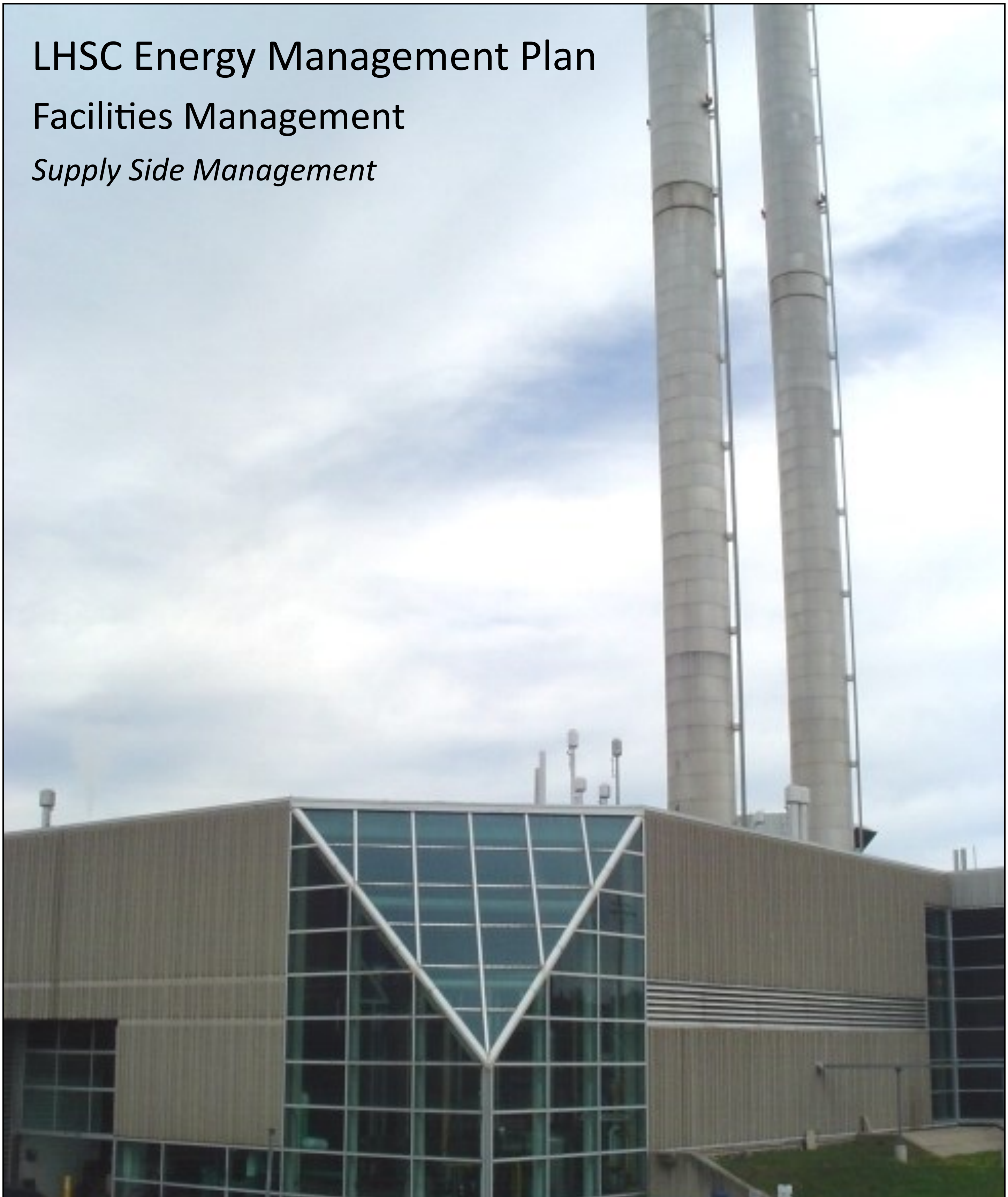
LHSC Energy Management Plan

Facilities Management

Supply Side Management



Energy Management Plan

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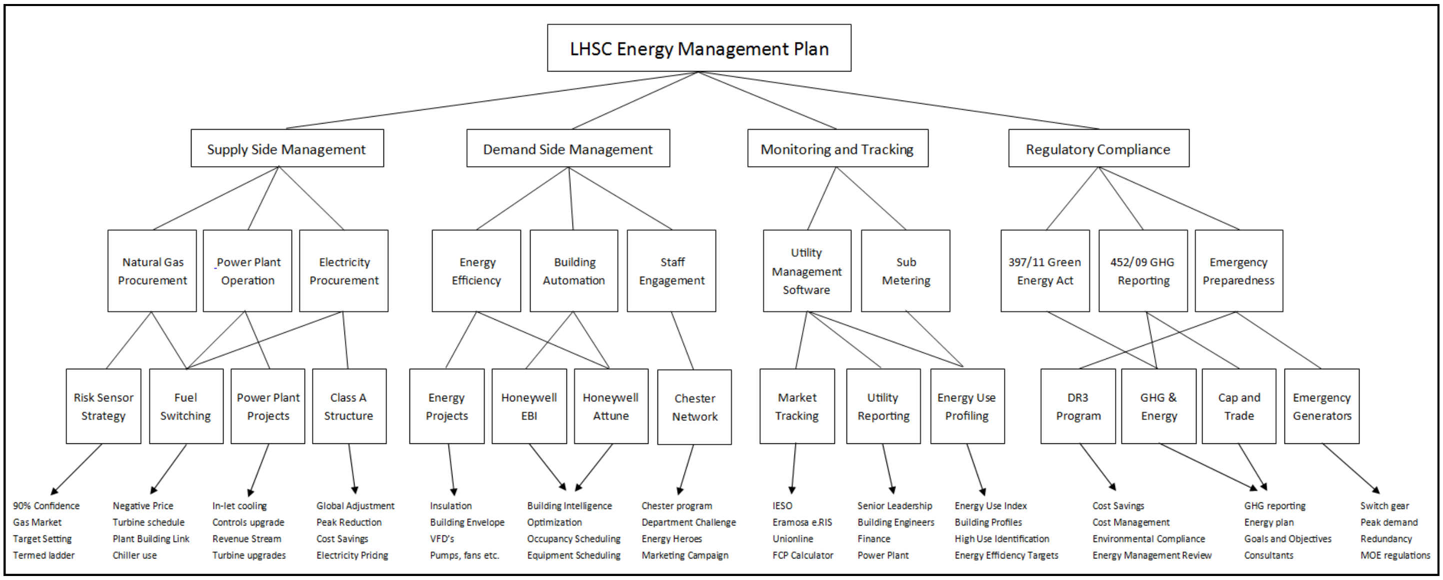


London Health Sciences Centre has a long history of energy management, dating back to the 1970's. In that time, there have been many advancements made toward building intelligence and how it impacts energy management. Equipment and technology have advanced in such a way that buildings can be programmed to optimize their performance for heating, cooling, and lighting. Automation is replacing manual tasks more and more. Much has also changed within the energy markets and the prices of natural gas, steam, and electricity have risen and fallen over time. New regulations have been introduced with energy conservation and greenhouse gas emission reduction in mind and there is now more than ever a cost associated with a lack of energy efficiency within an organization.

As a hospital, there is a financial responsibility toward public tax dollars and an environmental responsibility to minimize the negative impacts contributing to some of the very illnesses we treat. Proper energy management can save significant amounts of money, while at the same time, help to reduce air pollution, acid rain, carbon emissions etc. Being energy efficient falls under the "first do no harm" motto of the health care sector and LHSC has made great effort to do its part.

