Appendix E
Energy Audits

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ENERGY MANAGEMENT PLAN AND AUDIT ANALYSIS

UNIVERSITY PARK AIRPORT – AIRCRAFT MAINTENANCE FACILITY | OCTOBER 2013

REVISED 1/21/2013

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October, 2013

University Park Airport Officials,

Please find enclosed a copy of the energy management recommendations for the University Park Airport – Aircraft Maintenance Facility. You will find information on existing energy use patterns, analysis of Energy Conservation Measures (ECMs), and a framework that lays the path for improved energy management at your facility.

The findings communicated in this report can reduce annual energy costs at this facility by approximately 60%. ***Annually, the University Park Airport allocates approximately $36,570 on energy expenses for this facility. The recommendations in this report will reduce annual energy costs by approximately $21,700. The projects identified have an estimated install cost of $74,820, providing less than a 4 year payback and a 30% return on investment.***

As part of this work scope, Envinity reviewed existing/historic energy use patterns , performed an ASHRAE level II energy assessment and identified feasible energy conservation measures (ECMs). The top energy saving measures were identified and prioritized based on feasibility, payback period, and return on investment.

As the Airport proceeds with project implementation, Envinity can offer the following additional services: engineering and design of all recommendations, bid document preparation, construction administration, grant writing and management, building performance contracting, project commissioning and management, energy management services, and renewable energy deployment.

It is our pleasure to contribute our technical expertise toward the success of this important local project.

Sincerely,

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AIRCRAFT MAINTENANCE FACILITY BY THE NUMBERS

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$36,570	Annual Average Energy Cost (Fuel Oil| $19,460; Electricity | $17,109)
1,470 MMBtu	Annual Average Energy Use (198,720 kWh; 5,674 gal Fuel Oil)
16,200 ft^2	Building Area
95.5 $kBtu/ft^2$	Energy Use per Sq Ft
$2.26 $/ft^2$	Energy Cost per Sq Ft
50.5 $kBtu/ft^2$	National Average Energy Use per Sq Ft for "Repair Services"
$21,700 (57% reduction)	Identified Annual Cost Savings
$74,823	Estimated Project Hard Cost
30%	Internal Rate of Return for Recommendations
3.4 years	Total Project Payback

1 Utility Bill Analysis & Benchmarking Assessment

Understanding the historic utility usage and cost data is at the foundation of a strong energy management plan. Recognizing where you came from is necessary for setting a course for the future. The purpose of the utility bill analysis is to accurately quantify the total energy used and total energy costs at a site so that recommended energy conservations measures are based off of actual data. Understanding energy use trends observed during the utility bill analysis phase of the work scope also better prepares the energy professional for conditions and systems that will be observed on site. The utility bill analysis is performed prior to the audit team visiting the site and helps guide the system focus of the audit.

All utility data was obtained from February 2011 to April 2013. The Aircraft Maintenance Hangar has the following accounts:

Company	Commodity	Account Number
West Penn Power	Electric	100 096 268 816
CS Myers & Son Inc.	Fuel Oil	1300

A summary analysis of the results is as follows:

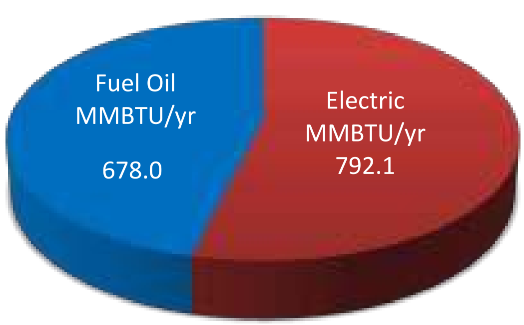
Energy Usage at the Aircraft Maintenance Building

Utility data was observed from February 2011 to April 2013 at the Maintenance Building. Electric data was obtained from West Penn Power. Fuel Oil data was obtained from previous bills filed by the staff from April 2011 to April 2013. During this period, the Maintenance Building consumed an average of 1,470 MMBtu annually, or $36,570 between electricity and fuel oil. Of this, 678 MMBtu ($17,110) goes toward electricity and 792 MMBtu ($19,460) is fuel oil consumption. The average unit costs are as follows:

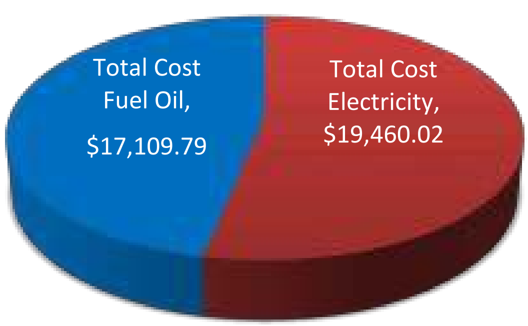
Electricity:	***$0.0861 per kWh;***	***$25.23 per MMBtu***
Fuel Oil:	***$3.43 per gal;***	***$24.57 per MMBtu***

Based on the data provided, the cost of Fuel Oil at the Maintenance Building costs about the same as electricity. The following graphs show total energy use and cost trends over the period assessed and compared to the effects of weather.

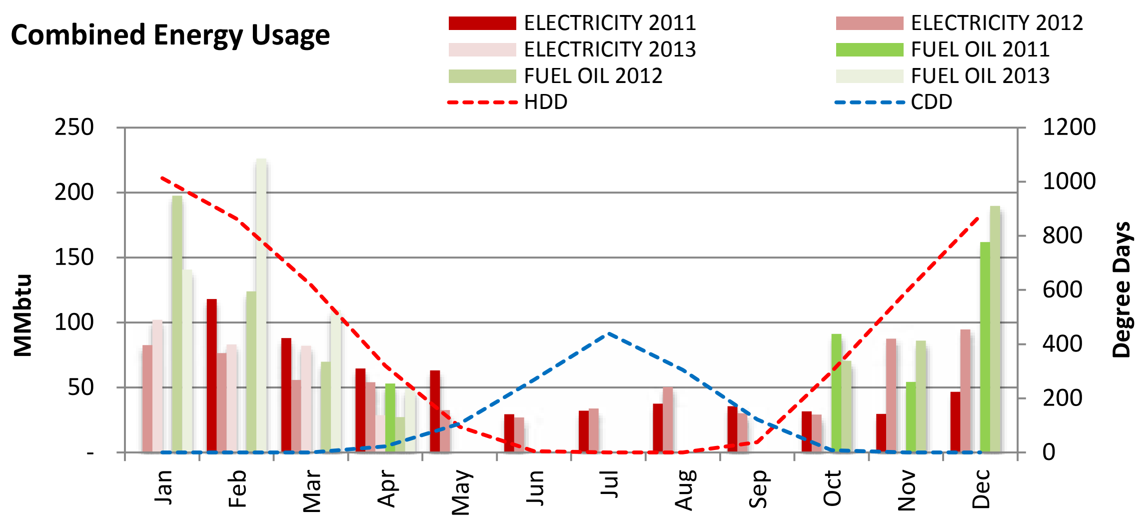
Energy Use Breakdown (MMBtu)



Energy Cost Breakdown



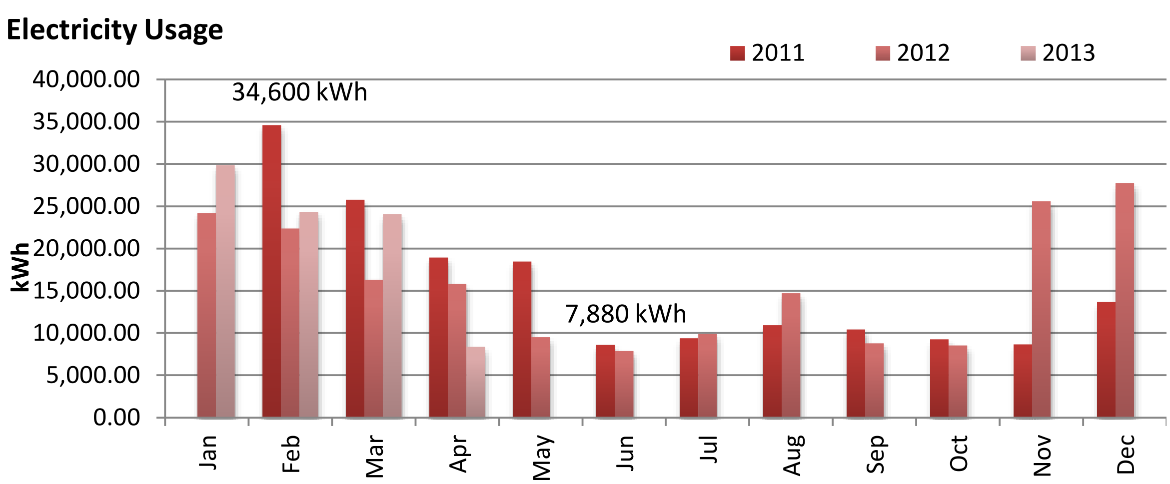
ELECTRIC USAGE AT AIRCRAFT MAINTENANCE BUILDING



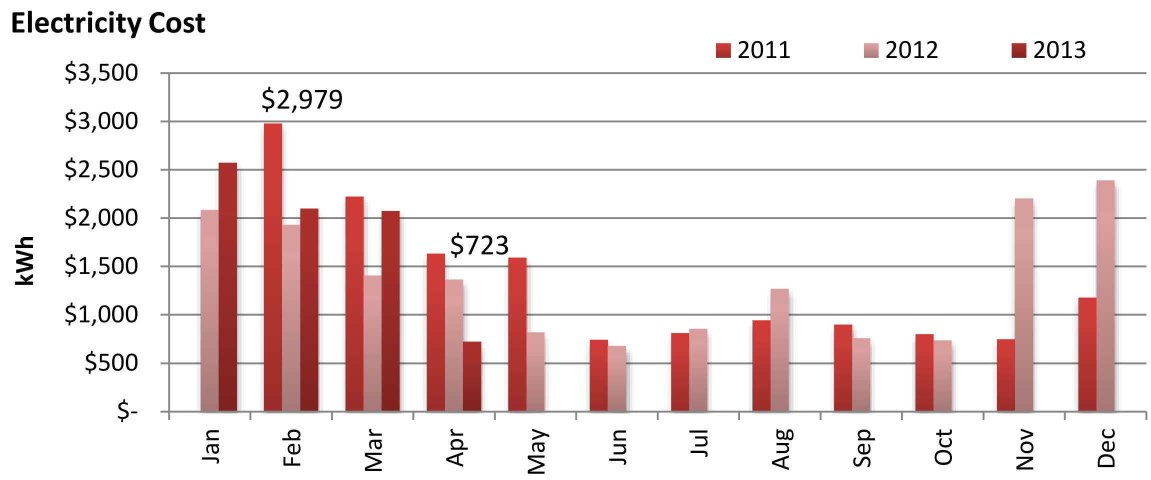
ELECTRIC USAGE AT THE AIRCRAFT MAINTENANCE HANGAR

Account: **West Penn Power**
Electricity Rate: **$0.0861/kWh**

The data shows that electric consumption throughout the year has remained consistent for each calendar year, following seasonal trends. Electricity increases with increased cooling degree days but more so with increased heating degree days. Over the period evaluated, the Maintenance Hangar consumed the most electricity in February 2011 (34,600 kWh) and the least in June 2012 (7,880 kWh).



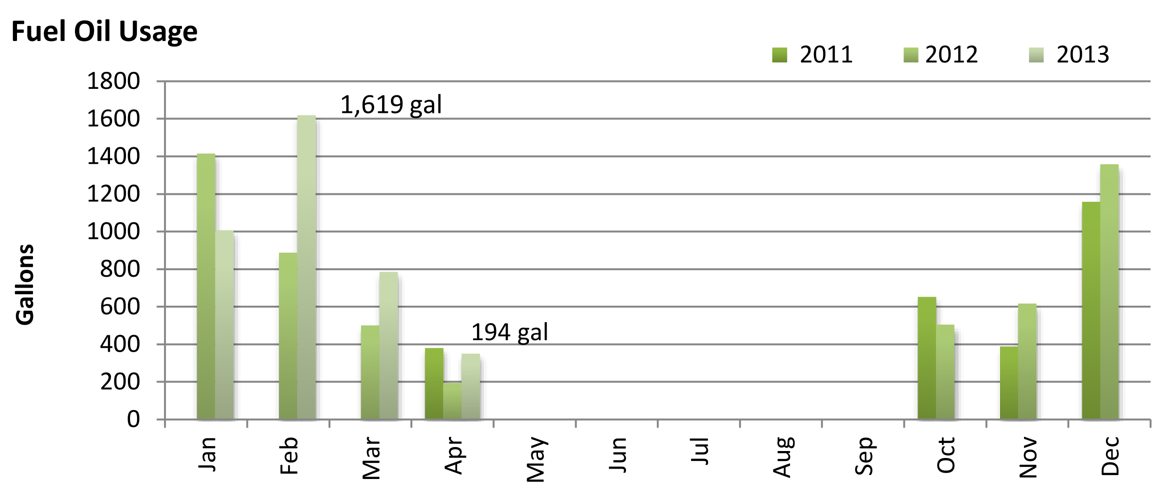
Annually, the Maintenance Hangar spends $17,110 on average for electricity. Electricity is currently received through West Penn Power at a rate of $0.0861/kWh. Electric cost was highest in February 2011($2,979) and lowest in June 2012 ($723). Consumption was unusually high for February 2011 which explains the spike in cost.



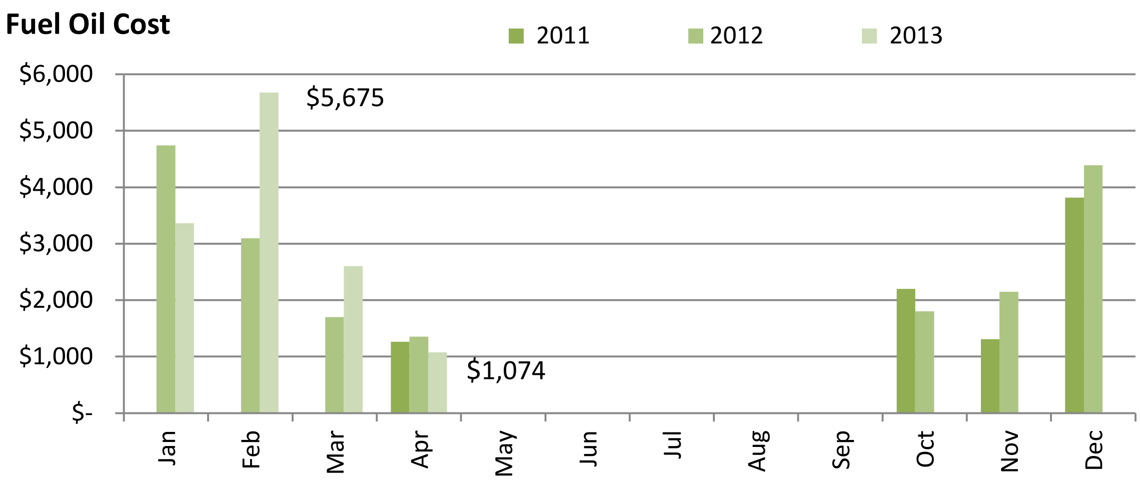
FUEL OIL AT THE MAINTENANCE BUILDING

Account: **CS Myers & Sons, Inc**
Commodity Rate: **$3.43 per gal**

Fuel oil at the Maintenance Building is used to heat the facility during winter months. Fuel oil is burned to heat water which runs through piping in the floor of the hangar. The following graph shows the fuel oil consumption for the last 3 years.



The cost of fuel oil is by far higher than propane and natural gas. The graph below shows the cost of fuel oil per month for the last 3 years. These costs would be significantly decreased if an alternative fuel were to be used.



The Maintenance Building uses fuel oil to heat the hangar floor. The graphs above show the demand for fuel oil spikes in the winter months when heating is needed. Fuel oil is a very expensive fuel to use. Below is a simple comparison of fuel types and their cost per useful amount of energy ($/MMBtu).

Fuel Type	Cost/unit	Btu/unit	$/MMBtu
Fuel Oil (gal)	$3.43	139,600	$24.57
Propane (gal)	$1.72	91,330	$18.83
Electricity (kWh)	$0.0861	3,412	$25.23
Natural Gas (ccf)	$0.75	105,000	$7.14

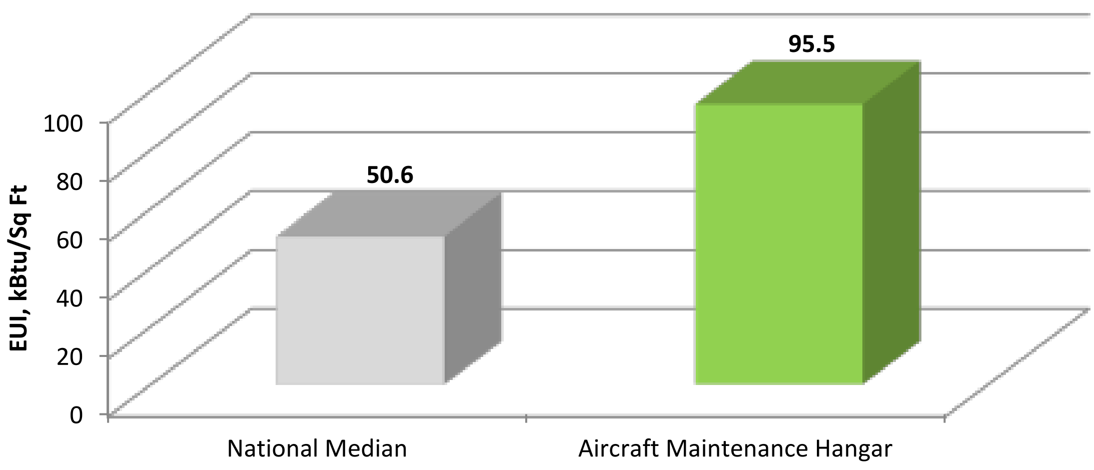
The table shows how fuel oil is far more expensive compared to all the other fuels available to the airport.

2 ENERGY USE CHARACTERIZATION & BENCHMARKING

One of the first steps in addressing energy use is to characterize the patterns of energy use for similar facilities. This involves developing expectations for the amount of energy used, the type of fuel used, and the breakdown of energy end use categories: lighting, cooling, fans, etc. To evaluate the amount of energy used by a building, it is conventional practice to estimate an ***Energy Use Index (EUI)***, expressed in KBtu/SF ● year (thousands of British Thermal Units per square foot per year). The EUI is estimated fairly simply by summing the annual energy use of all fuels (typically electricity and one or more fossil fuels), converting to a common energy unit (typically the Btu or KBtu in the US), and dividing by the applicable conditioned area of the facility. Once estimated, an EUI can be interpreted by comparison to a database of energy use statistics for similar facilities, a process called benchmarking.

The following graph shows how the EUI of the Aircraft Maintenance Hangar compared to the national average for "Repair Services".

ENERGY STAR Summary vs Target Energy Use



The Maintenance Hangar is operating within an EUI range that is higher than the average EUI range of similar facilities in the United States. The average repair service building, with an Energy Star Score of 50, has a EUI of 50.6 kBtu/ft^2, whereas the Aircraft Maintenance Building is operating at a EUI of 95.5 kBtu/ft^2.

To reach the national average energy use intensity, the Aircraft Maintenance Hangar will have to cut energy by 44.9 kBtu/ft^2. If this goal is reached, the following savings will follow:

Energy Source	Energy Savings (MMBtu)	Cost Savings
Fuel Oil	391.91	$ 6,473.89
Electricity	335.47	$ 5,541.64
Total	727.38	$ 12,015.53

3 Existing Conditions

Documenting existing conditions is a required deliverable of an investment grade energy audit. The purpose of documenting site conditions is so that the energy professional can lay the basis for which many of the recommended energy conservation measures are rooted in. During the onsite inspection, every piece of equipment, from the largest boiler down to a personal computer, is inventoried. Back at the Envinity "Lab", the audit team calculates how much energy each building system and system component consumes on an annual basis. These energy use quantifications make up a facility's "energy use profile" and gives the audit team a realistic vision as to how much energy can be saved in a facility.

The following existing conditions were observed at the Aircraft Maintenance Building.

Building Description and Occupancy

The Maintenance Building is a 16,200 sq ft facility consisting of a 12,000 maintenance hangar and 4,200 sq ft office space. The building was completed in 1998. The hangar is heated only, the office space fully conditioned. Half the office space is used for maintenance staff; the other half has served a variety of occupants with more sporadic usage. Currently, the Civil Air Patrol uses the space and holds evening and weekend meetings. Typical occupancy for the airplane maintenance staff is from 6am to 8pm on weekdays.

Energy Use by Category

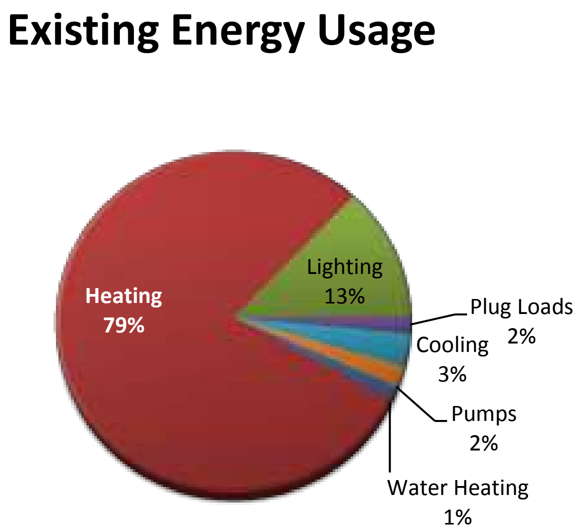
Energy is consumed within a building in a variety of ways. Heating, cooling, lighting, appliances, and water heating all consume most of the building's energy. To better visualize the energy consumption, the Maintenance Hangar energy use has been separated into individual categories. Areas of each building that consume large amounts were the main areas of focus for Envinity to find any problems and to determine the feasibility of energy efficiency improvements.

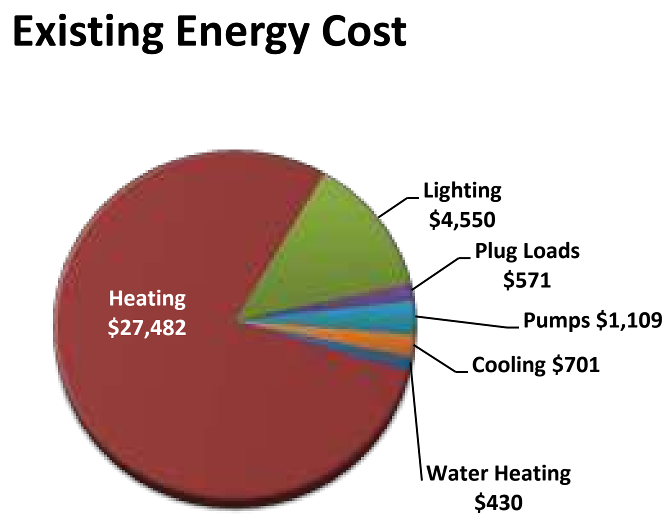
Through the utility bill analysis, engineering analysis and computer modeling, the energy usage was disaggregated into each of its energy-using components, providing a visual reference as to how energy is consumed annually within each building and how to best reduce energy consumption.

Envinity received 27 months of utility data for the Maintenance Hangar from February 2011 to April 2013. Over this time period, the Maintenance building consumed an annual average of 1,470 MMBTU of energy, resulting in annual energy costs of $36,570 or $2.26 per square foot. Broken up by electric and fuel oil:

Electric: ***198,720 kWh (678 MMBtu); $17,110***
Fuel Oil: ***171,527 gal (792 MMBtu); $19,460***

The following charts are a disaggregation of how energy has been consumed at the Maintenance Hangar over the past 24 months:





EXISTING

	Electric, kWh	Fuel Oil, gallons	Total Energy Use, MMBtu	Total Energy Cost	% ENERGY	% COST
Water Heating	5,000	-	17	$431	1%	1%
Heating	89,889	5,756	1,110	$27,482	76%	75%
Lighting	52,849	-	180	$4,550	12%	12%
Plug Loads	6,630	-	23	$571	2%	2%
Cooling	12,886	-	44	$1,109	3%	3%
Pumps	8,145	-	28	$701	2%	2%
TOTAL:	**175,399**	**5,756**	**1,402**	**$34,845**	95%	95%

The data shows that most of the energy consumed at the Maintenance Hangar is used to heat the building. The next largest consumer is the lighting system. These areas will have the most room for improvement.

