BUILDING ENERGY EVALUATION

Beat Test One

1 Test St.

Albany

The data for this building is open for entry and modification.
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Executive Summary

Overview

An assessment of the utility data for Beat Test One (1 Test St.) was carried out to determine the overall Building Energy Performance Index (BEPI) and to determine the potential for energy and water savings. Utility data was provided from January 2007 through December 2007. The data was analyzed to develop a baseline, and to study the building's electricity, fuel and water consumption trends.

Utility Consumption and Cost Tabulation

Utility	Consumption	Cost	Unit Cost	BEPI
Electricity	2,322,919 kWh	$215,528.06	$0.093 per kWh	22.98 ekWh/ft2
Natural Gas	100,353 m3	$45,486.46	$0.453 per m3	10.42 ekWh/ft2
Oil	3,678 Litre	$3,600.78	$0.979 per Litre	0.40 ekWh/ft2
Propane	4,878 Litre	$4,800.78	$0.984 per Litre	0.41 ekWh/ft2
Steam	7,600 Mlb	$190,000.00	$25.000 per Mlb	22.03 ekWh/ft2
Chilled Water (deep lake)	289,912 Ton hour	$79,362.94	$0.274 per Ton hour	10.08 ekWh/ft2
Energy Total	**6,705,136 ekWh**	**$538,779.02**	**$0.080 per ekWh**	**66.33 ekWh/ft2**
Water	17,300 m3	$40,740.00	$2.355 per m3	171.13 Litre/ft2

Building Energy Performance Index

The Beat Test One facility's overall energy use is 66.33 equivalent kWh/ft2 (226.31 kbtu/ ft2) based on a gross floor area of 101,090 ft2. By comparison, a typical office building, operating on a typical 12 to 14 hours per weekday schedule, has a BEPI in the range of 35.0 ekWh/ft2 (119 kBtu/ft2). Water consumption is 171.13 Litre/ft2.

Energy and Water Reduction Potential

Overall, a reduction of 16.5% of the current electricity, fuel and water cost is expected with implementation of the recommendations outlined in this report. Projected annual cost savings are in the range of $95,734. Implementation costs are in the $594,985 range - generating a simple payback of 6.2 years.

Potential Savings Opportunities

Potential Annual Utility Cost Savings	$95,734
Estimated Implementation Cost	$594,985
Overall Program Simple Payback	6.2 years
Projected Building Energy Performance Index	53.93 ekWh/ft2

1. Building Energy and Water Evaluation

Methodology

The following outlines the methodology used to first assess the building's potential for an energy optimization and retrofit project.

- Utility Data Collection - Monthly consumption and cost data are extracted from utility invoices to determine exactly how much energy and water the building is using, and what the facility paid for utilities. This allows for the establishment of an accurate BASELINE of actual energy use and costs, against which future energy use and costs can be evaluated.

- Enter data to a database format - This allows the data to be used for various engineering functions throughout the duration of the project. The database is set up in EXCEL format to allow for ongoing updating and analysis throughout the pre and post retrofit periods.

- Analyze data trends, excesses, anomalies - A weather-correlated energy baseline is developed, based on actual usage trends. Graphing the energy use data allows the analyst to identify heating, cooling and baseload components, and to pinpoint uncharacteristic and undesirable energy use trends that give a first indication of the magnitude of energy saving potential.

- The Building Energy Performance Index (BEPI) is established based on the building's gross floor area. This breaking down of energy and water use based on building floor area (benchmarking) allows for immediate evaluation of building energy "performance" against similar facilities - providing additional indicators of energy savings potential.

- Allocation of energy use by major end user - Through trend analysis, the percentage of a building's major energy end uses is allocated to help identify excesses and efficiencies, and to further assist the analysis in determining energy reduction potential.

- Based on results of the utility analysis and end use energy allocation for each utility, a retrofit "opportunity"

program framework is developed, with estimated implementation costs and simple payback period.

Allocation of Energy and Water Use

The following "Building Energy Allocation and Projected Savings" table shows the results of the initial energy analysis for each utility. Monthly data is analyzed, with energy and water use apportioned to the major end users, and a pre retrofit and post retrofit, or "target" BEPI, established. Overall energy and water reduction potential is identified, with expected cost savings based on current energy and water rates.

Energy and water use is broken out for the following utilities:

Electricity
Gas
Propane
Oil
Steam
Chilled Water (deep lake)
Water

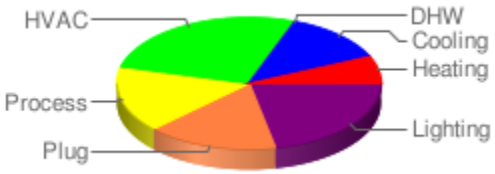
Energy and Water Trend Graphs

Detailed analysis and review of actual energy consumption trends form the building block for the allocation of energy use by major building equipment, and in the development of projected or "potential" energy and cost savings.