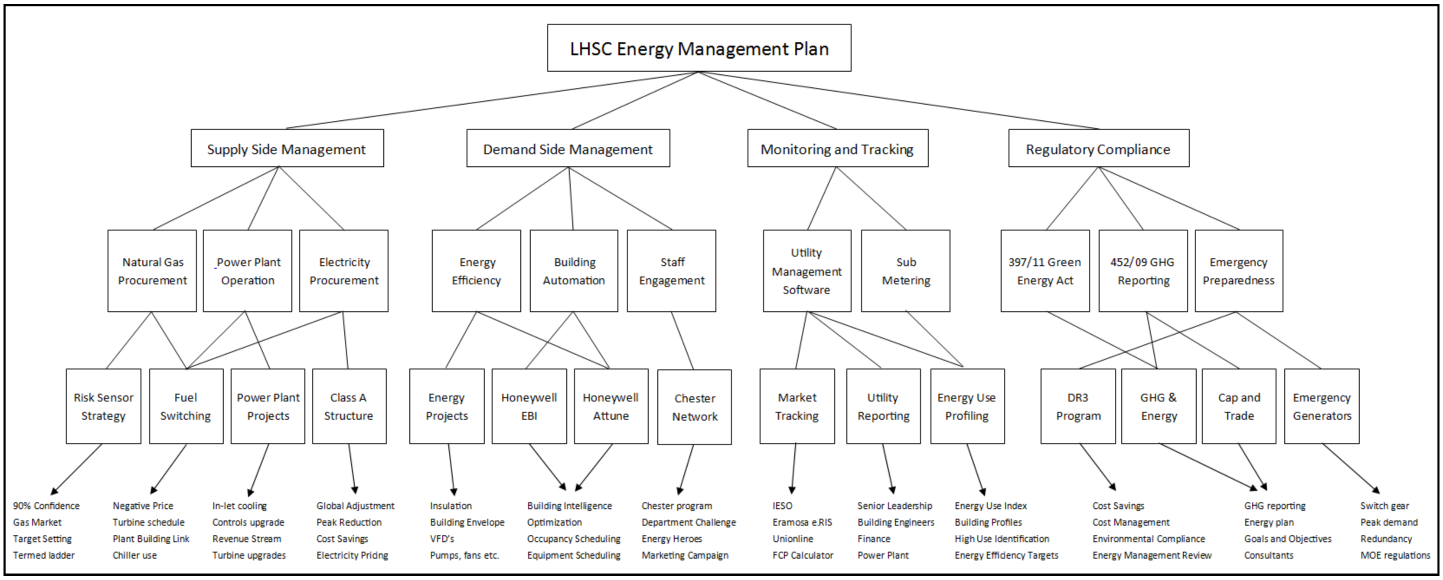
The energy management plan at LHSC has been broken down into four major categories; supply side management, demand side management, monitoring and tracking, and regulatory obligations. This forces the hospital to look at its energy streams from the point of purchase to the point of exit and how its being used in between. LHSC has the ability to generate its own electricity at the Victoria Hospital power plant as well as supply steam and electricity to others, like Parkwood Institute.

Deciding how to invest in energy management is one the biggest and most important challenges one faces considering the many different possibilities and opinions that present themselves. Much of the easier work with short payback periods has already been exhausted at LHSC and so Facilities Management is always looking for the next opportunity and weighing the options carefully. Each project is considered for how it impacts the whole and fits together with existing strategies, equipment, and systems.

The following contains a more detailed review of the energy management plan by category until such time that the entire plan is constructed in web format on the Facilities Management website. In particular, this section focuses on supply side management.

Energy Management Plan

Supply Side Management



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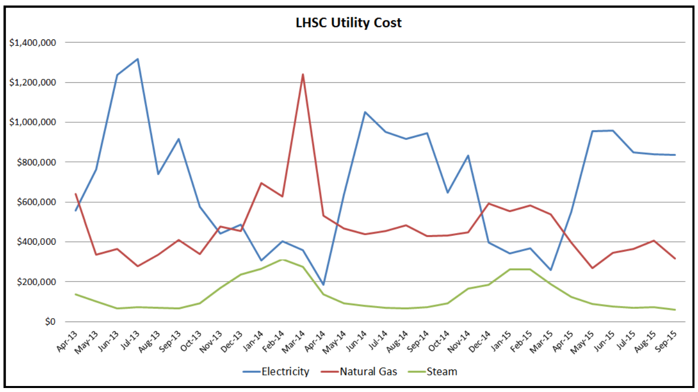
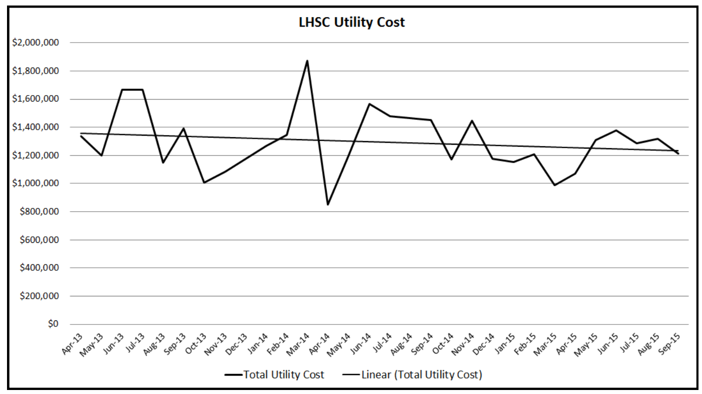
What is supply side management?

Supply side management relates to the process of procuring, generating, and distributing energy in the most efficient manner possible. This includes the construction of appropriate energy procurement contracts with suppliers and distributers, implementing gas and electricity purchasing strategies, and making operational improvements at the power plant.

Supply Side Management Via Procurement

LHSC purchases large amounts of natural gas, steam, and electricity. The graphs below show the monthly cost of each energy stream and the total monthly utility cost over the last three years. Considering a spending of $15,000,000 per year, ensuring that proper contracts and procurement strategies are in place can mean hundreds of thousands of dollars in savings. As we can see, the utility cost has been trending downward over the last three years and this is a result of adapting our procurement strategies to the changing market on both the natural gas and electricity side.

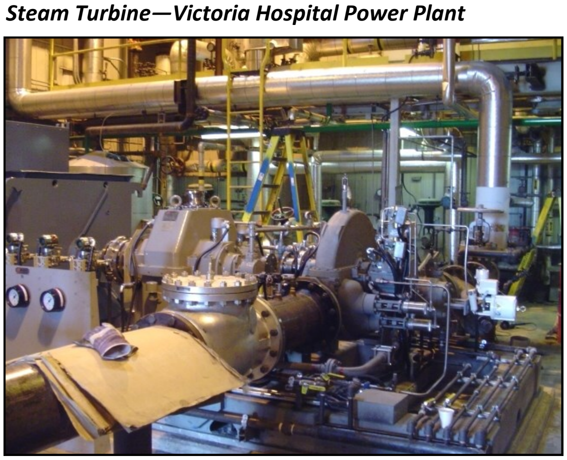




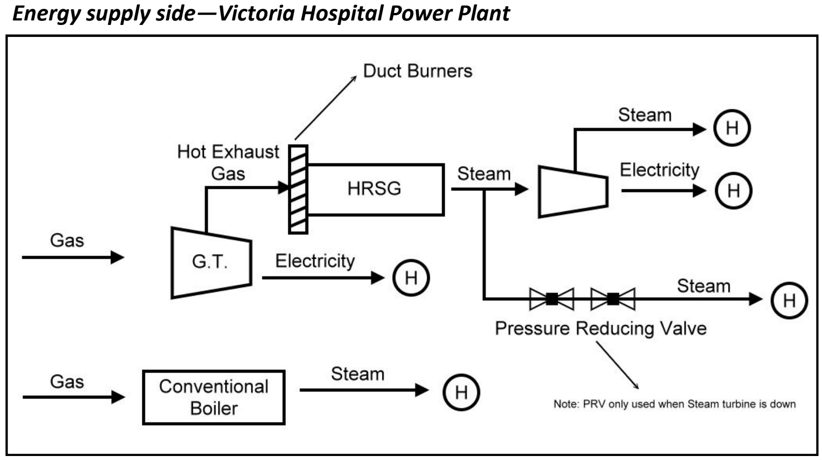
Supply Side Management Via Power Plant Operation

LHSC has a co-generation based power plant at Victoria Hospital. This means we use natural gas to make both electricity and steam. Currently, the power plant has a five megawatt gas turbine, a four megawatt gas turbine, and a two megawatt steam driven turbine. Making operational efficiencies to the way that energy transitions within the power plant can also lead to large savings. For example, the introduction of our two megawatt steam turbine created substantial savings in electricity. The power plant generates high pressure steam at 650 psi. This steam used to enter into a pressure reducing station to bring the steam pressure down to 30 psi for distribution throughout the hospital. The pressure reducing valve absorbed a lot of 'energy' in the process. A steam driven turbine was put in place of the pressure reducing valve and so now as the steam pressure is reduced, the turbine spins and produces electricity. This brings Victoria Hospital another 1.5 MW of power and a great deal of savings.