Heating, Ventilation, and Air Conditioning

Heating

The hangar is heated only. The large hangar doors are cracked or opened fully as needed to provide natural ventilation. The high height of the ceiling provides for excellent circulation.

The heating source is a Weil-McLain Model 478 fuel-oil water boiler with a Carlin burner. Rated oil input is 3.4 gal/hr with a 348 Mbh output. Heat distribution is through an under floor heating system across the entire concrete hangar floor. Based on conversations with the building manager who was on staff during construction, the floor is at least 12" thick with the heating piping about 6" deep. Due to a combination of the building mass and a low limit on the return water temperature that turns off the distribution pumps, it takes about 3 days to bring the building up to temperature. Boiler temperature set point is 180°F with mixing valves reducing supply temperature to around 120°F. The return water low limit is set to 140°F.

One ⅓ hp primary pump circulates water through the boiler; it is in operation constantly during the heating season. Five ⅓ hp secondary pumps are cycled together to maintain the space temperature setpoint of 65°F set at a non-programmable thermostat in the hangar. The manager reported that the building heating was unable to keep up below 15°F outdoor air temperature, maintaining roughly 50°F above outdoor temperature when it dipped below this point. Six ceiling fans are operated in the high bay during heating to prevent stratification.

The boiler is turned on when the heating season begins, roughly early October, and off in mid-spring.

The office space is separated into two zones. Each zone is served by a 5-ton rooftop packaged heat pump with electric resistance supplemental. The east zone unit was replaced in 2004 while the west unit is original to the 1998 building.

Heating at the Maintenance Hangar consumes approximately 89,889 kWh and 5,756 gal of fuel oil annually, costing $27,482.

Cooling

Cooling in the Maintenance Hangar is provided by the two 5-ton rooftop heat pumps. These units each serve their own zone in a constant-volume manner. During the building survey, the thermostat for maintenance was found at 71°F cooling, the other unoccupied space was set to 65°F.

Cooling at the Maintenance Hangar consumes approximately 12,886 kWh annually, costing $1,109 annually.

Domestic Hot Water

There was one electric hot water tank serving the Maintenance Building.

Domestic hot water at the Maintenance Hangar consumes approximately 5,000 kWh, costing $431 annually.

Lighting

The maintenance hangar is where any repairs or maintenance on aircrafts takes place. There is a small office and conference room at the main entrance of the building. Lighting in these areas consists of linear fluorescent T8s with electronic ballasts. The maintenance hangar is illuminated by (12) 400W metal halide high bay fixtures. There are several tool and part rooms which consist of 2-bulb, 8ft 96W T12 lamps with magnetic ballasts. Staff noted it has been hard to purchase these 8ft T12 lamps. This is because they are no longer produced due to the T12 lighting government phase out. This should be kept in mind when upgrading the lighting systems at the airport. The exterior lighting of the maintenance hangar was comprised of (8) 400W metal halide wall pack flood lights and (3) 400W HPS pole mounted fixtures. No lighting controls were observed at the maintenance hangar.

Existing lighting uses approximately 52,849 kWh and costs approximately $4,550 annually.

Plug Loads

A plug load is made up of the energy consumed by any electrical device that is plugged into an electrical socket. Often associated with plug loads are "phantom loads", which describe the amount of energy a device consumes while in standby mode or "off" mode.

Plug loads at the Maintenance Building consisted of desktop computers, coffee makers, power tools, and a radio.

The plug loads at the Maintenance Building consume approximately 6,630 kWh annually, costing $571.

4 CAPITAL RECOMMENDATIONS

Using the utility bill analysis, results and findings from the comprehensive on-site assessment, and outputs from the computer modeling of the facility, a number of capital and operational upgrades were identified for the Aircraft Maintenance Building.

Proposed Energy Conservation Measures (ECMs)

After reviewing all data, performing the onsite assessment, and creating a computer model of The Administration Building, Envinity has identified and prioritized potential energy conservation measures (ECMs). These measures have been organized based on their suggested order of implementation.

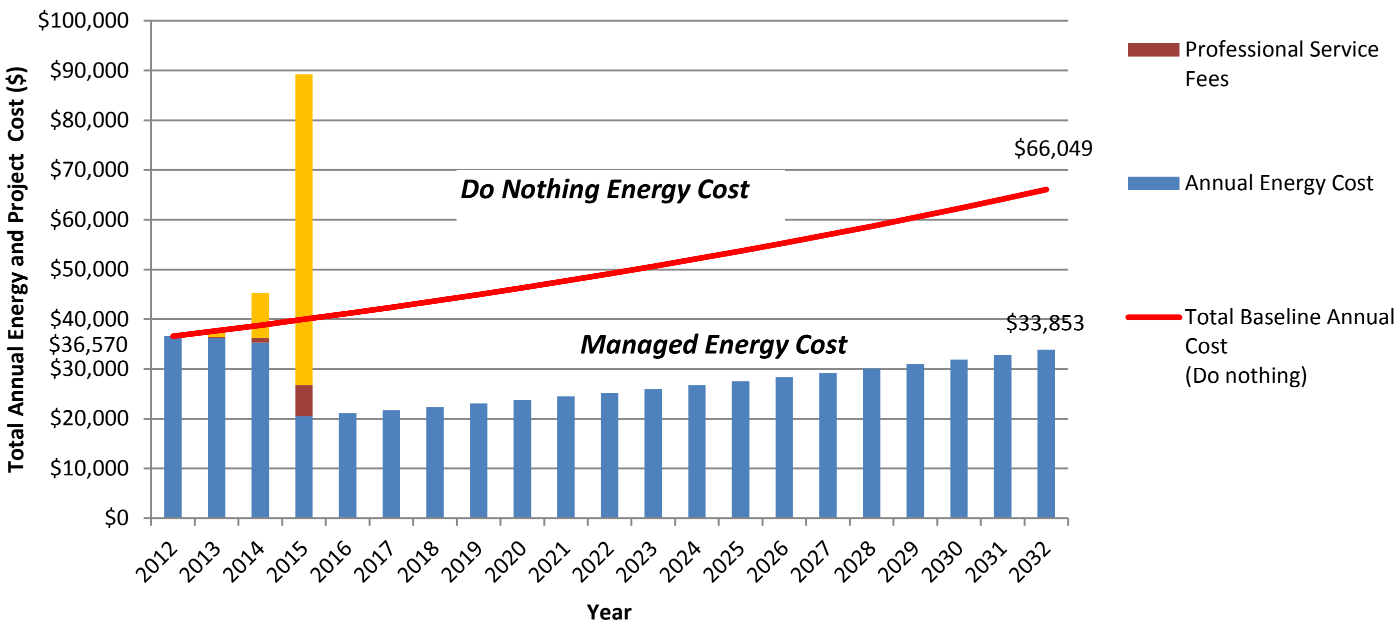
Energy Conservation Measure	Annual Energy Savings	Lifetime Savings	Initial Cost	Simple Payback	Internal Rate of Return	Year to Implement
Install programmable thermostat for office spaces	**$829**	$8,291	**$700**	0.8	**121%**	**Year 1**
Replace all incandescent and halogen lamps with LED equivalent	**$622**	$6,221	**$1,196**	1.9	**74%**	**Year 1**
Replace exterior 400W metal halide high bay fixtures with 78W RAB LED floodlight	**$789**	$7,887	**$6,613**	8.4	**75%**	**Year 2**
Retrofit all 2-lamp, 96W 8ft T12 to 4-lamp, 32W 4ft w/ electronic ballasts	**$632**	$10,109	**$2,677**	4.2	**24%**	**Year 2**
Replace 400W metal halide high bay fixtures with 6 lamp, 4ft T5 high bay fixtures	**$616**	$7,386	**$3,207**	5.2	**19%**	**Year 2**
Propane infrared heaters (Hanger)	**$12,905**	$193,578	**$24,340**	1.9	**53%**	**Year 3**
Building envelope improvements (Hanger)	**$4,150**	$62,248	**$26,730**	6.4	**16%**	**Year 3**
Insulate office walls	**$1,161**	$17,409	**$9,360**	8.1	**12%**	**Year 3**
	$21,703	**$313,130**	**$74,823**	**3.4**	**29%**	**-**

Envinity performed a ***cash flow analysis*** scenario to show how the recommended Energy Conservation Measures can be budgeted and how energy savings from the measures can help pay for implementation of future measures. It is important to note that this Energy Management Plan is ***SELF FINANCING, FLEXIBLE and SCALABLE***. This analysis correlates directly with the ECM tables presented above. Analysis shows that if the recommendations in this strategy are acted upon, the University Park Airport can effectively negate annual increases in energy costs over the next 20 years.

The following guidance can be applied to the cash flow presented: Using the "Year" to implement guidance listed in each ECM's Description, the following graph shows energy costs can significantly decrease over the next 20 years.

What are most important to note in the cash flow analysis is the RED "do nothing" line (which assumes a 3% annual energy cost increase) and the BLUE "annual energy cost" bars. The red line shows what the facility can expect to be paying in energy costs as time progresses if NO ACTION is taken from this point forward. The blue bars show the predicted annual energy cost if the recommendations of this report are acted upon.

Energy Management Cash Flow



The energy management cash flow shows that when the projects recommended in this report are implemented, annual energy costs will be significantly reduced, When projects are implemented in a planned manner, the annual investments can be staged in a way that the facilitiy's expenses would remain below the project utility costs the majority of the time.

The following recommendations are reflected in the above cash flow:

4.1 Install programmable thermostat

Annual Energy Savings: ***$ 829 (9,630 kWh***
Estimated Install Cost: ***$700***
Payback Period: ***0.8 years***
ROI: ***121%***

Description: The two rooftop heat pumps for the office space are controlled with a manual turn dial thermostats. Regardless of how well office staff remembers to set back temperature at the end of the day, the human element is still in play and can end up costing hundreds of dollars over the course of the year.

Recommendation: Replace the existing thermostat with a simple weekday/weekend (also known as 5 day/2 day) programmable thermostat to automatically set the office temperature back to reduce the amount of time the heating and cooling operates. To eliminate occupant discomfort, keep the normal daytime settings the same and allow office staff to change temperature as they wish. ***During the heating season, set back the thermostat back to 60°-62°F after 5 pm. In the cooling season, set the thermostat up to 80°-82°F after 5 pm.***

A common misconception associated with thermostats is that a heat pump works harder than normal to warm the space back to a comfortable temperature after the thermostat has been set back, resulting in little or no savings. In fact, as soon as your office drops below its normal temperature, it will lose energy to the surrounding environment more slowly. The lower the interior temperature, the slower the heat loss. So the longer your office remains at the lower temperature, the more energy you save, because your office has lost less energy than it would have at the higher temperature. The same concept applies to raising your thermostat setting in the summer; a higher interior temperature will slow the flow of heat into your office, saving energy on air conditioning.

Assumptions:

- Cooling season set-back temperature is between 80°-82°F after 5 pm
- Heating season set-back temperature is between 60°-62°F after 5 pm
- Savings of 10% heating energy and 5% cooling energy.

4.2 Replace all incandescent and halogen lamps with LED equivalent

Annual Energy Savings: ***$621 (7,225 kWh)***
Est. Implementation Cost: ***$1196***
Payback Period: ***1.9 years***
ROI: ***74%***

Description: There are several types of incandescent lamps throughout the maintenance hangar. There are (9) 200W incandescent lamps, (7) 90W incandescent lamps, and (3) 50W halogen lamps. These lamps are assumed to be on 12 hours per day, 5 days per week.

Recommendation: Replace all lighting mentioned above with an LED equivalent. The 90W and 200W incandescent lamps should be replaced with 15W PAR30 LED lamps. The 50W MR16 halogen lamps should be replaced with an 8W MR15 LED. This replacement will reduce the energy consumed by 90%. Replacement costs will be reduced significantly with the extended operating hours of the LED lamps.

Assumptions:

- Electricity rate of $0.086/kWh
- Running for 12 hours/day, 5 days/week

4.3 Replace exterior 400W metal halide high bay fixtures with 78W RAB LED floodlight

Annual Energy Savings: ***$788 (9,160 kWh)***
Est. Implementation Cost: ***$6,613***
Payback Period: ***8.4 years***
ROI: ***16%***

Description: The exterior lighting of the maintenance building is made up of (8) 400W metal halide fixtures. These fixtures are assumed to be on for 12 hours per day and 5 days a week.

Recommendation: Replace the existing 400W metal halide fixtures with 78W RAB LED floodlights. The energy used by the proposed fixtures will be 20% of the energy consumed by the existing fixtures. Replacement costs will be significantly decreased because of the extended life hours of the LED fixtures.

Assumptions:

- Electricity rate of $0.086/kWh
- Running for 12 hours/day, 5 days/week
- Metal halide lamps run at 458W with ballasts

4.4 Retrofit all 2-lamp, 96W 8ft T12 fixtures to 4-lamp, 32W T8 fixtures

Annual Energy Savings: ***$631 (****7,338 kWh****)***
Est. Implementation Cost: ***$2677***
Payback Period: ***4.2 years***
ROI: ***32%***

Description: The parts crib and several other tool lofts were illuminated by 8ft T12 fixtures with magnetic ballasts. These lamps were assumed to be on for 12 hours a day, 5 days a week.

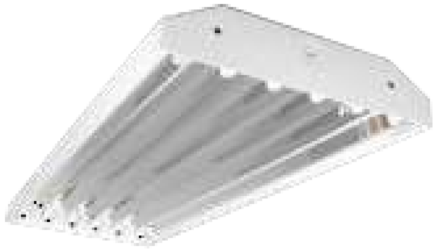
Recommendation: These fixtures should be retro-fitted with a 4-lamp, 32W 4ft T8 fixture. The energy used will be 35% of the existing lamps. This change to T8 lamps will make the maintenance team's job much easier because T8 lamps are very easy to come by. 8ft T12 lamps are no longer being produced and a very difficult to obtain. Changing to electronic ballasts will also improve the energy efficiency of the fixtures.

Assumptions:

- Electricity rate of $0.086/kWh
- Running for 12 hours/day, 5 days/week

4.5 Replace 400W metal halide high bay fixtures with 6 lamp, 4ft T5 high bay fixtures

Annual Energy Savings: ***$615** (7,149 kWh)*
Est. Implementation Cost: ***$3207***
Payback Period: ***5.2 years***
ROI: ***26%***



Description: Currently the high bay lighting in the maintenance hangar consists of (12) 400W metal halide fixtures. These fixtures are assumed to be on for 12 hours per day and 5 days a week.

Recommendation: Replace all 400W metal halide lamps with (4) 6-lamp, 4ft T5 high bay fixtures and (8) 4-lamp, 4ft T5 high bay fixtures. The 6-lamp fixtures will serve as 2-lamp emergency fixtures and use 4 lamps when in normal operation. The energy used by these fixtures will be 58% of the energy used by the existing fixtures.

Assumptions:

- Electricity rate of $0.086/kWh
- Running for 12 hours/day, 5 days/week
- Metal halide fixtures run at 458W with ballast

4.6 Propane Infrared Heaters (Or Direct Fire) for Hangar

Energy Savings: ***$ 12,900 (5,760 gal, 8,000 kWh, -5,543 gal propane)***
Estimated Install Cost: ***$24,340***
Payback Period: ***1.8 years***

Description: The 100' x 120' high-bay hangar is heated with a fuel-oil boiler with in-floor heating. Due to the thermal mass of the concrete, the boiler is kept in operation from October - April and set to maintain a constant temperature of 65°F. If shutdown, it is reported that the boiler takes 2 days to warm up the slab. One boiler pump runs continuously throughout the winter and another five circulation pumps cycle to meet space load.

Recommendations: Install propane infrared heaters at 30' above the work floor to provide primary heat to the building. Install programmable thermostats and take maximum advantage of potential setback temperatures during unoccupied periods. In addition, during design, consider a direct-fire fresh air unit such as the Cambridge "Blow-Thru" unit to carry base load and reduce the number of task heaters needed.

The fuel oil system could be left in place as a back-up and future fuel flexibility. Based on current capacity, about 325 MBH of heaters would need to be installed, however, to provide full coverage of the space, there may need to be more installed. The design and cost basis is for six 60 MBH heaters installed in a 2x3 grid. Use two-stage heaters to reduce cycling and improve comfort and efficiency during swing seasons and purchase highest efficiency, electric ignition, direct-vent heaters available.

Two key factors provide energy cost savings. The first is the lower cost of propane as a fuel compared to current Fuel Oil prices. On an effective Btu heat basis, electric resistance heat is about 45% less expensive than fuel oil. The second is the potential for unoccupied setbacks. In a large open building such as the hangar with large infiltration amounts, a great deal of energy is lost heating the building when it is not being used. Consider setting the temperature back to 55F at nights and on weekends with an override if occupied.

Assumptions:

- Would be able to do night and weekend setback. 30% reduction due to unoccupied setbacks (65 down to 50) 6am-6pm, no weekends.
- 80% eff. boiler. 10% less heat loss through ground conduction.
- 8,000 kWh pump power saved
- $2,060 for 60 MBH heater installed model. get 6 for coverage (8 would be best). $8,000 for piping, $4,000 wiring.

4.7 Hangar envelope Improvements

Energy Savings: ***$ 4,150 (1,210 gallons)***
Estimated Install Cost: ***$26,730***
Payback Period: ***6.4 years***
ROI: ***16%***

Description: The 100' x 120' high-bay hangar is a typical steel building with vinyl-faced fiberglass panels exposed interior of the metal sheathing. The unique requirements of a maintenance hangar include two large 100' x 35' hangar doors. These doors have a rubberized gasket but these are showing some wear and have some gaps in them.

The building is heated only; the hangar doors are cracked as needed to provide natural ventilation cooling. A ridge vent is installed along the roof that had initially been operated by normally open mechanical louvers. The vents would not completely close in the winter resulting in significant air infiltration. In summer, the hangar doors provided plenty of ventilation so the vent was recently modified to be normally closed and the gap filled with vinyl-faced fiberglass insulation. However, the seal job has not been perfect and wind-driven rain has been observed to infiltrate and wet the insulation.

Recommendations: Undertake the following envelope improvements:

<u>Remove hanger ridge vent:</u>
The ridge vent should be fully removed and replace with a continuous roof cap. Air seal and insulate the underside of roof peak. Besides the energy savings, a major benefit of completing this work would be to prolong the life of the existing roof by reducing the amount of rain infiltration. Dampness at the roof line, including saturation of the fiberglass insulation will eventually lead to deterioration of the roof.

<u>Install brush seals to hangar doors:</u>
The two hangar doors are each 100' x 35', leading to 540' of crack space along the edge where air can infiltrate. The gaps have a rubber gasket applied to them, but these are imperfect and still allow significant air through. Air infiltration is the greatest source of heat loss in the hangar and the hangar door performance can be greatly improved by adding a second layer of defence against infiltration. Brush seals are more durable than gaskets to regular opening and closing, they block heavy air drafts caused by wind and, in conjunction with the existing gaskets will reduce cold air infiltration. Install brush seals on vertical edges of the hangar doors.

<u>Install gaskets on man doors:</u>
There are four man doors in the hangar. Though they are small in comparison to the hangar doors it is recommended that rubber door seals and threshold sweeps be installed to eliminate this source of air infiltration.

Assumptions:

- Total 30% heating energy savings changing infiltration from 0.12 to 0.06 calculated with eQuest energy model.
- 8% fuel savings due to hangar door. $6/foot for material. $4 for install. two 100'x35' doors = 540ft
- 21% fuel savings from sealing roof vent. Removing roof vent will require rigging, roof work. 100' x 10' section. roofing $1,675 per sq from RS Means
- 1% fuel savings from man doors

4.8 Insulate Office Parapet Walls

Energy Savings: **_$ 1,160 (13,480 kWh)_**
Estimated Install Cost: **_$9,360_**
Payback Period: **_8.1 years_**
ROI: **_12%_**

Description: The Maintenance Building office space is a 1-storey metal building attached to the hangar. The offices are heated and cooled by two single-zone rooftop heat pumps. The roof is a flat roof with parapet walls. The walls insulated with vinyl-faced fiberglass. In the occupied space, they are studded out and further insulated with fiberglass batts. However, it was observed that the fiberglass batts stop above the drop ceiling and the vinyl-faced fiberglass ends at the parapet leaving the parapet wall exposed and open to the plenum space. Additionally, no air sealing was observed at the cap plate of the parapet. Air infiltration is a major source of heat loss in small commercial buildings.
The site survey was conducted in summer but occupants reported the plenum space was extremely cold in winter.

Recommendations: Insulate and air seal parapet walls. Install 3.5" foil faced foam board or fiberglass board insulation (such as CertaPro board) as approved by local building jurisdiction for a minimum R-value or R-14. The insulation should cover the entire exterior wall. Air seal at the parapet cap with closed-cell foam or caulking as allowed by code.

Assumptions:

- Reduce office electric heating costs by 15%

5 CONCLUSIONS

All facilities have the opportunity to significantly reduce annual energy expenses and apply those savings to more vital services or investing in other facilities or products. **The findings communicated in this report can reduce annual energy costs at this facility by approximately 60%.** ***Annually, the University Park Airport allocates approximately $36,570 on energy expenses for this facility. The recommendations in this report will reduce annual energy costs by approximately $21,700. The projects identified have an estimated install cost of $74,820, providing less than a 4 year payback and a 30% return on investment.***

We have provided this facility with 8 capital improvement recommendations that are based on our findings while on site, reviewing building plans, and analyzing utility data. The major recommendations in this report are:

Energy Conservation Measure	Annual Energy Savings	Lifetime Savings	Initial Cost	Simple Payback	Internal Rate of Return	Year to Implement
Install programmable thermostat for office spaces	**$829**	$8,291	**$700**	0.8	**121%**	**Year 1**
Replace all incandescent and halogen lamps with LED equivalent	**$622**	$6,221	**$1,196**	1.9	**74%**	**Year 1**
Replace exterior 400W metal halide high bay fixtures with 78W RAB LED floodlight	**$789**	$7,887	**$6,613**	8.4	**75%**	**Year 2**
Retrofit all 2-lamp, 96W 8ft T12 to 4-lamp, 32W 4ft w/ electronic ballasts	**$632**	$10,109	**$2,677**	4.2	**24%**	**Year 2**
Replace 400W metal halide high bay fixtures with 6 lamp, 4ft T5 high bay fixtures	**$616**	$7,386	**$3,207**	5.2	**19%**	**Year 2**
Propane infrared heaters (Hanger)	**$12,905**	$193,578	**$24,340**	1.9	**53%**	**Year 3**
Building envelope improvements (Hanger)	**$4,150**	$62,248	**$26,730**	6.4	**16%**	**Year 3**
Insulate office walls	**$1,161**	$17,409	**$9,360**	8.1	**12%**	**Year 3**
	$21,703	**$313,130**	**$74,823**	**3.4**	**29%**	**-**

If you wish to pursue any of the recommendations made in this report further, but need more guidance, please feel free to contact Envinity. We recommend and install energy efficient technology every day and would be happy to discuss your projects further.

Sincerely,

Kevin Gombotz, PE, CEM
Project Manager
kevin@envinity.com

Walk Through Audit Analysis

University Park Airport – Air Traffic Control Tower | October 2013

Revised 1/21/2013

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Facsimile: 814.231.1862
Web: www.envinity.com

October, 2013

University Park Airport Officials,

Please find enclosed a copy of the walk through level energy audit recommendations for the University Park Airport – Air Traffic Control Tower. You will find information on existing energy use patterns, identification of Energy Conservation Measures (ECMs), and a framework that lays the path for improved energy management at your facility.

