Mechanical Energy Study
Sample Report

Purpose

Power Smart's *Minimum Requirements for an Energy Study* (see Appendix) provides a comprehensive list of the basic elements which must be included in an Energy Study Report. The intent of this sample report is to provide additional information to consultants and customers and communicate the level of detail expected from the Energy Study Report, supporting documents and calculations.

Power Smart Engineering reviews the Energy Study Report to determine whether the proposed energy savings measures are feasible and sustainable. To support the development of local energy efficiency expertise and speed the turnaround time of future technical reviews, Power Smart Engineering tools and examples are shared with the consultant in this sample report.

Scope

The sections in this sample report correspond to the mechanical items listed in the *Minimum Requirements for an Energy Study*, which can be found in the Power Smart Energy Study Funding Agreement. This sample report does not cover the items related to lighting.

The sample report format is applicable to many different building types and systems and the examples provided cover a variety of applications.

Background

An energy study identifies, analyzes and recommends cost-effective solutions to improve inefficient systems and increase the reliability and energy efficiency of a customer's facility. BC Hydro's Energy Study program helps Power Smart Partners conduct studies within their commercial organizations by co-funding up to 50% of the energy study, maintaining a directory of pre-qualified consultants and providing access to Power Smart's technical and energy management resources.

After the energy study is complete, the customer receives an Energy Study Report that includes suggestions for improvements supported by detailed technical information, quantified energy savings potential and expected implementation costs. Based on the Energy Study Report, the customer should be able to determine the most effective energy savings measures for implementation.

Requirements

At a minimum, the Energy Study Report must include the relevant elements listed in the *Minimum Requirements for an Energy Study*. The consultant should include a brief explanation if elements from the *Minimum Requirements* are not applicable or not relevant to the energy study.

In addition to the Report, separate calculation spreadsheets are required to support the values reported. All energy savings measures being recommended for implementation must adhere to ASHRAE and Illuminating Engineering Society design guidelines and calculation procedure. Energy modeling outputs are not accepted as a substitute for calculation spreadsheets.

The energy consumption baseline for measures that involve equipment replacement is the current version of ASHRAE 90.1.

Additional information and documentation that are relevant to the building energy analysis, performance data and calculations can be provided in the appendices of the Report.

Table of Contents

BC Hydro Power Smart Energy Study Sample Report

1.0 Applicant Information

Provide the following information for the project:

- Customer company name and address
- Contact person
- Telephone and email
- Facility type
- Consultant name and address
- Contact information
- Date of Energy Study Report completion

For example:

Site identifier:	Power Smart Head Quarters Kingsway Burnaby, BC Canada
Report prepared for:	BC Hydro Power Smart Mr. Energy Manager Vancouver, BC (604) 555-5555 Mr.energy.manager@bchydro.com
Report prepared by:	Mr. Energy Conservation Consultant Main Street Vancouver, BC (604) 555-5555 Mr.Energy@consultant.com
Date of report completion	October 15, 2009

2.0 Executive Summary

This executive summary is important as it will be used to provide the customer and BC Hydro with an outline of the Energy Study's recommendations.

Summarize the report in a tabulated format containing the following information:

- List of energy savings options
- Measure descriptions
- Anticipated energy savings (kWh)
- Anticipated demand reduction (kW)
- Peak load demand reduction (kW) if applicable (Dec & Jan from 5pm – 7pm)
- Other fuel savings
- Cost savings and estimated incremental and/or project costs to implement each option
- Simple paybacks
- Assumptions

Energy Conservation Measures should be grouped into retrofit, operational or maintenance measures. Both recommended and non-recommended measures should be documented in separate tables.

For example:

A. Energy Conservation Measures Recommended for Implementation

Retrofit Measures		Electric Savings			Other Fuel Savings		Measure	Simple
ID	Description	kW	kWh/yr	$/yr	GJ/yr	$/yr	Cost	Payback
M1	Waterside economizer	0	45,000	$1,485			$15,000	10
M2	Replace VIV with ASD	0	15,000	$495			$3,000	6
Operational Measures		**Electric Savings**			**Other Fuel Savings**		**Measure**	**Simple**
ID	**Description**	**kW**	**kWh/yr**	**$/yr**	**GJ/yr**	**$/yr**	**Cost**	**Payback**
M3	Rescheduling HW pumps		25,000	$825			$800	1
M4	Night set back		10,000	$330	20	$164	$2,000	4
Maintenance Measures		**Electric Savings**			**Other Fuel Savings**		**Measure**	**Simple**
ID	**Description**	**kW**	**kWh/yr**	**$/yr**	**GJ/yr**	**$/yr**	**Cost**	**Payback**
M5	Re-commissioning		5,000	$165	25	$205	$2,500	6.8
M6	Repairing override		8,000	$264	15	$123	$500	1.3