Steam Turbine—Victoria Hospital Power Plant

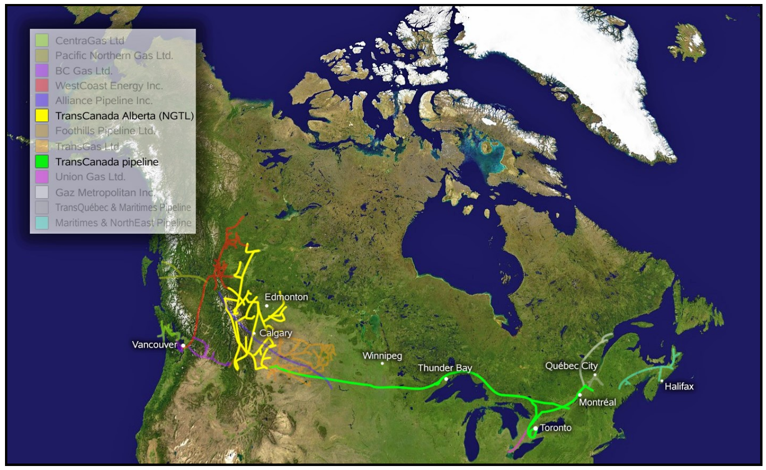


Energy supply side—Victoria Hospital Power Plant

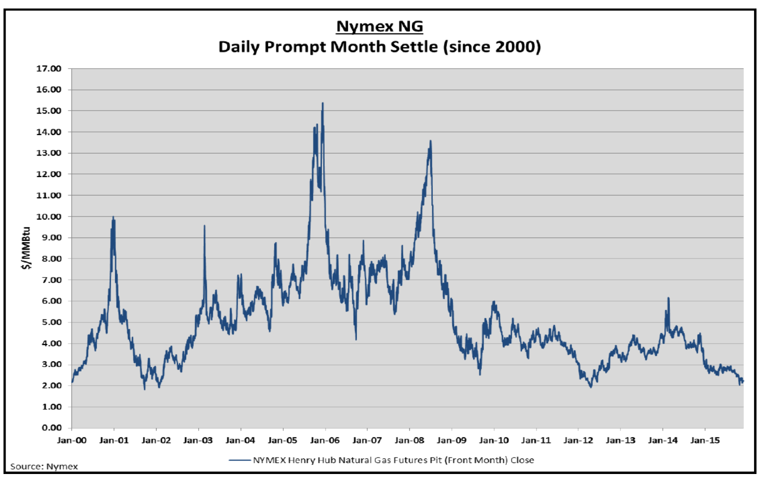


Natural gas procurement

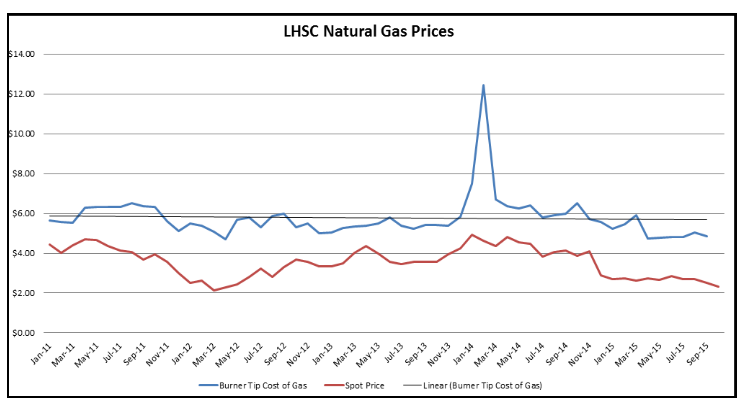
LHSC purchases over twenty five million cubic meters of natural gas each year, enough to heat approximately 10,000 Canadian homes. The cost of this is approximately five million dollars per year. Natural gas is used primarily at the Victoria Hospital power plant to produce both steam and electricity. More gas is used in the winter because more steam is required for heating. LHSC buys it's large gas volumes from gas suppliers Direct Energy and BP Energy. The gas is purchased in Alberta and transported across the Trans Canada pipeline to a Union Gas storage hub. The gas is then distributed to the hospital via Union Gas. LHSC must pay for the gas volume consumed in the transportation of this Alberta gas so the hospital first maximizes the amount of gas it can purchase locally. LHSC also has a gas storage allocation to help manage the difference between the purchased gas volume and the actual gas volume consumed. Contract parameters with Union Gas are set each November for the upcoming gas year and so gas forecasting is completed to ensure the most cost effective parameters can be set.



Natural gas market and prices



LHSC watches the natural gas market very closely, checking prices on a daily basis. Gas is purchased by unit volume gigajoule (GJ) and so gas rates are shown as dollars per gigajoule ($/GJ). Prices have gone from seven to eight dollars per gigajoule down to three to four dollars per gigajoule over the last decade or so. The gas year runs from November to October with a five month winter term and a seven month summer term. Bulk gas can be purchased for one of these terms or for a calendar year depending on how much and how far out one wishes to hedge. Gas prices are greatly affected by how much gas is in storage. When storage is low, gas prices increase and vice versa. In the winter of 2014, we had a long period of very cold temperatures, which depleted much of the storage. As a result the gas prices in Alberta spiked. Unfortunately there was also a much larger spike in the basis (the transportation price from Alberta to Ontario) and Ontario's prices went from five dollars per gigajoule up as high as seventy five dollars per gigajoule. Fortunately, LHSC was partly protected and also had some gas available to sell. LHSC sold gas for seventeen and twenty three dollars per gigajoule so that the net cost was twelve dollars per gigajoule. Risk sensor reports did not anticipate this cost because it was a transportation cost rather than a commodity cost. To prevent this from happening again, LHSC now locks in the basis portion of the gas purchase for the winter period. Despite the very expensive March 2014, the year still came out quite well because LHSC was buying the low priced spot gas that surrounded the year.

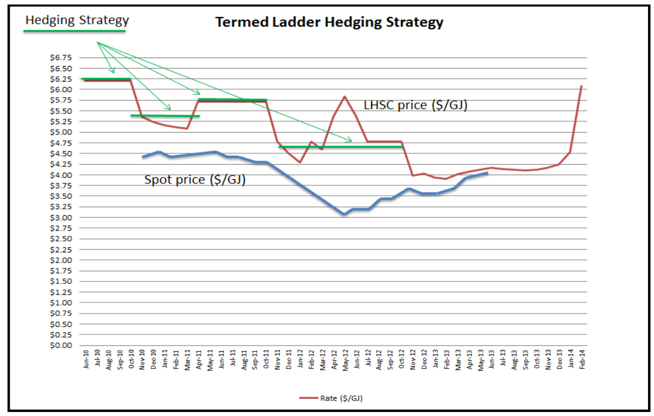


Choosing a Procurement Strategy

The natural gas market can be very volatile and has fluctuated a great deal over the last 15 years or so. Gas price spikes can happen very quickly can be triggered by a number of different factors. The effects of hurricane Katrina in 2005 can be seen in in any price history report, like the one above. Events like this are what make the gas market so unpredictable and so the hospital needs a proper risk management strategy in place to minimize the impact of such a volatile market.

The termed ladder approach

Prior to 2012, LHSC used what was called a termed ladder approach to purchasing natural gas. This was a hedging (buying bulk in advance) strategy that required a gas purchase every three to four months whereby a portion of the gas was bought for the subsequent three gas terms. We can see this hedging pattern in the attached graph marked by the green lines. Buying gas this way would smooth out the ups and downs of the gas prices so that the gas account and the hospital gas budgeting process would be easier to manage. The long term changes in gas prices cannot be avoided however the risk of absorbing short term price spikes was minimized. The down side of buying gas this way is that a premium is paid for reaching out and locking in. We can see the gap between the gas purchase price (green) and the spot price (blue) as a result of buying gas well in advance of the actual consumption date. After 2012, the procurement strategy was changed and the price of purchase for LHSC became much closer to the market spot price and essentially less money was being left on the table.



