Delaware Department of Natural Resource and Environmental Control.

Energy Audit

For:

Village of Arden
Buzz Ware Village Center
Arden, DE 19810

SUBMITTED TO:

DELAWARE ENERGY OFFICE

1203 COLLEGE PARK DRIVE, SUITE 10, DOVER, DE 19904

PREPARED BY:

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And

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May 28, 2010

Introduction

Desmond A. Baker & Associates, LLC, and Practical Energy Solutions (PES) were contracted by the applicant, Village of Arden, through the State of Delaware Energy Audit rebate program to perform an Energy Audit for the facility located at 2119 the Highway in the Village of Arden, Delaware on May 17, 2010. The primary focus of the performed audit was to identify energy conservation measures (ECMs) that would lead to the most effective efficiency improvements within the building's operational systems (HVAC, lighting, building envelope, and plug loads).

A field visit performed by the audit team was completed on May 21, 2010. Information gained from this visit and one year's worth of past utility bills was used to compile the below report.

Building Description

The Village of Arden's Buzz Ware Village Center (BWVC) is wood framed, wooden siding, 4,500 square foot community center used for community social, cultural, and educational events as well as the town offices. The building is split up into four (4) main rooms. Rooms 1&2 are largely open and combine to make one large room. Rooms 3 & 4 are divided by a wall but are adjacent to one another. According to the Village of Arden, three (3) of the rooms were constructed in 1946 and 1947 with the fourth room added on in 1950. The building contains many windows located on the south side of the building and also has hot water radiant heat. The windows and doors are light to medium duty commercial grade and appear to be sound and weather tight as many of them were replaced recently (2007). The rear of the building still contains a few windows from the original construction, which are on the "table" to be replaced soon.

As mentioned previously, the building has been in use since 1946 when it was the primary school house for the village; it functioned this way until the 1970s. Occupancy is primarily in the evening and on weekends, with the office area occupied less than 8 hours per week. Weekend occupancy involves rentals on Saturdays, and use by an outside group every Sunday from 8:30 AM – 2:30 PM. The space is rented throughout the year for different functions, but has no established day to day hourly operation. In determining the system operational hours, we estimated the usage, based on thermostat settings and calendar events. For the most part, the building is lit approximately 25 hours per week, but it is heated or cooled more regularly.

Energy Use

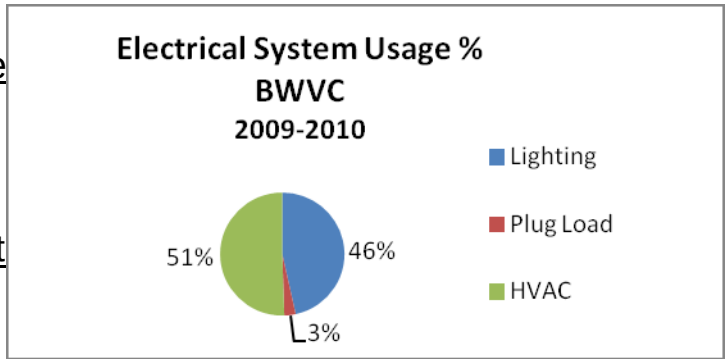
All electrical utility consumption for the center is billed and metered by Delmarva Power. Fuel oil (for heating) is delivered to the site by contract and is billed for each delivery. Twelve months of utility data was reviewed and analyzed in preparation of this report. This information was used to prepare all energy savings calculations contained within this report.

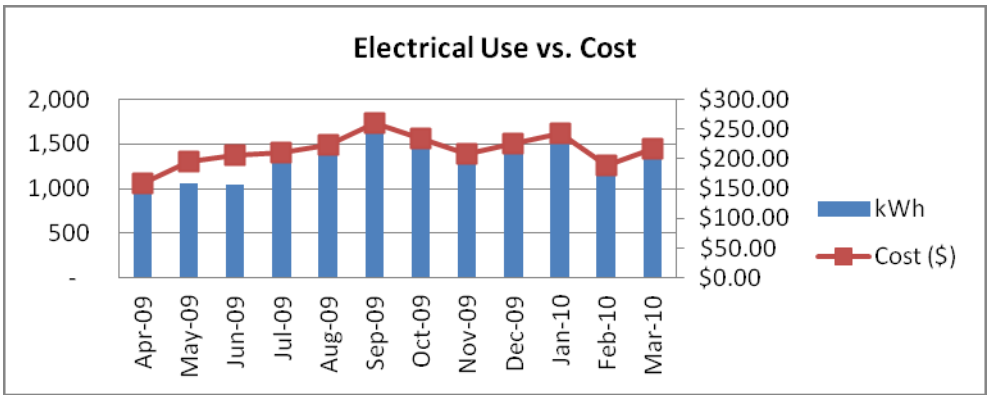
Energy Use (cont'd)