As part of this work scope, Envinity reviewed existing/historic energy use patterns, performed a walk through energy assessment and identified feasible energy conservation measures (ECMs). The top energy saving measures are identified and described in the following report.

As the Airport proceeds with project implementation, Envinity can offer the following additional services: level II analysis of the ECMs, engineering and design of all recommendations, bid document preparation, construction administration, grant writing and management, building performance contracting, project commissioning and management, energy management services, and renewable energy deployment.

It is our pleasure to contribute our technical expertise toward the success of this important local project.

Sincerely,

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AIR TRAFFIC CONTROL TOWER BY THE NUMBERS

$11,260	**Annual Average Energy Cost (Propane| $1,031; Electricity | $10,227)**
1,077 MMBtu	**Annual Average Energy Use (296,581 kWh; 718 gal Propane)**
5,588 ft^2	**Building Area**
91.8 $kBtu/ft^2$	**Energy Use per Sq Ft**
$2.01 $/ft^2$	**Energy Cost per Sq Ft**

1 Utility Bill Analysis & Benchmarking Assessment

Understanding the historic utility usage and cost data is at the foundation of a strong energy management plan. Recognizing where you came from is necessary for setting a course for the future. The purpose of the utility bill analysis is to accurately quantify the total energy used and total energy costs at a site so that recommended energy conservations measures are based off of actual data. Understanding energy use trends observed during the utility bill analysis phase of the work scope also better prepares the energy professional for conditions and systems that will be observed on site. The utility bill analysis is performed prior to the audit team visiting the site and helps guide the system focus of the audit.

Utility data was obtained from April 2011 to May 2013. The Air Traffic Control Tower has the following accounts:

Company	Commodity	Account Number
West Penn Power	Electric	Primary Meter
AmeriGas	Propane	200479526

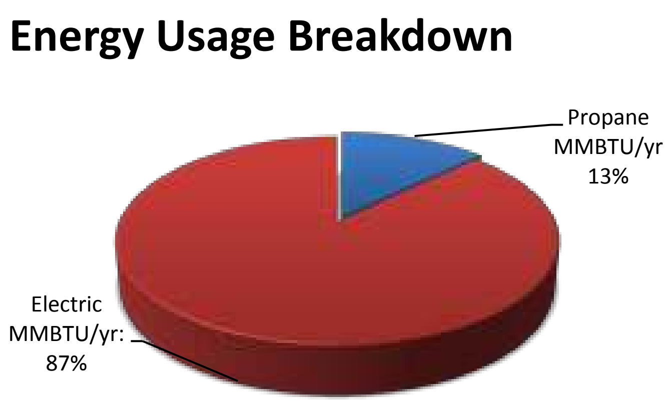
A summary analysis of the results is as follows:

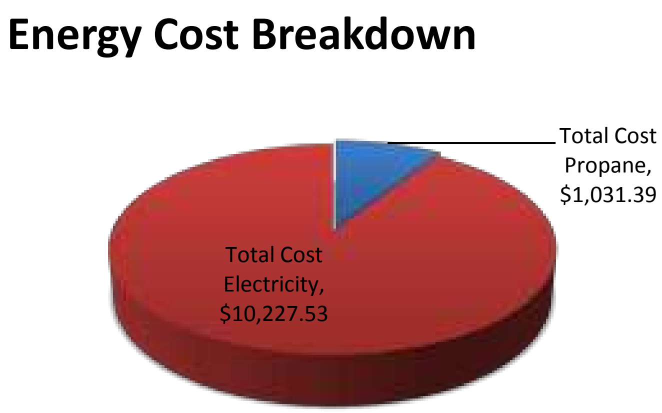
1.1 Energy Usage at the ATCT

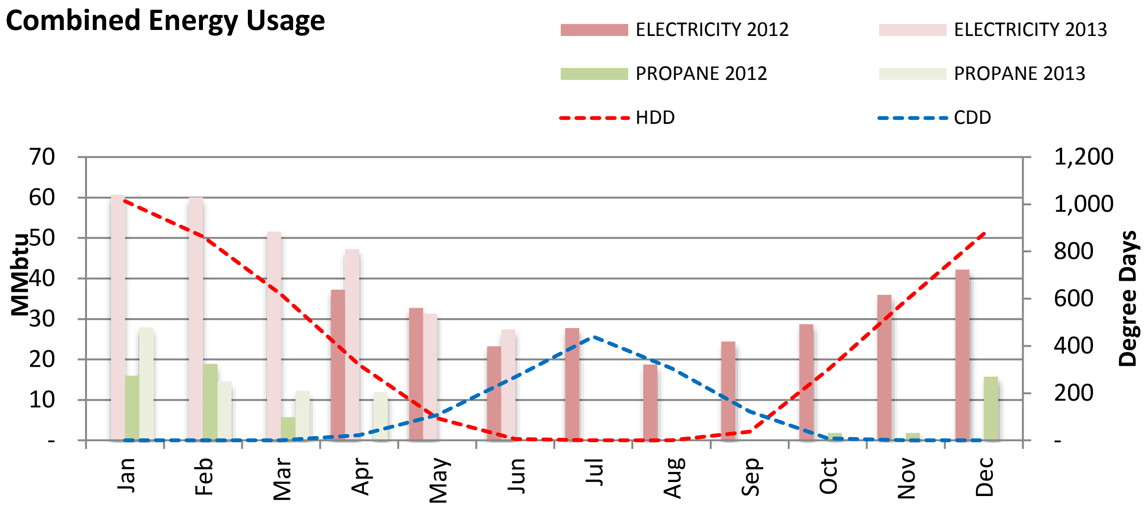
Utility data was observed from April 2011 to May 2013 at the ATCT. Electric data was obtained from the electric utility provider and Penn State OPP. Propane data was obtained from AmeriGas. The average unit costs are as follows:

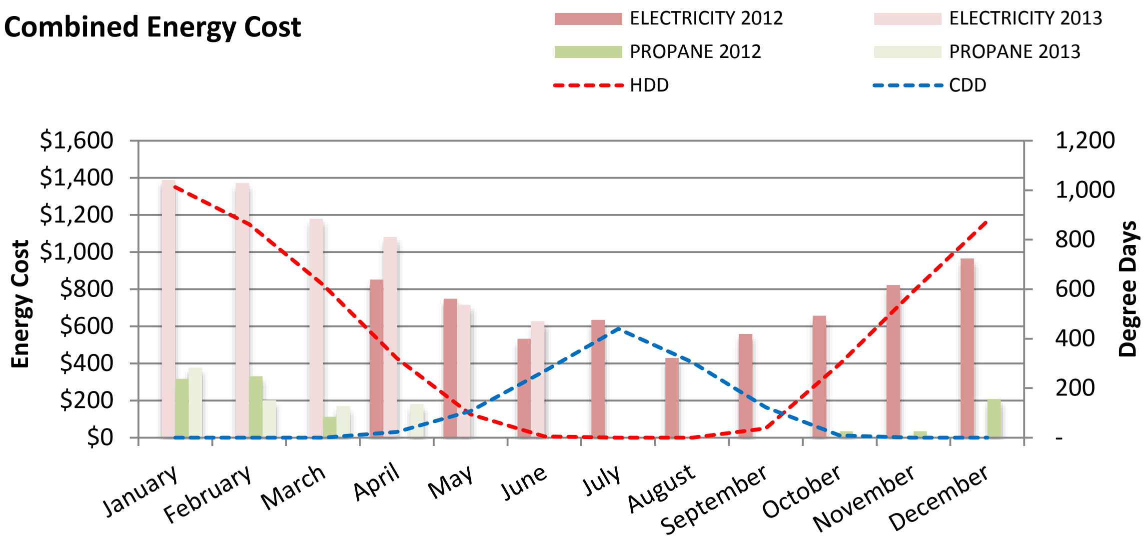
Electricity: ***$0.0861 per kWh;*** ***$22.86 per MMBtu***
Propane: ***$1.44 per gallon;*** ***$15.73 per MMBtu***

The following graphs show total energy use and cost trends over the period assessed and compared to the effects of weather.







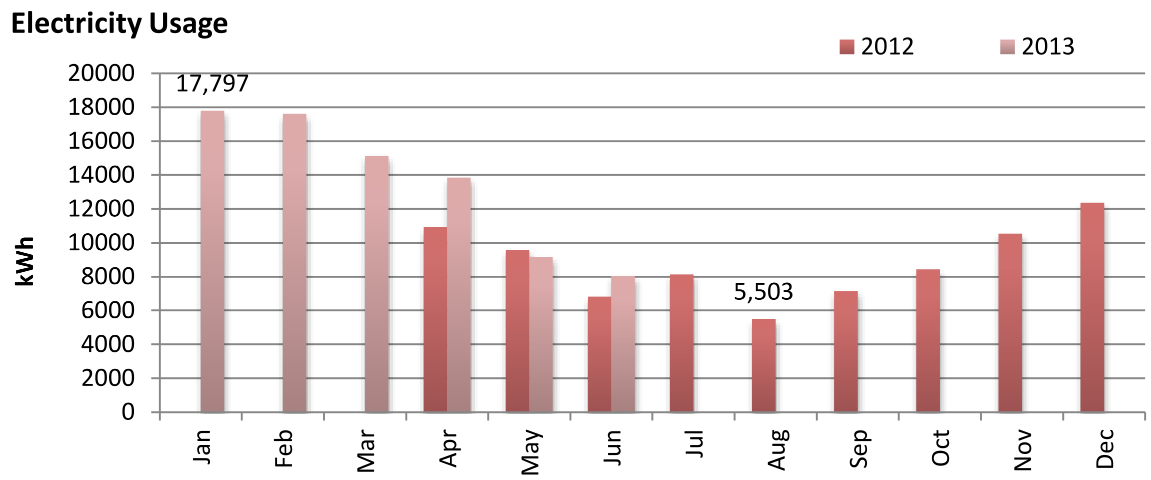


1.2 Electric Usage at the Air Traffic Control Tower

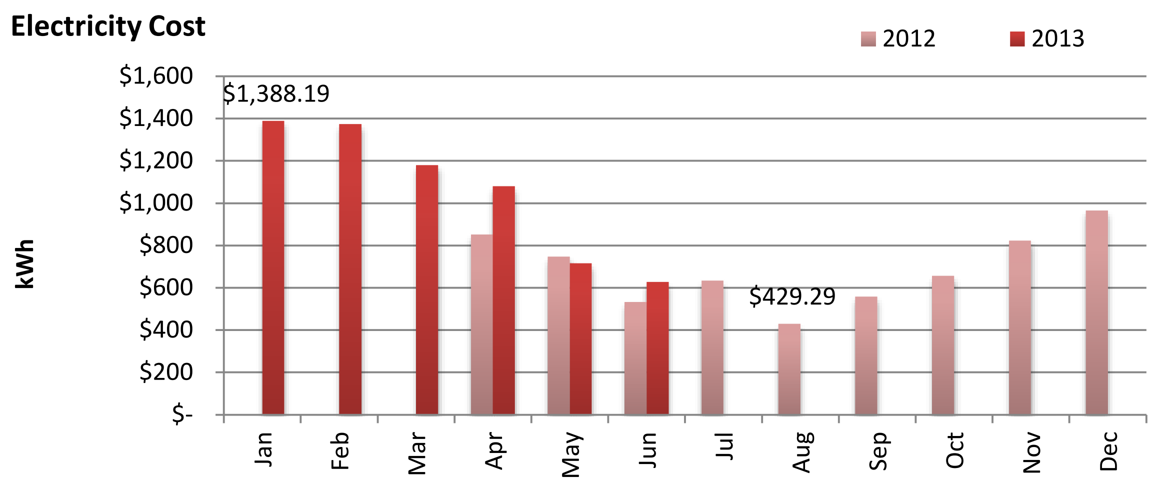
Electric Usage at the Air Traffic Control Tower

Account: **West Penn Power**
Distribution Rate: **$0.078/kWh**

The data shows that electric consumption throughout the year has remained consistent for each calendar year, following seasonal trends. Usage peaks during the winter months due to an increase in heating. Over the period evaluated, the ATCT consumed the most electricity in January 2013 (17,797 kWh) and the least in Aug 2012 (5,503 kWh).



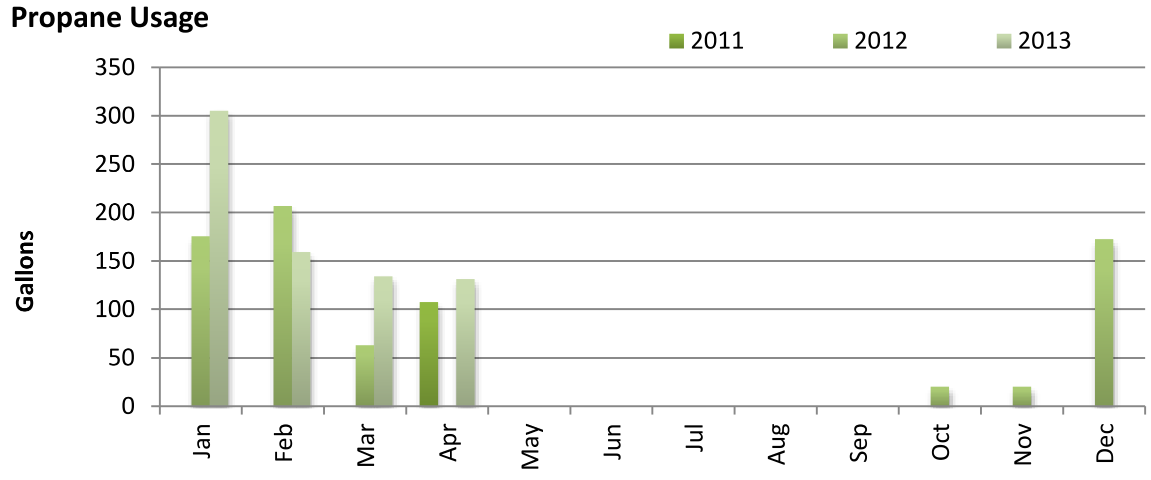
Annually, the ATCT spends $25,536 on average for electricity. Electric supply is currently procured through West Penn Power at a rate of $0.078/kWh. Electric cost was highest in January 2013 ($1,338) and lowest in Aug 2012 ($430).



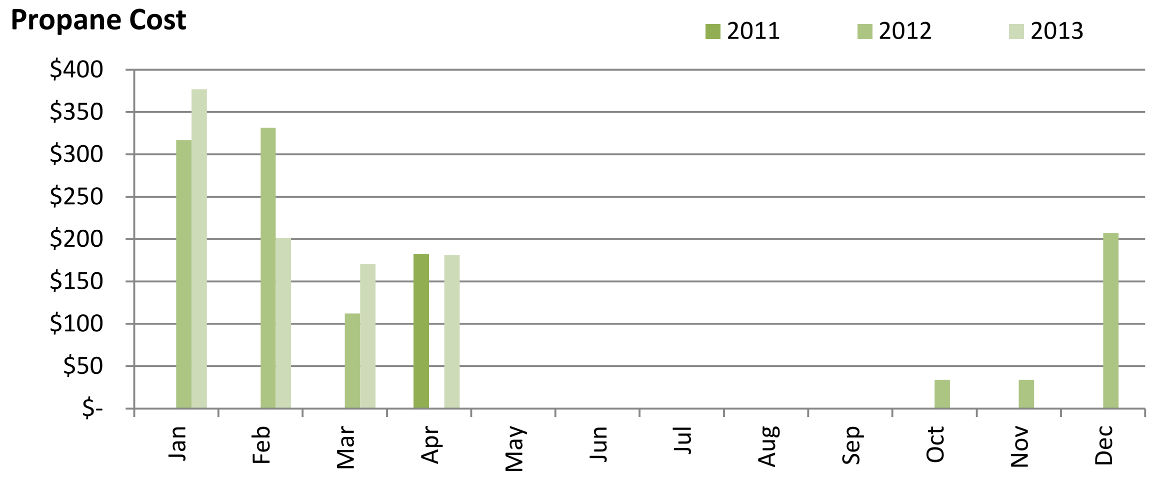
1.3 PROPANE UASGE AT THE AIR TRAFFIC CONTROL TOWER

Account: **AmeriGas**
Received by: **Delivery**
Rate: **$1.44/gal**

Propane is delivered to the airport as needed, picking up in the winter months with the increased demand for heating. Propane usage was at a maximum in January 2013 (305 gal) and a minimum in October 2012 (20 gal).



Propane cost follows the same trend as the consumption trend. Propane cost was at a maximum in January 2013 ($377) and a minimum in October 2012 ($34).



2 ENERGY USE PROFILE

The following existing conditions were observed at the Air Traffic Control Tower.

2.1 Building Description and Occupancy

The ATCT is a newly constructed building that was completed in late 2010 and went into operation September 2011. The building is manned for 16 hours per day, 6AM - 10PM. Besides the air traffic control cab on top, there is also a conference room and several offices. The occupancy is low with a staff of 2 usually on premises and the conference room being used infrequently. A conditioned electrical room contains electronic communications equipment and airfield equipment.

2.2 Energy Use by Category

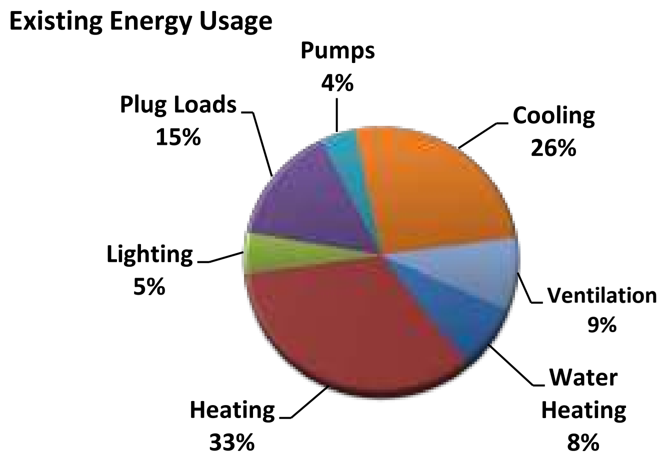
Energy is consumed within a building in a variety of ways. Heating, cooling, lighting, appliances, and water heating all consume most of the building's energy. To better visualize the energy consumption, the ATCT energy use has been separated into individual categories. Areas of each building that consume large amounts were the main areas of focus for Envinity to find any problems and to determine the feasibility of energy efficiency improvements.

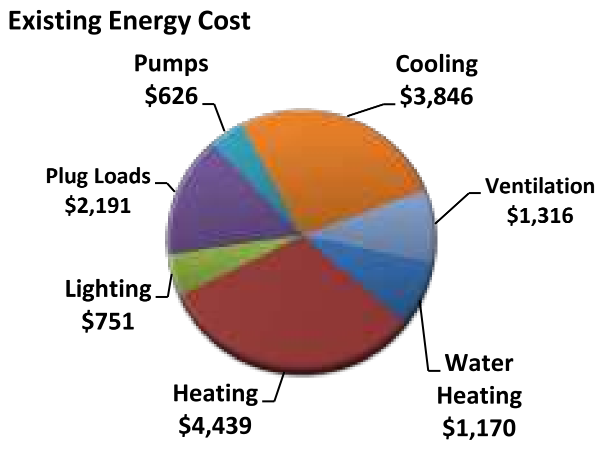
Through the utility bill analysis, engineering analysis and computer modeling, the energy usage was disaggregated into each of its energy-using components, providing a visual reference as to how energy is consumed annually within each building and how to best reduce energy consumption.

Envinity received 27 months of utility data for the ACTC from February 2011 to April 2013. Over this time period, the ATCT consumed an annual average of 513 MMBTU of energy, resulting in annual energy costs of $11,259 or $2.01 per square foot. Broken up by electric and fuel oil:

Electric: ***131,122 kWh (447 MMBtu); $10,227***
Propane: ***718 gallons (65.6 MMBtu); $1,031***

The following charts are a disaggregation of how energy has been consumed at the ATCT over the past 15 months:





Energy Use Breakdown[1]

	Electric, kWh	Propane, gallons	Total Energy Use, MMBtu	Total Energy Cost	% ENERGY	% COST
Water Heating	15,000		51	$1,170	10%	10%
Heating	43,691	718	215	$4,439	42%	39%
Lighting	9,633		33	$751	6%	7%
Plug Loads	28,095		96	$2,191	19%	19%
Pumps	8,027		27	$626	5%	6%
Cooling	7,864		27	$613	5%	5%
Ventilation	16,876		58	$1,316	11%	12%
TOTAL:	**129,185**	**718**	**506**	**$11,108**	99%	99%

[1]Energy use breakdown provides an inventory of energy usage based on collected data on site.

3 Capital Recommendations

The following recommendations were observed during the walk through assessment. Primary focus was given to identifying mechanical system adjustments to increase the efficiency of the Air Traffic Control Tower.

3.1 Take advantage of Building Environmental Systems unoccupied setbacks. Consider occupancy sensors.

The ATCT is occupied for 16 hours per day and during this time it is usually lightly occupied. The existing BES provides opportunity to significantly reduce energy consumption by taking advantage of unoccupied setbacks to adjust the temperature setpoints, the fan operation, and ventilation air. In addition, in the spaces that are lightly used such as bathrooms, conference rooms, break rooms, and offices, occupancy sensors could be installed to allow the spaces to go into unoccupied mode when no one is present.

Recommendations:

- Provide for unoccupied modes in all spaces except ATCT equipment room during the 8 hours when the building is unoccupied.
  - Set unoccupied Heating setpoint to 65F, with fans allowed to cycle.
  - Set unoccupied Cooling setpoint to 85F, with fans allowed to cycle.
  - Close outdoor air dampers
  - Turn off exhaust fans
  - Zones where no occupancy scheduling was observed
    - HP-5: CAB 701
    - HP-6: CAB 701
- Allow fan to cycle and close OA damper at night for ATCT Equipment room
- Install and utilize occupancy sensors in zones with intermittent occupancy to put zones in unoccupied mode.
  - HP-2: Conference Room
  - HP-3: Breakroom
  - HP-4: Office/Workspace

3.2 Balance Outdoor Air amounts.

Outdoor air for ventilation is provided individually to each zone water-source heat pump. Outdoor air heating and cooling is a significant energy cost. Outdoor air control dampers were observed to be fully open, indicating that the system may never have been properly balanced to design OA minimums. Outdoor air minimums indicated on design documents should be referenced for a system-wide outdoor air rebalancing effort.

3.3 Consider Addition of a Ground Loop.

The water-source heat pump system combined with a cooling tower can be a relatively efficient arrangement during the cooling season. However, during the heating season, the heat pumps are effectively getting all of their heat from the propane boiler. By adding a geothermal loop to the arrangement the heat pumps would be able to source heat from the ground for most of the year. To reduce costs, the propane boiler could be kept online to supplement a smaller well feild during the coldest days. A geothermal loop would also reduce costs on the cooling side by increasing cooling efficiency with lower water temperatures and limiting the amount of time that the fan tower is running.

4 CONCLUSIONS

All facilities have the opportunity to significantly reduce annual energy expenses and apply those savings to more vital services or investing in other facilities or products. The Air Traffic Control Tower underwent a walk through level energy survey where several strong conservation projects were identified for building mechanical systems. Envinity recommends that the University Park Airport evaluate these recommendations in more depth through an ASHRAE Level II energy audit so that estimated costs, savings, and project economics can all be vetted in more detail.

The energy saving projects identified were:

1. Optimize Building Environmental Systems for enhanced energy savings
2. Balance outdoor air flow
3. Add ground loop to the existing water source heat pump system

If you wish to pursue any of the recommendations made in this report further, but need more engineering guidance, please feel free to contact Envinity. We recommend and install energy efficient technology every day and would be happy to discuss your projects further.