B. Energy Conservation Measures Not Recommended for Implementation

Retrofit Measures		Electric Savings			Other Fuel Savings		Measure	Simple
ID	Description	kW	kWh/yr	$/yr	GJ/yr	$/yr	Cost	Payback
M7	Free-cooling chiller	15	85,000	$2,805			$375,000	134
M8	Elevators	1	34,000	$1,122			$95,000	85
Operational Measures		**Electric Savings**			**Other Fuel Savings**		**Measure**	**Simple**
ID	Description	kW	kWh/yr	$/yr	GJ/yr	$/yr	Cost	Payback
M9	Demand Control Ventilation		15,000	$495	22	$180	$12,000	18
M10	Chilled water temperature reset		9,000	$297			$6,000	20
Maintenance Measures		**Electric Savings**			**Other Fuel Savings**		**Measure**	**Simple**
ID	Description	kW	kWh/yr	$/yr	GJ/yr	$/yr	Cost	Payback
M11	Insulation replacement				5	$41	$350	8.5

3.0 Facility Description

Provide adequate information to allow a 3rd party reviewer of the report a good understanding of the facility's attributes. The information should include the following:

- Building type
- Construction and envelope description (wall construction, types of doors, types of windows and window shadings, type of glazing, glazing levels (% wall area))
- Age and renovation years
- Physical condition
- Internal space use and layout (sketches optional)
- Floor area and number of floors
- Occupancy pattern

For example:

The Tower Office is an office facility in the city's downtown area. The building is concrete block construction with curtain walls. The office offers in excess of 400,000 ft2 of office space. The podium section was completed in 1989 and the tower was completed approximately two years later. The podium is 10 stories with a conditioned area of approximately 150,000 ft2. The tower is 25 stories of general offices with a total conditioned area of approximately 250,000 ft2. The parkade consists of 500 stalls…

The building envelope is curtain wall construction with reflective glazing. The building is judged to be excellent with respect to air infiltration. The main entrances have glass doors with vestibules. Fixed windows make up 50% of the overall wall area and are double-glazed with a reflective tint. The building has no shading other than tenant controlled blinds. The building is partially shaded by adjacent office towers resulting in uneven thermal loads during sunny mornings…

The podium has Tenant A as a prime tenant on 8 floors. Tenants B and C have floors 1 and 10 respectively. Tenant C operates 24/7 and has special loads. The office tower has other tenants. Approximately 20 floors are multi-tenant floors. Floor layout for tenants is typically open office type with fully enclosed meetings

rooms in each corner of the floor. Generally, the open office areas are divided into 5 zones: one for each orientation and one interior zone. The large meeting rooms in the corners are zoned separately…
Typical building operating hours are from 5:00AM to 9:00PM Monday to Saturday with tenant occupancy primarily between 7:00AM and 6:00PM Monday to Friday. The cleaning is performed daily from 8:00PM to Midnight. Security staff are on site after 6:00PM daily…

4.0 Mechanical System Description

Provide adequate information to allow a 3rd party reviewer of the report a good understanding of the facility's mechanical systems, operations and known issues. The information should include the following:

- Types of systems and areas served
- Inventory of equipment
- Operating schedules
- Sequence of operation
- Maintenance schedules
- Equipment conditions
- Equipment efficiencies
- Energy use baseline (in Excel spreadsheet format)

For example:

Ventilation System
The upper floors are zoned on each exposure with an additional interior zone. Floors 2 through 9 are served with separate multi-zone air handling units AHU-2 through AHU-9 respectively. The multi-zone systems operate by blending heated and cooled air to meet space thermal requirements. The units are controlled by a XX brand DDC system comprised of approximately 126 points. The hot and cold deck set-points are --F and --F respectively. Unit AHU-2 runs from 6:00 AM to 5:00 pm. The damper minimum position…

Cooling System
The facility has two chillers. One 450 ton centrifugal Brand A chiller has variable speed capabilities. The other chiller is a 150 ton Brand B screw chiller and operates during peak summer loads only. Chilled water is supplied to the ventilation fans, floor air handling units and fan coil units…