Electricity

The electricity is billed on the GS or General Service commercial rate.
Electrical usage and cost for the 4/2009 – 3/2010 time period amounted to:

Annual Usage
15,622 kWh
Annual Cost
$ 2,568
Average Cost
$0.17 / kWh

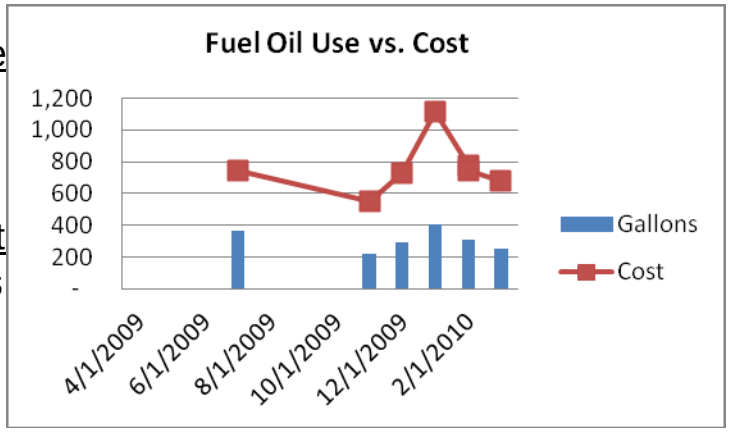




Fuel Oil

Fuel oil is delivered to the applicant on an as needed basis by Burns & McBride. Between the time period of 7/2009 and 3/2010 fuel oil usage and cost amounted to:

Annual Usage
2,111 gallons
Annual Cost
$ 5,334.74
Average Cost
$2.53/ gallons



Carbon Dioxide Emissions

Based on our analysis, the operation of the Buzz Ware Village Center emitted approximately 66,936 lbs. of CO_2 during the 4/2009-3/2010 time period. That is equivalent to almost 6 cars on the road. (11,450 lbs per car, epa.gov)

Reviewed Building Systems

Building Envelope

Though no destructive testing was performed the building appears to be appropriately insulated. The windows and doors located on all walls were replaced 3 years ago (2007) with low-e double pane windows. Given the age of the building and the construction, no further testing was performed on the building envelope.

Lighting

Lighting is achieved throughout the facility with various wattage incandescent flood track lighting (Rms. 3 & 4) and ceiling mounted fluorescent fixtures (Hallways, office, and Rms. 1 & 2 – see attached floor plan). This type of lighting gives the facility users a large amount of flexibility in lighting the artwork displayed in rooms 3&4 while still allowing users of the other rooms the temperature and energy saving benefits of fluorescent lighting. Most of the fluorescent lighting throughout the building is achieved through T-12 (1-1/2 in.) – 34W type lamps. Many of the fixtures were 4-lamp fixtures, but approximately 70% of the fixtures only contained 2 lamps. In determining the potential energy saving measures available to the applicant we considered this information.

The following table (Table 1) exhibits the tallied light count found within BWVC as well as the system's total estimated contribution to the facility electrical load:

Table 1 - Lighting Use

	T-12	Incandescent	Display Light
# bulbs in use	68	33	2
Watts/Bulb	34	-	40
kW	2.3	2.7	0.1
hours/week	25	25	168
weeks	52	52	52
Burn time/yr	1,300	1,300	8,736
kWh	3,006	3,559	699
% of Total Lighting	41.4%	49.0%	9.6%
Total Ann. Lighting kWh	**7,264**		
Total Ann. Facility kWh	**15,622**		
Lighting % of Total Facility Load	**46%**		

According to our study, lighting throughout BWVC accounts for approximately **7,264 kWh** of electricity per year, or approximately **46%** of the entire facility consumption.

HVAC

The following primary energy using equipment was noted during our visit:

Boilers:

The boiler room adjacent to town office contained two (2) Utica Oil Boilers, Model BOP66, Ser. # 09191 (boiler #1) and Ser. # 09193 (Boiler #2). The boilers are staged, so when there is minimal load (outside air temps from 45 – 55 degrees F), only one boiler runs. I=B=R gross output indicated as 243,000 BTU; water output as 211,300 BTU/hr. Appear to be 1970 +/- installation, so efficiency is likely to be low. The boilers provide heat for the entire building.

