ANALYSIS OF ENERGY USE FOR ONTARIO HOSPITALS

PREPARED FOR

INDEPENDENT ELECTRICITY SYSTEM OPERATOR (IESO)

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REPORT DATE: MARCH 13, 2009

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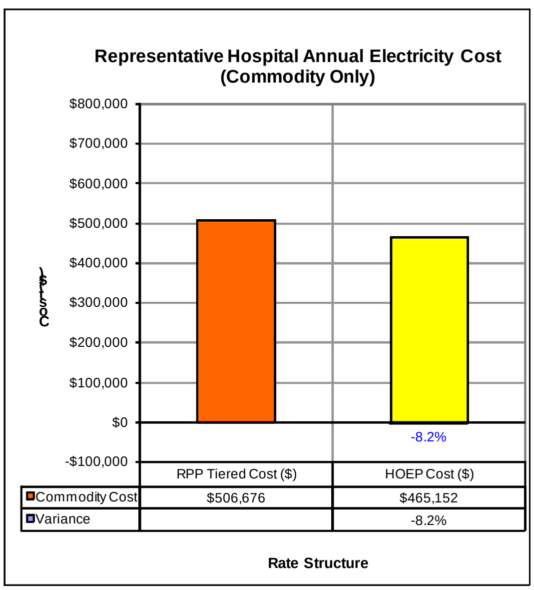
1 EXECUTIVE SUMMARY

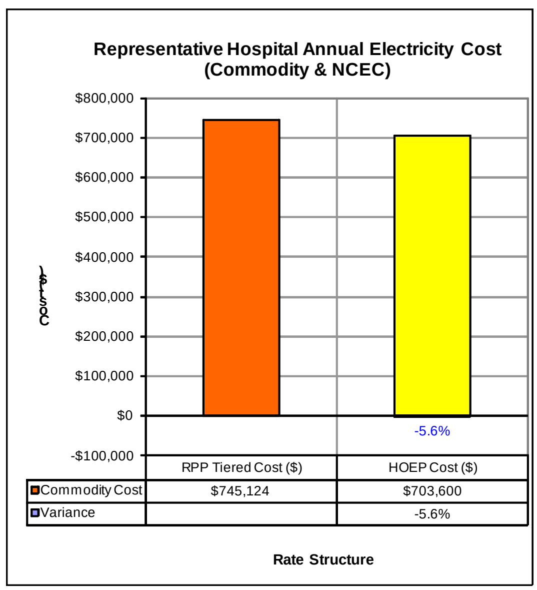
The Public Sector in Ontario will move from paying the Regulated Price Plan (RPP) to hourly electricity pricing beginning November 1, 2009. To support understanding of the impacts of this price change within the hospitals and long term health facilities sectors, the Independent Electricity System Operator (IESO) contracted with Finn Projects to provide an analysis of the energy use and potential energy reduction strategies. This information will ultimately be used in the development of materials designed to support the IESO's Customer Education Program.

The sector analysis and investigations carried out by Finn Projects for the hospitals in Ontario identifies excellent opportunities for energy cost reductions in a number of areas, as described in this report, including the change of rate structure; energy auditing and retrofits of energy efficiency measures; HVAC; fume hoods; lighting; kitchens and laundries; plug load; retro-commissioning; energy awareness, including social marketing, employee engagement and energy training; and monitoring and targeting of energy consumption.

The analysis concludes the hospitals will benefit from Ontario's public sector move on November 1, 2009 from paying the Regulated Price Plan (RPP) to hourly electricity pricing (HOEP). In general, it is expected the electricity commodity costs for the average hospital will decrease approximately 8% to 11% when switching from RPP to HOEP rates, including OPG rebate and provincial benefits. If the non-competitive energy costs (NCEC), such as debt retirement, transmission and distribution, are taken into account the overall billed electricity costs will decrease by approximately 5% to 8% when switching from RPP to HOEP rates.

The following two graphs show a representative hospital's energy costs before and after the change from RPP to HOEP. The graph on the left shows the differences in the electricity commodity cost only, while the graph on the right shows the impact on the total bill, i.e. electricity commodity plus NCEC charges.