Sincerely,

Kevin Gombotz, PE, CEM
Project Manager
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EXTERIOR LIGHTING AUDIT ANALYSIS

UNIVERSITY PARK AIRPORT | OCTOBER 2013

REVISED 1/21/2013

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October 2013

University Park Airport Officials,

Please find enclosed a copy of the exterior lighting energy audit recommendations for the University Park Airport. You will find information on existing energy use patterns, identification of Energy Conservation Measures (ECMs), and a framework that lays the path for improved energy management at your facility.

As part of this work scope, Envinity reviewed existing/historic energy use patterns, performed a comprehensive lighting energy assessment and identified feasible energy conservation measures (ECMs). The top energy saving measures are identified and described in the following report.

As the Airport proceeds with project implementation, Envinity can offer the following additional services: engineering and design of all recommendations, bid document preparation, construction administration, grant writing and management, building performance contracting, project commissioning and management, energy management services, and renewable energy deployment.

It is our pleasure to contribute our technical expertise toward the success of this important local project.

Sincerely,

Kevin Gombotz, PE, CEM
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1 CAPITAL RECOMMENDATIONS

The east hangars are used for aircraft storage. The staff asked the audit team to focus on the exterior lighting of these hangars. The hangars have 175W metal halide fixtures mounted on the bay doors and also on the end closest to the runway. Pole lighting is also being used which is mounting a 400W HPS bulb. Tarmac lighting and De-icing pad lighting is included in this exterior lighting evaluation. At the East Hangers, the maintenance staff has had problems with the existing 175W metal halide bulbs burning out well before their rate life expectancy. The audit team suspects this is from the vibrations of the door when it opens and closes. These vibrations are harmful the metal halide bulbs and are the reasoning for the decreased run hours. The east hangar exterior lighting is on during the night hours without any type of lighting control.

1.1 Replace existing 175W metal halide wall packs located on bay doors with 25W RAB LED wall packs

Annual Energy Savings: ***$4,507 (**52,416 kWh**)***
Est. Implementation Cost: ***$23656***
Payback Period: ***5.25 years***
Economics: ***IRR – 24%***

Description: The East Hangars currently have (60) 175W metal halide fixtures illuminating the rows between the hangars. The wall packs have been placed on the doors of the hangars. The vibrations from the doors opening and closing have caused the life hours of these metal halide bulbs to be decreased dramatically. There are no controls on the fixtures causing them to be on all night long.

Recommendation: All 175W metal halide wall packs should be replaced with 25W RAB LED wall packs. Energy consumption will be reduced by 93% with the use of occupancy sensors. Switching to LED will also increase the life hours of the fixtures. LED fixtures are resistant to vibration so mounting these fixtures on the existing hangar door location will not be an issue.

Assumptions:

- Electricity rate of $0.086/kWh
- Existing fixtures running 84 hours/week, proposed fixtures running 42 hours/week with occupancy sensors
- Existing fixture runs at 215W with ballast

1.2 Replace existing 250W metal halide wall packs located at end of hangars with 78W RAB LED wall pack

Annual Energy Savings: ***$468 (**5,449 kWh**)***
Est. Implementation Cost: ***$3,800***
Payback Period: ***8.11 years***
Economics: ***IRR – 15%***

Description: The East Hangars currently have (5) 250W metal halide fixtures located on the ends of the hangars. No controls were observed to be reducing lighting when not needed.

Recommendation: All (5) 250W metal halide wall packs should be replaced with 78W RAB LED wall packs. Energy consumption will be reduced by 85% with the use of occupancy sensors. Switching to LED will also increase the life hours of the fixtures. 78W RAB LED wall packs will operate for up to 100,000 hours compared to the 15,000 operating hours of the existing 250W metal halide. Labor and replacement costs will also be significantly decreased, further reducing payback period.

Assumptions:

- Electricity rate of $0.086/kWh
- Existing fixtures running 84 hours/week, proposed fixtures running 42 hours/week with occupancy sensors
- Existing fixture runs at 295W with ballast

1.3 Installed occupancy sensors at the ends of each hangar

Annual Energy Savings: ***$389 (****4,925 kWh****)***
Est. Implementation Cost: ***$1500***
Payback Period: ***3.85 years***
Economics: ***IRR – 129%***

Description: The East Hangars currently have no control system on their exterior lighting. These fixtures are on for all hours of the night.

Recommendation: Install occupancy sensors at the beginning of every row, in between each hangar. These sensors will turn on both rows of wall packs when tripped by a car or pedestrian. The installation of these sensors will provide further energy savings by lighting occupied space only.

Assumptions:

- Electricity rate of $0.086/kWh
- Conservatively assuming sensors will cut run time of fixtures in half

1.4 Replace existing 400w metal halides along entrance road with 78w LED

Annual Energy Savings: ***$1,545 (****18,970 kWh****)***
Est. Implementation Cost: ***$8360***
Payback Period: ***5.4 years***
Economics: ***IRR – 23%***

Description: The pole lights along the entrance road currently have (11) 400W metal halide fixtures. No controls were observed to be reducing lighting when not needed.

Recommendation: All (11) 400W metal halide wall packs should be replaced with 78W RAB LED wall packs. Energy consumption will be reduced by 85% with the use of occupancy sensors. Switching to LED will also increase the life hours of the fixtures. 78W RAB LED wall packs will operate for up to 100,000 hours compared to the 15,000 operating hours of the existing 250W metal halide. Labor and replacement costs will also be significantly decreased.

Assumptions:

- Electricity rate of $0.086/kWh
- Existing fixtures running 84 hours/week
- Existing fixture runs at 465W with ballast

1.5 Replace existing 400w high pressure sodium floodlights and wallpacks along tarmac and de-icing pad with 78w LED

Annual Energy Savings: ***$4,635 (****53,895 kWh****)***
Est. Implementation Cost: ***$32,697***
Payback Period: ***7 years***
Economics: ***IRR – 18%***

Description: The Tarmac is illuminated with (33) 400 watt high pressure sodium fixtures operating an assumed 84 hours per week. With ballast, each fixture is assumed to have a power draw of 465 watts.

Recommendation: All (33) 400W high pressure sodium fixtures should be replaced with 78W RAB LED wall packs and flood lights. Energy consumption will be reduced by 85% with the use of occupancy sensors. Switching to LED will also increase the life hours of the fixtures. 78W RAB LED wall packs will operate for up to 100,000 hours compared to the 15,000 operating hours of the existing 250W metal halide. Labor and replacement costs will also be significantly decreased.

Assumptions:

- Electricity rate of $0.086/kWh
- Existing fixtures running 84 hours/week
- Existing fixture runs at 465W with ballast

1.6 Replace existing select 400w high pressure sodium floodlights at de-icing pad with T5 high-bay

Annual Energy Savings: ***$1,041 (****12,108 kWh****)***
Est. Implementation Cost: ***$6,615***
Payback Period: ***6.35 years***
Economics: ***IRR – 18%***

Description: Portions of the de-icing pad is illuminated with (12) 400 watt high pressure sodium fixtures operating an assumed 84 hours per week. With ballast, each fixture is assumed to have a power draw of 465 watts.

Recommendation: Select 400W high pressure sodium fixtures should be replaced with T5 high bay fixtures with enclosure for wet location use

Assumptions:

- Electricity rate of $0.086/kWh
- Existing fixtures running 84 hours/week
- Existing fixture runs at 465W with ballast

2 CONCLUSIONS

All facilities have the opportunity to significantly reduce annual energy expenses and apply those savings to more vital services or investing in other facilities or products. The Exterior Lighting underwent a comprehensive energy survey where several strong conservation projects were identified for exterior lighting systems. Envinity has identified five projects that aim to eliminate ineficient high intensity discharge lighting with LED technology. The following economics can be applied to the project as a whole:

Total Estimated Cost to Install: ***$76,628***
Estimated Annual Energy Savings: ***$11,544***
Project Payback Period: ***6.6 years***
Return on Investment: ***21%***

If you wish to pursue any of the recommendations made in this report further, but need more engineering guidance, please feel free to contact Envinity. We recommend and install energy efficient technology every day and would be happy to discuss your projects further.

Sincerely,

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Energy Management Plan and Audit Analysis

University Park Airport – General Aviation Terminal | October 2013

Revised 1/21/2013

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Web: www.envinity.com

October 13, 2013

University Park Airport Officials,

Please find enclosed a copy of the energy management recommendations for the University Park Airport – General Aviation Terminal. You will find information on existing energy use patterns, analysis of Energy Conservation Measures (ECMs), and a framework that lays the path for improved energy management at your facility.

The findings communicated in this report can reduce annual energy costs at this facility by approximately 60%. ***Annually, the University Park Airport allocates approximately $16,938 on energy expenses for this facility. The recommendations in this report will reduce annual energy costs by approximately $10,500. The projects identified have an estimated install cost of $126,800, providing a 12 year payback.***

As part of this work scope, Envinity reviewed existing/historic energy use patterns , performed an ASHRAE level II energy assessment and identified feasible energy conservation measures (ECMs). The top energy saving measures were identified and prioritized based on feasibility, payback period, and return on investment.

As the Airport proceeds with project implementation, Envinity can offer the following additional services: engineering and design of all recommendations, bid document preparation, construction administration, grant writing and management, building performance contracting, project commissioning and management, energy management services, and renewable energy deployment.

It is our pleasure to contribute our technical expertise toward the success of this important local project.

Sincerely,

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1 General Aviation Building By the Numbers

<table>
<tr><td>$16,938</td><td>Annual Average Energy Cost (Propane| $6,707; Electric | $10,230</td></tr>
<tr><td>896 MMBtu</td><td>Annual Average Energy Use (133,750 kWh; 3,968 gal Propane)</td></tr>
<tr><td>5,590 ft^2</td><td>Building Area</td></tr>
<tr><td>160.4 kBtu /ft^2</td><td>Energy Use per Sq Ft</td></tr>
<tr><td>$3.03 /$ft^2$</td><td>Energy Cost per Sq Ft</td></tr>
<tr><td>85 kBtu/ft^2</td><td>National Average Energy Use per Sq Ft for “Office”</td></tr>
<tr><td>$10,462 (61% reduction)</td><td>Identified Annual Cost Savings</td></tr>
<tr><td>$126,800</td><td>Estimated Project Hard Cost</td></tr>
<tr><td>12.1 years</td><td>Total Project Payback</td></tr>
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2 UTILITY BILL ANALYSIS & BENCHMARKING ASSESSMENT

Understanding the historic utility usage and cost data is at the foundation of a strong energy management plan. Recognizing where you came from is necessary for setting a course for the future. The purpose of the utility bill analysis is to accurately quantify the total energy used and total energy costs at a site so that recommended energy conservations measures are based off of actual data. Understanding energy use trends observed during the utility bill analysis phase of the work scope also better prepares the energy professional for conditions and systems that will be observed on site. The utility bill analysis is performed prior to the audit team visiting the site and helps guide the system focus of the audit.

All utility data was obtained for December 2011 to May 2013. The General Aviation Terminal has the following accounts:

Company	Commodity	Account Number
West Penn Power	Electric	Primary Meter (shared with ATCT, Snow, Fire, field lighting)
AmeriGas	Propane	200576345

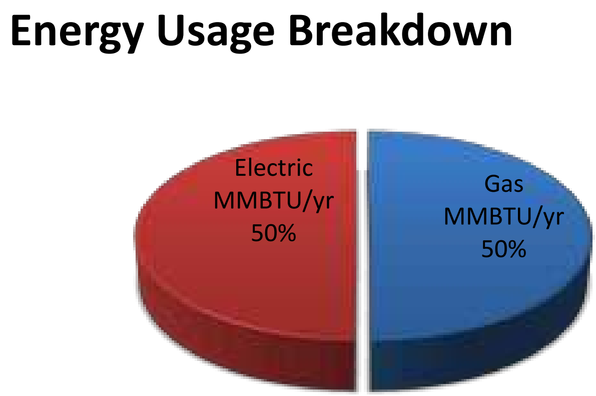
A summary analysis of the results is as follows:

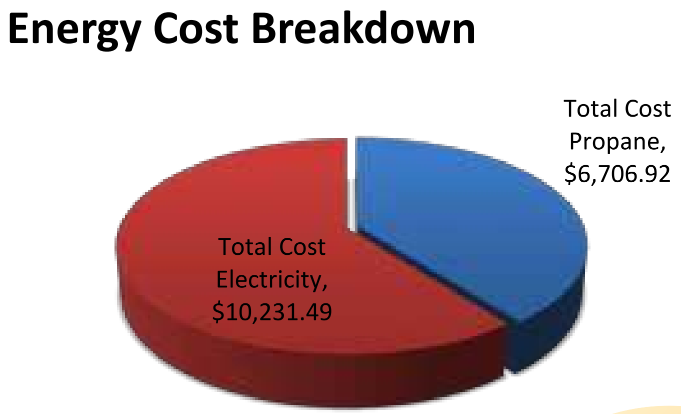
1.1.2 Energy Usage at the General Aviation Terminal

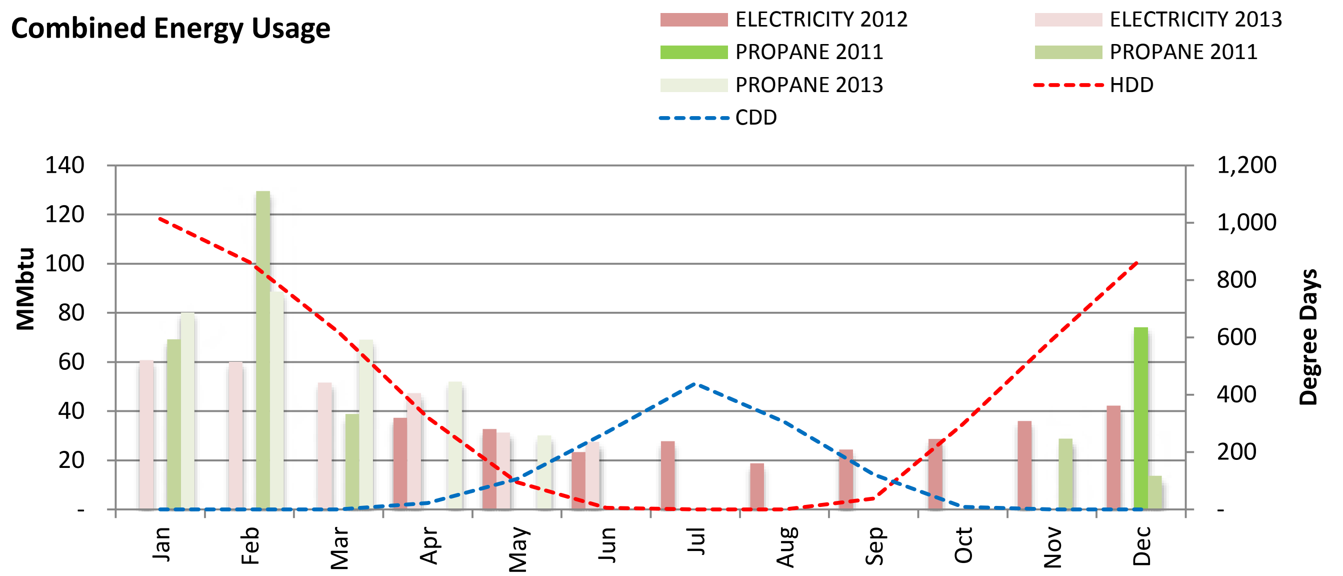
Utility data was observed from December 2011 to May 2013 at the GA Terminal. Electric data was obtained from West Penn Power from April 2012 to May 2013. Propane data was obtained from AmeriGas from December 2011 to May 2013. During this period, the GA Terminal consumed an average of 1,384 MMBtu annually, or $30,287 between electricity and propane. Of this, 934.4 MMBtu ($23,580) goes toward electricity and 449 MMBtu ($6,707) is propane consumption. The average unit costs are as follows:

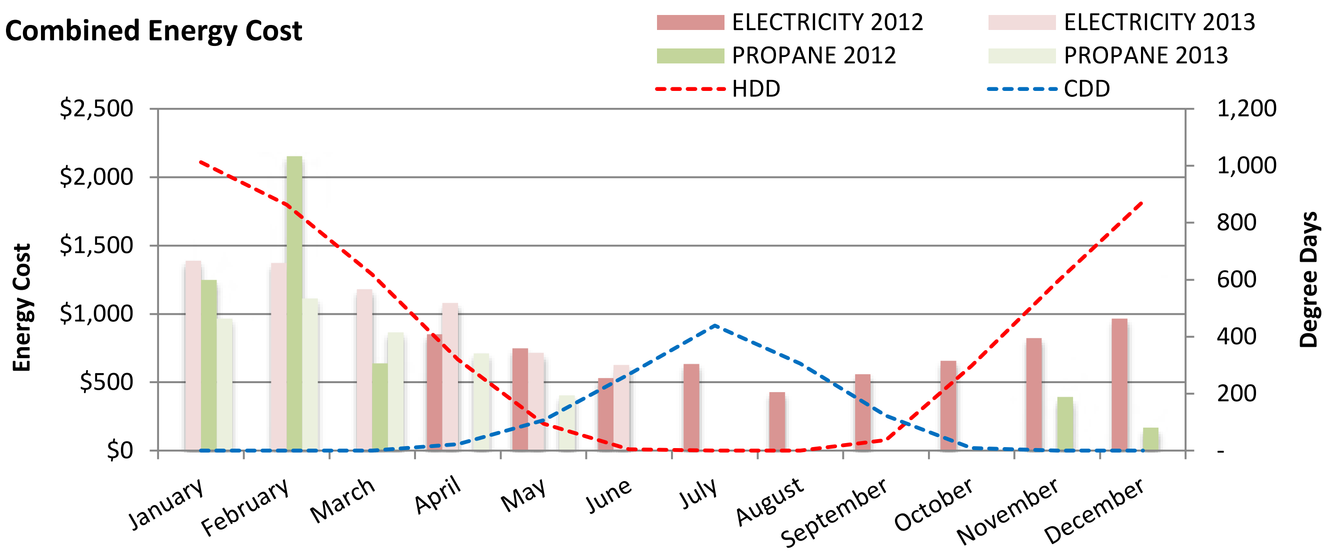
Electricity: ***$0.078 per kWh;*** ***$22.86 per MMBtu***
Propane: ***$1.36 per gal;*** ***$14.56 per MMBtu***

Based on the data provided, the cost of electricity costs 57% more than an equivalent amount of propane.
The following graphs show total energy use and cost trends over the period assessed and compared to the effects of weather.









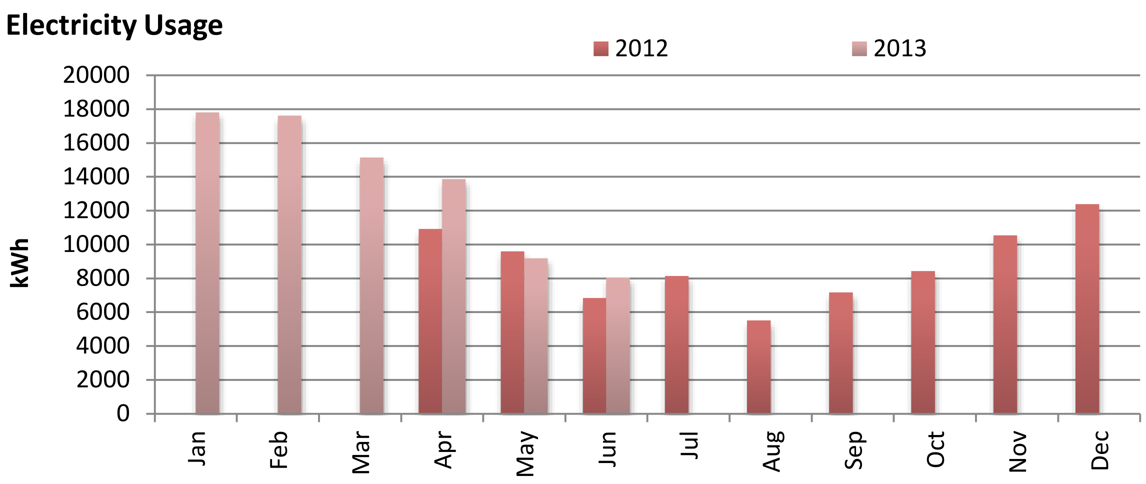
The data shows peaks of electricity use in the summer and winter months and peaks of propane use in the winter months.

1.1.3 Electric Usage at the GA Terminal

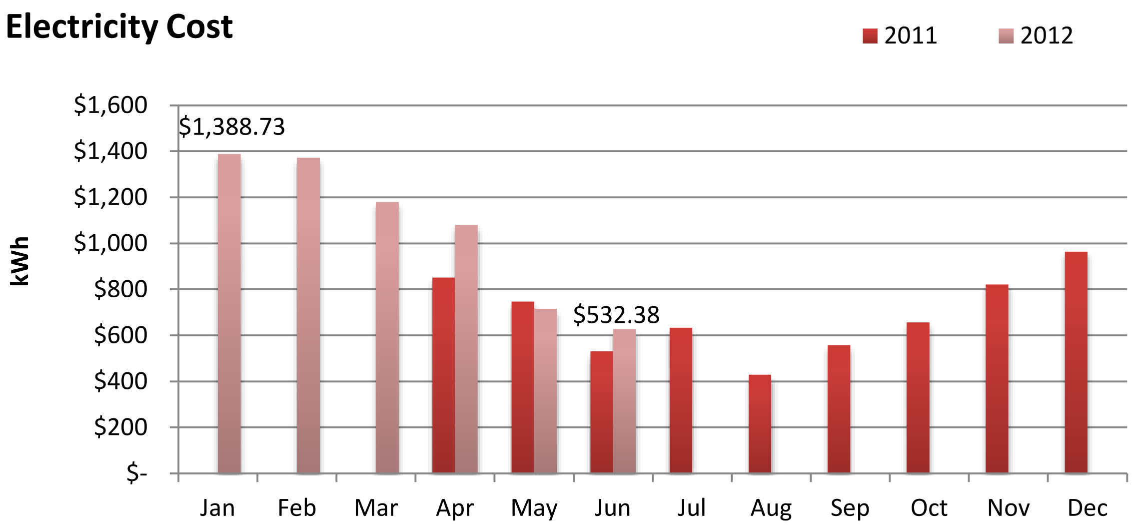
Electric Usage at the GA Terminal

Account: West Penn Power
Electricity Rate: $0.078/kWh

The data shows that electric consumption throughout the year has followed seasonal trends. Electricity consumption increases during the winter months. NOTE: The winter consumption is unusual for a building with propane heat and should be investigated. However, error in this building's estimated electric consumption is expected due to poor sub-metering. Improved sub-metering is recommended to differentiate between airfield lighting, ATCT, GA, Snow, and Fire Buildings.



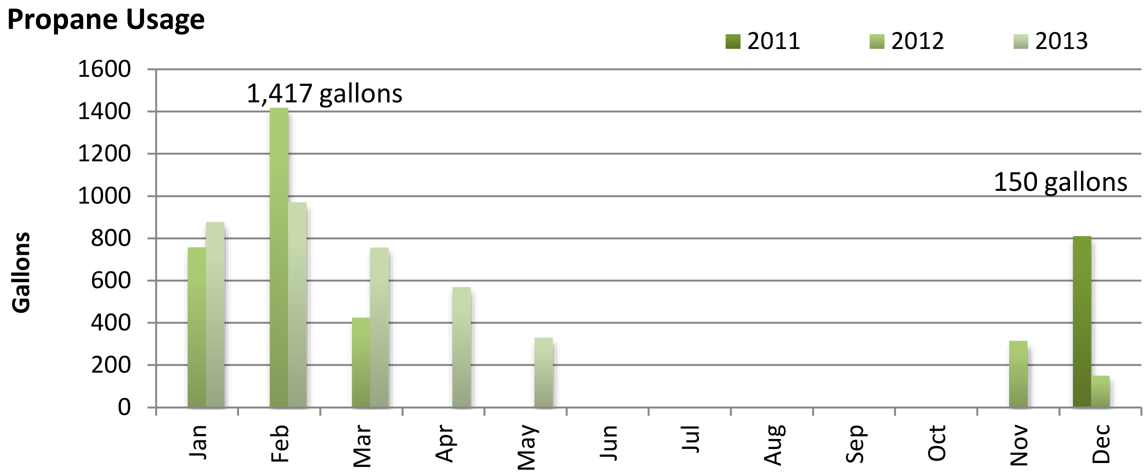
Electric supply is currently procured through West Penn Power and American Power Net at a rate of $0.078/kWh. Electric cost was highest in Jan 2012 ($1,388) and lowest in June 2011 ($532).