AC Units & Controls:

Rooms 1 & 2 are cooled by rooftop units – no access provided to get make, model, efficiency rating, etc. Rooms scheduled together with a single programmable thermostat (heating & cooling). This is not a concern, because it was indicated that the rooms are used together 90% of the time.

Town office is cooled by a wall mounted "Quiet-side" AC unit with condenser on roof. Includes remote control for operation. No model # available.

Room #3 is cooled by 2 wall mounted AC units, Chigo Mod # QCIH12A, 12,000 Btu/hr, with condensers in ceiling. These were installed in August of 2009. Only turned on when needed.

Room #4 is cooled by a window AC unit, GE Mod #ASV18DBS1, EER 9.7, Ser #AZ820161.

Room 3 & 4 have heat controlled by a single thermostat – this was indicated as a concern, because the rooms are typically used independently, and so they heat both rooms when only one is in use. A split control was considered an opportunity to reduce oil consumption.

Table 2 – HVAC Equipment

BWVC- Mechanical Inventory							
Quantity	Type	Make	Year	Energy	Model #	Serial #	Efficiency
1	Boiler	Utica	1970	Oil	BOP66	9191	60%
1	Boiler	Utica	1971	Oil	BOP67	9193	60%
?	AC Rooftop Units	Ducane		Electric	2AC13L36 P		13 SEER
1	AC Unit	Quiet-side		Electric			13 SEER
2	AC Unit	Chigo		Electric	QCIH12A		13 SEER
1	AC Window Unit	GE		Electric	ASV18DBS1	AZ820161	9.7 EER

HVAC accounts for approximately **7,889 kWh** of electricity usage or approximately **51%** of the total building load and **2,111 gallons** of fuel oil or **100%** of the total building fuel usage. Because the HVAC systems located in the building utilize more than half of the buildings total electrical load and 100% of its fuel usage the opportunity to save energy and money lies greatly in improving the HVAC system and its operation.

The following section will show, in detail, the potential energy and cost savings associated with equipment changes or changes in practice.

Renewable Energy measures
The opportunities for renewable energy for this site are limited. The results for a solar (PV) system is as follows

Solar PV system 14.76Kw - cost - $91512,
Delmarva Energy grant = $32029,
Net $59483.

Due to time restraints, we were not able to evaluate the any opportunity for geothermal nor wind systems.

Recommended Energy Conservation Measures

HVAC

Zone Rms. 3 & 4
Due to the atypical usage patterns associated with this space (rentals and sporadic use) it is imperative that the owner gain better control over the climatization – especially the heating of the individual rooms, as some rooms are occupied while others are not and the central heating system does not allow segregation. The first recommended HVAC ECM is to create separate heating zones between Rooms 3 & 4 with a zoning control system.

A zoning control system will allow heat to be delivered to Room 3 while it is occupied and not to Room 4 if it is not. If one were to assume that 50% of the time, wasted heat is being delivered to Room 4 - unoccupied, for instance, while Room 3 is occupied than one could surmise that there is a potential savings associated with stopping this practice of approximately 25% (4 rooms) of the fuel oil consumption. A more conservative estimate would be that there is a potential savings of approximately 15%, or **316 gal.** and **$800**. Please refer to the table at the end of this section to illustrate the full savings and payback associated with this measure.

Boiler system upgrade
The two (2) staged Utica boilers were manufactured in 1970 and were designed with an efficiency factor, or A.F.U.E. of 60%. More than likely, through the years this efficiency factor has deteriorated and is most likely near 50% or lower. This presents a substantial opportunity for improvement, as the minimum efficiency associated with oil boilers today is 80%, or greater with an Energy Star qualified model. Simply upgrading to the minimum would result in a fuel oil savings of almost 30%. That is **633 gallons** and approx. **$1,600**. Please note that if the boilers were replaced prior to zoning control, the

savings associated with the zoning control would be significantly less as the fuel oil consumption would be less.

Insulation of H.W. piping

There is approximately 661 L.F. of 1.5" and 740 L.F. of 1.25" diameter copper pipe run throughout the facility. None of the piping is currently insulated which also presents a significant opportunity to save energy. By insulating all of the piping throughout the facility, assuming the current boiler efficiency and a standby time of approximately 50%, it is possible that BWVC could save approximately 422 gallons and $1066 in fuel consumption. Please refer to the table below for the supporting calculations.

