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Delaware Department of Natural Resource  
And Environmental Control.



Energy Audit

For:

Village of Arden  
Gild Hall  
Arden, DE 19810

SUBMITTED TO:

DELAWARE ENERGY OFFICE

1203 COLLEGE PARK DRIVE, SUITE 10,

DOVER, DE 19904

PREPARED BY:



*Desmond A. Baker & Associates, LLC*

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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 2126 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

Built in 1910, the Village of Arden's Gild Hall is a wood framed, wood sided, 11,888 square foot community center used for community social, cultural, and educational events as well as the large (>50 people) town meetings. The facility also contains a stage area used for regular theatre/drama events throughout the year. The building is split up into four (4) main sections, the Theatre/Upper Hall, Lower Hall and Kitchen, Bratton Room, and the Library.

This wood frame building has minimal insulation in the building envelope. Many roof areas are completely un-insulated, and exterior walls appear to be composed of one layer each of wood, asphalt shingle, and stucco. Foundation walls are concrete. There was a building addition in 1965, and the attic for the majority of this portion of the building is un-insulated.

Occupancy is 4 - 7 nights each week, primarily in the months of September through May, with little or no use during July & August.

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 30 hours per week.

Heating and cooling systems are controlled by programmable thermostats, but for the most part are only activated when needed for events. The Library has heat on 2 nights per week and Saturdays, and the AC unit is set to run at 75 degrees F +/- all summer, 7 days per week, 24 hours per day, to regulate humidity in the room.

## Energy Use

All electrical utility consumption for the hall 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, with a separate meter for "Space Heat" usage.

Electrical usage and cost for the 5/2009 – 4/2010-time period amounted to:

#### Annual Usage

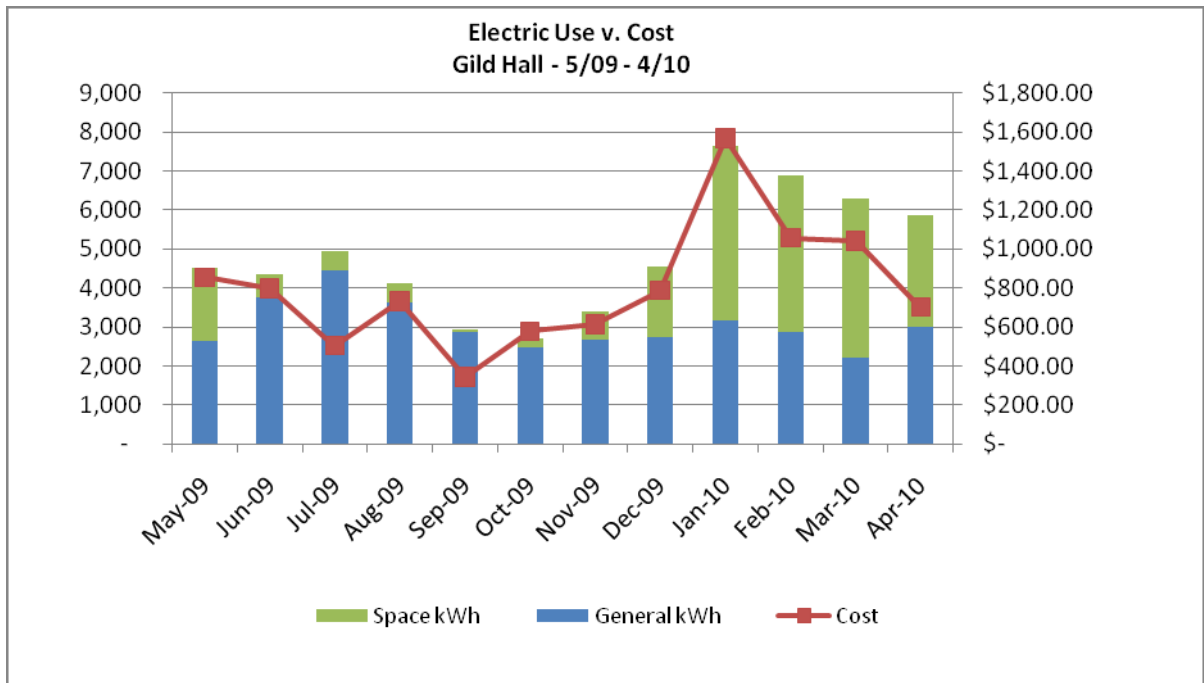
58,227 kWh

#### Annual Cost

\$ 9,585

#### Average Cost

\$0.16 / kWh



Energy Use (cont'd)

