclaim Heat from Prime Movers	NO
		ECM 116	Install Piggyback Absorption Systems	NO
		ECM 117	Recover Heat from Light Systems	NO
		ECM 118	Reclaim Heat from Refrigerator Hot Gas	NO
		ECM 119	Reclaim Heat from Steam Condensate	NO
		ECM 120	Reclaim Heat from Waste Water	NO
	Appliances	ECM 121	Install Energy-Efficient Appliances	NO
		ECM 122	Convert Electric Dryers to Natural Gas	NO
	Domestic Water Conservation	WCM 1	Install Low Flow Aerators on Sinks	NO
		WCM 2	Install Low Flow Toilets, Urinals	NO
		WCM 3	Install Low Flow Shower Heads	NO
		WCM 4	Install Reverse Osmosis Water Demineralizing Systems	NO
		WCM 5	Install Cooling Towers Where Once Through Cooling is Prevalent	NO

RECOMMENDED MEASURES

Based on the scoping audit and analysis, ADI recommends that the following Energy Conservation Measures be further evaluated with a detailed study. ADI believes that the implementation of these ECM's will provide a relatively short simple payback period.

ECM 87: Use High-Efficiency Fluorescent Lighting

Measure Description

ADI is recommending the replacement of 120 T12 fluorescent fixtures with High Efficiency T8 lamps and electronic ballasts. T8 lamps and electronic ballasts are up 30% more energy efficient than T12 lamps and magnetic ballasts. This retrofit will also provide enhanced lighting in the facility.

Incentives will likely be available from National Grid based on the installation of the new lighting fixtures. These incentives are subject to the discretion of National Grid and will improve the simple payback for this ECM; incentives shown are estimated.

Economic Summary

The following table provides an economic summary of this ECM.

	Savings			Total			Net	Net
ECM #	Electricity kWh	Fuel MMBTU	$	Cost $	Payback yrs	Utility Funding ($)	Cost $	Payback yrs
ECM 87	295	0	$ 66	$ 1,290	19.4	$ 160	$ 1,130	17.0

ECM 102: Install Temperature Setup/Setback Control System

Measure Description

The control of the facility thermostat is currently manual, requiring occupant intervention to set the thermostat at the setback setting before they leave. If this isn't done, the facility could be heated unnecessarily for days before the facility is occupied again.

ADI recommends that the facility install an occupancy based thermostat, similar to those used in the hotel industry. These thermostats are equipped with occupancy sensors that reset the space thermostat from an occupied setpoint to an unoccupied setback setpoint automatically based on the sensed occupancy of the space. This automated control will eliminate the possibility of occupants forgetting to turn the thermostat down, resulting in heating energy savings.

Economic Summary

The following table provides an economic summary of this ECM.

	Savings			Total			Net	Net
ECM #	Electricity kWh	Fuel MMBTU	$	Cost $	Payback yrs	Utility Funding ($)	Cost $	Payback yrs
ECM 102	0	9	$ 356	$ 1,200	3.4	$ -	$ 1,200	3.4

MEASURES CONSIDERED BUT NOT RECOMMENDED

ADI reviewed the systems in the facility and considered a number of potential Energy Conservation Measures (ECM's). Based on a preliminary review, most of the possible ECM's were deemed to be not applicable for implementation due to long payback periods:

Window Replacement

All the windows in the facility are single pane and in poor condition. Although some energy savings would accrue through a window retrofit program, the cost would likely be prohibitive with paybacks in the 15 to 20 year range.