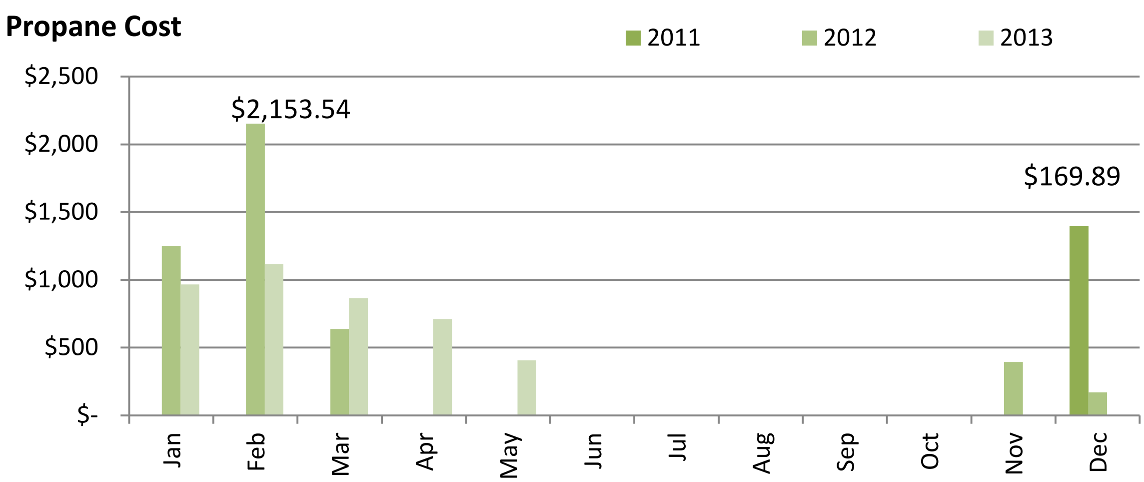
PROPANE USAGE AT THE ADMINISTRATION BUILDING

Account: AmeriGas
Commodity Rate: $1.36 per gallon

Propane at the GA Terminal is used for heating. The airport receives deliveries as needed which is then stored in tanks on the grounds. Trends show usage stops in the summer time and picks up in the winter months when heating demand is high. Usage was a maximum in February 2012 (1,417 gal) and a minimum in December 2012 (150 gal).



Propane cost follows the same trend as the consumption, following the demand for heating during the winter months. Propane cost was at a high in February 2012 ($2,154) and a low in December of 2012 ($170).

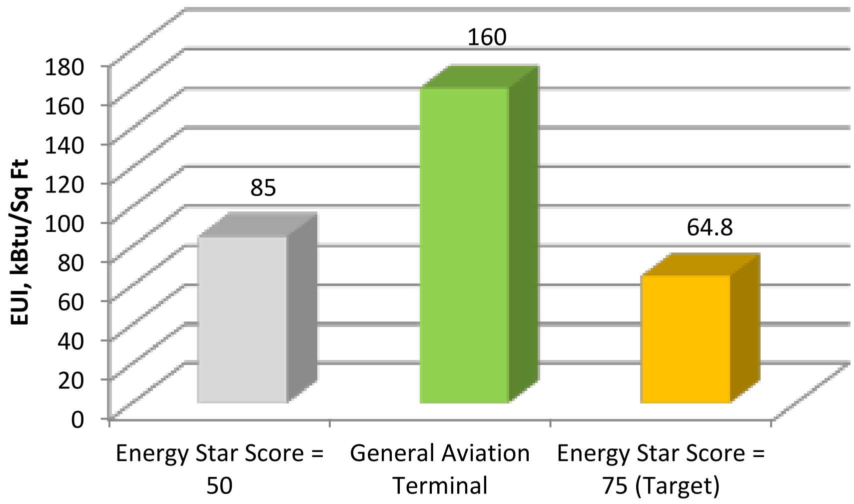


3 Energy Use Characterization & Benchmarking

One of the first steps in addressing energy use is to characterize the patterns of energy use for similar facilities. This involves developing expectations for the amount of energy used, the type of fuel used, and the breakdown of energy end use categories: lighting, cooling, fans, etc. To evaluate the amount of energy used by a building, it is conventional practice to estimate an ***Energy Use Index (EUI)***, expressed in KBtu/SF ● year (thousands of British Thermal Units per square foot per year). The EUI is estimated fairly simply by summing the annual energy use of all fuels (typically electricity and one or more fossil fuels), converting to a common energy unit (typically the Btu or KBtu in the US), and dividing by the applicable conditioned area of the facility. Once estimated, a EUI can be interpreted by comparison to a database of energy use statistics for similar facilities, a process called benchmarking.

The following graph shows how the EUI of the GA Terminal compared to the national average for "Offices" and an office with an Energy Star score of 75.

ENERGY STAR Summary vs Target Energy Use



The GA Terminal is operating within an EUI range that is higher than the average EUI range of similar facilities in the United States. The average office, with an Energy Star Score of 50, has a EUI of 85 kBtu/ft^2, whereas the GA Terminal is operating at a EUI of 160 kBtu/ft^2. An office with an Energy Star score of 75 has an EUI of 64.8 kBtu/ft^2.

To reach the Energy Star score of 75, the GA Terminal will have to cut energy by 75 kBtu/ft^2. If this goal is reached, the following savings will follow:

Energy Source	Energy Savings (MMBtu)	Cost Savings
Propane	267.8	$ 3,998.08
Electricity	266.8	$ 6,099.12
Total	534.6	$ 10,097.20

4 EXISTING CONDITIONS

Documenting existing conditions is a required deliverable of an investment grade energy audit. The purpose of documenting site conditions is so that the energy professional can lay the basis for which many of the recommended energy conservation measures are rooted in. During the onsite inspection, every piece of equipment, from the largest boiler down to a personal computer, is inventoried. Back at the Envinity "Lab", the audit team calculates how much energy each building system and system component consumes on an annual basis. These energy use quantifications make up a facility's "energy use profile" and gives the audit team a realistic vision as to how much energy can be saved in a facility.

The following existing conditions were observed at the GA Terminal.

Building Description and Occupancy

The building is primarily occupied 7am to 5pm by administrative staff and pilots resting in the pilot lounge. On average there are 10 occupants in the building. There are occasional meetings in the conference room which can accommodate approximately 25 people.

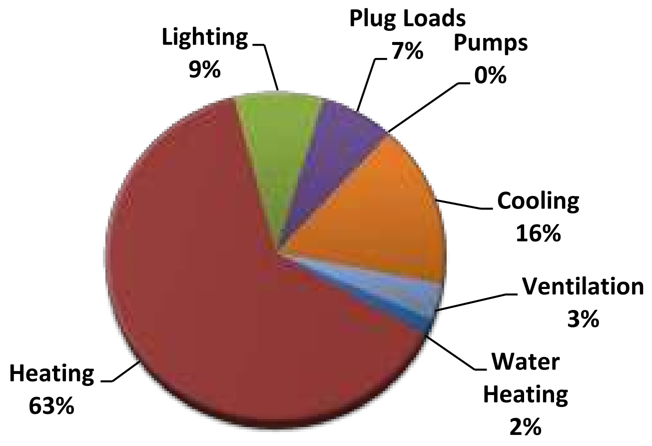
Energy Use by Category

Energy is consumed within a building in a variety of ways. Heating, cooling, lighting, appliances, and water heating all consume most of the building's energy. To better visualize the energy consumption, the GA Terminal's energy use has been separated into individual categories. Areas of each building that consume large amounts were the main areas of focus for Envinity to find any problems and to determine the feasibility of energy efficiency improvements.

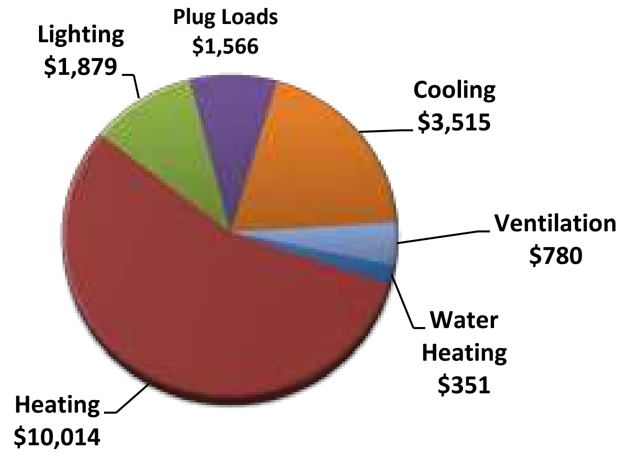
Through the utility bill analysis, engineering analysis and computer modeling, the energy usage was disaggregated into each of its energy-using components, providing a visual reference as to how energy is consumed annually within each building and how to best reduce energy consumption.

Envinity received 15 months of utility data for the GA Terminal from December 2011 to May 2013. These data were used to develop a disaggregation of end use is the average year as shown in the figure below:

Existing Energy Usage



Existing Energy Cost



EXISTING

	Electric, kWh	Propane, Gals	Total Energy Use, MMBtu	Total Energy Cost	% ENERGY	% COST
Water Heating	4,500		15	$351	2%	2%
Heating	41,395	4,920	591	$9,936	66%	59%
Lighting	24,091		82	$1,879	9%	11%
Plug Loads	12,045		41	$940	5%	6%
Cooling	39,061		133	$3,047	15%	18%
Ventilation	10,000		34	$780	4%	5%
TOTAL:	**131,092**	**4,920**	**897**	**$16,932**	**100%**	

Ventilation

Ventilation is provided by 2 natural gas packaged gas/electric Roof Top Units converted to run on propane for heating. Outdoor air is introduced at the units. It was assumed a standard 25% minimum outdoor air setting was used to provide pressurization and replenish exhaust air from the bathrooms. Economizer operation could not be evalutated due to warm ambient temperatures. This system provides central air distribution. Although originally configured to have 8 separate zones run on a VVT control logic, the systems are currently operated as constant volume single zone systems. Constant exhaust is provided to the bathrooms.

Ventilation at the GA Terminal consumes approximately 10,000 kWh annually, costing $780 in fan energy.

Heating

Heating is provided by 2 natural gas packaged gas/electric Roof Top Units converted to run on propane. There is also some electric resistance perimeter and entryway heat. Several electric space heaters were observed on premises and appear to be necessary to maintain comfort due to poor HVAC zoning control.

Heating at GA Terminal consumes approximately 41,395 kWh and 4,920 gallons propane annually, costing $9,936.

Cooling

Cooling is provided by 2 packaged gas/electric Roof Top Units. There is a separate mini-split system for the electric room which houses the locations IT infrastructure.

Cooling at the GA Terminal consumes approximately 39,061 kWh annually, costing $3,047 annually.

Domestic Hot Water

Domestic hot water is provided by a central electric resistance hot water storage heater original to the building.

Domestic hot water at the GA Terminal consumes approximately 4,500 kWh costing $350.

Lighting

The General Aviation Terminal is where the main offices are for the operations at the airport. There is a lounge for pilots, offices for administration, conference rooms, reception desk, and restrooms. There are several types of lighting being used for this facility. An abundance of 19W CFLs are being used along with some 50W and 75W incandescent. The incandescent bulbs are being used primarily because of their dimming capabilities. Staff mentioned the dimming switches are rarely used but rather either all the way on or off. There is excessive lighting in the lobby with the south wall consisting of windows. With this abundance of natural lighting, additional lighting in the lobby should rarely be used. Staff mentioned they were testing a LED bulb compared to the incandescent and were pleased with the outcome. The usual operating hours for the General Aviation Terminal are 12 hours a day, 7 days a week. Other than dimming switches, no other lighting controls were observed.

The exterior lighting is comprised of accent lighting, pole lighting, and flood lighting. The entrance has (4) 70W metal halide lamps accenting the support beams of the entrance. There is a grouping of 19W CFLs lighting underneath the entranceway awning. Sidewalks are illuminated by (4) 150W metal halide lamps. The parking lots are being lit by (6) 400W HPS lamps. These outdoor lamps are operating during night hours without lighting controls.

The lighting at the GA Terminal consumes approximately 24,091 kWh annually, costing $1,879.

Plug Loads

The plug loads at GA Terminal consume approximately 12,045 kWh annually, costing $940.

5 CAPITAL RECOMMENDATIONS

Using the utility bill analysis, results and findings from the comprehensive on-site assessment, and outputs from the computer modeling of the facility, a number of capital and operational upgrades were identified for the GA Terminal.

Proposed Energy Conservation Measures (ECMs)

After reviewing all data, performing the onsite assessment, and creating a computer model of the GA Terminal, Envinity has identified and prioritized potential energy conservation measures (ECMs). These measures have been organized based on their suggested order of implementation.

Energy Conservation Measure	Annual Energy Savings	Lifetime Savings	Initial Cost	Simple Payback	SIR	Year to Implement
Lighting 1 Replace all 19W CFL, 50W incandescent, and 75W incandescent with 8W A19 LED	$966	$9,664	$4,086	4.2	2.4	Year 1
Lighting 2 Replace 70W metal halide accent lighting with 20W RAB LED wall pack	$65	$654	$1,469	22.4	0.4	Year 1
Lighting 3 Replace 120W incandescent spot lights with 15W PAR30 LED	$179	$1,789	$634	3.5	2.8	Year 1
Lighting 4 Replace all pole mounted exterior lighting with 78W RAB LED wall pack	$899	$8,995	$7,844	8.7	1.1	Year 1
Install residential class refrigerator in place of Arctic Air	$191	$2,864	$1,500	7.9	1.9	Year 1
Replace Faucet Aerators to 1gpm	$259	$2,592	$200	0.8	13.0	Year 1
Install Vending Miser	$115	$1,154	$400	3.5	2.9	Year 1
Repair fiberglass insulation and install vapor barrier	$1,411	$42,335	$9,000	6.4	4.7	Year 2
HVAC Controls Upgrade to Restore Zoning	$3,795	$94,883	$25,000	6.6	3.8	Year 3
Upgrade Rooftop Units to Heatpump RTUs with Propane Backup	$2,580	$64,493	$76,650	29.7	0.8	Year 3
Year 1 to 3 Totals	**$10,462**	**$229,423**	**$126,784**	**12.1**		

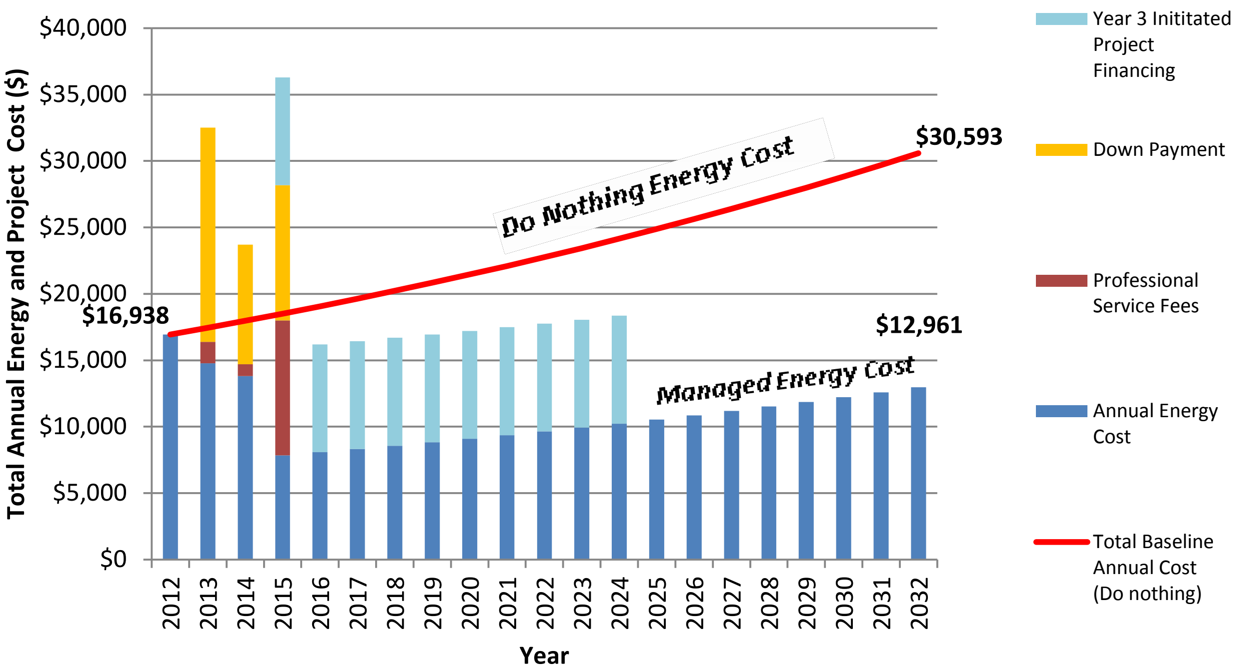
The recommendations made in this plan are projected to reduce annual energy costs by $10,462 annually and provide an estimated lifetime savings of $229,462.

Envinity performed a ***cash flow analysis*** scenario to show how the recommended Energy Conservation Measures can be budgeted and how energy savings from the measures can help pay for implementation of future measures. It is important to note that this Energy Management Plan is ***SELF FINANCING, FLEXIBLE and SCALABLE***. This analysis correlates directly with the ECM tables presented above. Analysis shows that if the recommendations in this strategy are acted upon, the University Park Airport can effectively negate annual increases in energy costs over the next 20 years.

The following guidance can be applied to the cash flow presented: Using the "Year" to implement guidance listed in each ECM's Description, the following graph shows energy costs can significantly decrease over the next 20 years.

What are most important to note in the cash flow analysis is the RED "do nothing" line (which assumes a 3% annual energy cost increase) and the BLUE "annual energy cost" bars. The red line shows what the facility can expect to be paying in energy costs as time progresses if NO ACTION is taken from this point forward. The blue bars show the predicted annual energy cost if the recommendations of this report are acted upon.

Energy Management Cash Flow



1. **Replace all 19W CFL, 50W incandescent, and 75W incandescent with 8W A19 LED**

Annual Energy Savings: ***$966 (12,390 kWh)***
Est. Implementation Cost: ***$4,086***
Payback Period: ***4.2***
Year to Implement: ***Year 1***

Description: The General Aviation Terminal has (56) 19W CFL, (30) 50W incandescent, and (16) 75W incandescent throughout the facility. Some of these fixtures are on dimmer switches. The majority of these fixtures are running for 12 hours/day.

Recommendation: All of the CFL and incandescent lamps should be replaced with 8W A19 LED bulb. The energy will be decreased significantly while increasing the life of the bulbs. The rated life for the A19 LED is 50,000 hours compared to 15,000 hours of a CFL and 2,000 hours of an incandescent.

Assumptions:

- Electricity rate of $0.086/kWh
- Run time is 8 hours/day, 5 days/week

2. **Replace 70W metal halide accent lighting with 20W RAB LED wall packs**

Annual Energy Savings: ***$65 (839 kWh)***
Est. Implementation Cost: ***$1,469***
Payback Period: ***22.4***
Year to Implement: ***Year 1***

Description: The General Aviation Terminal has (4) 70W metal halide accent lamps at the entrance of the building. These fixtures are turned on at night to accent the support beams of the entrance.

Recommendation: Replace the 70W metal halide fixtures with 20W RAB LED fixtures. By replacing with LEDs, energy consumed will be decreased by 69%. The long life of the LED will also decrease maintenance needed for the fixtures.

Assumptions:

- Electricity rate of $0.086/kWh
- Running for 12 hours/day, 7 days/week

3. Replace 120W incandescent spot lights with 15W PAR30 LED

Annual Energy Savings: ***$634 (2,293kWh)***
Est. Implementation Cost: ***$179***
Payback Period: ***3.5***
Year to Implement: ***Year 1***

Description: The ramp at the rear of the facility has (10) 120W incandescent lamps. These fixtures are on for 12 hours/day.

Recommendation: Replace the 120W incandescent lamps with 15W PAR30 LED lamps. This replacement will use 12.5% of the energy used by the existing fixtures.

Assumptions:

- Electricity rate of $0.086/kWh
- Running for 8 hours/day, 5 days/week

4. Replace all pole mounted exterior lighting with 78W RAB LED wall pack

Annual Energy Savings: ***$899 (11,532kWh)***
Est. Implementation Cost: ***$7,844***
Payback Period: ***8.7***
Year to Implement: ***Year 1***

Description: The exterior lighting of the General Aviation Terminal consists of (4) 150W metal halide wall packs and (6) 400W HPS pole mounted lights. These lights are on for the night hours. The existing lighting provides an unpleasant yellow light.

Recommendation: Replace all of the exterior lighting with 78W RAB LED wall packs. The energy used by the LED fixtures will be 26% of the energy used by the existing system. The 100,000 hours of operation will significantly decrease maintenance for the exterior lighting of the facility. Light provided by the LED fixtures will improve light quality for the exterior of the General Aviation Terminal.

Assumptions:

- Electricity rate of $0.086/kWh
- Running for 12 hours/day, 7days/week
- Metal halide runs at 190W with ballast, HPS runs at 465W with ballast

5. Install Residential Class Refrigerator In Place of Commercial

Annual Energy Savings: ***$191 (2,448kWh)***
Est. Implementation Cost: ***$1,500***
Payback Period: ***7.9***
Year to Implement: ***Year 1***

Description: The General Aviation terminal has an industrial-grade refrigerator for intermittent use by caterers. This style unit uses considerably more energy per unit volume than a residential Energy Star certified unit.

Recommendation: Evaluate the use of the refrigerator and determine if a large residential unit can accommodate refrigeration demands.

Assumptions:
- Existing model # Continental Refrigerator Mod 2R-GD, 13.6 A
- assume 3000 run hours per year
- 50% power savings.

6. Replace Faucet Aerators to 1gpm

Annual Energy Savings: ***$259 (2,246 kWh)***
Est. Implementation Cost: ***$200***
Payback Period: ***0.8***
Year to Implement: ***Year 1***

Description: Existing sink aerators were 2.5 gallon per minute.

Recommendation: Install 1 gpm sink aerators to save on water and electricity for water heating.

Assumptions:
- 3 minutes per day per person hand washing
- Average water temperature rise is 70F

7. Install Vending Miser on Vending Machines

Annual Energy Savings: ***$115 (1,480 kWh)***
Est. Implementation Cost: ***$400***
Payback Period: ***3.5***
Year to Implement: ***Year 1***

***Description*:** **The** vending machines, both refrigerated and non-refrigerated, for employees that consume energy through refrigeration (running a compressor) and lighting. These machines consume energy 24-7 whether or not the building is occupied.

Recommendation: Installing a control device such as the Vending Miser will power down the machine whenever there is no foot traffic in front of the machine for a determined amount of time. The Vending Miser does this through the use of a motion sensor. Other controls in the Vending Miser periodically power up the refrigeration system to maintain product temperature and to sense machine operation so that the vendor is only powered down when the compressor is not operating (in order to prevent adverse impacts on compressor life).