Natural Gas

Natural Gas is also supplied to the applicant by Delmarva Power. Between the time period of 5/2009 and 4/2010 natural gas usage and cost amounted to:

Annual Usage

2,715 CCF

Annual Cost

\$ 4,110

Average Cost

\$1.51/ ccf

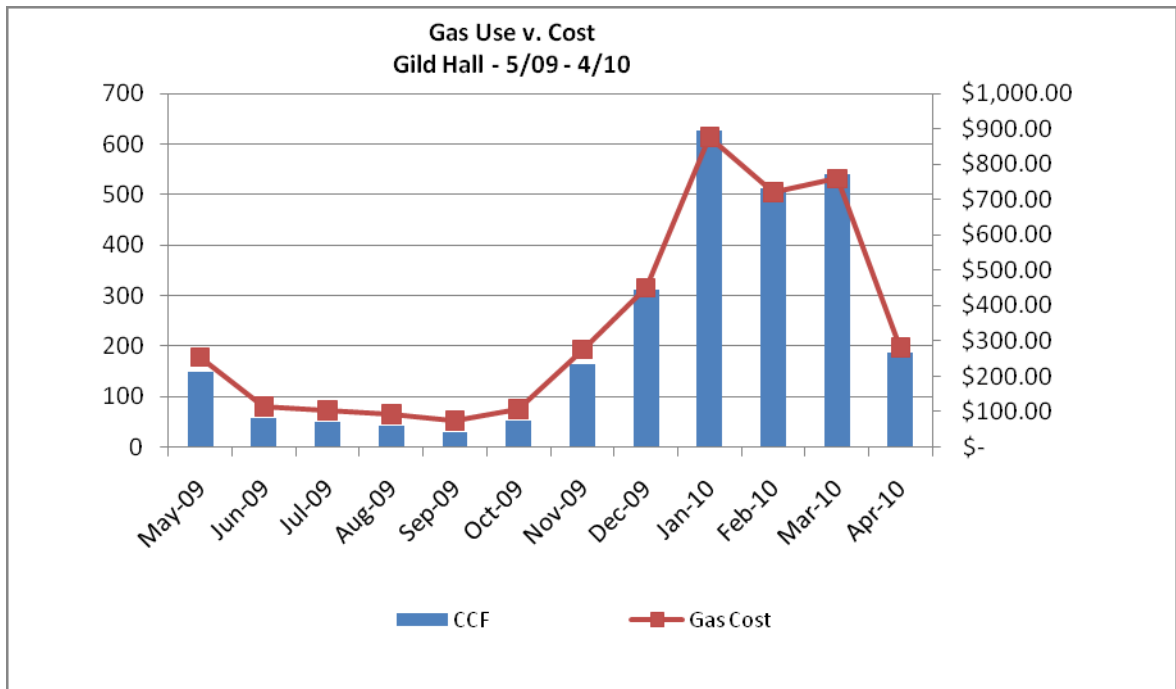


Table 1 - Utility Usage - Gild Hall

Period Ending	Electric						Natural Gas		
	Demand (kW)	General Service (kWh)	Space Heat (kWh)	Total Electrical (kWh)	Electricity Cost (\$)	Cost/kWh (\$)	Gas (CCF)	Gas Cost (\$)	Cost/CCF (\$)
May-09	22	2,625	1,902	4,527	\$ 854.54	\$ 0.19	149	\$ 253.63	\$ 1.70
Jun-09	18	3,759	586	4,345	\$ 799.50	\$ 0.18	57	\$ 114.61	\$ 2.01
Jul-09	20	4,459	489	4,948	\$ 504.20	\$ 0.10	50	\$ 104.03	\$ 2.08
Aug-09	17	3,622	496	4,118	\$ 732.99	\$ 0.18	42	\$ 91.99	\$ 2.19
Sep-09	11	2,855	83	2,938	\$ 344.37	\$ 0.12	30	\$ 74.33	\$ 2.48
Oct-09	19	2,470	243	2,713	\$ 578.45	\$ 0.21	51	\$ 106.30	\$ 2.08
Nov-09	16	2,677	734	3,411	\$ 613.24	\$ 0.18	163	\$ 275.12	\$ 1.69
Dec-09	18	2,732	1,832	4,564	\$ 787.73	\$ 0.17	311	\$ 450.38	\$ 1.45
Jan-10	32	3,170	4,469	7,639	\$ 1,569.86	\$ 0.21	626	\$ 877.51	\$ 1.40
Feb-10	16	2,863	4,026	6,889	\$ 1,057.14	\$ 0.15	511	\$ 721.58	\$ 1.41
Mar-10	18	2,214	4,063	6,277	\$ 1,041.89	\$ 0.17	539	\$ 759.56	\$ 1.41
Apr-10	21	2,998	2,860	5,858	\$ 701.51	\$ 0.12	186	\$ 280.88	\$ 1.51
<b>Total</b>	<b>19</b>	<b>36,444</b>	<b>21,783</b>	<b>58,227</b>	<b>\$ 9,585.42</b>	<b>\$ 0.16</b>	<b>2,715</b>	<b>\$ 4,110</b>	<b>\$ 1.51</b>

Carbon Dioxide Emissions

Based on our analysis, the operation of The Buzz Ware Village Center was determined to be emitting approximately 105,294 lbs. of CO<sub>2</sub> during the 5/2009-4/2010 time period. That is equivalent to over 9 cars on the road. (11,450 per car, epa.gov)

**Reviewed Building Systems**

Building Envelope

This wood frame building (barn-like structure) has minimal insulation in the building envelope. Many roof areas are completely un-insulated, and exterior walls appear to be composed of one layer each of wood, asphalt shingle, and stucco.

There was a building addition in 1965, and the attic for the majority of this portion of the building is un-insulated.