Trend graphs are created to help show monthly energy use patterns over the entire analysis period. Trend graphing helps to identify excessive energy use, undesirable patterns, and "target" areas that would likely benefit from optimization of building operational strategies, and through equipment replacements and upgrades.

To the trained energy analyst, graphical presentation of the monthly electricity, natural gas and water consumption data serves as a "window" into actual energy use, and in the accurate defining of a building's energy performance and savings potential.

Electricity Consumption:



The building's electricity usage has been apportioned as follows among the major building components:

- **Lighting:** 21.79%
- **Plug Load:** 16.14%
- **Process Electricity:** 16.14%
- **HVAC (Fans and Pumps):** 26.63%
- **Domestic Hot Water:** 0.00%
- **Cooling / Summer Extra:** 12.64%
- **Heating / Winter Extra:** 6.67%

The building's monthly electricity consumption is shown by the red line. Horizontal line indicates baseload. Blue area is cooling season, pink area is heating season.

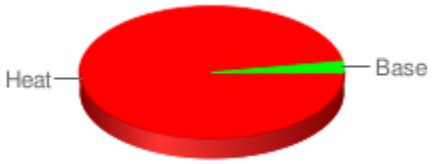
Electricity use:

Period:	Jan 2007 to Dec 2007
Annual Usage:	2,322,919 kWh
Annual Cost:	$215,528.06
Unit Cost:	$0.093 per kWh

BEPI: 22.98 ekWh/ft2

End Use	End Use Allocation	kWh/ft^2	Energy Consumption	Energy Cost	End Use Reduction Potential	Projected annual utility use	Projected utility savings	Projected annual cost savings	Overall reduction potential
Lighting	21.79 %	5.01	506,088	$46,957	18.00%	414,992	91,096	$8,452	3.92%
Plug Load	16.14 %	3.71	374,880	$34,783	6.00%	352,387	22,493	$2,087	0.97%
Process Electricity	16.14 %	3.71	374,880	$34,783	20.00%	299,904	74,976	$6,957	3.23%
HVAC (Fans and Pumps)	26.63 %	6.12	618,552	$57,391	24.50%	467,007	151,545	$14,061	6.52%
DHW	0.00 %	0.00	0	$0	1.00%	0	0	$0	0.00%
Cooling / Summer Extra	12.64 %	2.90	293,605	$27,242	11.00%	261,308	32,297	$2,997	1.39%
Heating / Winter Extra	6.67 %	1.53	154,914	$14,373	11.00%	137,873	17,041	$1,581	0.73%
		22.98	**2,322,919**	**$215,528**	**16.77%**	**1,933,472**	**389,447**	**$36,134**	**16.77%**

Natural Gas Consumption:



The building's gas usage has been apportioned as follows among the major building components:

- **Building Heating / Ventilation:** 97.34%
- **Baseload:** 2.66%

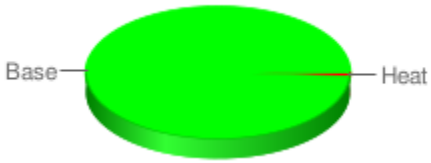
The building's monthly gas consumption is shown by the red line. Horizontal line indicates baseload. Blue area is cooling season, pink area is heating season.

Natural Gas use:

Period:	Jan 2007 to Dec 2007
Annual Usage:	100,353 m3
Annual Cost:	$45,486.46
Unit Cost:	$0.453 per m3
BEPI:	10.42 ekWh/ft2

End Use	End Use Allocation	kWh/ft^2	Energy Consumption	Energy Cost	End Use Reduction Potential	Projected annual utility use	Projected utility savings	Projected annual cost savings	Overall reduction potential
Heating / Ventilation	97.34 %	10.15	97,687	$44,278	43.00%	55,682	42,005	$19,040	41.86%
Baseload	2.66 %	0.28	2,666	$1,208	56.00%	1,173	1,493	$677	1.49%
		10.42	**100,353**	**$45,486**	**43.35%**	**56,855**	**43,498**	**$19,716**	**43.35%**

Oil Consumption:



The building's oil usage has been apportioned as follows among the major building components:

- **Building Heating:** 0.98%
- **Baseload:** 99.02%

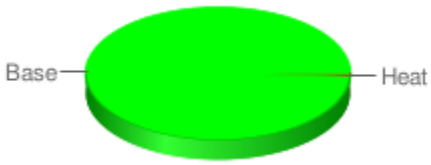
The building's monthly oil consumption is shown by the red line. Horizontal line indicates baseload. Blue area is cooling season, pink area is heating season.