Assumptions:

- Soda machines consume 3,000 kWh/yr
- Vending machines consume 700 kWh/yr
- Vending Miser savings are 40% based on compiled historic data
- Unit cost is $170; Install cost is $30 per unit

8. Repair Fiberglass Insulation

Annual Energy Savings: ***$1,411 (1,216 kWh, 966 gal propane)***
Est. Implementation Cost: ***$9,000***
Payback Period: ***6.4***
Year to Implement: ***Year 2***

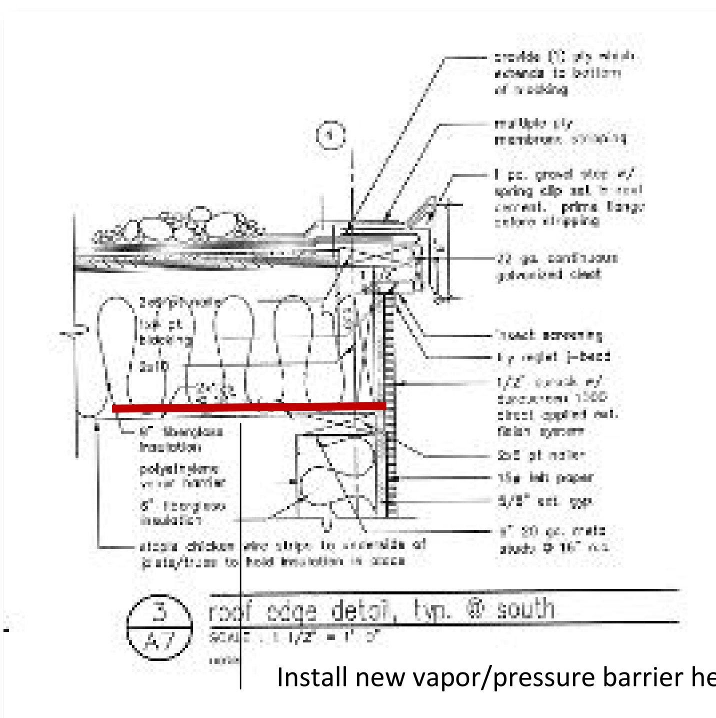
Description: The existing ceiling insulation has no pressure or vapor barrier installed. The space above the insulation is vented for moisture removal, and with the pressure barrier, the venting goes straight through the insulation to conditioned space. On inspection in April, the space above the drop ceiling was at 45 degrees, proving that the insulation is presently very ineffective.

Recommendation: Repair holes and missing batts of fiberglass insulation. Install new foil skim craft or similar pressure and vapor barrier. Tape seams with heavy-duty seaming tape. Spray foam may be used to seal seams and utility penetrations if the product selected meets smoke and fire code requirements.

As an alternate, when the roof needs to be replaced (20 years life remaining), install continuous insulation on the exterior such as spray applied polyurethane roofing. Seal vened perimeter with closed cell spray foam or mineral fiber as approved by code jurisdiction.

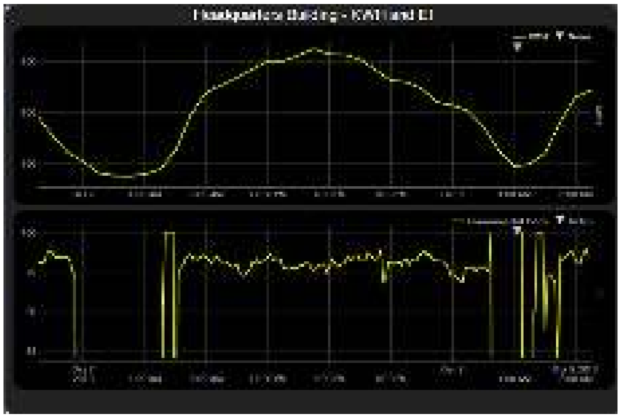
Assumptions:

- assume reduction of .5 ACH = ~450 cfm
- estimated at $2/sf to tape seams
- would need to vacate offices for work to occur. Drop ceiling needs to be removed.



9. Controls Upgrade

Annual Energy Savings: **$3,795 *(4,574kWh,* 2522 gal propane*)***
Est. Implementation Cost: **$25,000**
Payback Period: **6.6**
Year to Implement: ***Year 3***



Description: The building is heated and cooled with a pair of 13 year old gas/electric packaged rooftop units. While the system was designed as a VVT zoned system (8zones) the controls for these units are by-passed and they are presently running as constant volume units. Zone dampers and bypass dampers were found to be in fixed positions. A single residential thermostat was installed on each unit to maintain single zone setpoint. Overheating in some rooms was noted during the cold weather site visit. Also, the bathroom exhaust fan appeared to run 24-7 at a flow rate higher than require by code.

Recommendation: The existing system's efficiency can be improved based on new controls. The energy savings will be modest as the existing system is configured to duty cycle base on heating or cooling call. This is a code violation of ASHRAE 62.1 which requires continuous fresh air. Install a non-proprietary controls front end to tie each of the VAV boxes together for optimization of RTU operation and increased comfort. Configure controls to allow zone setpoint limits, have unoccupied setback temperatures, and optimize duct supply air temperature and pressure for energy savings. Confirm economizer is enabled at favorable outdoor temperatures. Install exhaust fan on occupancy sensor to run for 15 minutes from last motion in either rest room room.

Assumptions:

- demand control ventilation conference room
- set outdoor rate of other unit to 550 for pressurization of bath exhaust
- assume both units on 25% outdoor air and can go to 0% at night
- assume average runtime of 30% overnight
- 8 zones @ $ 2250 ea plus small job factor, $2500 for bathroom controls
- assume setback saves 10% heating energy, and 2 hours fan runtime per night
- balance exhaust fan to reduce to 450cfm (50 cfm/unit)
- existing cooling EER of 9.5, furnace efficiency of .8
- assume runtime reduction of 16 hrs per day on bath fan
- Controls Upgrade to Restore Zoning

10. Upgrade Rooftop Units to Heat Pump RTUs with Propane Backup

Annual Energy Savings: ***$2,580 (9,284kWh, 1361 gal propane)***
Est. Implementation Cost: ***$76,650***
Payback Period: ***29.7 (14 yrs on incremental cost over like replacement)***
Year to Implement: ***Year 3***

Description: The building is heated and cooled with a pair of 13 year old gas/electric packaged rooftop units. These units run on propane for heating as there is no natural gas available onsite. While the system was designed as a VVT zoned system (8zones) the controls for these units are by-passed and they are presently running as constant volume units.

Recommendation: These units should be scheduled for replacement in the next 5-7 years based on standard equipment life. Install high efficiency units with heat pump option and backup propane heat (such as Aaon RN series). During 90% of heating load hours (the hours above 30 F) the heat pump will carry the heating requirements more cost effectively than propane.

Assumptions:

- improved efficiency: SEER 12.7 big unit SEER 19 smaller unit
- propane usage is 5000gal/yr
- base cooling run hours on PA Tech Resource Manual Equiv Full Load Cooling Hs for Williamsport: 642
- assume heat pump operation above 30F
- 90% of heating load occurs at temperatures above 30F based on degree days
- use lower COP of both units at 32F of (COP=3.27) used
- assume installed cost is 1.75 unit list price
- assume 50% reduction in fan energy with backward curved and VFD
- neglect outdoor air reduction of eliminating unit bypass (currently 50%)
- baseline cost of standard efficiency "like" replacement is $39,000
- assume other measures which reduce heating energy have been made
- assume 50% of apparent electric heat load can be switched to properly zone rooftop unit

6 CONCLUSIONS

All facilities have the opportunity to significantly reduce annual energy expenses and apply those savings to more vital services or investing in other facilities or products. ***The findings communicated in this report can reduce annual energy costs at this facility by approximately 60%.*** Annually, the University Park Airport allocates approximately $16,938 on energy expenses for this facility. The recommendations in this report will reduce annual energy costs by approximately $10,500. The projects identified have an estimated install cost of $126,800, providing a 12 year payback.

We have provided this facility with 10 capital improvement recommendations that are based on our findings while on site, reviewing building plans, and analyzing utility data. The major recommendations in this report are:

Energy Conservation Measure	Annual Energy Savings	Lifetime Savings	Initial Cost	Simple Payback	SIR	Year to Implement
Lighting 1 Replace all 19W CFL, 50W incandescent, and 75W incandescent with 8W A19 LED	$966	$9,664	$4,086	4.2	2.4	Year 1
Lighting 2 Replace 70W metal halide accent lighting with 20W RAB LED wall pack	$65	$654	$1,469	22.4	0.4	Year 1
Lighting 3 Replace 120W incandescent spot lights with 15W PAR30 LED	$179	$1,789	$634	3.5	2.8	Year 1
Lighting 4 Replace all pole mounted exterior lighting with 78W RAB LED wall pack	$899	$8,995	$7,844	8.7	1.1	Year 1
Install residential class refrigerator in place of Arctic Air	$191	$2,864	$1,500	7.9	1.9	Year 1
Replace Faucet Aerators to 1gpm	$259	$2,592	$200	0.8	13.0	Year 1
Install Vending Miser	$115	$1,154	$400	3.5	2.9	Year 1
Repair fiberglass insulation and install vapor barrier	$1,411	$42,335	$9,000	6.4	4.7	Year 2
HVAC Controls Upgrade to Restore Zoning	$3,795	$94,883	$25,000	6.6	3.8	Year 3
Upgrade Rooftop Units to Heatpump RTUs with Propane Backup	$2,580	$64,493	$76,650	29.7	0.8	Year 3
Year 1 to 3 Totals	**$10,462**	**$229,423**	**$126,784**	**12.1**		

If you wish to pursue any of the recommendations made in this report further, but need more guidance, please feel free to contact Envinity. We recommend and install energy efficient technology every day and would be happy to discuss your projects further.

Sincerely,

Kevin Gombotz, PE, CEM
Director of Commercial Services
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WALK THROUGH AUDIT ANALYSIS

UNIVERSITY PARK AIRPORT – PASSENGER TERMINAL | OCTOBER 2013

REVISED 2/4/2013

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October, 2013

University Park Airport Officials,

Please find enclosed a copy of the walk through level energy audit recommendations for the University Park Airport – Passenger Terminal. You will find information on existing energy use patterns, identification of Energy Conservation Measures (ECMs), and a framework that lays the path for improved energy management at your facility.

As part of this work scope, Envinity reviewed existing/historic energy use patterns, performed a walk through energy assessment and identified feasible energy conservation measures (ECMs). The top energy saving measures are identified and described in the following report.

As the Airport proceeds with project implementation, Envinity can offer the following additional services: engineering and design of all recommendations, bid document preparation, construction administration, grant writing and management, building performance contracting, project commissioning and management, energy management services, and renewable energy deployment.

It is our pleasure to contribute our technical expertise toward the success of this important local project.

Sincerely,

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PASSENGER TERMINAL BY THE NUMBERS

$69,982	Annual Average Energy Cost (Electricity | $69,982)
3,165 MMBtu	Annual Average Energy Use (927,652 kWh)
34,258 ft^2	Building Area
92.4 $kBtu/ft^2$	Energy Use per Sq Ft
$2.04 $/ft^2$	Energy Cost per Sq Ft

1 Utility Bill Analysis & Benchmarking Assessment

Understanding the historic utility usage and cost data is at the foundation of a strong energy management plan. Recognizing where you came from is necessary for setting a course for the future. The purpose of the utility bill analysis is to accurately quantify the total energy used and total energy costs at a site so that recommended energy conservations measures are based off of actual data. Understanding energy use trends observed during the utility bill analysis phase of the work scope also better prepares the energy professional for conditions and systems that will be observed on site. The utility bill analysis is performed prior to the audit team visiting the site and helps guide the system focus of the audit.

All utility data was obtained for May 2012 to June 2013. The Passenger Terminal has the following accounts:

Company	Commodity	Account Number
West Penn Power	Electric	100 096 267 800
West Penn Power	Electric	100 092 537 487

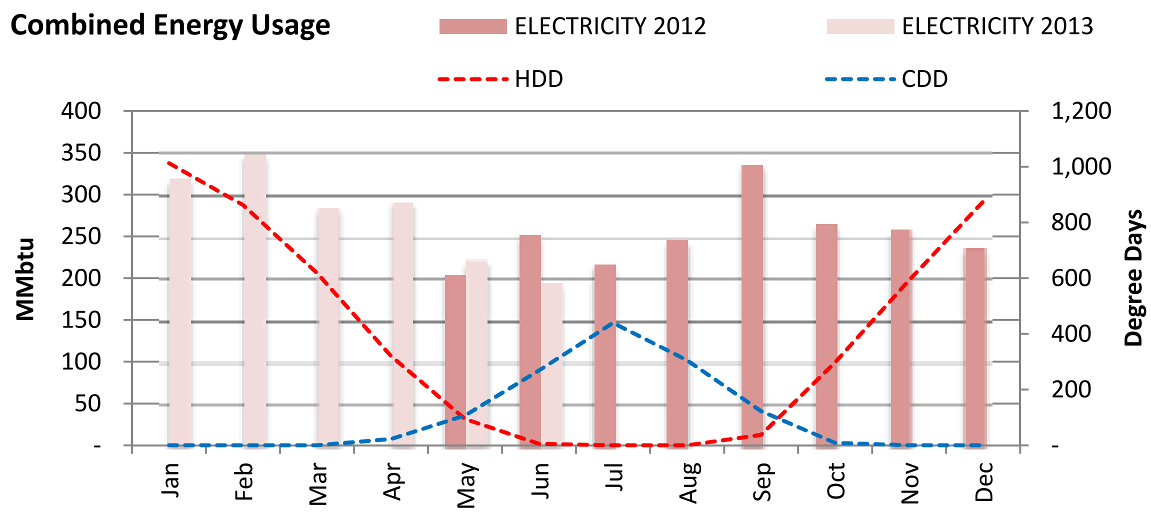
A summary analysis of the results is as follows:

Energy Usage at the Passenger Terminal

Utility data was observed from May 2012 to June 2013 at the Passenger Terminal. Electric data was obtained from the electric utility provider West Penn Power. During this period, the Passenger Terminal consumed an average of 3,165.1 MMBtu annually, or $69,982. The average unit costs are as follows:

Electricity: $0.0754 per kWh; $22.11 per MMBtu

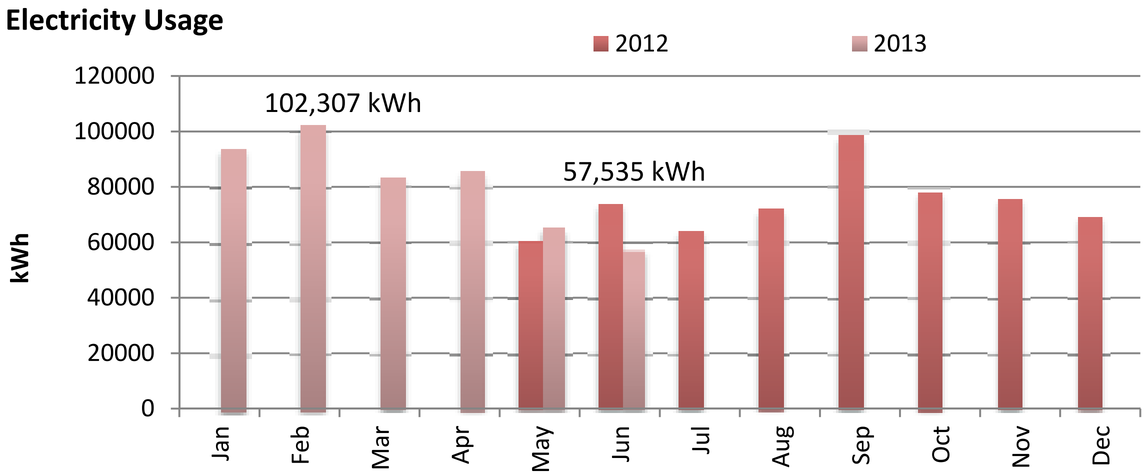
Electric Usage at the Passenger Terminal



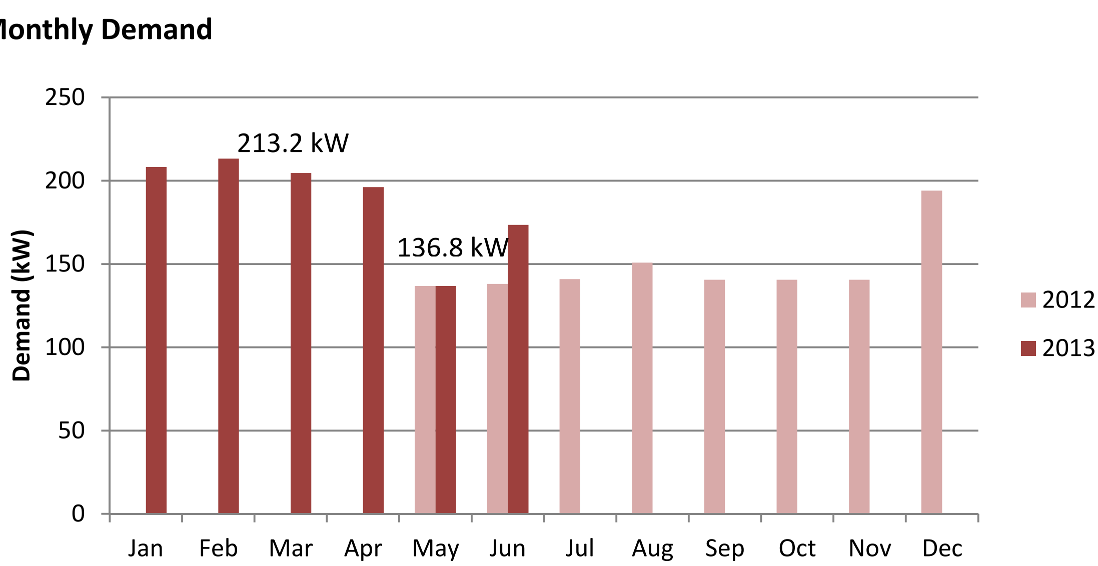
ELECTRIC USAGE AT THE PASSENGER TERMINAL

Account: West Penn Power
Electricity Rate: $0.0754/kWh

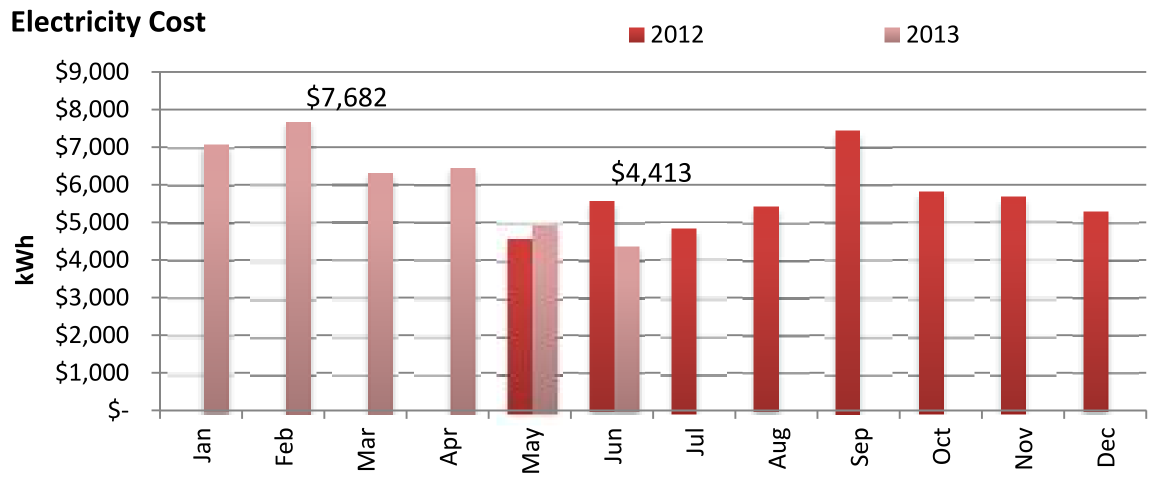
The data shows that electric consumption throughout the year has remained consistent for each calendar year, following seasonal trends. Usage peaks in the transition months from summer to winter and winter to summer Over the period evaluated, the Passenger Terminal consumed the most electricity in February 2013 (102,307 kWh) and the least in June 2013 (57,535 kWh).



In addition to energy usage, Envinity analyzed the electric demand cycles of the Passenger Terminal. Electric demand refers to the maximum amount of electrical energy that is consumed during a given 15-minute interval during the billing cycle. Demand at the Passenger Terminal was obtained from PECO from the same period. During this period, monthly demand ranged from 137kW to 213 kW. The following table and graph shows monthly demand charges for this period:



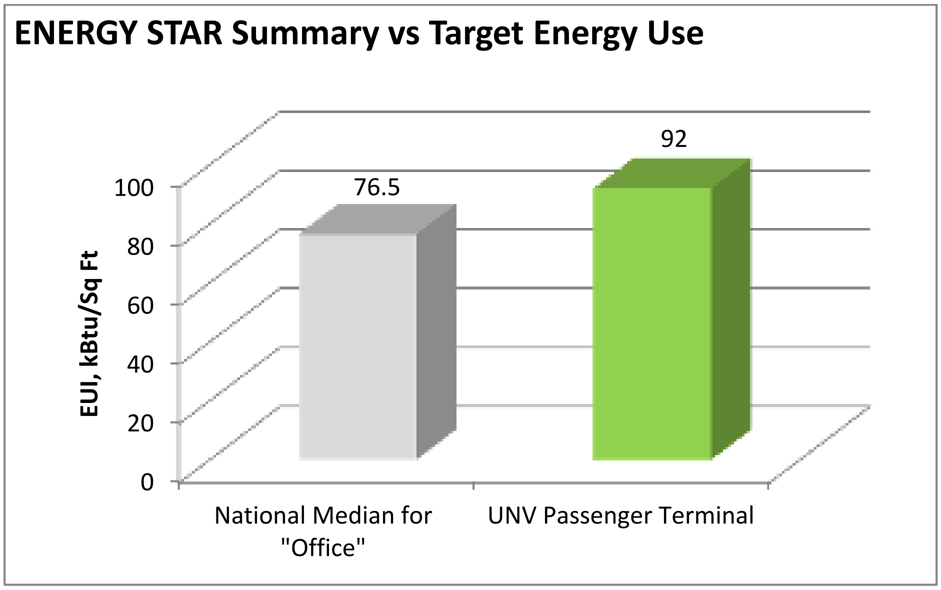
Annually, the Passenger Terminal spends $69,982 on average for electricity. Electric supply is currently procured through West Penn Power at a rate of $0.0754/kWh. Electric cost was highest in February 2013 ($7,682) and lowest in June 2013 ($4,413).



2 Energy Use Characterization & Benchmarking

One of the first steps in addressing energy use is to characterize the patterns of energy use for peer facilities. This involves developing expectations for the amount of energy used, the type of fuel used, and the breakdown of energy end use categories: lighting, cooling, fans, etc. To evaluate the amount of energy used by a building, it is conventional practice to estimate an ***Energy Use Index (EUI)***, expressed in KBtu/SF ● year (thousands of British Thermal Units per square foot per year). The EUI is estimated fairly simply by summing the annual energy use of all fuels (typically electricity and one or more fossil fuels), converting to a common energy unit (typically the Btu or KBtu in the US), and dividing by the applicable conditioned area of the facility. Once estimated, an EUI can be interpreted by comparison to a database of energy use statistics for similar facilities, a process called benchmarking.

The following graph shows how the EUI of the Passenger Terminal compared to the median EUI for Transportation Terminals.



The Passenger Terminal is operating with an EUI which is well over the national median. By reaching the national median, the Passenger Terminal will see the following savings.

EUI difference		15.50	kBtu/ft^2
Energy Saved to Reach Median		530,999.00	kBtu
kWh Savings		155,626.91	kWh
Cost Savings	**$**	**11,740.56**	

**Note: The national median EUI for "transportation terminal" in Energy Star's building database does not appear to be a relevant peer group (it produced a median EUI of 27 kbtu/sf). As such, the terminal was reclassified as an office building for purposes of this benchmarking. Further benchmarking in comparison to regional peer airports is advised.*

3 Capital Recommendations

Building Description and Occupancy

The Airport Terminal is a 34,258 ft^2 facility with an original construction in 1985 and additions in 1992 and 2008. The building is open 24 hours a day and currently serves an average of 28 commercial flights per day with flights scheduled from 5:45AM to 11:50PM.