Windows located on all sides except the north side near the Library and the exterior wall located in the Lower Hall have been replaced with double pane, low-e windows. The remaining windows are older, primarily double hung, single pane, possibly original (1900s) windows. There is very little weather stripping associated with these windows and in some cases visible gaps are evident. Replacing the older windows and doors throughout the remainder of the facility presents a significant opportunity for energy savings. The sliding glass patio door located toward the rear of the Bratton room also showed visible light penetration around the frame, indicating a poor installation, or fit. This unit should also be repaired or appropriately replaced.

### Lighting

Lighting is achieved throughout the facility primarily with standard T-12 (40W) fluorescent fixtures and recessed lighting. The bulbs located in the recessed lights have almost all been replaced with lower wattage CFL spot/flood lights. The Stage area is lit with an array of theatre lighting cans, with each containing 100W light bulbs. Lighting throughout the remainder of the facility is achieved with various wattage incandescent bulbs.

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

Table 2 - Lighting Use

Gild Hall - Lighting										
Room	T-12 (40W)	Watts Used	CFL	Wattage	Watts Used	Other	Wattage	Incand.Watts	Burn Time	kWh
Changing Rms	12	480			0				480	230.4
	12	480			0			0	480	230.4
Upper Hall	32	1280			0			0	1560	1996.8
Fair Rm		0	1	15	15			0	416	6.24
Stage		0	4	15	60	36	100	3600	1200	4392
Dressing Rm.		0			0	18	100	1800	1200	2160
		0			0	16	50	800	1200	960
Library		0	9	15	135			0	1300	175.5
Bratton Rm.		0	19	18	342			0	1560	533.52
		0	3	15	45			0	1560	70.2
Lower Hall	10	400	16	15	240			0	1560	998.4
Kitchen	8	320	2	15	30			0	1560	546
Directors Room		0			0	6	150	900	104	93.6
<i>Totals</i>	<i>74</i>	<i>2,960</i>	<i>54</i>	<i>-</i>	<i>867</i>	<i>76</i>	<i>-</i>	<i>7,100</i>		<i>12,393</i>

According to our study, lighting throughout Gild Hall accounts for approximately **12,393 kWh** of electricity per year, or approximately **34%** of the entire non "space-heat" electrical consumption.