Heating System
Two new forced draft gas fired boilers, 3000 MBH input each, are piped in parallel. Two hot water pumps circulate the water across both boilers. Heating is required all year on the north side of the perimeter except for 4 weeks in the summer. The boiler provides hot water for fan coil units, the heating coils in the multi-zone units and perimeter radiators…

Domestic Water System
The domestic hot water for all buildings is generated via the integral shell and tube heat exchanger with the heating water system fed from the boilers. The hot water passes through an anti-scalding temperature mixing valve at 140 degree F set-point. DHW is re-circulated by the pump located behind the tank. The system serves the kitchen, refreshment counter and four washrooms on the main floor. Small electric hot water tanks serve the remaining 12 bathrooms in the building…

Inventory Information Spreadsheets

Along with the general mechanical equipment descriptions, this section should provide spreadsheets detailing inventory energy consumption, hours of operation and weekly/seasonal profiles. The detailed inventory spreadsheet and the annual hours of operation spreadsheets are required to be submitted with the final Report in Excel format for review, and should include the following:

- Equipment identifier
- Zones served
- Nameplate information
- Set points
- Annual hours of operation
- Annual energy consumption

The inventory data can also be provided separately in the appendices.

Inventory Calculation Spreadsheet

Existing Equiptment Motor Lis		Click here for existing Chiller list													
Equipment		Category (select from drop down list)	Area Served	Name Plate Data				Measured Amps	Power Factor (%)	Load Factor (%)	Efficiency		kW	Annual hours	Annual Consumption
Tag	Type			Voltage	Phase	HP	Amps				%	Actual or Estimated?			
AHU-1SF	Fan (Supply)	Ventilation / Auxilaries	Lobby	575	3	25.0		5.0	65%	82%	60.0%	Actual	3.2	4,500	14,565
DH-1	Duct Heater Elec	Heating	Lobby	575	3								5.0	4,500	22,500
AHU-2SF	Fan (Supply)	Cooling	2nd Flr	575	3	20.0		15.0	80%	85%	60.0%	Actual	12.0	4,500	53,780
AHU-2RF	Fan (Return)	Cooling	2nd Flr	575	3	10.0		15.0	80%	85%	90.0%	Actual	12.0	4,500	53,780
AHU-3SF	Fan (Supply)	Heating	3rd Flr	575	3	20.0			80%	85%	65.0%	Estimated	19.5	4,500	87,798
AFHU-3RF	Fan (Return)	Heating	3rd Flr	575	3	10.0		20.0	80%	85%	60.0%	Actual	15.9	4,500	71,707
AHU-4SF	Fan (Supply)	Ventilation / Auxilaries	4th Flr	575	3	20.0			75%	75%	80.0%	Estimated	14.0	4,500	62,344
AHU-4RF	Fan (Return)	Ventilation / Auxilaries	4th Flr	575	3	7.5			75%	75%	50.3%	Estimated	8.3	4,500	37,541
B-1	Boiler (Elec)	Heating	Flr 1- 10	575	3			2.0					15.9	3,800	60,420
D-1	DHW heater (Elec)	Domestic Water	Flr 1- 10	230	3			3.0					6.5	4,500	29,250
MAU-1	Fan (Supply)	Ventilation / Auxilaries	Kitchen	575	3	15.0			75%	75%	80.0%	Estimated	10.5	3,000	31,472
MAU-2	Fan (Supply)	Ventilation / Auxilaries	Gym	575	3	5.0			70%	75%	63.0%	Actual	4.4	2,000	8,881
IC-1	Misc Equipment	Refrigeration / Food Preparation	10th Flr	575	3								12.0	1,000	12,000
EF-1	Fan (Exhaust)	Ventilation / Auxilaries	Kitchen	230	3	10.0			60%	60%	60.3%	Estimated	7.3	3,000	22,049
ER-1	Electric radiant heater	Heating	Loading dock	575	3								2.0	2,500	5,000
CP-1	Control air compressor	Other Load	Mech Rm	575	3	5.0			60%	50%	60.0%	Estimated	3.1	4,500	13,388