Mechanical System Assessment

A recent mechanical upgrade project was completed in late 2011. The upgrade converted an existing boiler-tower heat pump system to a full geothermal water loop heat-pump system. As part of the upgrade, the building was put on a Building Automation System (BAS) that provides both improved control of building systems and more transparency of system functionality and set points. Ventilation is predominantly provided through two unit ventilators in series with the heat pumps but a few of the smaller heat pumps also have some outdoor air.

The geothermal system is a single loop. Two pumps are on VFD with only one operating at a time. The pump was observed at 40 Hz during the survey and was set to maintain a pressure differential of 22 psi. The geothermal well field is a closed loop with 5 loops being combined in a vault. During inspection, the geothermal supply temperature was 70°F with the return ranging from 63.5°F to 65.5°F. The building and system were observed to be functioning as designed; particularly, the closed-loop geothermal well field temperatures were sufficient at 71°F. Wide variations in well field return temperature are normal due to seasonal demands and heat pump operation. Specific design conditions may vary, but temperatures between 35°F and 80°F are normal highs and lows for winter operation and summer operation, respectively. The site evaluation was on a mild day in June, generally not a time when extreme temperatures should be expected. Over time, if an unbalance of heating and cooling loads exists in the building, a geothermal well field temperature may creep from normal operating temperatures. For this reason, it is important to track well field temperature from the start of system service. A steady increase or decrease in summer high or winter low temperatures is a sign that the system is unbalanced and the well field is performing poorly, usually due to poor ground conductance. By catching problems before they become critical, corrective actions can be made before the system fails to meet building demand.

The newer wing of the building still has two 4-ton rooftop packaged air-source heat pumps. The units were installed with the new addition in 2009.

Domestic hot water is provided by electric tank water heaters.

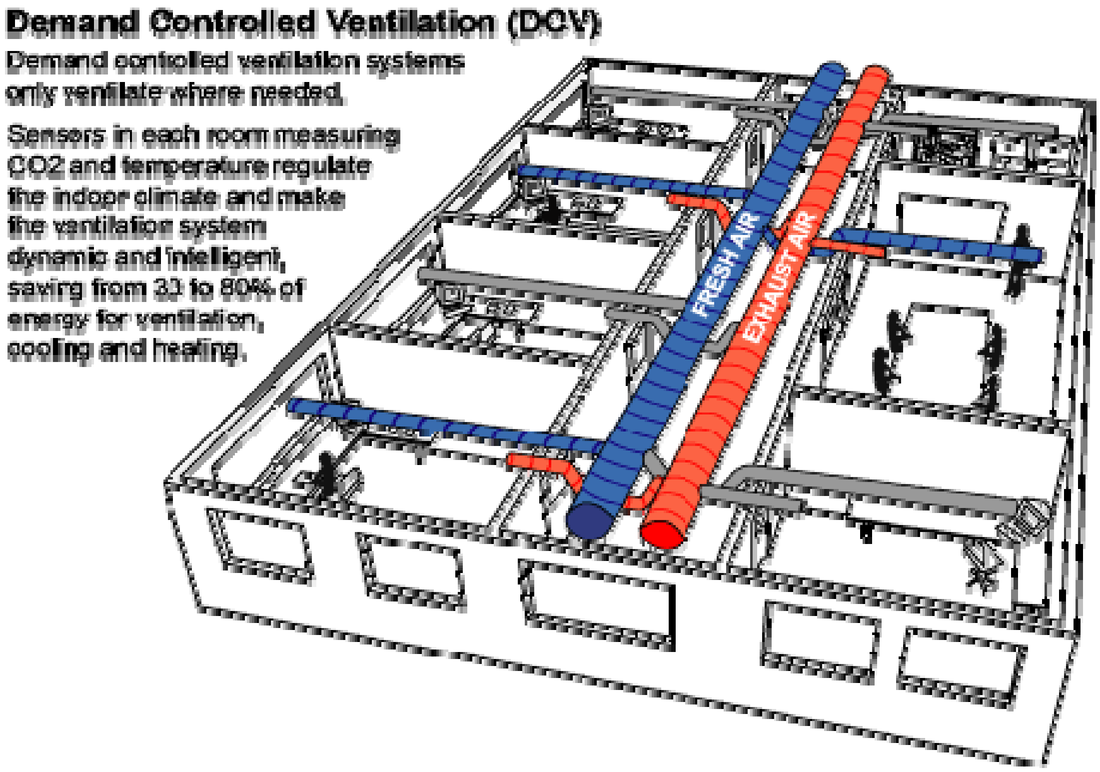
The following recommendations were observed during the walk through assessment. Primary focus was given to identifying mechanical system adjustments to increase the efficiency of the Passenger Terminal.

1. <u>Unoccupied Setbacks.</u>
   Though the building is occupied 24/7 there are several spaces that are unoccupied for part of the day. The BAS system has the capability to allow setpoint temperatures to be setback during unoccupied times. In addition, outdoor air supplied to zones can be closed or reduced if unoccupied and supply fans can be set to cycle to meet space setpoints instead of being on constantly.

   HP-1A and HP-2A, for example, serve the concessions and kitchen areas and could have outdoor air dampers closed during periods when the concessions area is closed.

2. Demand Controlled Ventilation.
HP-28 and ERV-1 (which serves HP-29) provide the majority of ventilation air for the building. HP-28 serves Departure Lounge as well as offices. ERV-1 and HP-29 serve the Baggage area and corridor.
The ventilation rate is designed for a maximum potential capacity of the building and conditioning this outdoor air is usually a large portion of building energy use, particularly heating.. For the Terminal, the total OA amount is 3,300 cfm; however, actual occupancy varies greatly and is often well below design maximums. When occupancy is low, ventilation rates can be reduced by implementing a Demand Controlled Ventilation (DCV) strategy by adding CO2 monitors to major systems and implementing a reset strategy to maintain CO2 levels that correlate to proper ventilation amounts per person.



3. Water-to-Water heat pumps for DHW.
Hot water for restrooms, janitorial, and kitchens is provided by electric storage heaters. Direct electric resistance is an expensive heat source. In a building that already has a geothermal water loop, a water-to-water heat pump may be used to instead provide hot water at a COP of about 4. During the cooling season the heat pump will actually be pulling heat from the water loop; operating at higher efficiency and boosting the performance of all other heat pumps in the system.

4. Enroll in Demand Response with Backup Generator.
If the facility is not yet enrolled in a Demand Response program for emergency curtailments, it should evaluate this opportunity. The program offers payment to be "on-call" during grid emergency such as extremely hot weather for use of emergency backup power.

4 Conclusions

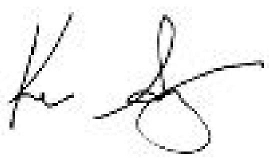
All facilities have the opportunity to significantly reduce annual energy expenses and apply those savings to more vital services or investing in other facilities or products. The Passenger Terminal underwent a walk through level energy survey where several strong conservation projects were identified for building mechanical systems. Envinity recommends that the University Park Airport evaluate these recommendations in more depth through an ASHRAE Level II energy audit so that estimated costs, savings, and project economics can all be vetted in more detail.

The energy saving projects identified were:

1. Optimize Building Automation Systems for enhanced energy savings
2. Install demand controlled ventilation
3. Install water-to-water heat pump

If you wish to pursue any of the recommendations made in this report further, but need more engineering guidance, please feel free to contact Envinity. We recommend and install energy efficient technology every day and would be happy to discuss your projects further.

Sincerely,



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Energy Management Plan and Audit Analysis

University Park Airport – Snow Removal Equipment Facility | October 2013

Revised 1/21/2013
Revised 4/28/2014

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October, 2013

University Park Airport Officials,

Please find enclosed a copy of the energy management recommendations for the University Park Airport – Snow Removal Equipment Facility. You will find information on existing energy use patterns, analysis of Energy Conservation Measures (ECMs), and a framework that lays the path for improved energy management at your facility.

The findings communicated in this report can reduce annual energy costs at this facility by approximately 38%. ***Annually, the University Park Airport allocates approximately $9,078 on energy expenses. The recommendations in this report will reduce annual energy costs by approximately $5,749. The projects identified have an estimated install cost of $25,150, providing a 4.4 year payback.***

As part of this work scope, Envinity reviewed existing/historic energy use patterns , performed an ASHRAE level II energy assessment and identified feasible energy conservation measures (ECMs). The top energy saving measures were identified and prioritized based on feasibility, payback period, and return on investment.

As the Airport proceeds with project implementation, Envinity can offer the following additional services: engineering and design of all recommendations, bid document preparation, construction administration, grant writing and management, building performance contracting, project commissioning and management, energy management services, and renewable energy deployment.

It is our pleasure to contribute our technical expertise toward the success of this important local project.

Sincerely,

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Snow Removal Equipment Facility By the Numbers

$9,228	Annual Average Energy Cost (gas| $7,634; electric | $1,594)
599 MMBtu	Annual Average Energy Use (18,503 kWh; 5,869 gal)
7,600 ft^2	Building Area
78.8 $kBtu/ft^2$	Energy Use per Sq Ft
$1.21 $/ft^2$	Energy Cost per Sq Ft
50.6 $kBtu/ft^2$	National Average Energy Use per Sq Ft for "Repair Services"
$5,354 (58% reduction)	Identified Annual Cost Savings
$25,150	Estimated Project Hard Cost
28%	Internal Rate of Return for Recommendations
4.4 years	Total Project Payback

1 Utility Bill Analysis & Benchmarking Assessment

Understanding the historic utility usage and cost data is at the foundation of a strong energy management plan. Recognizing where you came from is necessary for setting a course for the future. The purpose of the utility bill analysis is to accurately quantify the total energy used and total energy costs at a site so that recommended energy conservations measures are based off of actual data. Understanding energy use trends observed during the utility bill analysis phase of the work scope also better prepares the energy professional for conditions and systems that will be observed on site. The utility bill analysis is performed prior to the audit team visiting the site and helps guide the system focus of the audit.

All utility data was obtained for July 2011 to June 2013. The Snow Removal Building has the following accounts:

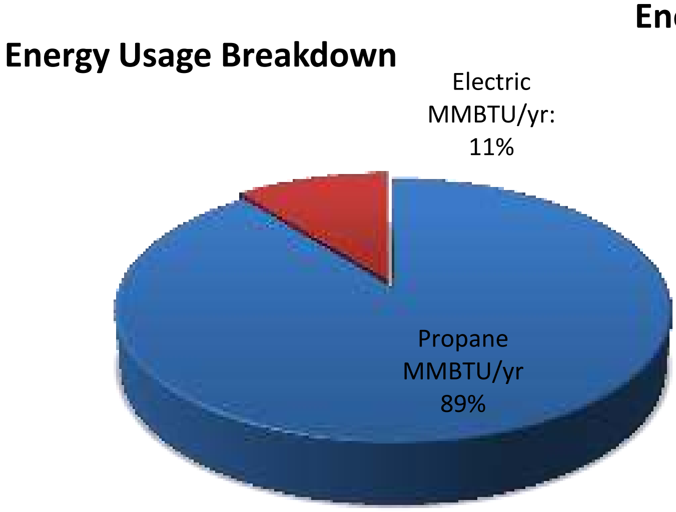
Company	Commodity	Account Number
West Penn Power	Electric	0963013E01M
AmeriGas	Propane	200576345

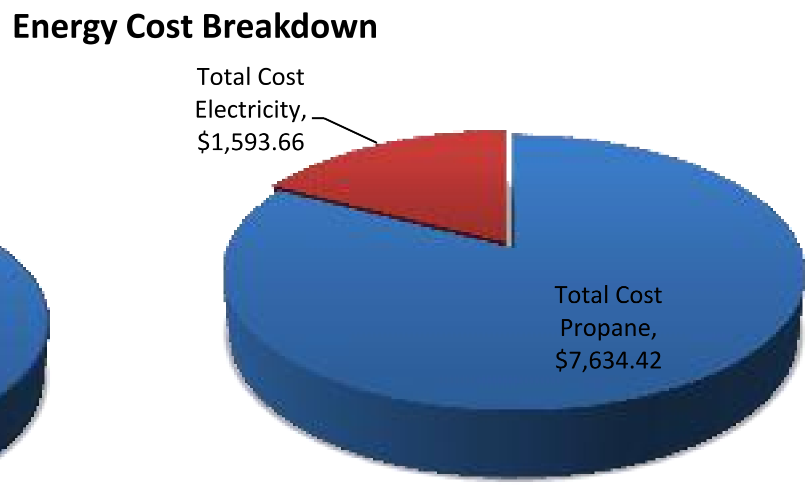
A summary analysis of the results is as follows:

Energy Usage at the Snow Removal Building

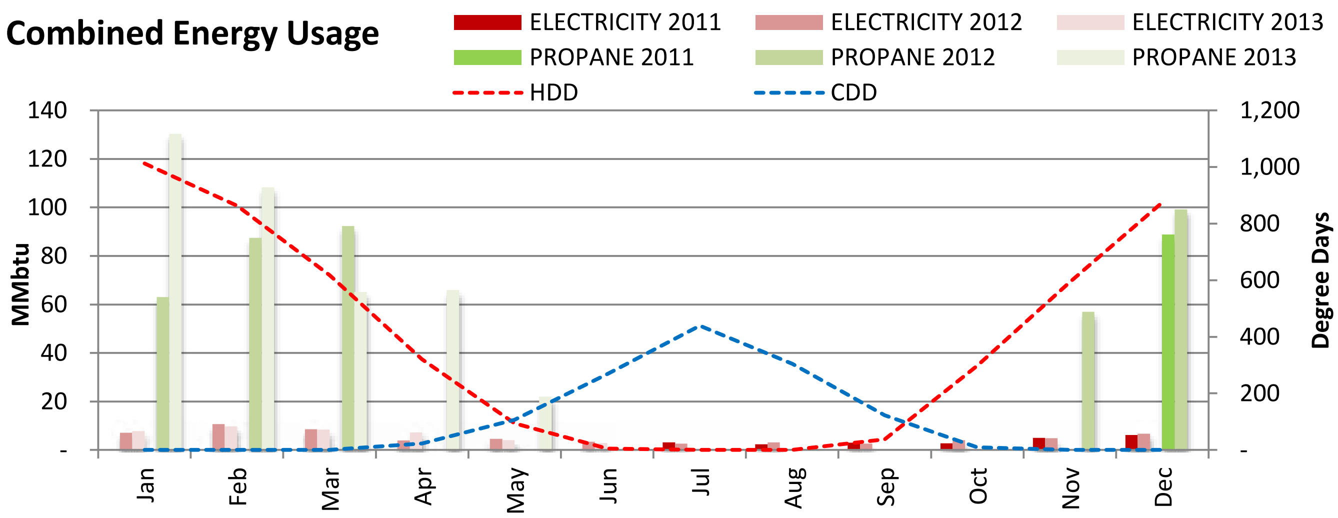
Utility data was observed from July 2011 to June 2013 at the Snow Removal Building. Electric data was obtained from the Office of the Physical Plant at Penn State. The Snow Removal Building is metered by a University meter. Propane data was obtained from previous bills received by the airport staff. During this period, the Snow Removal Building consumed an average of 599.1 MMBtu annually, or $9,228 between electricity and natural gas. Of this, 63.1 MMBtu ($1,594) goes toward electricity and 536 MMBtu ($7,634) is natural gas consumption. The average unit costs are as follows:

Electricity:	***$0.076 per kWh;***	***$22.27 per MMBtu***
Propane:	***$1.30 per gal;***	***$14.24 per MMBtu***





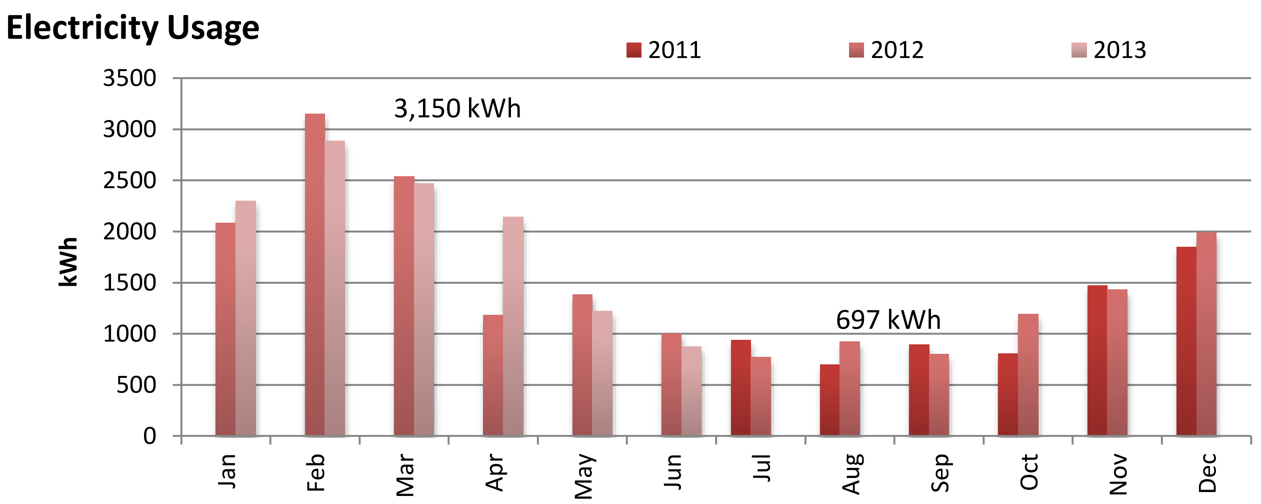
The following graph shows total energy use and cost trends over the period assessed and compared to the effects of weather.



ELECTRIC USAGE AT THE SNOW REMOVAL BUILDING

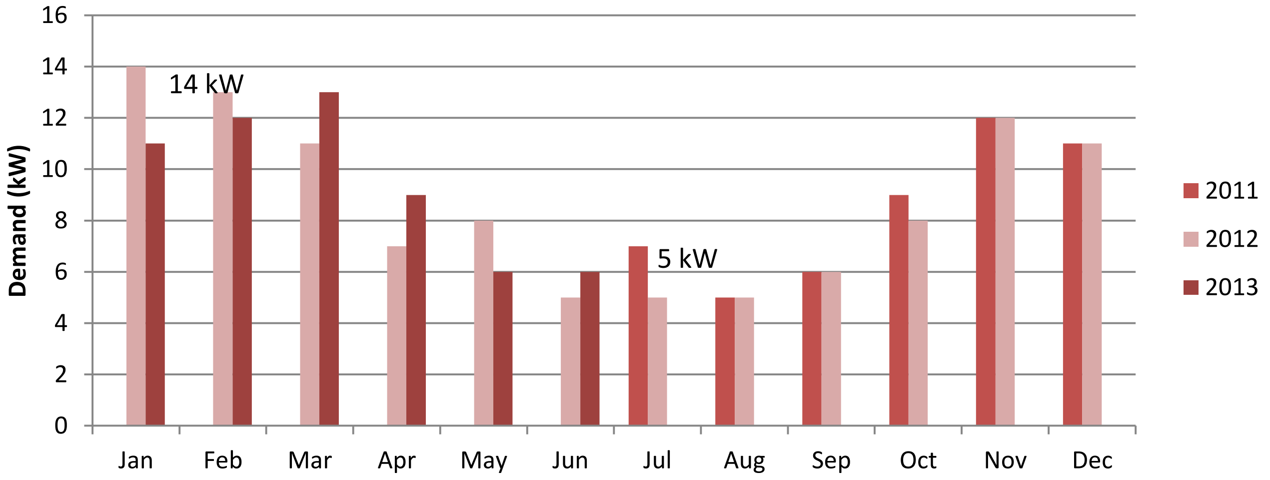
Account: **West Penn Power**
Electricity Rate: **$0.076/kWh**

The data shows that electric consumption throughout the year has remained consistent for each calendar year, following seasonal trends. Usage peaks during the heating season due to electric baseboard heating of the office and restroom. Over the period evaluated, the Snow Removal Building consumed the most electricity in February 2012 (3,150 kWh) and the least in August 2011 (697 kWh).



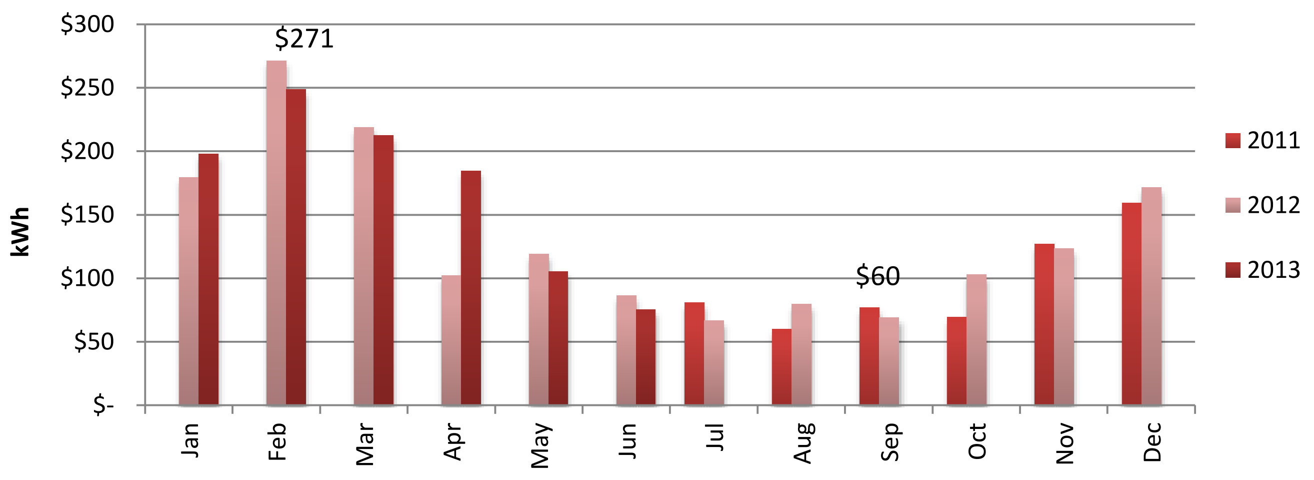
In addition to energy usage, Envinity analyzed the electric demand cycles the Snow Removal Building. Electric demand refers to the maximum amount of electrical energy that is consumed during a given 15-minute interval during the billing cycle. Demand at the Snow Removal Building was obtained for same period. During this period, monthly demand ranged from 324 kW to 679 kW. The following table and graph shows monthly demand charges for this period:

Monthly Demand



Annually, the Snow Removal Building spends $1,594 on average for electricity. Electric supply is currently procured through West Penn Power at a rate of $0.0861/kWh. Electric cost was highest in February ($271) and lowest in August 2011 ($60).