#### Mechanical Equipment

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

#### **HVAC - Heat**

The two main boilers were installed in December of 2007 – due to recent replacement; these are not good candidates for replacement under this program. The two gas boilers are different sizes, but same model numbers - Trane Model #XL90, 92.5 AFUE. The larger unit, 120,000 Btu/hr, is for upstairs (the main theater room), and the smaller unit, 80,000 Btu/hr, is for downstairs – meeting rooms, kitchen, etc.

The library is heated with a 1.5 year old natural gas heater, Empire Mod. # DV20E-4, Ser. #04-33-339776, 20,000 Btu/hr. Since this is a new heater, this is not a good candidate for replacement under this program.

**HVAC – A/C**

The library contains a small air conditioning unit that runs 24/7 during the summer at 75°F to prevent excessive humidity. Bratton room has two (2) older split a/c units; model numbers were not obtained or provided. Lower Hall contains an older window air conditioning unit.

**Table 3 –Mechanical Equipment**

Gild Hall Mechanical Inventory							
Quantity	Type	Make	Year	Energy	Model #	Efficiency	Notes
1	Boiler	Trane	1997	Gas	XL90	92.5 AFUE	Supplies heat for upstairs
1	Boiler	Trane	1990	Gas	XL90	92.5 AFUE	Supplies heat for downstairs
1	Furnace	Empire	2008	Gas	DV20E-4	20,000 BTU/Hr	Supplies heat for Library
1	Hot Water Heater	Pwrflex		Gas	PVG62-75-T75	75,000 BTU	
2	Split AC Systems					1 Ton	
1	Window AC Unit						

**Refrigeration**

Refrigerators and freezers run 24 hours per day, 7 days per week, and tend to be in use primarily on Friday and Saturday each week for the town dinner that takes place at Gild Hall. There are 2 new commercial grade refrigerators, but there is one older unit (Continental Model 1R, Ser #A97D5660, purchased in 1997) and one old side-by-side freezer, approx 20 years old, Continental A2FDA-2S. Since these 2 older units run at all times, replacement with ENERGY STAR units could save 40% or more of the energy use of the units.

Table 4 - Refrigeration Equipment

Gild Hall Refrigeration Inventory								
Quant.	Type	Make	Year	Energy	Vol . (ft <sup>3</sup> )	Model #	Serial #	Efficiency
2	Refrig.	-	-	-	-	-	-	HIGH
1	Refrig.	Continental	1997	Electric	18.9	1R	A97D5660	2.59 kWh/day
1	Freezer	Continental	1990	Electric		A2FDA-2S	-	2.12 kWh/day

The following section illustrates 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

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

**However using the Buss Ware site as an example for solar PV system the following is an approximation of a typical system Solar:**

**PV system 14 .76Kw  
 Cost - \$91,512,  
 Delmarva Energy grant = \$32,029  
 Net \$59,483.**

## **Recommended Energy Conservation Measures**

### *Insulation - Attic and Walls*

By insulating the attic and walls with a minimum of R19 insulation, Gild Hall could achieve an energy savings of approximately **197,023 MBtu** of energy or 41% of the total energy (470,228 MBtu) consumed on the premises. (See attached calculations in appendix)

### *Lighting Retrofit*

T-12 Fluorescent lighting comprises approximately 30% (4,002 kWh) of the lighting throughout the facility. By upgrading the lighting from T-12 (40W) to T-8 (32W) lighting Gild Hall could achieve an annual electrical savings of approximately **800 kWh, or \$128/yr.**

### *Refrigeration*

There are currently two (2) older refrigeration units located in Gild Hall. By replacing these units with higher efficiency (Energy Star qualified units it is possible to save approximately **1,018 kWh** per year. (See below calculation).