Chiller Calculation Spreadsheet

Chiller List | Click here for existing motor list | Print

Tag	Size (ton)	Type	Load %	Load (ton)	FL Eff (kW/ton)	Load (kW)	Operating Hours (logged Hours) Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Hours by Load % (hr/yr)	Consumption by Load%	Equivalent FL hours by Load %	Total Consumption (kWh/yr)	Total Equivalent FL hours
ch-1	450	Water Cooled Centrifugal	0	0	0.00	0													0	0	0	278,753	1,107
			25	113	0.40	45				123						123			246	11,070	35		
			50	225	0.50	113				50	123				123	50			346	38,925	346		
			75	338	0.60	203					25	321	321	321	25				1,013	205,133	651		
			100	450	0.70	315						25	25	25					75	23,625	75		
ch-2	200	Water Cooled Scroll and Screw	0	0	0.00	0													0	0	0	11,550	88
			25	50	0.60	30													0	0	0		
			50	100	0.80	80						20	10	10	20				60	4,800	60		
			75	150	1.00	150						5	20	20					45	6,750	28		
			100	200	1.20	240													0	0	0		
		Air-Cooled w/ Condenser	0	0		0													0	0		0	0
			25	50		0													0	0			
			50	100		0													0	0			
			75	150		0													0	0			
			100	200		0													0	0			
		Water Cooled Reciprocating	0	0		0													0	0		0	0
			25	25		0													0	0			
			50	50		0													0	0			
			75	75		0													0	0			
			100	100		0													0	0			
		Air-Cooled w/o Condenser	0	0		0													0	0		0	0
			25	63		0													0	0			
			50	125		0													0	0			
			75	188		0													0	0			
			100	250		0													0	0			

Weekly Schedules Calculation Spreadsheet

WEEKLY SCHEDULES

Enter times in 24-hour clock format *4.345 weeks in a month

PROFILE #	Profile Name (Optional)	BACK to Schedules	Mon	Tue	Wed	Thu	Fri	Sat	Sun	MONTHLY Hours Total
1	General	start	6.0	6.0	6.0	6.0	6.0	8.0	8.0	332.4
		stop	18.0	18.0	18.0	18.0	18.0	16.5	16.0	
2	Summer	start	7.0	7.0	7.0	7.0	7.0	9.0	9.0	243.3
		stop	16.0	16.0	16.0	16.0	16.0	15.0	14.0	
3	Continuous	start	0.0	0.0	0.0	0.0	0.0	0.0	0.0	730.0
		stop	24.0	24.0	24.0	24.0	24.0	24.0	24.0	
4	Cooling	start	5.0	5.0	5.0	5.0	5.0	7.0	7.0	482.3
		stop	22.0	22.0	22.0	22.0	22.0	20.0	20.0	

5.0 Control Equipment Description

Provide adequate information to allow a 3rd party reviewer of the report a good understanding of the facility's control systems. The information should include the following:

- Systems applications
- Equipment inventory
- DDC system points
- Maintenance schedule
- Age

- Operating strategies

For example:

In the north wing, the Big Guy pneumatic system controls the perimeter fan coil units with local electronic pneumatic transducers. There is no central control with a network of remote monitoring of equipment and conditions. While this system is still effective at maintaining temperature set-points in the space, all modifications to the system are manual. The age of the Big Guy system is approximately 18 years…

In the south wing, the Big Guy pneumatic system has been upgraded over the years with DDC technologies. This wing has 4 Delicat version AA panels that provide DDC control to the chillers, pumps and air handling units AHU-1, AHU-2 and F-3. The boilers are operated with Manufacturer D boiler controllers that are shown in the figures below. They are not connected to the DDC system. Only 1 of the 10 fan coil units are connected to the DDC system. Remote access to these controls is provided via a modem link to the Delicat interface…

The control system for the workshop consists primarily of stand-alone programmable electronic thermostats for the HVAC systems and single temperature electric of self-contained thermostats for electric terminal heating units…

6.0 Energy Use Analysis

Provide adequate information to allow a 3rd party reviewer of the report a good understanding of the facility's energy use. A comparison with similar buildings is recommended. The information should include the following:

- Energy rate schedules for each fuel
- Annual energy consumption history for all fuels
- Annual peak demand
- Energy use analysis
- Energy consumption break-down by end use
- Electrical consumption break-down by end use

The major end use categories include the following:

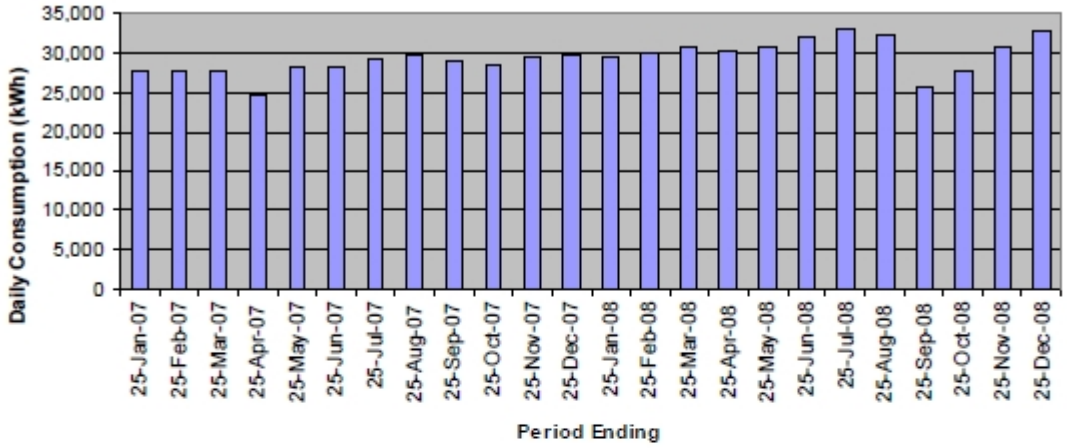
- Heating
- Cooling
- Ventilation/Auxiliary
- Lighting
- Domestic Water
- Refrigeration/Food preparation
- Plug loads
- Other loads

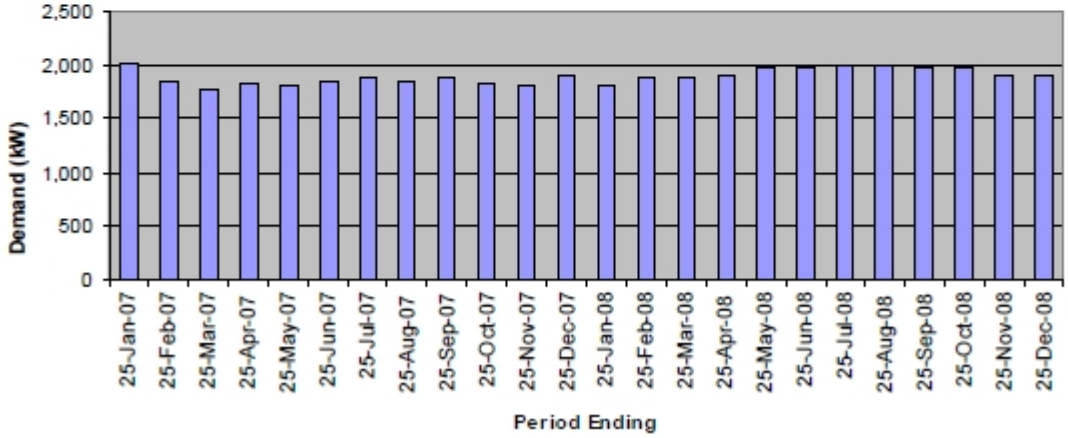
For example:

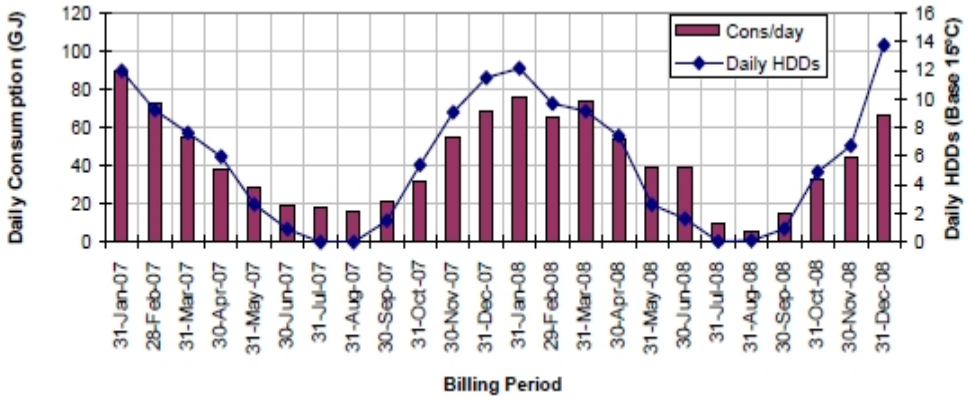
The Building Energy Performance Index (BEPI) for the building is 15 kWh/ft2 based on a building area of 43,000 ft2. This is much better than the average building in the regional district. Electrical use has decreased in 2007 and 2008 compared with 2005. This is likely due to the lighting retrofit projects completed

at the end of 2006. A large percentage of the annual consumption is during the summer months and is due to cooling, which may indicate an issue with the cooling system.