Risk Sensor—target setting at 90 % confidence

In 2012, LHSC changed the gas purchasing strategy from a termed ladder approach to a "Risk Sensor" approach. The risk sensor approach is a process of assessing the market projections for gas prices and using this information to guide when and how much gas to hedge instead of just buying set volumes of gas on a termed schedule. A target price is set at the beginning of each fiscal year and the risk sensor reports determine if that target can be reached with 90% confidence each week. If the risk sensor reports that LHSC can reach it's target with 90% confidence then no hedge is made and LHSC will buy gas on the spot. If the report suggests that LHSC cannot make its target without a hedge, then the minimum hedge required to maintain the target at 90% confidence is made. Essentially, it is a way of managing risk and still taking advantage of cheaper spot price gas VS hedged price gas. The result is that LHSC is now buying gas much cheaper in the long run and still can remain fairly confident when creating gas budgets.

22-Jan	*Apr15*	*Apr16*
MtM	$ 3.70	$ 3.55
RiskSensor	$ 3.76	$ 3.84
Budget Target	*$ 3.92*	*$ 3.92*
Contingency	*$ 0.06*	*$ 0.29*
Budget Surplus	*$ 0.16*	*$ 0.08*

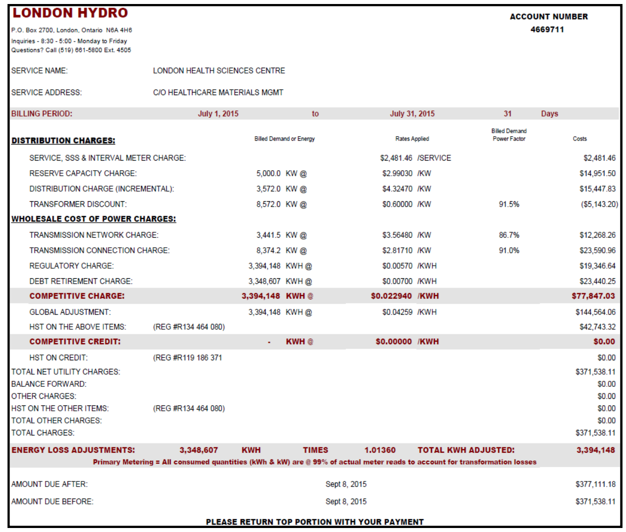
Gas budget

To the right you can see a typical budget sheet with forecasted gas volumes and gas pricing. The actual volumes and pricing are then tracked below so the hospital can see how accurately it is approaching its gas price target for the fiscal year. The budget price for April 2016 to March 2017 has been set at $3.92/GJ, which means that at the current market projection of $3.84/GJ, (above in orange) no hedge is required. We can now buy gas for $3.55/GJ and continue to buy cheap spot price gas while being 90% confident that we will end the year no higher than $3.92/GJ. This approach to buying gas is much more cost effective.

	Forecasted											
	Apr-15	**May-15**	**Jun-15**	**Jul-15**	**Aug-15**	**Sep-15**	**Oct-15**	**Nov-15**	**Dec-15**	**Jan-16**	**Feb-16**	**Mar-16**
DCQ	*2619*	2319	2319	2319	2319	2319	2519	3100	3100	3100	3100	3100
Total GJ	*78,570*	71,889	69,570	71,889	71,889	69,570	78,089	93,000	96,100	96,100	86,800	96,100
Market Rate	*$ 4.32*	*$ 4.32*	*$ 4.32*	*$ 4.32*	*$ 4.32*	*$ 4.32*	*$ 4.32*	*$ 4.32*	*$ 4.32*	*$ 4.32*	*$ 4.32*	*$ 4.32*
Cost	$339,422	$310,560	$300,542	$310,560	$310,560	$300,542	$337,344	$401,760	$415,152	$415,152	$374,976	$415,152
Tax	$44,125	$40,373	$39,071	$40,373	$40,373	$39,071	$43,855	$52,229	$53,970	$53,970	$48,747	$53,970
Union Gas	$48,585	$48,585	$48,585	$48,585	$48,585	$48,585	$48,585	$48,585	$48,585	$48,585	$48,585	$48,585
Total	**$432,132**	**$399,518**	**$388,198**	**$399,518**	**$399,518**	**$388,198**	**$429,784**	**$502,574**	**$517,707**	**$517,707**	**$472,308**	**$517,707**
	Actual											
Actual DCQ	2800	1800	2400	2442	2800	2092	2800	2969	2751	2600		
Total GJ	84000	55800	72000	75700	86800	62760	86800	89070	85294	80600		
Direct	$84,451	$168,775	$0	$241,755	$240,614	$241,076	$336,943	$362,788	$374,206	$362,522		
BP	$263,701	$51,469	$299,848	$48,882	$119,386	$30,849	$31,877	$30,849	$10,122	-$19,404		
Union	$42,933	$43,128	$42,913	$71,830	$43,106	$42,741	$50,001	$49,664	$43,302	$45,000		
AVG Rate	*$3.67*	*$3.49*	*$3.69*	*$3.39*	*$3.67*	*$3.83*	*$3.76*	*$3.86*	*$4.02*	*$3.66*		
Actual Total	**$391,085**	**$263,372**	**$342,761**	**$362,470**	**$403,107**	**$314,670**	**$418,824**	**$443,305**	**$427,630**	**$388,122**	**$0**	**$0**
Variance	**-$41,047**	**-$136,147**	**-$45,437**	**-$37,049**	**$3,589**	**-$73,528**	**-$10,960**	**-$59,268**	**-$90,077**	**-$129,585**		
% Variance	-9%	-34%	-12%	-9%	1%	-19%	-3%	-12%	-17%	-25%		
Avg $/GJ to date		$3.71							**Budget Projection** →			

Electricity procurement

LHSC uses approximately 75,000,000 kWh of electricity each year, enough to power 8,000 average size homes in London. The cost of this electricity is approximately eight million dollars per year. LHSC buys electricity from London Hydro, generates electricity at the Victoria Hospital power plant, and sells electricity to Parkwood Institute and back to the grid. A typical electricity bill consists of consumption charges for the amount of electricity we use, demand charges for the peak hours of electricity use, Global Adjustment charges to bridge the difference between market price and the true cost of generation, debt retirement charges, transportation charges, and regulatory charges. Understanding how we are charged for electricity is the first and most important step to being able to manage our cost. By targeting each of these charges with reduction strategies LHSC has mitigated electricity costs as electricity prices increase and the hospital continues to expand.


LONDON HYDRO
P.O. Box 2700, London, Ontario N6A 4H6
Inquiries - 8:30 - 5:00 - Monday to Friday
Questions? Call (519) 661-5800 Ext. 4505

ACCOUNT NUMBER
4669711

SERVICE NAME: LONDON HEALTH SCIENCES CENTRE

SERVICE ADDRESS: C/O HEALTHCARE MATERIALS MGMT

BILLING PERIOD: July 1, 2015 to July 31, 2015 31 Days

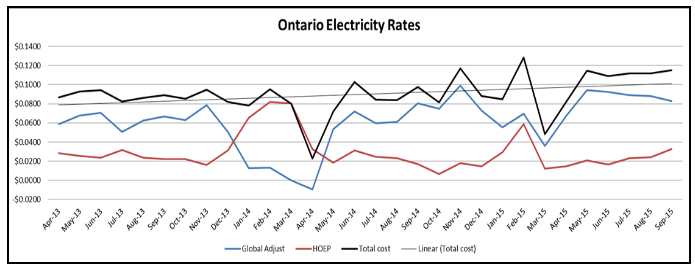
	Billed Demand or Energy	Rates Applied	Billed Demand Power Factor	Costs
DISTRIBUTION CHARGES:				
SERVICE, SSS & INTERVAL METER CHARGE:		$2,481.46 /SERVICE		$2,481.46
RESERVE CAPACITY CHARGE:	5,000.0 KW @	$2.99030 /KW		$14,951.50
DISTRIBUTION CHARGE (INCREMENTAL):	3,572.0 KW @	$4.32470 /KW		$15,447.83
TRANSFORMER DISCOUNT:	8,572.0 KW @	$0.60000 /KW	91.5%	($5,143.20)
WHOLESALE COST OF POWER CHARGES:				
TRANSMISSION NETWORK CHARGE:	3,441.5 KW @	$3.56480 /KW	86.7%	$12,268.26
TRANSMISSION CONNECTION CHARGE:	8,374.2 KW @	$2.81710 /KW	91.0%	$23,590.96
REGULATORY CHARGE:	3,394,148 KWH @	$0.00570 /KWH		$19,346.64
DEBT RETIREMENT CHARGE:	3,348,607 KWH @	$0.00700 /KWH		$23,440.25
COMPETITIVE CHARGE:	**3,394,148 KWH @**	**$0.022940 /KWH**		**$77,847.03**
GLOBAL ADJUSTMENT:	3,394,148 KWH @	$0.04259 /KWH		$144,564.06
HST ON THE ABOVE ITEMS: (REG #R134 464 080)				$42,743.32
COMPETITIVE CREDIT:	**- KWH @**	**$0.00000 /KWH**		**$0.00**
HST ON CREDIT: (REG #R119 186 371				$0.00
TOTAL NET UTILITY CHARGES:				$371,538.11
BALANCE FORWARD:				$0.00
OTHER CHARGES:				$0.00
HST ON THE OTHER ITEMS: (REG #R134 464 080)				$0.00
TOTAL OTHER CHARGES:				$0.00
TOTAL CHARGES:				$371,538.11