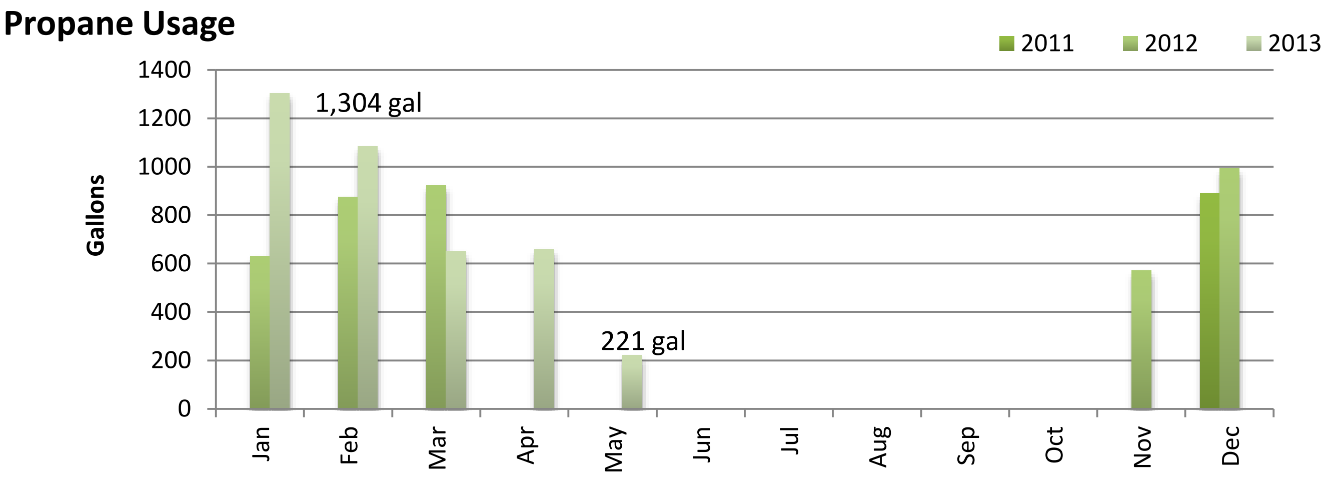
Electricity Cost



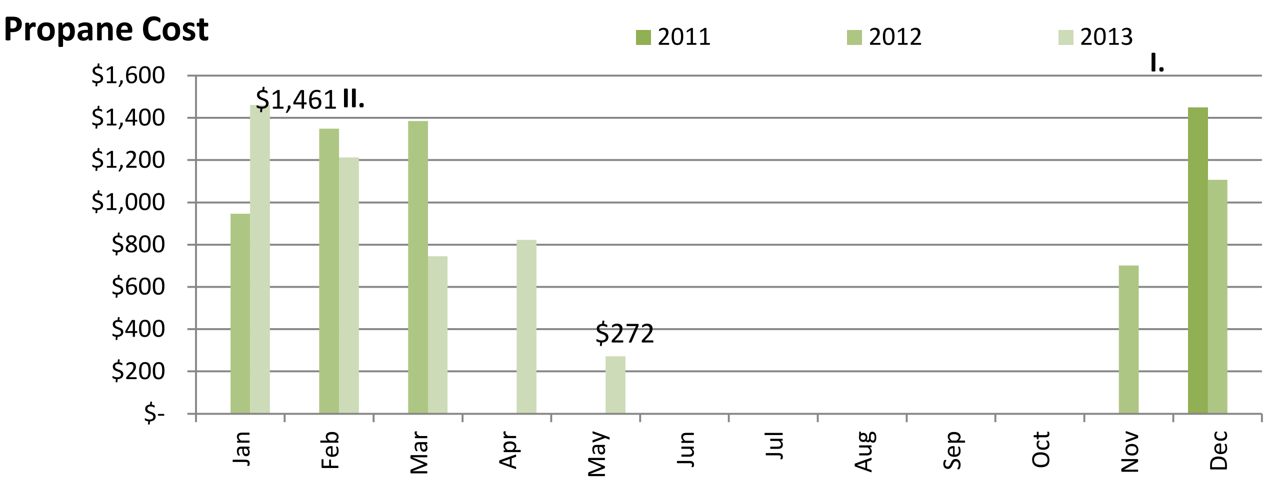
PROPANE USAGE AT THE SNOW REMOVAL EQUIPMENT FACILITY

Account: AmeriGas
Propane Rate: $1.30/gal (averaged over analysis period)
Received by: Delivery

Propane is used at the Snow Removal Building to run the high-bay infrared heaters. These heaters are used primarily in the winter months and are controlled by the occupants. Trends show consumption following this pattern, with use only in the winter months. Consumption was a maximum in January of 2013 (1,304 gal) and a minimum in May of 2013 (221 gal).



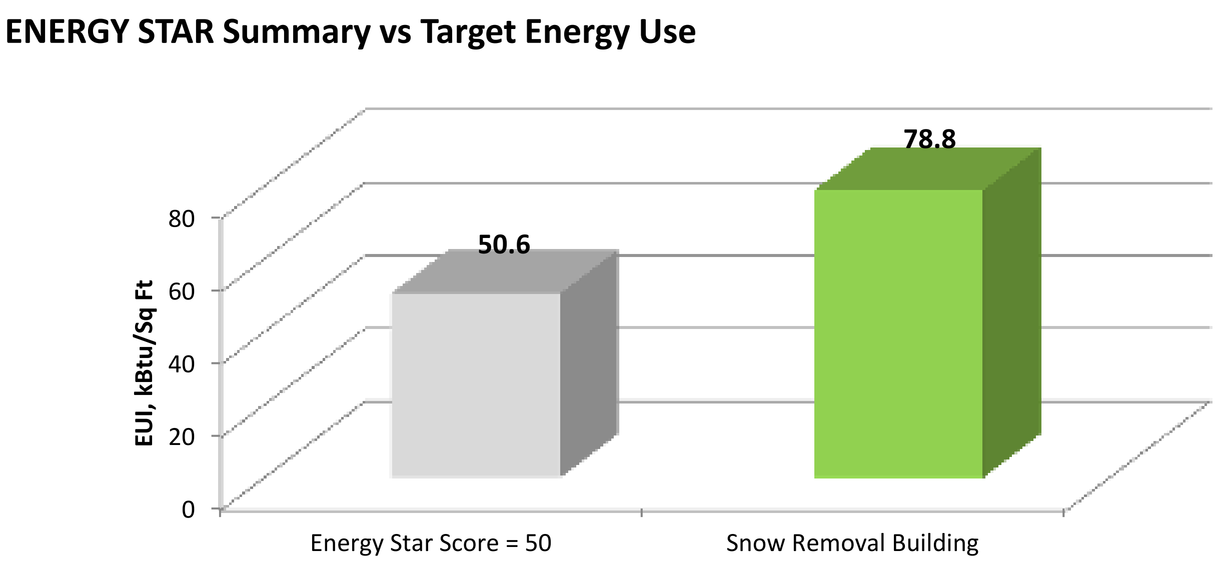
Propane costs have followed the same trend as consumption with costs reaching a maximum in January of 2013 ($1,461) and a minimum in May 2013 ($272).



2 Energy Use Characterization & Benchmarking

One of the first steps in addressing energy use is to characterize the patterns of energy use for similar facilities. This involves developing expectations for the amount of energy used, the type of fuel used, and the breakdown of energy end use categories: lighting, cooling, fans, etc. To evaluate the amount of energy used by a building, it is conventional practice to estimate an ***Energy Use Index (EUI)***, expressed in KBtu/SF ● year (thousands of British Thermal Units per square foot per year). The EUI is estimated fairly simply by summing the annual energy use of all fuels (typically electricity and one or more fossil fuels), converting to a common energy unit (typically the Btu or KBtu in the US), and dividing by the applicable conditioned area of the facility. Once estimated, an EUI can be interpreted by comparison to a database of energy use statistics for similar facilities, a process called benchmarking.

The following graph shows how the EUI of the Snow Removal Building compared to the national average for "Repair Services".



The Snow Removal Building is operating withinan EUI range that is higher than the average EUI range of similar facilities in the United States. The average repair service building, with an Energy Star Score of 50, has a EUI of 50.6 kBtu/ft^2, whereas the Snow Removal Building is operating at a EUI of 78.8kBtu/ft^2.

To reach the national average energy use intensity, the Snow Removal Building will have to cut energy by 28.2 kBtu/ft^2. If this goal is reached, the following savings will follow:

Energy Source	Energy Savings (MMBtu)	Cost Savings
Propane	191.96	$ 2,584.77
Electricity	22.61	$ 304.45
Total	214.57	$ 2,889.21

3 EXISTING CONDITIONS

Documenting existing conditions is a required deliverable of an investment grade energy audit. The purpose of documenting site conditions is so that the energy professional can lay the basis for which many of the recommended energy conservation measures are rooted in. During the onsite inspection, every piece of equipment, from the largest boiler down to a personal computer, is inventoried. Back at the Envinity "Lab", the audit team calculates how much energy each building system and system component consumes on an annual basis. These energy use quantifications make up a facility's "energy use profile" and gives the audit team a realistic vision as to how much energy can be saved in a facility.

The following existing conditions were observed at the Snow Removal Building.

Building Description and Occupancy

The Snow Removal Building is a 7,600 square foot facility; the building was completed in 1997. The space is heated throughout and is not cooled. The primary usage of this facility has been designated as garage and storage space with one enclosed office. Typical occupancy is from 6am to 8pm Monday through Friday; the office is occupied sporadically during that period.

Energy Use by Category

Energy is consumed within a building in a variety of ways. Heating, cooling, lighting, appliances, and water heating all consume most of the building's energy. To better visualize the energy consumption, The Snow Removal Building's energy use has been separated into individual categories. Areas of each building that consume large amounts were the main areas of focus for Envinity to find any problems and to determine the feasibility of energy efficiency improvements.

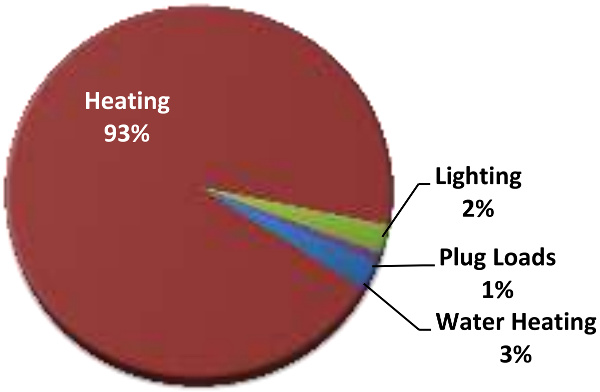
Through the utility bill analysis, engineering analysis and computer modeling, the energy usage was disaggregated into each of its energy-using components, providing a visual reference as to how energy is consumed annually within each building and how to best reduce energy consumption.

Envinity received 24 months of utility data for Snow Removal Building from July 2011 to June 2013. Over this time period, the facility consumed an annual average of 599 MMBTU of energy, resulting in annual energy costs of $9,228 or $1.21 per square foot. Broken up by electric and propane:

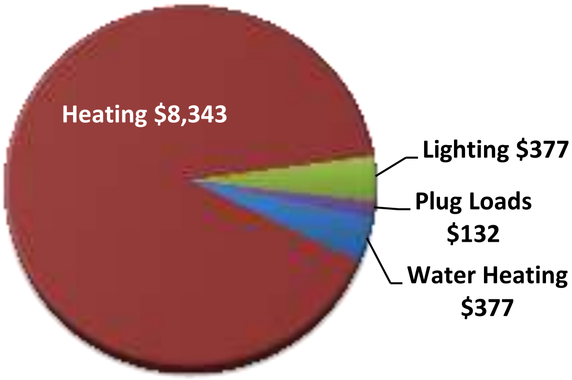
Electric: ***18,503 kWh (63.1 MMBtu); $1,594***
Propane: ***5,869 gal (536 MMBtu); $7,634***

The following charts are a disaggregation of how energy has been consumed at the Snow Removal Building over the past 24 months:

Existing Energy Usage



Existing Energy Cost



EXISTING

	Electric, kWh	Propane, gal	Total Energy Use, MMBtu	Total Energy Cost	% ENERGY	% COST
Water Heating	4,374		15	$376	2%	4%
Heating	8,226	5,869	564	$8,343	94%	90%
Lighting	4,374		15	$377	2%	4%
Plug Loads	1,529		5	$132	1%	1%
TOTAL:	**18,503**	**5,869**	**491**	**$9,228**	100%	100%

Mechanical Systems

The building is heated only. The majority of the space is high-bay garage and is served by infrared propane heaters. There are two 100 MBH heaters and three 80 MBH for a total of 440 MBH installed. Two - 4kW electric baseboard heating units serve the office and restroom.

Several ventilation fans, most significantly, six ⅓ hp fans, are manually operated but rarely utilized as ample fresh air is introduced when the garage doors are fully opened.

Heating at the Snow Removal Building consumes approximately 8,226 kWh and 5,869 gallons of propane annually, costing $8,343.

Building Envelope

The high-bay garage building is constructed with a combination of masonry block and metal cladding. The portion of the building with metal cladding is insulated with 4" vinyl-faced fiberglass, with an R-value of R-13. The metal roof is insulated with R-19 vinyl-faced fiberglass.

Lighting

Lighting is comprised of high pressure sodium (HPS) and incandescent lighting of varying wattages. The wash bays are using 200W HPS high bay fixtures and the vehicle bays are using 310W HPS fixtures. There are several 90W incandescent bulbs throughout the facility as emergency lighting. The small office and side bay have several 75W incandescent bulbs. The schedules for these lights are just under 12 hours a day, 5 days a week.

Overall, Envinity estimates the lighting at the Snow Removal Building consumes approximately 4,374 kWh annually, costing approximately $377.

Plug Loads

Plug loads in the Snow Removal Building are minimal. These consist of coffee pots, power tools, and space fans. ***The plug loads at the Snow Removal Building consume approximately 1,529 kWh annually, costing $132.***

4 CAPITAL RECOMMENDATIONS

Using the utility bill analysis, results and findings from the comprehensive on-site assessment, and outputs from the computer modeling of the facility, a number of capital and operational upgrades were identified for the Snow Removal Building.

Proposed Energy Conservation Measures (ECMs)

After reviewing all data, performing the onsite assessment, and creating a computer model of The Administration Building, Envinity has identified and prioritized potential energy conservation measures (ECMs). These measures have been organized based on their suggested order of implementation.

Energy Conservation Measure	Annual Energy Savings	Lifetime Savings	Initial Cost	Simple Payback	Internal Rate of Return	Year to Implement
Install occupancy sensing thermostats	**$1,821**	$18,212	**$3,375**	**2.0**	**56.1%**	**Year 1**
IR Tube heating units maintenance program	**$304**	$304	**$200**	**0.7**	**52.0%**	**Year 1**
Install waste oil furnace	**$3,049**	$45,738	**$13,650**	**4.5**	**23.5%**	**Year 2**
Lighting upgrade: 200W HPS for 4ft T8	**$222**	$1,335	**$2,031**	9.1	**30.7%**	**Year 3**
Lighting upgrade: 310W for 4ft T5	**$352**	$2,253	**$5,897**	16.8	**5.0%**	**Year 3**
	$5,749	**$67,843**	**$25,153**	**4.4**	**28%**	

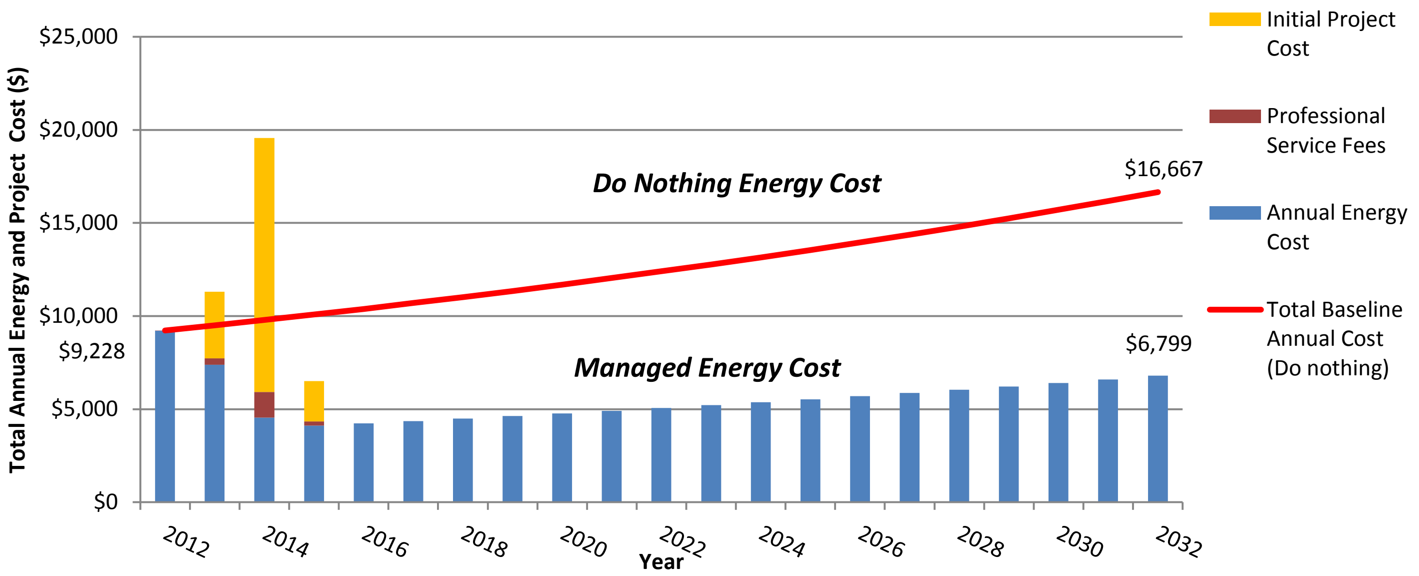
The recommendations made in this plan are projected to reduce annual energy costs by $5,749 annually and provide an estimated lifetime savings of $67,843 while exhibiting a combined return on investment of 28%.

Envinity performed a ***cash flow analysis*** scenario to show how the recommended Energy Conservation Measures can be budgeted and how energy savings from the measures can help pay for implementation of future measures. It is important to note that this Energy Management Plan is ***SELF FINANCING, FLEXIBLE and SCALABLE***. This analysis correlates directly with the ECM tables presented above. Analysis shows that if the recommendations in this strategy are acted upon, the University Park Airport can effectively negate annual increases in energy costs over the next 20 years.

The following guidance can be applied to the cash flow presented: Using the "Year" to implement guidance listed in each ECM's Description, the following graph shows energy costs can significantly decrease over the next 20 years.

What are most important to note in the cash flow analysis is the RED "do nothing" line (which assumes a 3% annual energy cost increase) and the BLUE "annual energy cost" bars. The red line shows what the faciliy can expect to be paying in energy costs as time progresses if NO ACTION is taken from this point forward. The blue bars show the predicted annual energy cost if the recommendations of this report are acted upon.

Energy Management Cash Flow



The energy management cash flow shows that when the projects recommended in this report are implemented, annual energy costs will be significantly reduced, When projects are implemented in a planned manner, the annual investments can be staged in a way that the facility's expenses would remain below the project utility costs the majority of the time.

The following recommendations are reflected in the above cash flow:

1. Install occupancy sensing thermostats

Annual Energy Savings: ***$ 1,821 (1,400 gallons)***
Estimated Install Cost: ***$3,375***
Payback Period: ***1.9 years***
ROI: ***56.1%***
Year to Implement: ***Year 1***

Description: Propane IR (infrared) heaters serve each garage bay and are controlled by constant-setpoint thermostats, incapable of programmed setbacks. The Snow Removal Building is occupied sporadically and has a high heat load due to the large garage doors. IR heaters perform most efficiently when they can utilize radiative heating to warm up an occupant without having to raise the temperature.

Recommendations: Install occupancy-based thermostats (such as SOLAIRA10115) to control the propane heaters based on occupancy. Set the unoccupied temperature setpoint to a minimum tolerance of equipment and materials stored in the space. Occupied setpoint should be a minimum that allows a comfortable work environment. Consider combining occupancy based thermostats with a lighting control solution to maximize the benefit of the installation.

Assumptions:

- Occupancy controls reduce heat consumption by 30%

2. IR tube heating units maintenance program

Annual Energy Savings:	***$304 (234 gallons)***
Estimated Install Cost:	***8 hours in house labor, est. at $200/yr***
Payback Period:	***0.7 years***
ROI:	***52%***
Year to Implement:	***Year 1***

Description: The Snow Removal garage bays currently heat using five infrared tube heaters totaling 440 MBH. Each zone (garage bay) has a dedicated controlled by wall mounted manual turn dial thermostats with no automated set-back operation. While radiant heating can be an efficient means to heat a garage bay, measures can be taken to increase efficiency.

Recommendation: The following actions can be taken to increase the efficiency of these units and decrease energy costs:

Once per year, allow for one or two employees to perform recommended maintenance procedures such as:

- Clean outside reflector with a damp cloth
- Inspect vent pipe and tube for cracks
- Clean outside air inlet, blower wheel and motor
- Inspect for gas leaks
- Consider the use of a line voltage programmable set back thermostat to control each heating zone

While the energy savings may not appear to be exciting, annual maintenance of heating and cooling systems is good practice. As long as the work can be done in house on down time, this measure makes good economic sense.

Assumptions:

- Annual maintenance program will reduce propane energy consumption by 5%

3. Install a waste oil furnace

Annual Energy Savings:	***$3,049 (2,344 gallons)***
Estimated Install Cost:	***$13,650***
Payback Period:	***4.5***
ROI:	***23.5%***
Year to Implement:	***Year 2***

Description: Propane IR heaters serve the Snow Removal high bays. IR heaters can be very efficient at spot-heating, the radiative heat allows occupants to be comfortable at lower air temperatures. However, for maintaining air temperature during unoccupied periods, propane can be an expensive fuel. By utilizing on-site waste oil the airport could offset a large portion of the heating cost and maintain the advantages of the IR tube heaters for spot heating.

Recommendation: The success of this measure is dependent on one variable, the ability to collect enough waste oil. Install a Waste oil heater to provide base heat load for the building when unoccupied. Utilize the propane heaters as a supplemental heat source to spot-heat specific bays while they are being occupied.

Assumptions:

- 50% of annual energy is stand-by heat (doors closed when waste oil furnace can meet load.)
- 2,300 gallons of waste oil available at no cost.
- Energy Logic EL-340H Waste Oil Heater 340 MBH
- Purchase cost of an EL-340 is approximately $10,500 based on vendor quote.
- Cost of waste oil disposal is not factored in.

4. Replace 200W HPS high bay fixtures with 4-lamp, 4ft T8 High Output fixtures with electronic ballasts

Annual Energy Savings: ***$222** (2,583 kWh)*
Est. Implementation Cost: **$2,031**
Payback Period: ***9.1***
Year to Implement: ***Year 3***

Description: The wash bay of the Snow Removal building is illuminated by (6) 200W HPS (high pressure sodium) fixtures. This space is estimated to be illuminated for 12 hours a day, 5 days a week.

Recommendation: The 200W HPS fixtures should be replaced with 4-lamp 4ft 32W T8 fixtures with electronic ballasts. This will provide the needed light at just under half of the energy. The light provided by the proposed fixtures will have much better quality than the yellow light provided by the HPS fixtures.

For additional energy savings, consider tying these fixtures to either a central occupancy sensor.

Assumptions:

- Electricity rate of $0.086/kWh
- Running for 12 hours/day, 5 days/week
- HPS fixture runs at 250W with ballast

5. Replace 310W HPS high bay fixtures with 4-lamp, 4ft T5 high output fixtures with electronic ballasts

Annual Energy Savings: ***$351*** *(4,088 kWh)*
Est. Implementation Cost: **$5,897**
Payback Period: ***16.8***
Year to Implement: ***Year 3***

Description: Bays 1 through 5 are illuminated by 310W HPS fixtures. These bays are for the snow removal vehicles and other equipment. The HPS fixtures are estimated to be running for 60 hours per week.

Recommendation: The 310W HPS fixtures should be replaced with 4-lamp 4ft T5 fixtures with electronic ballasts. This replacement will provide an increase in quality of light. The T5 fixtures will use 65% of the energy the existing system consumes.

Assumptions:
- Running for 12 hours/day, 5 days/week
- Electricity rate of $0.086/kWh
- HPS fixture runs at 365W with ballast

5 CONCLUSIONS

All facilities have the opportunity to significantly reduce annual energy expenses and apply those savings to more vital services or investing in other facilities or products. **The findings communicated in this report can reduce annual energy costs at this facility by approximately 38%.** ***Annually, the University Park Airport allocates approximately $9,078 on energy expenses. The recommendations in this report will reduce annual energy costs by approximately $5,749. The projects identified have an estimated install cost of $25,150, providing a 4.4 year payback.***

We have provided this facility with 5 capital improvement recommendations that are based on our findings while on site, reviewing building plans, and analyzing utility data. The major recommendations in this report are:

Energy Conservation Measure	Annual Energy Savings	Lifetime Savings	Initial Cost	Simple Payback	Internal Rate of Return	Year to Implement
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	$5,749	**$67,843**	**$25,153**	**4.4**	**28%**	

If you wish to pursue any of the recommendations made in this report further, but need more guidance, please feel free to contact Envinity. We recommend and install energy efficient technology every day and would be happy to discuss your projects further.

Sincerely,

Kevin Gombotz, PE, CEM
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