Oil use:

Period:	Jan 2007 to Dec 2007
Annual Usage:	3,678 Litre
Annual Cost:	$3,600.78
Unit Cost:	$0.979 per Litre
BEPI:	0.40 ekWh/ft2

End Use	End Use Allocation	kWh/ft^2	Energy Consumption	Energy Cost	End Use Reduction Potential	Projected annual utility use	Projected utility savings	Projected annual cost savings	Overall reduction potential
Building Heating	0.98 %	0.00	36	$35	38.50%	22	14	$14	0.38%
Baseload	99.02 %	0.40	3,642	$3,566	51.50%	1,766	1,876	$1,836	51.00%
		0.40	**3,678**	**$3,601**	**51.37%**	**1,789**	**1,889**	**$1,850**	**51.37%**

Propane Consumption:



The building's propane usage has been apportioned as follows among the major building components:

- **Building Heating:** 0.74%
- **Baseload:** 99.26%

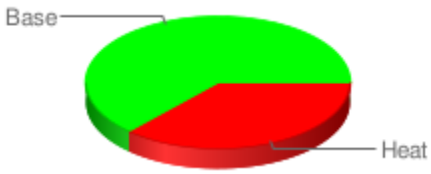
The building's monthly propane consumption is shown by the red line. Horizontal line indicates baseload. Blue area is cooling season, pink area is heating season.

Propane use:

Period:	Jan 2007 to Dec 2007
Annual Usage:	4,878 Litre
Annual Cost:	$4,800.78
Unit Cost:	$0.984 per Litre
BEPI:	0.41 ekWh/ft2

End Use	End Use Allocation	kWh/ft^2	Energy Consumption	Energy Cost	End Use Reduction Potential	Projected annual utility use	Projected utility savings	Projected annual cost savings	Overall reduction potential
Building Heating	0.74 %	0.00	36	$35	43.00%	21	15	$15	0.32%
Baseload	99.26 %	0.41	4,842	$4,765	56.00%	2,130	2,712	$2,669	55.59%
		0.41	**4,878**	**$4,801**	**55.90%**	**2,151**	**2,727**	**$2,684**	**55.90%**

Steam Consumption:



The building's steam usage has been apportioned as follows among the major building components:

- **Building Heating:** 36.84%
- **Baseload:** 63.16%

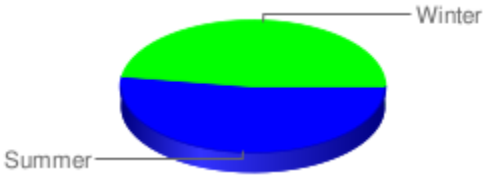
The building's monthly steam consumption is shown by the red line. Horizontal line indicates baseload. Blue area is cooling season, pink area is heating season.

Steam use:

Period:	Jan 2007 to Dec 2007
Annual Usage:	7,600 Mlb
Annual Cost:	$190,000.00
Unit Cost:	$25.000 per Mlb
BEPI:	22.03 ekWh/ft2

End Use	End Use Allocation	kWh/ft^2	Energy Consumption	Energy Cost	End Use Reduction Potential	Projected annual utility use	Projected utility savings	Projected annual cost savings	Overall reduction potential
Building Heating	36.84 %	8.12	2,800	$70,000	15.50%	2,366	434	$10,850	5.71%
Baseload	63.16 %	13.92	4,800	$120,000	3.00%	4,656	144	$3,600	1.89%
		22.03	**7,600**	**$190,000**	**7.61%**	**7,022**	**578**	**$14,450**	**7.61%**

Chilled Water (deep lake) Consumption:



The building's chilled water usage has been apportioned as follows among the major building components:

- **Summer Cooling:** 52.45%
- **Winter Cooling:** 47.55%

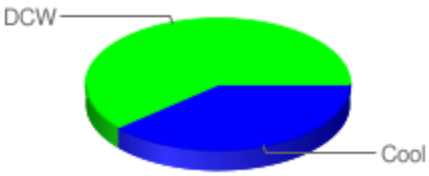
The building's monthly chilled water consumption is shown by the red line. Horizontal line indicates baseload. Blue area is cooling season, pink area is heating season.