ENERGY LOSS ADJUSTMENTS: 3,348,607 KWH TIMES 1.01360 TOTAL KWH ADJUSTED: 3,394,148
Primary Metering = All consumed quantities (kWh & kW) are @ 99% of actual meter reads to account for transformation losses

AMOUNT DUE AFTER: Sept 8, 2015 $377,111.18
AMOUNT DUE BEFORE: Sept 8, 2015 $371,538.11

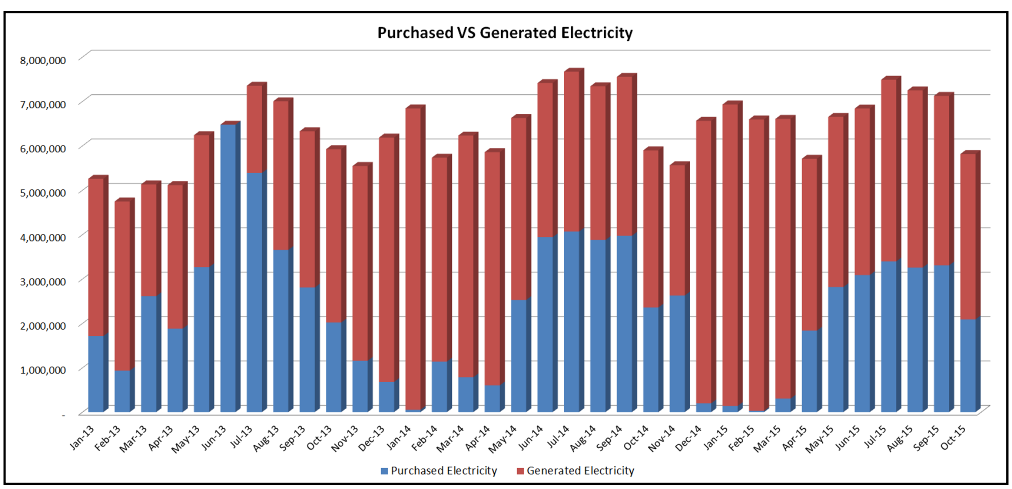
PLEASE RETURN TOP PORTION WITH YOUR PAYMENT

Electricity market and prices



Over the last several years, electricity prices have continued to increase. The price is broken into two parts, the Hourly Ontario Electricity Price (HOEP) and Global Adjustment. The HOEP is the market price of electricity set by electricity generators making bids to enter the market and sell electricity to the province. The market is regulated by the Independent System Electricity Operator (IESO). For the past several years there has been a large difference between the market price of electricity and the true cost to generate this electricity and maintain the electricity infrastructure. This gap in cost is recovered by the Global Adjustment, which now makes up the majority of the electricity rate. Victoria Hospital pays almost two million dollars per year in Global Adjustment alone.

Electricity generation



Part of the battle against rising electricity prices has been won with power generation. The power plant can generate all of Victoria Hospital's required electricity in the winter months and about half its electricity in the summer months. In the winter, Victoria hospital can even generate more electricity than it requires and so the extra is sold back to London Hydro, ideally at a profit. The power plant has eleven megawatts of generation capacity and can almost reach name plate capacity during extremely cold days. In the summer the hospital's electricity demand is much higher, at approximately fourteen megawatts during peak hour. Because the cogeneration system produces both electricity and steam, steam demand is required to run the turbines full out. In the summer, that steam demand has not been enough so only one of the two gas turbines has run in the past. What is lost in generation must be purchased. LHSC is trying to improve this situation by creating more steam demand in the summer through the use of steam absorption chillers that cool the hospital using steam.

Class A structure

LHSC has always been a **Class B** customer with London Hydro. That means Global Adjustment charges are part of the electricity rate LHSC pays for each kilowatt hour of electricity used. Because its average monthly demand is over five megawatts, Victoria Hospital qualifies to be a **Class A** customer and manage its Global Adjustment charges differently. Managing Global Adjustment by way of peak demand removes Global Adjustment from the electricity rate altogether and allows LHSC to mitigate the annual cost. The power generation of the power plant helps to curb the Hospital's electricity demand during the five provincial peak hours from which the customers peak portion is calculated. Essentially, if Victoria Hospital could bring their peak demand to zero during these peak days, the Global Adjustment cost could drop to zero and offer Victoria Hospital a much better electricity rate year round.

LHSC Electricity Bill – June 2015

Electricity Rate	$0.016730/kWh		
Global Adjustment	**$0.092280/kWh**	⟶	**Remove and manage differently**
Total LHSC Rate	$0.109010/kWh		

Becoming a Class A customer

Class A customers pay Global Adjustment based on their portion of Ontario's top five peak demand days. This portion is called the customer's **Peak Demand Factor**. The customer will look to reduce their peak on these five days enough to make Class A more economical than Class B. The more a Class A customer can lower their peak during these days, the lower their Peak Demand Factor and the less Global Adjustment they will pay throughout the year. These peaks usually occur in the summer during the hottest days between 4 pm and 8 pm. It became LHSC's goal to target these five days with electricity peak reduction exercises in an attempt to switch from a Class B customer to a Class A customer.

Victoria hospital becomes Class A

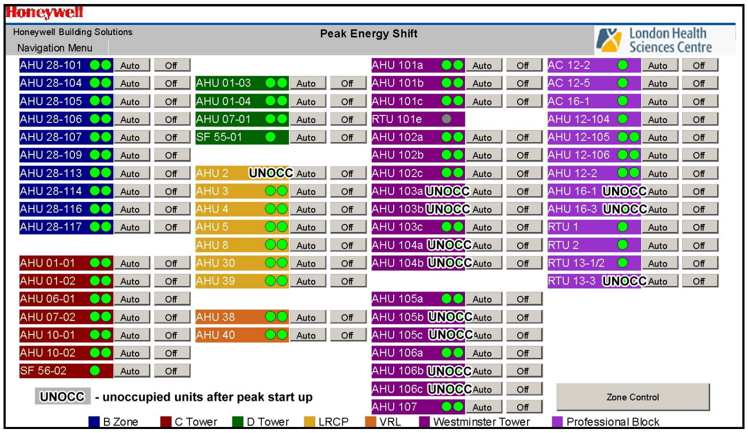
During the summer of the base period May 1, 2014 to April 30, 2015 LHSC had not yet considered becoming a Class A customer. The Victoria Hospital peak day demand averaged around 8,500 kW without effort being made to reduce it. Fortunately, for the first time in over a decade, Ontario later had three peak days in the winter of this base period, a time when Victoria Hospital's demand is zero. With three zeros in place, Victoria's average demand dropped to 3,500 kW and the hospital became a Class A customer for the first time with an estimated savings of $400,000 in Global Adjustment over a Class B status. Due to the low chance of seeing winter peaks again, Victoria Hospital had to devise a plan to maintain its Class A status for 2016 by addressing its peaks through the summer of the May 1, 2015 to April 30, 2016 base period.

Victoria hospital works to remain a Class A customer

Generation – Victoria hospital power plant normally generates 4,500-5,000 kW of electricity in the summer. Only the KB7 gas turbine and steam turbine run because there is not enough steam demand to run the KB5 gas turbine in addition. The first step to increasing generation was to ensure that all absorption chillers were running during peak days to create as much steam demand as possible. The second step was to install a pressure controlled steam venting valve at the power plant. The KB5 turbine would then run during peak days and excess steam would be vented into the atmosphere so that more electricity could be generated.