Table 5 - Refrigeration Savings Calculations

Unit	Refrigerator	Freezer
Make	Continental	Continental
Old Efficiency (kWh/Day)	2.59	2.12
New Efficiency (kWh/Day)	1.15	0.77
KWh Saved per Year	526	492
<i>Price per kWh</i>	<i>\$0.16</i>	<i>\$0.16</i>
<i>Cost Savings per Year</i>	<i>\$84</i>	<i>\$79</i>

Summary of ECMs

ECM	Cost of Measure*	Avoided Utility Cost	Payback (yrs)	Utility Savings		% Savings	Lbs. of CO <sub>2</sub> avoided
Insulate Attic and Walls*	\$21,000	\$3,100.00	7	543	ccf	20%	11,946
				11,645	KWh	20%	14,673
Retrofit Lights**	\$1,600	\$128.00	13	800	KWh	1%	1,008
Replace Refrigeration	\$2,000	\$163	12	1,018	KWh	2%	1,283
				543	Gal	20%	26,619
<b>Total</b>	<b>\$22,600</b>	<b>\$3,228.00</b>	<b>7</b>	<b>13,463</b>	<b>KWh</b>	<b>23%</b>	<b>27,627</b>

\*\$3/S.F.

\*\*\$50/Fixture

## Appendix

1. Insulation Calculation Sheets
2. Illustrative Frontal Photograph

**WALL INSULATION - GILD HALL**  
**ENERGY USAGE/PAYBACK**

Existing R-Value	3	
New R-Value	13	
Area (Wall/Roof/Window/Door)	2,400	sf

Heating Degree Days-HDD65 *	4,936
Cooling Degree Days-CDD50 *	-

Energy Cost (Electricity)	\$0.16	per Kwh
Energy Cost (Gas)	\$1.51	per Therm
Rate of Inflation (Electricity)	3.0%	
Rate of Inflation (Gas)	2.0%	

Cost of added insulation/window/door	\$3.00	per sf
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**RESULTS:**

	Existing	New	Savings
<b>Annual Energy Loss (MBTU)</b>	<b>94,771</b>	<b>20,121</b>	<b>74,650</b>
Annual Energy Cost (Heating)	\$1,431	\$330	\$1,101
Annual Energy Cost (Cooling)	\$0	\$0	\$0
<b>Total Annual Energy Cost</b>	<b>\$1,431</b>	<b>\$330</b>	<b>\$1,101</b>
<b>Energy Cost (15 Years)</b>	<b>\$26,599</b>	<b>\$5,711</b>	<b>\$20,888</b>
<b>Annual Energy Savings</b>	<b>\$1,101</b>		
<b>Annual MBTU Savings</b>	<b>74,650</b>		
<b>Energy Savings (15 Years)</b>	<b>\$20,888</b>		
<b>Payback</b>	<b>5.17</b>		years

**ATTIC INSULATION - GILD HALL  
ENERGY USAGE/PAYBACK CALCULATOR**

Existing R-Value	3	
New R-Value	19	
Area (Roof)	4,000	sf.

Heating Degree Days-HDD65 *	4,936
Cooling Degree Days-CDD50*	-

Energy Cost (Electricity)	\$0.16	per Kwh
Energy Cost (Gas)	\$1.51	per Therm
Rate of Inflation (Electricity)	3.0%	
Rate of Inflation (Gas)	2.0%	

Cost of added insulation/window/door	\$3.00	per sf
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**RESULTS:**

	Existing	New	Savings
<b>Annual Energy Loss (MBTU)</b>	145,318	22,945	122,373
Annual Energy Cost (Heating)	\$2,385	\$377	\$2,008
Annual Energy Cost (Cooling)	\$0	\$0	\$0
<b>Total Annual Energy Cost</b>	<b>\$2,385</b>	<b>\$377</b>	<b>\$2,008</b>
<b>Energy Cost (15 Years)</b>	<b>\$44,331</b>	<b>\$6,513</b>	<b>\$37,819</b>

<b>Annual Energy Cost Savings</b>	<b>\$2,008</b>
<b>Annual MBtu Savings</b>	<b>122,373</b>
<b>Energy Savings (15 Years)</b>	<b>\$37,819</b>

<b>Payback</b>	<b>4.76</b>	years
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