		Btu/hr. Loss		
	Lin. Ft. of Cu Pipe	Un-insulated	Insulated*	% savings
1.25"	740	33,300	17,020	49%
1.5"	661	29,745	15,203	49%

*1/2" fiberglass insulation

For un-insulated 1-1/4" copper = 45 Btu/h*ft
for 1/2" fiberglass insulated 1-1/4" copper = 23 Btu/h*ft

(Figures are from ASHRAE 2003 Applications Handbook 49.4 table 1)

Summary of ECMs and Savings

Table 3 - ECM and Savings

Scenario 1 – No Boiler

ECM	Cost of Measure*	Avoided Utility Cost	Payback (yrs)	Utility Savings		% Savings	Lbs. of CO_2 avoided
Zone Rms. 3 & 4 (w/current Boiler)	$2,425	$800.00	3	316	gal	15%	6,952
Insulate Piping (w/current Boiler)	$12,135	$1,066.00	11	422	gal	20%	9,284
Total	**$14,560**	**$1,866.00**	**8**	**738**	**gal**	**35%**	**16,236**

*includes cost of material, product and estimated installation costs

Scenario 2 - Boiler Upgrade

ECM	Cost of Measure*	Avoided Utility Cost	Payback (yrs)	Utility Savings		% Savings	Lbs. of CO_2 avoided
Zone Rms. 3 & 4 (w/new Boiler)	$2,425	$560.00	3	221	gal	15%	4,862
Insulate Piping (w/new Boiler)	$12,135	$560.00	22	221	gal	15%	4,862
Replace Boiler (min 80% A.F.U.E)	$20,000	$1,595.00	13	633	gal	30%	13,926
Total	**$34,560**	**$2,715.00**	**13**	**1,075**	**gal**	**51%**	**23,650**

*includes cost of material, product and estimated installation costs

Appendix

1. Energy Star™ Heat Pump Calculation Sheet
2. Utility Usage and Cost Chart
3. Illustrative Photograph-Existing Building

Products that earn the ENERGY STAR prevent greenhouse gas emissions by meeting strict energy efficiency guidelines set by the U.S. Environmental Protection Agency and the U.S. Department of Energy.
www.energystar.gov

CHANGE FOR THE BETTER WITH ENERGY STAR

Life Cycle Cost Estimate for 1 ENERGY STAR Qualified Air Source Heat Pump(s)

This simple energy savings calculator was developed by the U.S. EPA and U.S. DOE and is provided for estimating purposes only. Actual energy savings may vary based on use and other factors. For a more sophisticated estimate, use the ENERGY STAR HVAC Investor software or a bin-hour tool.

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

Number of units	1
Electric Rate ($/kWh)	$0.180
City	
Choose your city from the drop-down menu	PA-Philadelphia

	ENERGY STAR Qualified Unit	Conventional Unit
Initial Cost per Unit (estimated retail price)	$6,700	$5,700
Heating Seasonal Performance Factor (HSPF) rating	8.2	6.8
Seasonal Energy Efficiency Ratio (SEER) rating	15	10
Heat Pump Capacity (Btu/hr)	30,000	30,000
Use with programmable thermostat (Yes/No)	Yes	No

Annual and Life Cycle Costs and Savings for 1 Air Source Heat Pump(s)

	1 ENERGY STAR Qualified Units	1 Conventional Units	Savings with ENERGY STAR
Annual Operating Costs*			
Energy cost	$1,599	$2,406	$807
Energy consumption (kWh)	*8,884*	*13,367*	*4,483*
Maintenance cost	$0	$0	$0
Total	**$1,599**	**$2,406**	**$807**
Life Cycle Costs*			
Operating costs (energy and maintenance)	$15,008	$22,580	$7,573
Energy costs	$15,008	$22,580	$7,573
Maintenance costs	$0	$0	$0
Purchase price for 1 unit(s)	$6,700	$5,700	-$1,000
Total	**$21,708**	**$28,280**	**$6,573**
Simple payback of initial additional cost (years)†			**1.2**

** Annual costs exclude the initial purchase price. All costs, except initial cost, are discounted over the products' lifetime using a real discount rate of 4%. See "Assumptions" to change factors including the discount rate.*

† *A simple payback period of zero years means that the payback is immediate.*


PARKING