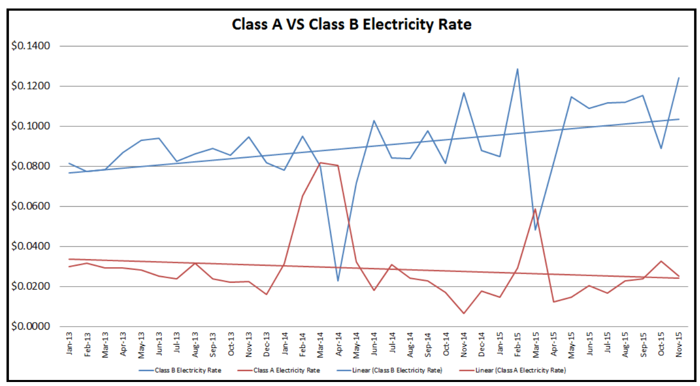
Building Shutdown – The second part of the plan was to shut down as much of the major electricity consuming equipment as possible during the projected peak days. The target was electric chillers, pumps, and air handling units. A map was created for all of the Victoria hospital space and corresponding cooling equipment. Areas that were unoccupied or non-patient care between 4 pm – 8 pm were identified and their cooling equipment was added to a shutdown list. A control screen was created on the building automation system and a shutdown procedure was developed and trialed prior to the peak days.

Maintaining Class A Status

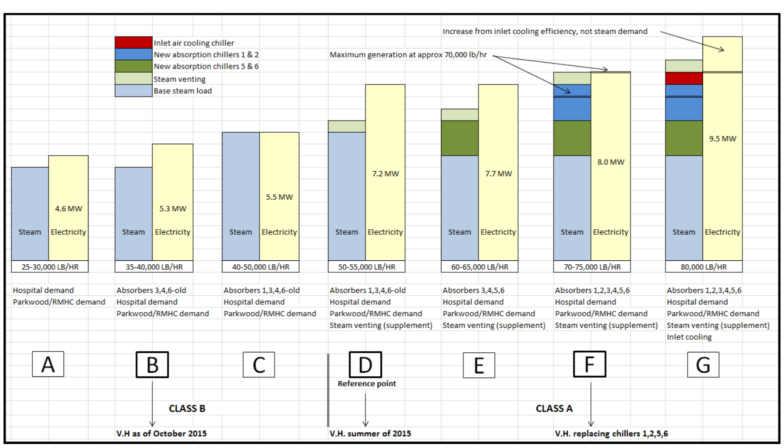


LHSC initiated twelve shutdown exercises in an attempt to capture the top five peak days. Shutdowns occurred in July, August, and September during hot, humid weather. The Ontario demand forecast was monitored giving LHSC an idea of when to run the peak reduction exercises. The five minute demand profile was followed through the peak hours so that startup could begin promptly after the peak had occurred. In most cases, the shutdown was initiated at 4:00 pm and startup was initiated by 7:00 pm. Since the exercise was very time sensitive, the procedure was automated where possible. A peak shutdown screen was created for the Honeywell EBI system whereby the air handling units for selected areas could be shut down in groups by the click of a button. This allowed for a controls person to manage the air handling units while the building engineer began a shutdown sequence for the chillers. By shutting down unnecessary air handling units the cooling demand lessened for the remaining areas of the hospital and only one of the usual five electric chillers was required. Temperatures did elevate in the building over the course of the shutdown period and adjustments were made to the process over time to minimize the impact on more sensitive areas. The shutdown reduced the peak demand by between two to three megawatts and the steam venting valve that allowed the use of the second gas turbine reduced it another three megawatts. Overall, Victoria hospital was able to target enough of the peak days with reduced peak demand to make Class A status favourable.

Operating as a Class A Customer



As stated above, as a Class A customer, the Global Adjustment portion of the electricity rate is removed and managed by peak demand. This leaves only the HOEP in the electricity rate and so the consumption cost of Victoria hospital's electricity is significantly reduced. IE; Victoria Hospital will pay the red line in the graph shown versus the blue line. At times we can now purchase electricity cheaper than we can make it and at other times the electricity price falls into the negative. This means that we will now follow the market price of natural gas and electricity and continuously decide the most cost effective way to run the power plant and hospital HVAC system. It will include knowing when to export electricity and when to back off from electricity generation. It will include switching from steam cooling to electric cooling as electricity prices fall into the negative. A good portion of this work will be facilitated through an Energy Management Utility software system called e.RIS from Eramosa. This system will combine the Utility Company and IESO external data with our hospital utility and systems data and input it through programed calculations and algorithms to provide the information that will guide these decisions.



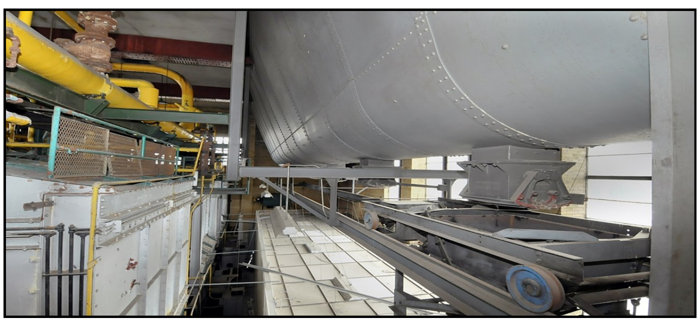
Moving toward cost savings

LHSC has devised a strategy for reducing peak demand by increasing steam load in the summer through the selection of steam absorption chillers. In addition, a project toward cooling the inlet combustion air of the turbines will increase the electricity generation output. LHSC's goal is to eliminate Global Adjustment costs altogether.

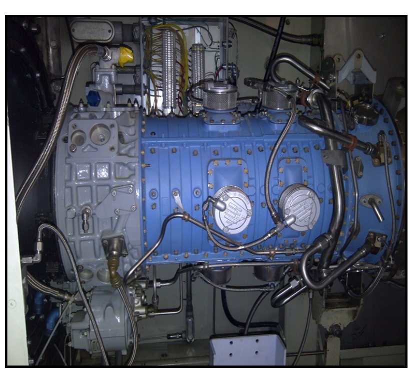
From coal to cogeneration

Westminster hospital in 1918 began as a military hospital that treated veterans suffering from mental illness following World War I. The first powerhouse was constructed to provide support to this hospital. Powerhouse boilers burned coal at the time, which was transported into the hoppers via a railway system. In 1949, a high influx of World War II veterans created the need to expand the old powerhouse to match the increasing steam demand. Today, this second powerhouse, originally designed for coal is still being used for maintenance shops. The old coal track and hopper system can still be seen today inside the building.

In 1967, the coal based powerhouse was converted to "Bunker C" oil and in 1979 it was converted into natural gas. In 1977 Victoria hospital acquired Westminster hospital and lands from the Federal Government. Its staff and patients were transferred to the Victoria hospital corporation. Together they fell under the administration of London Health Sciences Centre along with 80 acres of land.