Besides the savings that can be realized from the switch to the HOEP, hospitals can achieve additional cost savings by implementing various energy efficiency measures, The sector analysis and investigations carried out by Finn Projects for hospitals in Ontario identified excellent opportunities for energy cost reductions. Ontario's hospitals should embark on the following activities, as described in this report:

- Move from RPP to HOEP as soon as possible.
- Carry out energy audits and implement the resulting retrofit of energy efficiency measures.
- Undertake retro-commissioning of the building automations systems.
- Address energy and demand reduction strategies for HVAC, fume hoods, lighting, kitchens and laundries, and plug load.
- Enter into an energy awareness program that includes social marketing, employee engagement and energy training.
- Implement energy consumption monitoring and targeting systems.

The potential overall energy cost savings for the hospitals could be as high as 30%+ by carrying out the above recommendations, including rate changes and energy retrofits.

2 INTRODUCTION

The Public Sector in Ontario will move from paying the Regulated Price Plan (RPP) to paying the hourly electricity pricing, beginning November 1, 2009. To support understanding of the impacts of this price change within the sectors defined by hospitals and long term health facilities, the Independent Electricity System Operator (IESO) contracted with Finn Projects to develop materials designed to support the IESO's Customer Education Program.

The scope of the work for this project includes:

1. Conducting a series of interviews with hospital and long term facility staff responsible for energy management
2. Identifying risk management strategies in place or that under consideration by the facilities for coping with the change to the HOEP
3. Identifying the education needs of the facilities and how to address them regarding the switch to the HOEP and the management of electricity bills over the long term as a result of being in the wholesale market

3 OBJECTIVES OF ENERGY SECTOR PROFILE ANALYSIS

The objectives of the energy sector profile analysis are:

- To review information about how facilities in the hospital sector consume energy in order to develop case studies, fact sheets, information, workshops, educational brochures as Ontario's hospitals prepare for the move from paying the Regulated Price Plan (RPP) for electricity to market-based (or hourly) electricity pricing (HOEP) beginning November 1, 2009.
- Carry out energy audits in order to identify and quantify the opportunities for reducing electrical demand and energy consumption and to address specific opportunities for electrical demand reduction, load shifting, conservation and flexible load shape.

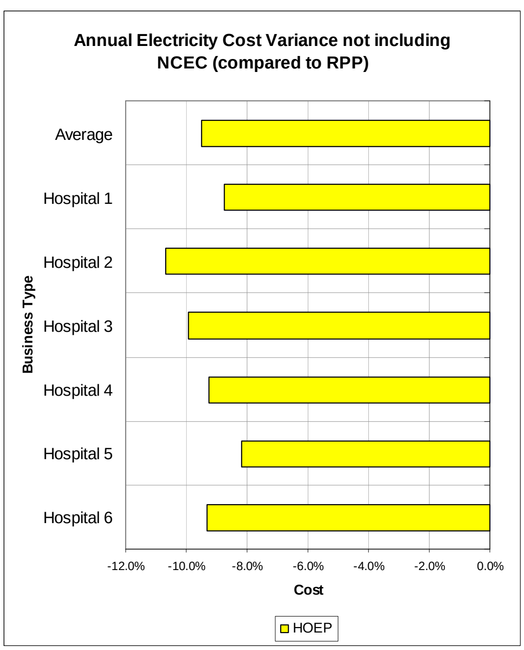
4 IMPACT OF THE ELECTRICITY RATE CHANGE BEGINNING NOV 1, 2009

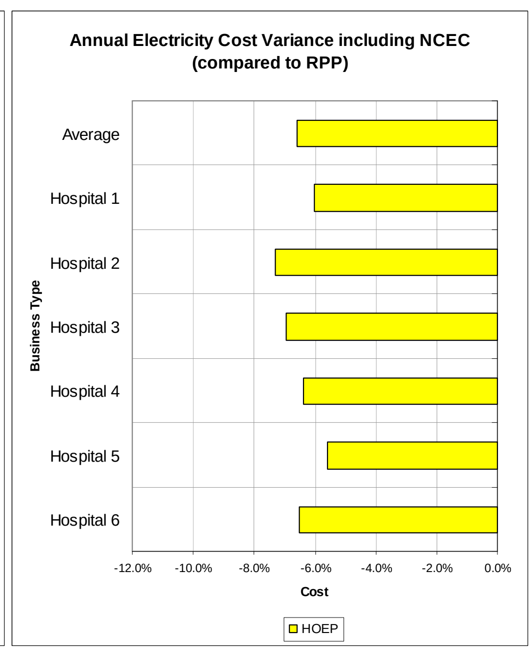
Finn Projects reviewed the impact of the change in the rate structure for a number of hospitals as Ontario's public sector moves from paying the Regulated Price Plan (RPP) to hourly electricity pricing beginning November 1, 2009.