Chilled Water (deep lake) use:

Period:	Jan 2007 to Dec 2007
Annual Usage:	289,912 Ton hour
Annual Cost:	$79,362.94
Unit Cost:	$0.274 per Ton hour
BEPI:	10.08 ekWh/ft2

End Use	End Use Allocation	kWh/ft^2	Energy Consumption	Energy Cost	End Use Reduction Potential	Projected annual utility use	Projected utility savings	Projected annual cost savings	Overall reduction potential
Summer Cooling	52.45 %	5.29	152,052	$41,624	19.00%	123,162	28,890	$7,909	9.97%
Winter Cooling	47.55 %	4.79	137,860	$37,739	19.00%	111,667	26,193	$7,170	9.03%
		10.08	**289,912**	**$79,363**	**19.00%**	**234,829**	**55,083**	**$15,079**	**19.00%**

Water Consumption:



The building's water usage has been apportioned as follows among the major building components:

- **Cooling / Summer Extra:** 38.73%
- **DCW / Baseload:** 61.27%

The building's monthly water consumption is shown by the red line. Horizontal line indicates baseload. Blue area is cooling season, pink area is heating season.

Water use:

Period:	Jan 2007 to Dec 2007
Annual Usage:	17,300 m3
Annual Cost:	$40,740.00
Unit Cost:	$2.355 per m3
BEPI:	171.13 Litre/ft2

End Use	End Use Allocation	Litre/ft^2	Water Consumption	Water Cost	End Use Reduction Potential	Projected annual utility use	Projected utility savings	Projected annual cost savings	Overall reduction potential
Cooling / Summer Extra:	38.73 %	66.28	6,700	$15,778	10.00%	6,030	670	$1,578	3.87%
DCW / Baseload	61.27 %	104.86	10,600	$24,962	17.00%	8,798	1,802	$4,244	10.42%
		171.13	**17,300**	**$40,740**	**14.29%**	**14,828**	**2,472**	**$5,821**	**14.29%**

2. Estimated Potential Savings

Energy Retrofit Project Cost Estimate

The following tables list major building equipment and systems, together with areas for potential energy and cost reduction.

Based on target energy use developed through the detailed analysis of utility data and trend graphs and by applying current construction and equipment costs, a preliminary estimate of overall project retrofit cost and simple payback period are developed.

The “Energy Retrofit Project Cost Estimate” is intended only as a guideline or tool to help identify a building's energy reduction potential. Once having determined a given building's “performance” when compared to other facilities of similar size, function and operation, and after detailed analysis of energy and water use trends, the approximate cost of energy conservation retrofit strategies and equipment changes can be developed.

The following tables highlight available energy retrofits, along with their estimated implementation costs, cost savings, and payback periods.
Recommendations marked with * appear in multiple consumption categories, with implementation costs divided amongst the categories on a pro-rated basis.

Electricity Savings Opportunities:

Recommendations	Implementation Cost	Yearly Cost Savings	Payback (years)
General			
Carry out an Energy Audit	$2,500		

Lighting

Upgrade interior lighting to high efficiency lamps	$30,327		
- Convert all incandescent lamps to compact fluorescent type			
- Convert fluorescent lamps to high efficiency T-8 or T-5 type			
- Replace/upgrade existing parking area lighting to high efficiency type			
- Reduce ambient lighting and provide high efficiency task lighting			
Convert existing EXIT lights to LED type	$948		
Upgrade/replace existing lighting controls	$60,654		
	$90,981	**$8,452**	**11**

Plug Load

Remove unnecessary loads or provide circuit control	$50,545		
Initiate an energy and environmental awareness campaign that involves employees, tenants, visitors	$99		
Upgrade to Energy Star rated equipment/appliances	$3,033		
	$53,677	**$2,087**	**26**

Process Electricity

Reduce load through server/consolidation, and installation of high efficiency equipment	$25,273		
	$25,273	**$6,957**	**4**

HVAC (Fans and Pumps)

Carry out heating and cooling distribution systems balancing*	$1,516
Carry out main air systems balancing*	$1,516
Convert existing Variable Inlet Vanes on main air handling units to Variable Frequency Drives (VFD)*	$5,055
Optimize/minimize reheat through set point adjustment	
Investigate feasibility of changing out individual fan and pump motors with high efficiency type whenever motor repairs or upgrades are required	
Upgrade/replace existing RTU's with new high efficiency type*	$3,033
Upgrade/replace existing RTU controls*	$253
Upgrade/replace existing thermostat controls with programmable type*	$1,011
Install central Building Automation System*	$3,033
Install VFD's on chilled water and condenser water pumping systems*	$3,639