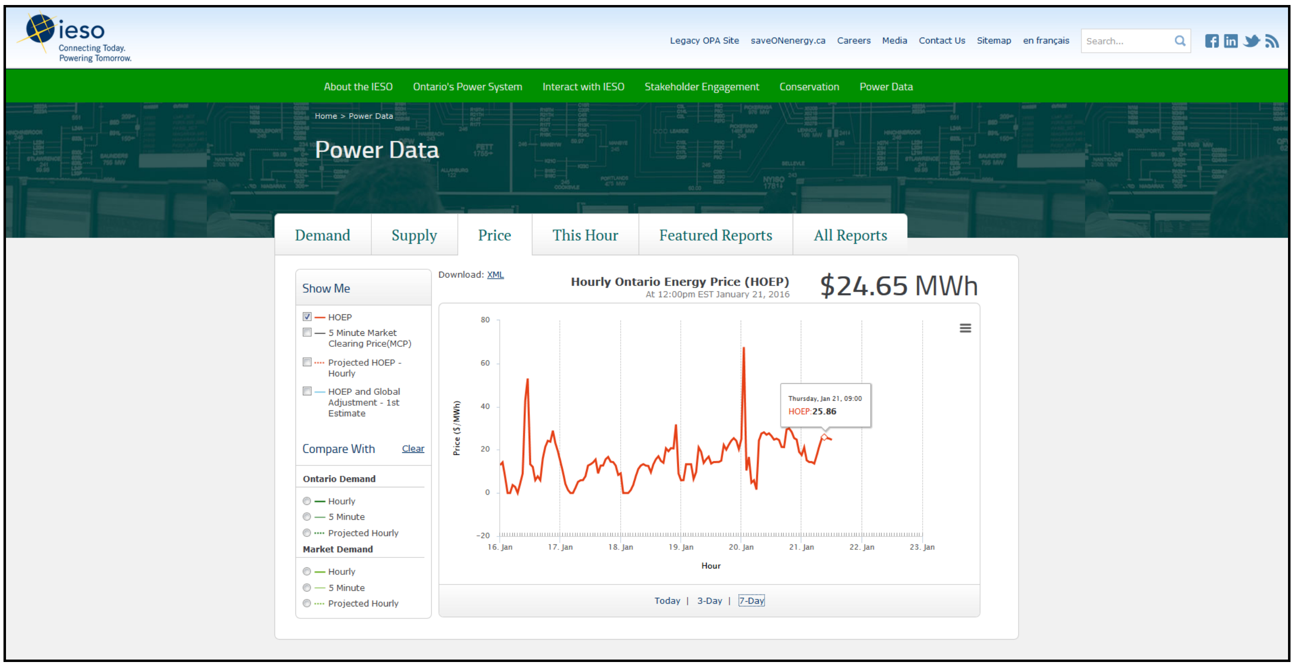


In 1984, an energy from waste plant was constructed to replace the old powerhouse and hospital and city waste was incinerated to offset the rising energy costs. The plant was opened in 1987 but decommissioned in 1999 when it was decided that the savings were no longer materializing. With the closing of the energy from waste plant, LHSC lost six megawatts of power generation and seventy thousand pounds per hour of steam supply. A combined heat and power plant (cogeneration) was the most efficient way to recover this energy supply and in 1999 LHSC started it's first gas turbine, a Rolls Royce jet engine that would produce five megawatts of electricity. A second four megawatt gas turbine was added in 2013 as part of a power plant expansion that can be seen today across the street from Victoria hospital.



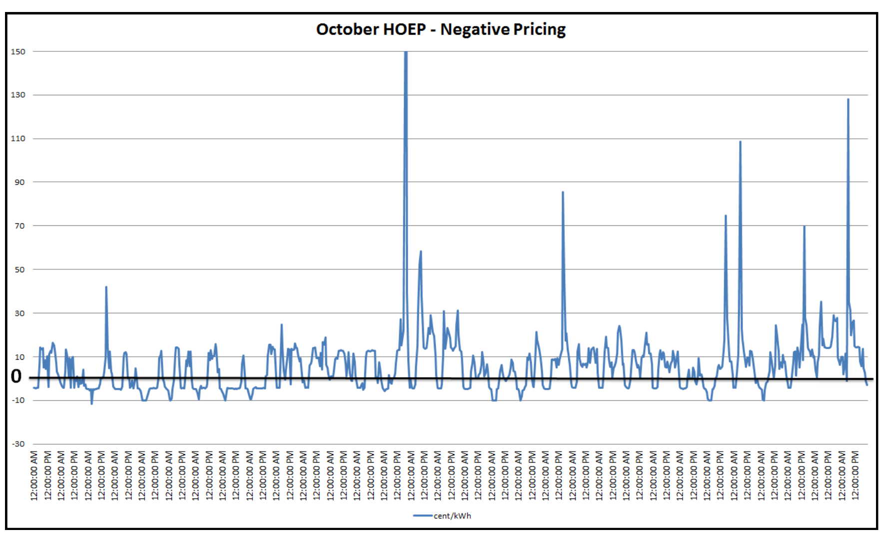
Choosing between gas and electricity

Now that Victoria Hospital has become a Class A customer and has been able to create and implement a plan to remain a Class A customer, we must become proficient in operating as a Class A customer as described above. A good portion of this work will be facilitated through an Energy Management Utility software system called e.RIS from Eramosa. This system will bring in live, five-minute pricing from the IESO and also calculate the cost to generate electricity at current gas purchase prices. Victoria hospital can then decide whether it will purchase or generate electricity and the building will adjust according. The ultimate goal will be to have this process automated so that the equipment is responding to the market prices, maximizing the amount of time that we are capturing the best price from either fuel source.



Negative prices

Because most electricity generators have contracts with the province, they are guaranteed a particular price for the electricity they sell, regardless of what price they bid to enter into the market. Since it would be very costly for generators to be shutting down and starting up if they were only participating periodically, they bid what is necessary to remain running continuously. This brings the market price of electricity (HOEP) down. During the shoulder seasons, when electricity demand is low in Ontario, there is not as much room in the market for generators and the bidding becomes very competitive. As a result we have seen the HOEP drop into the negative. This is a time when we would actually get paid to use electricity. LHSC will take advantage of these situations by backing off on electricity generation and steam absorption cooling and buying cheap electricity from the grid while cooling with the electric chillers. As can be seen in graph, we have had months where this negative pricing has been fairly consistent. Typically the prices drop in the evening and night so a turbine run schedule could be implemented during months like these without too much trouble.



Reliability

One of the most important aspects of an effective power plant is reliability. A large part of the supply side management strategy includes timed and controlled operation of the power plant. If a piece of equipment is not available when it is needed, the savings strategy is lost and cost can add up very quickly. It is therefore a priority to have the plant in good working condition and allocated money must complete this objective before other projects can be funded. This includes both capital investment and operational repair. Below is list of projects that could be slated for the next five years and the degree of risk associated with each. Projects that threaten the plant's reliability are labeled as high risk and projects aimed at efficiency as lower risk.

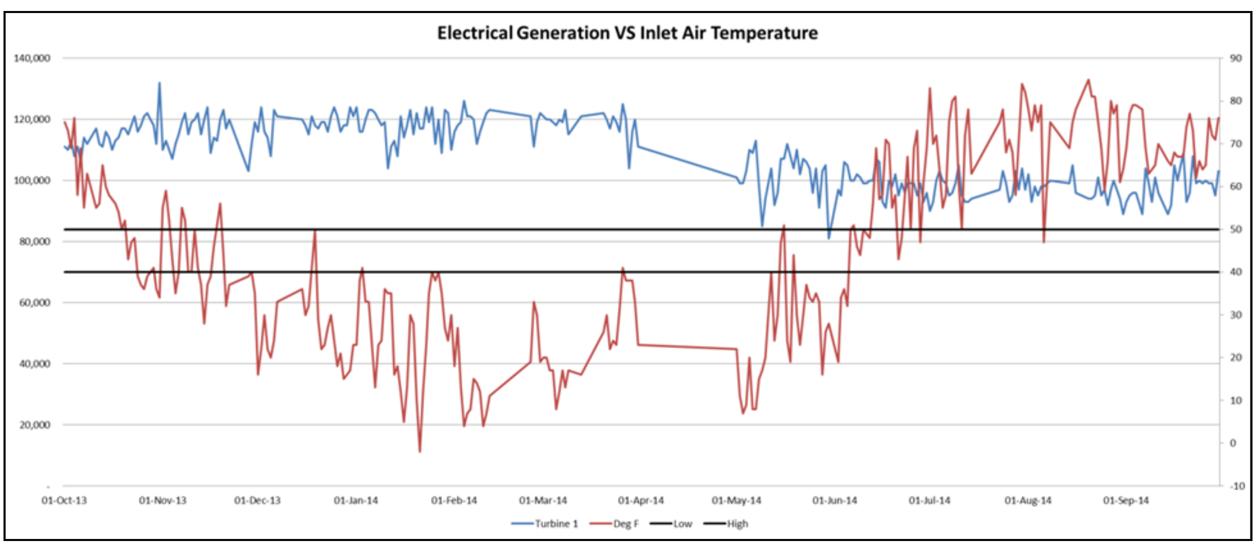
LHSC Power Plant Material Condition Status 2015