The hourly profiles for a number of hospitals were analyzed for electrical consumption for 2008 and the RPP and HOEP rates were applied:

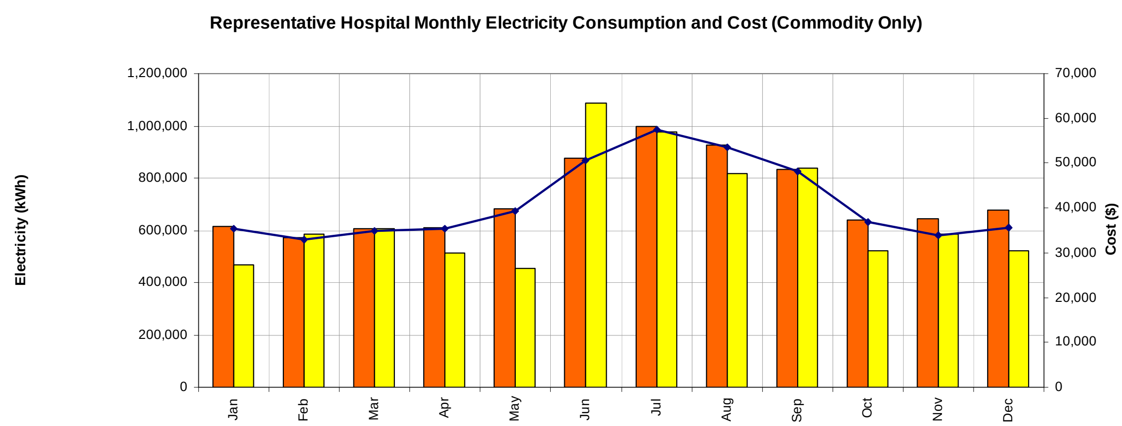
- The RPP rate from January to October 2008 was $0.050 for the first 750 kWh and $0.059 for the remainder; the RPP rate for November and December 2008 was $0.056 for the first 750 kWh and $0.065 for the remainder.
- For the comparison, the historical 2008 hourly electricity prices were applied against the hospitals' electricity consumption profiles. The OPG rebate and provincial benefits have been calculated and included these in the costs.
- To assess the impact of the change on the total hydro bill, and not just the electricity commodity cost, the non-competitive energy costs (NCEC) were added. These costs include transmission charge, distribution charge, foregone revenue rate rider, deferral account rate rider, customer charge, transformer allowance, wholesale market operations, standard supply service and debt retirement charge.

The analysis performed shows that the hospitals will benefit from in Ontario's public sector move on November 1, 2009 from paying the Regulated Price Plan (RPP) to hourly electricity pricing (HOEP). The hospitals analyzed showed electricity commodity cost reductions varying between 8.2% and 10.7% in switching from RPP to HOEP rates, including OPG rebate and provincial benefits. When taking the NCEC into account as well, the analysis revealed a reduction in the overall billed electricity costs of 5.6% to 7.3% in switching from RPP to the HOEP rate, as per the graphs below:





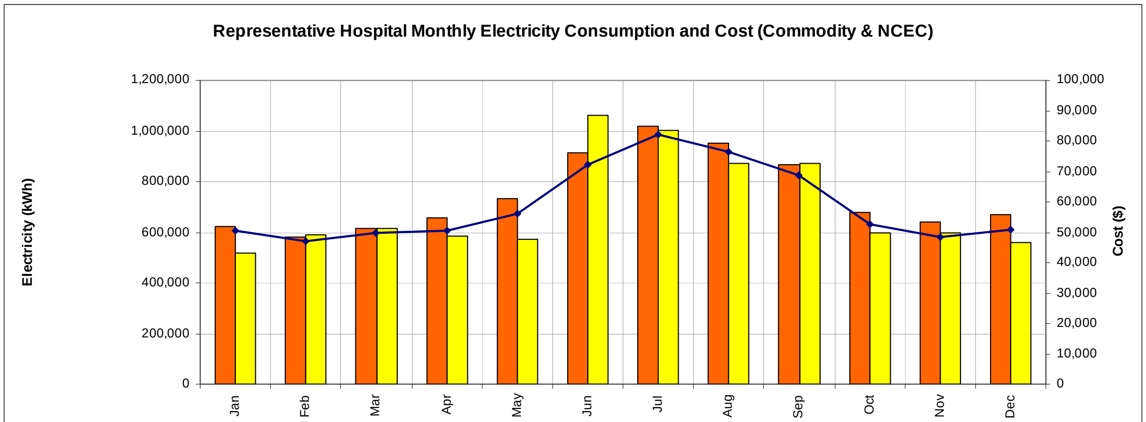
Considering the commodity costs only (no NCEC), the profile for one of the representative hospitals is given below, showing cost savings in almost every month except June 2008, with marginal differences in February, March and September.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
RPP Tiered Cost ($)	$35,780	$33,320	$35,313	$35,728	$39,832	$51,137	$58,237	$54,105	$48,712	$37,214	$37,684	$39,614
HOEP Cost ($)	$27,215	$34,073	$35,388	$29,955	$26,447	$63,425	$56,872	$47,541	$48,988	$30,512	$34,255	$30,480
Consumption (kWh)	606,553	564,859	598,642	605,672	675,227	866,840	987,182	917,145	825,749	630,860	579,855	609,554

Month

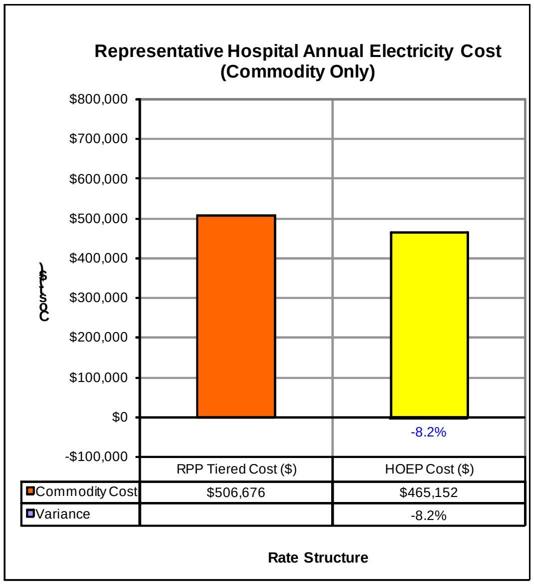
The graph below shows the commodity plus NCEC costs applied to the profile for the same hospital, showing associated monthly cost comparisons:

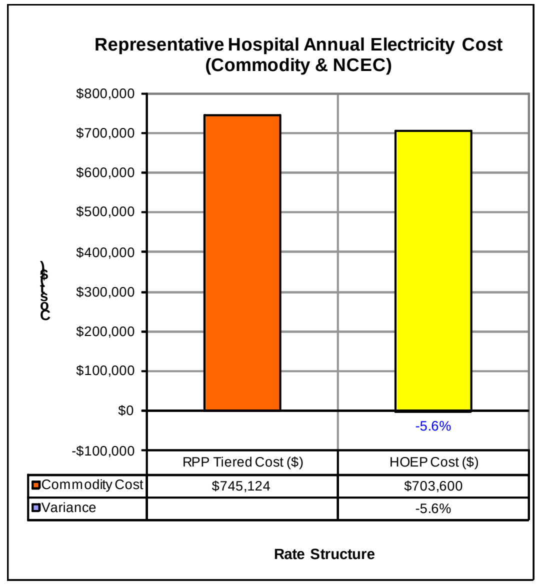


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
RPP Tiered Cost ($)	$51,835	$48,257	$51,197	$54,684	$61,100	$75,982	$84,806	$79,284	$72,399	$56,394	$53,313	$55,872
HOEP Cost ($)	$43,270	$49,010	$51,273	$48,911	$47,715	$88,270	$83,441	$72,720	$72,675	$49,693	$49,884	$46,737
Consumption (kWh)	606,553	564,859	598,642	605,672	675,227	866,840	987,182	917,145	825,749	630,860	579,855	609,554

Month

The following two graphs show a representative hospital's annual energy costs before and after the change from RPP to HOEP. The graph on the left shows the differences in the electricity commodity cost only, while the graph on the right shows the impact on the total bill, i.e. electricity commodity plus NCEC charges.