The natural gas use has increased in the last two years. The gas BEPI has increased six percent. The natural gas profiles for 2007 and 2008 are presented in the figures below referenced against Heating Degree Days…



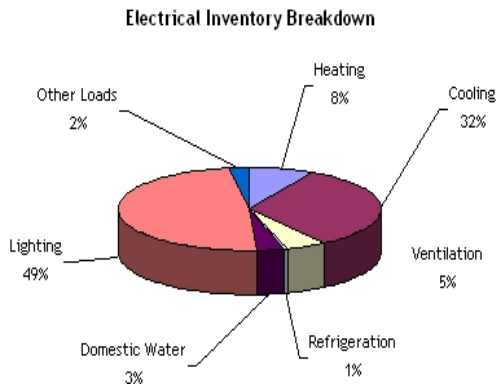




Billing Information	
Electricity	
Annual Consumption (kWh):	321,000
Amount Billed ($):	$17,655.00
Rate: ($/kWh):	0.0331
Fuel	
Type:	Natural Gas
Units:	GJ
Annual Consumption (GJ)	1,200
Amount Billed ($):	$9,840.00
*Total Floor Area in sqft:	21,400

Energy Intensity (BEPI)	
Electricity	
15	kWh/sqft
0.0229	$/sqft
Fuel: Natural Gas	
0.0560	GJ/sqft
0.4600	$/sqft

Electrical Inventory Breakdown			
	kW	kWh/yr	% of total kWh/yr
Heating	20	12,000	3.7%
Cooling	80	62,000	19.3%
Ventilation/Auxiliaries	12	45,000	14.0%
Refrigeration/Food preparation	2	2,000	0.6%
Domestic Water	8	20,000	6.2%
Lighting	120	160,000	49.8%
Other Loads	6	20,000	6.2%
Total		321,000	



7.0 Recommended Energy Conservation Measures

Provide information to allow a technical review of each energy conservation measure (ECM). The information should include the following for each recommended ECM:

- Description of each ECM and the work required to accomplish implementation
- Number of units affected
- Estimated service life
- Annual kWh and kW savings/system savings (include other fuel savings, such as natural gas)
- Material and commissioning requirements
- Estimate of capital cost to accomplish implementation (including design, material and commissioning costs)
- Annual dollar savings
- Other annual energy savings (natural gas, propane etc.) – unit and dollar savings (including GST)
- Other non-energy savings (maintenance, occupancy comfort etc.) – unit and dollar savings (including GST)
- Estimated payback

The consultant should provide a description of the energy analysis methodology, calculations and major assumptions to endorse electricity and fuel savings estimates.
Organize the measures according to the following categories:

- Retrofit
- Operational
- Maintenance

Please note that maintenance savings are not eligible for Power Smart implementation funding.

For example:

Retrofit
M.1 Replaced 3-way Piping with 2-way and VFD on Chilled Water Pump

Chilled water pump P-1 (15 hp) circulates chilled water to the cooling coils in the spot cooler serving the ice display in the main hall. The ice display is shut down for 3 weeks each summer for maintenance (504 hr/yr). When activated, the pump operates at full capacity continuously. Cooling capacity adjustments are made at the 3-way bypass valve located at the cooling coil header inlet. When reduced water flow is required, the valve redirects a portion of the flow to the return line.

As an energy conservation measure, the 3-way valve and bypass piping can be replaced with a 2-way valve. The flow modulation can be controlled by a new VFD on the chilled water pump P-1. The VFD will modulate flow using the existing infrared ice temperature sensor controlling the 3-way valve. Based upon a review of the 3-way valve operations, the modulation profile is estimated. Energy savings are possible via the pump operating at reduced flow. The estimated implementation cost is $500 for the piping and valve changes. There is no cost for the new VFD as it is surplus from last year's conservation project. The estimated annual electric savings are approximately 13,000 kWh/yr or $400 at current rates. There are no demand savings. The simple payback is 4.1 years. The expected service life of the VFD is 10 years…

Calculation Spreadsheet

ECM Name:	ECM Description:
VFD for chilled water pump	Replace 3-way valve and bypass piping with 2-way valve at main air handling unit cooling coil connection Install new VFD at chilled water pump ahu-1

Existing kWh:	55,618
kW Savings:	0
ECM Total cost:	$500.00
Payback:	4.1

Existing

Equipment Info		Name Plate Info	
Tag:	ahu-1	HP	15
Type:	Pump (Cooling)	Amps	15.0
Category	Cooling	Voltage	460
Area Served	main hall	Phase	3
Other Info			
Measured Amps	Not Available	kW	6.7
Power Factor %	75%		
Load Factor %	75%	Annual Hours:	8,273.3
Efficiency %	88.0%	Annual kWh:	55,618
	(Estimated Efficiency)		