Date/Year Required	Equipment	Issue	Estimated Hours to Complete Work	Estimated Cost	Loss of Revenue	Generation Replacement Costs	Total Cost	Impacts Class A Status	Risk
2015	Heat Recovery Steam Generator for 5 Megawatt Gas Turbine #1	Requires new refractory insulation and re-skin	168	$300,000	$83,215	$66,836	$450,051	Yes	
2015	5 Megawatt gas turbine #1 (KB7 GT) Operating System Replacement	Requires new Operating system old system obsolete/unreliable	168	$300,000	n/a	n/a	$300,000	Yes	
2015	Power Plant Fuel Tank removal	Three fuel tanks must be pumped out and removed	48	$40,000	n/a	n/a	$40,000	No	
2015	Power Plant expansion Fuel header to be connected to older power plant fuel header	Since TSSA has mandated fuel tanks to be removed we need to be able to supply Boilers# 1&2 with back up	12	$14,000	n/a	n/a	$14,000	No	
2015	125 Psig header to steam muffler back pressure control valve for 4MW gas turbine #2	A portion of the steam that the 4MW gas turbine #2 produces during the summer months will have to be vented off to prevent 125Psig steam header from over pressurizing	24	$30,000	n/a	n/a	$30,000	Yes	
2015	27.6KV 600A M24 high voltage cable from LH Pole Breaker Switch #049-5 to LHSC Bay#6	High voltage cable over 30 years old sheath hard and britle. This work must be done before we can double feed the site from m25/m24 feeders	48	$60,000	n/a	n/a	$60,000	No	
2015	Power Plant Entrance Security Gate	No controlled access to Power Plant no security measures in place	48	$120,000	n/a	n/a	$120,000	No	
2015	Boiler#3	Decomissioning/Removal	72	$35,000	n/a	n/a	$35,000	No	
2015	Utility Management Software	Required to capitalize on energy savings	2 months	$100,000	n/a	n/a	$100,000	Yes	
2016	Steam Turbine Operating System	Requires new Operating system old system obsolete/unreliable	168	$100,000	$10,542	$13,706	$124,247	Yes	
2016	VH Redundant 30Psig steam line header	Install another 12" 30 Psig main steam line from power plant to VH	672	$1,500,000	n/a	n/a	$1,500,000	Yes	
2017	Gas turbine air inlet cooling for gas turbines	Installing air inlet coolers and extending duct work for gas turbines	72	$2,400,000	$5,211	$6,775	$2,411,986	Yes	
2019	Air Compressors	Both Air compressors end of life	72	$500,000	n/a	n/a	$500,000	No	

Class A Note: Due to Ontario having 3/5 peaks during the winter of 2015, LHSC can switch to a Class A customer in July 2015 and save a minimum of $400,000 in global adjustment charges over the following 12 months. In order to maintain a Class A status and maintain global adjustment savings with the potential to increase savings up to $1.5 million/year, LHSC will have to reduce it's electricity demand during Ontario's 5 peaks each year. **This reduction must begin this summer 2015 to remain Class A during the July 2016-June 2017 year.** Project listed above have been flagged in column "I" as to whether they will impact our ability to maintain Class A status.

Improved efficiency

One of the power plant efficiency projects that is being reviewed is the in-let combustion air cooling project whereby small chillers would cool the combustion air entering the two gas turbines. Since turbines run more efficiently with cool, dry air (like in the winter months) having the in-let air reduced to 42 degrees prior to entering the combustion chamber will result in an increase in turbine efficiency and electricity generation. Estimations show that LHSC could acquire 1-1.5 MW of additional summer generation.

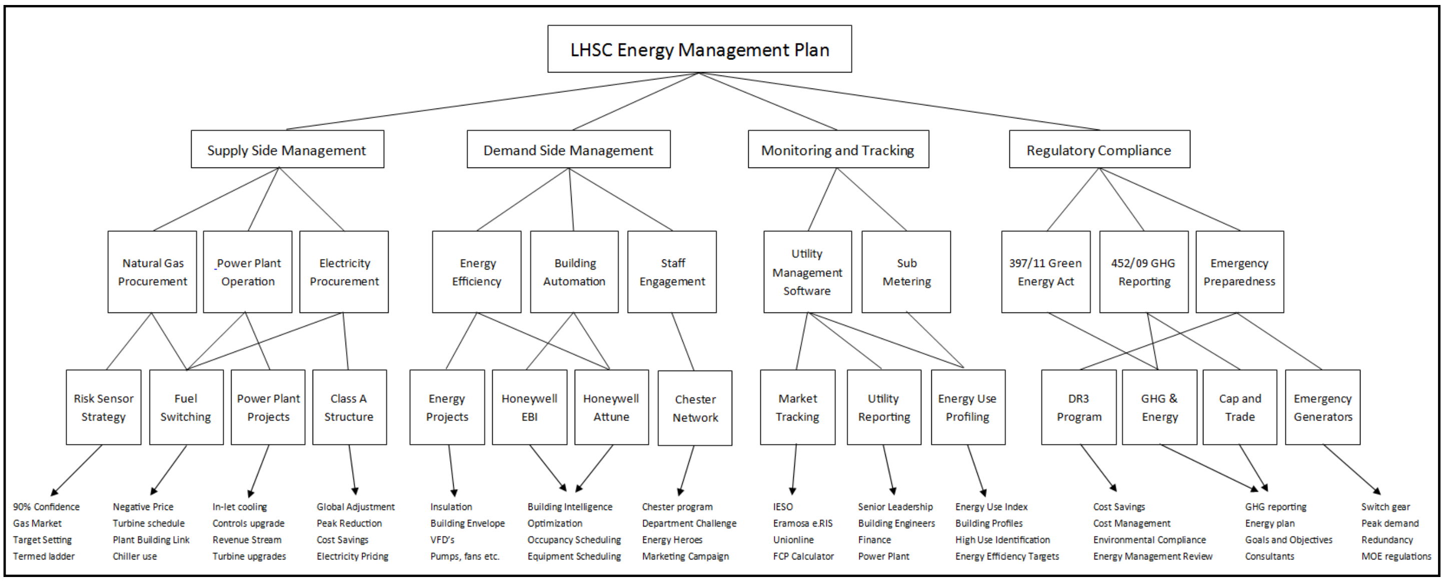


Energy Management Plan > Supply Side Management > Project Schedule

As new opportunities present themselves they are added to a list with other projects that support the direction the hospital is taking toward energy management. Projects pertaining to supply side management have been slated into a five year schedule below. Some items have been completed and some are ongoing. Many of the power plant projects have been slated according to forecasted HIRF money and do not necessarily represent the desired implementation period. Each project is weighed against the rest for the positive impact it has on the whole and the size of the investment that must be made. Timing of projects may also change do to unforeseen circumstances or equipment failures.

One of the greatest challenges to deciding how to invest in supply side management is predicting what the provincial and federal government will do with respect to regulations and legislations that affect utility costs. For example, the introduction of Global Adjustment and the class A structure presented a savings opportunity for LHSC but changed the strategy for how the hospital runs its power plant and building equipment. The introduction of the Cap and Trade system will again affect the supply side management strategy by placing additional cost on natural gas consumption.

In light of this challenge, LHSC has made it an objective to be as flexible as possible for how energy is produced and used so that it can adapt to changes in government legislation and market prices of natural gas and electricity.



Supply Side Management - Project Schedule

	Apr-15	Jul-15	Oct-15	Jan-16	Apr-16	Jul-16	Oct-16	Jan-17	Apr-17	Jul-17	Oct-17	Jan-18	Apr-18	Jul-18	Oct-18	Jan-19	Apr-19	Jul-19	Oct-19	Jan-20	Apr-20	Jul-20	Oct-20	Jan-21	Project Cost
Natural Gas - Risk Sensor Targets	*$4.92/GJ - $5,513,931*				*$3.92/GJ - $4,434,329*				*TBD*																$25,000/yr
Class A Schedule		*Complete - 3,500 kW AVG*				*To Date - 4,135 kW AVG*				*Peak Shaving Exercises*															$5,000
Steam Venting	*Valve*	*As needed*				*As needed*				*As needed*				*As needed*				*As needed*							$15,000
Utility Management Software		*Buy*	*Installation*			*Training*																			$30,000
Fuel Switching						*Ongoing according to market price of natural gas and electricity*																			$0
Steam Turbine Operating System																									$100,000
Standard Arrow Controls Upgrade			Complete																						$160,000
Hobbs Welding HRSG Refurbishment			Complete																						$20,000
Hardie PLC Hardware				Complete																					$56,132
Boiler #3 Removal																									$35,000
Power Plant Entrance Gate																									$25,000
KB7 Generator Refurbishment																									$250,000
Power Plant Boiler Roof Replacement																									$300,00
Internal Repairs																									$400,000
Victoria Hospital 30 psi steam line																									$1,500,000
Power Plant Turbine Building Roof																									$120,000
Boilers																									$350,000
Air Compressors																									$500,000
Gas Turbine Inlet Cooling																									$2,000,000

Note: Projects have been slated according to forecasted HIRF money and not necessarily according to desired implementation periods