The application of the 2008 rates detailed above raises a couple issues:

- Firstly, if the current RPP rate of $0.065 per kWh was applied to the hospitals' annual consumptions, the RPP costs would be higher and thus the savings in moving to HOEP would be increased.
- Secondly, basing the analysis of the HOEP cost structure on the 2008 rates provides no guarantee that the same level of savings will be achieved. The savings could be higher or lower, depending on how the electricity market reacts in 2009.

5 Potential Energy Consumption Savings and Demand Reduction Measures for Hospitals

The following sections detail potential energy efficiency measures that hospitals could undertake to reduce their energy consumptions and reduce their electrical demand.

5.1 Energy Audits & Retrofits of Energy Efficiency Measures

Energy audits of the hospitals should be carried out to assess the energy savings opportunities. The energy audit reports should include the estimated capital costs, energy savings, cost savings and paybacks for each energy efficiency measures, as well as the operational impacts. The goal, of course, is to lower the operating costs without sacrificing occupational comfort.

Finn Projects conducted energy audits of two hospitals and the analysis of the hourly energy profiles of six hospitals for the IESO under this contract to identify opportunities for the selected hospitals, in particular with respect to electrical demand and energy consumption reducing. While the audits concentrated on electricity consumption and demand savings, natural gas use and potential savings were also assessed.

The first step in the process was to establish the weather-corrected energy consumption baselines and review the electricity load profiles. The energy baseline is the amount of energy that a facility will consume based on normal conditions. Specialized utility accounting programs allow for baseline adjustments due to the impacts of variables such as heating degree days (HDD), cooling degree days (CDD) and occupancy, using multi-linear regression analysis. The historical daily local weather data was entered into Metrix™ Utility Accounting System along with the historical energy billing data in order to develop the adjusted energy baselines.

The onsite energy audits of the facilities included an examination of all energy consuming equipment and building systems, including all public areas, offices, mechanical rooms, other back-of-house areas, as well as rooftop and parking areas. The audit captured the electrical and mechanical equipment condition and performance, including load inventory and review the controls systems with respect to type, condition, status and set-up. The operational and maintenance staff were interviewed to get an understanding of the building operation and control and to assess whether there were any problems that could be resolved or improved with the implementation of energy efficiency measures. The audits included mechanical and electrical systems; the building envelope and orientation; exterior energy and water usage; and it will incorporate a review of the present operating conditions and procedures, including the hours of operation.

The audits identified potential energy savings measures of over 20% with paybacks in the order of 6 to 8 years after incentives are taken into account. This is in addition to the cost savings that would be realized through the imminent rate change.

The measures identified in the energy audits include:

ENERGY EFFICIENCY MEAURES	
Heat Recovery	Recover the heat from the building's exhaust & use it to preheat the make-up air
	Recover the heat rejected by the chillers to be used in the reheat coils and to preheat the domestic hot water
	Recover the heat from the refrigeration walk-in equipment & use it to preheat the domestic hot water
	Recover the heat from the refrigeration walk-in equipment to heat ancillary spaces
	Use a heat exchanger to cool off the refrigerant hot gas generated by the refrigeration compressors serving the IT department and use it to preheat the domestic hot water
HVAC	Replace the existing chillers with new modular units, with integral variable speed drives and magnetic bearings
	Replace the existing cooling tower with a new unit, equipped with a variable speed drive fan
	Replace the kitchen make-up & exhaust fan motors with new motors with variable speed drives
	Use variable speed drives on the surgical areas make-up air unit & associated exhaust fan
	Replace the chilled water 3-way mixing valves with 2-way valves and use variable speed drives on the secondary chilled water pumps to maintain the secondary chilled water loop flow at the levels required by the building load
	Replace the existing heating boilers with new ones, with linkage-less modulating burners
	Replace the steam as the primary heating agent for heating, ventilation, snow melting, domestic hot water and humidification
	Implement a set-back/set-forward temperature policy on the third floor
Motors	Replace the pressure booster system with a new one, equipped with a variable speed drive
	Install high efficiency motors
Controls	Provide a new DDC system to include all major building services components
Lighting	Retrofit energy efficiency lighting, install lighting controls and carry out lighting redesign for specific areas

5.2 HEATING, VENTILATION AND AIR CONDITIONING (HVAC)

100% fresh air units in hospitals can be used to produce free cooling during the winter months; the make-up air units can also be used to provide cooling for the chilled water in the building for equipment cooling, fancoils and other winter uses.