Proposed

ASD Profile

% Flow	% Time	Hours	kW	kWh
100.00%	10%	827.3	6.7	5,562
90.00%	20%	1,654.7	6.1	10,011
80.00%	30%	2,482.0	5.4	13,348
70.00%	20%	1,654.7	4.7	7,786
60.00%	10%	827.3	4.0	3,337
50.00%	10%	827.3	3.4	2,781
40.00%		0.0	5.1	0
30.00%		0.0	3.8	0
20.00%		0.0	2.5	0
10.00%		0.0	1.3	0
0.00%		0.0	0.0	0
			Annual kWh:	42,826

Annual Savings

kWh Savings	12,792	kW Savings	0.0	$ Savings	$423

Operational

M.2 Reprogramming DDC System to Allow Night Setback and Free Cooling

The top 2 floors of the facility were the operations center for the Incident Investigation Units (IIU). The IIU used 3 daily shifts with the overnight shift operating at 75% of capacity. The morning and afternoon shifts operated at 100% capacity. With the recent amalgamation with the Regional operations, the overnight shift has been reduced to computer automated operations only. Only security is on duty during the overnight shift. This change in operations is an opportunity to save energy using night setback strategies.

The annual perimeter baseboard heating energy usage is estimated at 100,000 kWh. The current temperature set point at night is 22 degrees C throughout the year. The proposed set point for the 2 floors during unoccupied hours is 18 degrees C. In addition to reprogramming the DDC system to allow night setback, the outside air damper controls will also be revised to allow for pre-cooling of the space when outside air temperature is lower than the indoor temperature set point in the morning.

The analysis uses the weather data of Vancouver to determine the times in the day and year that perimeter heating would have been operating…

The calculated annual electric savings is 10,000 kWh or $330. There are no demand savings. There are no other fuel savings. The estimated cost to implement the revised control strategy is $950, achieving a simple payback of 3 years. The expected service life of the programming change is 5 years…

Calculation spreadsheet

ECM Name:	ECM Description:
Unoccupied Setback	Reprogramming DDC System to Allow Night Setback

Existing kWh:	100,000
kW Savings:	0
ECM Total cost:	$965.35
Payback:	2.93

*See 'Weather data' sheet for more information on weather stations

Weather Station (from summary page):	Vancouver	Outdoor Design Temperature:	-7	degrees Celcius	
Established existing space perimeter heating energy usage:	100,000	kWh			
		Building Occupancy Schedule (24 hour clock)			
Proposed Indoor OCCUPIED setpoint:	21	degrees Celcius	Weekdays		to
Proposed Indoor UNOCCUPIED setpoint:	18	degrees Celcius	Saturday	8	to 20
			Sunday	0	to 0
Capital Cost ($):	$965.35	$ Savings	$329.51	Payback:	2.93

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	365
HDD (below 18 degrees Celcius)	454.9	374	352.6	264.5	170.9	87.5	34.3	31.2	103.7	245.8	357.6	449.4	**2,926**
Perimeter Heating kWh	15,545	12,780	12,049	9,038	5,840	2,990	1,172	1,066	3,544	8,399	12,220	15,357	**100,000**
Hours below 18 degrees Celcius (Occ)	48	48	48	48	48	39	24	9	38	48	48	48	**494**
Hours below 18 degrees Celcius (UnOcc)	696	624	696	655	673	570	437	441	608	696	672	696	**7,464**
Existing kWh (Occ)	802	730	622	494	311	153	49	17	167	434	652	793	**5,223**
Existing kWh (UnOcc)	14,742	12,050	11,427	8,545	5,529	2,837	1,123	1,049	3,377	7,966	11,568	14,564	**94,777**
Avg OAT C (unocc period)	3.08	5.02	5.96	8.22	11.50	14.12	14.70	15.18	13.06	9.79	5.20	3.68	**9.13**
Savings (with 85% safety factor)	1,610	1,287	1,208	880	547	272	107	99	328	805	1,233	1,580	**9,955**
Savings (% of existing)	10.36%	10.07%	10.02%	9.73%	9.37%	9.09%	9.11%	9.30%	9.25%	9.58%	10.09%	10.29%	**9.95%**

Maintenance

M.3 Repairing Occupancy Override Mode

The multipurpose room has an occupancy override button that can be used to obtain after-hours air conditioning to the specific space only. There are instructions next to the thermostat to push the red button for after-hours operation. The red indicator on the button is missing and this has led to poor control of the system. In order to provide air conditioning after hours, the entire building is cooled rather than the space linked to the override button. We recommend replacing the red button and making sure the control system allows for cooling in the override zone only during after-hours operations…