Install VFD's on heating water pumping systems*	$3,639		
Install VFD's on domestic water booster pump systems	$6,065		
Install VFD's cooling tower fan motors	$6,065		
	$34,826	**$14,061**	**3**

Cooling / Summer Extra

Upgrade/replace existing RTU's with new high efficiency type*	$13,647		
Install economizer section on RTU's*	$442		
Upgrade/replace existing RTU controls*	$1,137		
	$15,227	**$2,997**	**5**

Heating / Winter Extra

Fine tune heating controls to minimise winter heating excess			
	$0	**$1,581**	**0**

Electricity Grand Total	**$222,482**	**$36,134**	**6**

Fuel Savings Opportunities:

Recommendations	Implementation Cost	Yearly Cost Savings	Payback (years)

General

Carry out an Energy Audit	$2,500

Building Heating

Upgrade to High Efficiency Boilers	$40,436
Convert existing Variable Inlet Vanes on main air handling units to Variable Frequency Drives (VFD)*	$2,527
Carry out heating and cooling distribution systems balancing*	$6,824
Carry out main air systems balancing*	$6,824
Upgrade/replace existing boiler controls	$5,055
Collect condensate for preheat applications	$20,218
Implement a comprehensive maintenance and inspection program to identify and repair steam distribution related problems	$5,055
Upgrade/replace existing RTU's with new high efficiency type*	$13,647
Install economizer section on RTU's*	$442
Upgrade/replace existing RTU controls*	$1,137
Upgrade/replace existing thermostat controls with programmable type*	$3,033
Install central Building Automation System*	$1,516

Install VFD's on heating water pumping systems*	$2,426		
Install CO_2 ventilation control on main air systems*	$5,055		
Investigate feasibility of recovering heat from exhaust air to preheat outside air			
Investigate feasibility of installing a cogeneration system			
Investigate feasibility of solar thermal (heating and preheating) or solar photovoltaic (electricity generating) heating systems			
Seal all building openings, including doors, windows, loading areas, pipe, duct and elevator shafts and roof*	$3,033		
Install vestibules or revolving doors at all main building entrances with high pedestrian traffic*	$30,000		
Implement a regular bi-annual inspection and repair of weather-stripping at all exterior doors*	$600		
	$147,826	**$29,918**	**5**

Cooling

Upgrade/replace existing chillers with high efficiency type using non-CFC refrigerant	$151,635		
Modify existing cooling towers to operate during the winter months	$5,055		
Convert existing Variable Inlet Vanes on main air handling units to Variable Frequency Drives (VFD)*	$2,527		
Carry out heating and cooling distribution systems balancing*	$6,824		

Carry out main air systems balancing*	$6,824		
Upgrade/replace existing thermostat controls with programmable type*	$1,011		
Install central Building Automation System*	$1,516		
Install VFD's on chilled water and condenser water pumping systems*	$2,426		
Install CO_2 ventilation control on main air systems*	$5,055		
Investigate feasibility of converting to central chilled water from local supplier			
Investigate feasibility of installing a natural gas fired absorption cooling system			
Investigate feasibility of installing solar film and/or internal shading devices to reduce cooling load and heat transfer			
Seal all building openings, including doors, windows, loading areas, pipe, duct and elevator shafts and roof*	$2,022		
Install vestibules or revolving doors at all main building entrances with high pedestrian traffic*	$20,000		
Implement a regular bi-annual inspection and repair of weather-stripping at all exterior doors*	$400		
	$205,294	**$15,079**	**14**

Baseload

Install separate DHW/Summer heating boiler	$5,055		

Optimize/minimize reheat through set point adjustment			
Investigate opportunities to optimise / reduce natural gas consumption			
	$5,055	**$8,782**	**1**
Fuel Grand Total	**$360,675**	**$53,779**	**7**

Water Savings Opportunities:

Recommendations	Implementation Cost	Yearly Cost Savings	Payback (years)
Cooling			
Investigate the feasibility of installing an irrigation control system to optimize water use for landscaping			
Investigate the feasibility of removing water cooled air conditioning units and replacing with a conventional cooling system			
	$0	**$1,578**	**0**
Baseload			
Complete the conversion of toilets to low flush or dual flush type	$4,549		
Complete the conversion of urinals to low flow type	$4,549		
Complete the conversion of toilets and urinals to automatic proximity control type	$1,820		

Complete the conversion of faucets to low flow type with automatic proximity control	$910		
	$11,828	**$4,244**	**3**
Water Grand Total	**$11,828**	**$5,821**	**2**

Building Overall:

	Implementation Cost	Yearly Cost Savings	Payback (years)
Building Grand Total	**$594,985**	**$95,734**	**6**