8.0 Project Definition

Provide recommendations for the energy conservation measures. Include the following:

- Reason for selection of the preferred measures
- Total investment required
- Annual energy savings
- Project simple payback

Revisions

Date	Change	Acknowledgments
March 17, 2011	Updated Minimum Requirements list to include only mechanical items	
	Inserted Table of Content	
June 18, 2014	Added QMS# back into document, added “Purpose” to the Table of Contents. Under “Background”, changed co-funding to “…up to 50%...”. Under 2.0 Exec Summary, added “incremental and/or project”, “Peak load demand…”, “Assumptions” to the list.	Updated by Greg Morandini, based upon feedback from Stan Ma and Tommy Yim.

Appendix: Minimum Requirements for an Energy Study

The following minimum requirements for an Energy Study are a set of basic elements which must be included in the Energy Study but these requirements are not intended as a step by step protocol for the Consultant to follow.

1. **Applicant Information:**
    - Customer company name and address
    - Site contact person (Facility Owner/Manager)
    - Contact name, telephone and email.
    - Facility type (reference ASHRAE building types)
    - Date of energy study report completion
    - For Adaptive Street Lighting Program only: Roadway lighting types analyzed (residential, collector, major, freeway, etc)
2. **Executive Summary**
    - List of energy saving options
    - Measure description
    - Provide anticipated energy savings in kWh
    - Indicate anticipated demand reduction in kW
    - Other fuel savings
    - $ Saved and estimated costs to implement option
    - Simple paybacks

The executive summary is important as it will be used to provide the Applicant and BC Hydro with an outline of the Energy Study's recommendations.

3. **Facility(ies) Description**
    - Building Type
    - Construction and envelope description (wall construction, types of doors, types of windows, and window shadings, type of glazing and % glazing)
    - Age and renovation years
    - Floor area and number of floors
    - Internal space use and layout (sketches optional)
    - Physical condition
    - Occupancy pattern
4. **Mechanical System Description**

- Types of systems and areas served
- Inventory of equipment
- Operating schedules
- Sequences of operation
- Maintenance schedules
- Equipment conditions
- Equipment efficiencies
- Energy use baseline (in Excel spreadsheet format)

5. **Control Equipment Description**
   - System applications
   - Equipment inventory
   - DDC system points
   - Maintenance schedule
   - Age
   - Operating strategies

6. **Other Electrical Load Description**
   - Description and inventory
   - Estimate of plug loads

7. **Energy Use Analysis**
   - Energy rate schedules for each fuel
   - Annual energy consumption history for all fuels
   - Annual peak demand
   - Energy Use Analysis
   - Energy consumption break-down by end use
   - Electrical consumption break-down by end-use

8. **Recommended Energy Conservation Measures ("ECM")**
   - Description of each ECM and the work required to accomplish implementation
   - Number of units affected
   - Estimated service life
   - Annual kWh and kW savings per measure (include other fuel savings, such as natural gas)
   - Material and commissioning requirements
   - Estimate of capital cost to accomplish implementation including design, material and commissioning
   - Annual dollar savings
   - Estimate payback
   - Provide a description of the energy analysis methodology, calculations and major assumptions to endorse electricity and fuel savings estimates

- Provide calculations for the energy analysis, identify other energy (natural gas, propane etc.) savings and non-energy savings (maintenance, occupancy comfort etc.) unit and dollar savings
- Organize the mechanical measures according to the following categories:
  - Retrofit
  - Operational
  - Maintenance

9. **Project Definition**
   - Reason for selection of the preferred measures
   - Total investment required
   - Annual energy savings
   - Project simple payback

Any energy saving measures being recommended for implementation must adhere to current ASHRAE design guidelines and calculation procedure.

For Energy Performance Contract Projects the following additional requirements must also be included in the Energy Study.

1. **Energy Savings**
   - Provide anticipated Energy Savings (kWh) with a minimum target of 10% in electrical energy reduction
2. **Measurement and Verification**
   - Consultant submits an M&V plan with the Energy Study / concept report that complies with the BC Hydro EPC Measurement and Verification Guidelines as outlined below
     - Consultant provides a baseline and energy model for BC Hydro review before the contract is executed
     - Consultant / Customer / BC Hydro agree to the M&V plan and baseline
     - Consultant submits M&V reports including baseline adjustments ("BLA") at the same frequency to BC Hydro as to the customer