Heat recovery measures should be explored, including heat recovery from the exhaust air to transfer to the incoming fresh air stream.

Variable frequency drives (VFDs) should be considered for pumping systems and for the air handling units wherever possible. The VFD savings are very significant, for example running a fan at 80% of its speed would reduce the energy consumption by 50%.

The BAS should be used to optimize the chiller and chilled water system to provide very tight control of the chilled water production, distribution and usage in the facility.

The air-systems should be properly insulated and sealed and all hot water piping, where accessible, should be properly insulated.

A steam-trap maintenance and replacement program should be in place for all facilities that utilize steam heating. Boiler combustion analyses should be carried out and the corrections that are identified should be implemented.

5.3 FUME HOODS

Fume hoods in the hospitals represent a tremendous opportunity for energy savings. The hoods are very often left running at 100% exhaust volumes for 24-hours per day, 7-days per week. Modern laboratory exhaust systems make use of digital automation systems to vary system capacity in response to requirements at the fume hoods, to minimize the exhaust and makeup air flows without compromising safe laboratory conditions. Each fume hood is equipped with a special-purpose controller incorporating sash position sensing, airspeed sensing, and detection of an operator directly in front of the hood. The controller modulates an air valve above the hood to throttle air flow in response to requirements and the exhaust fans and makeup air fans would be equipped with either variable frequency drives or bypass arrangements to control air flow to the exact requirements indicated by the fume hoods. Makeup air is modulated to track total exhaust flow and ensure a slight positive pressure in the laboratory at all times.

5.4 LIGHTING

While the majority of fluorescent lighting in most hospitals has been changed from T-12 to T-8 there are still some opportunities to upgrade the magnetic ballasts to electronic ballasts. Compact fluorescent lighting should replace all incandescent lights. Occupancy sensors should be installed in areas such as washrooms, storage rooms, mechanical and electrical rooms. LED exit lights should be installed.

Lighting levels throughout the building should be measured. Corridors and rooms are often over lit and there is an opportunity to reduce the number of lamps in the fixtures, which could significantly reduce electricity consumption.

Night audits should take place to ensure that the lighting control shut off all lighting in unoccupied areas, except the emergency exit lighting.

5.5 KITCHENS AND LAUNDRIES

Demand ventilation systems with VFDs should be installed on all kitchen exhaust hoods to provide reduced exhaust volumes during periods when little cooking takes place below the hood. Turn fryers off, or cover and reduce them to idling temperatures during slow periods. During slow periods, turn off as many griddle burners as possible, and turn down other sections. Turn broiler flames to low between broiling operations and shut them off during slow periods.

Refrigeration coils should be cleaned at least once a quarter and strip curtains or plastic doors should be installed on the walk-in refrigerators and freezers as they can significantly reduce compressor runtime.

For maximum efficiency, ensure washers and dryers run only when fully and properly loaded. Consider using ozone laundry equipment for reduced energy use and reduced chemical use. Use the lowest water temperature at which proper cleaning and disinfecting can be achieved. The belts, pulleys, drain valves and balance of pressure for the equipment should be checked.

5.6 PLUG LOAD

Computers and monitors should be shut down when the staff leave for the evening or weekend; software updates could be carried out during regular business hours.

Printers and copy machines should be also switched off if possible.

VendingMisers monitor both occupancy levels in the area around the vending machine and ambient temperate changes, allowing only enough power to keep the cooled product inside at the right temperature and have it ready to dispense when someone is in the vicinity, powering down costly heat generating lighting and denying compressor cycles to run when they are not required.

5.7 RETRO-COMMISSIONING

Hospitals can achieve additional energy savings through a process called retro-commissioning. Retro-commissioning (RCx), or existing building commissioning, is a systematic process that identifies low-cost operational and maintenance improvements in existing buildings and brings the buildings up to the design intentions of its current usage. RCx focuses on mechanical equipment, lighting and related controls. RCx optimizes existing system performance, rather than relying on major equipment replacement.

RCx would include the review of the hospital's building automation systems (BAS) to ensure that the proper ventilation levels are provided to each discrete area and that that the programmed temperature settings are appropriate. Due to changes in function within the facilities there are many areas, for example, that are provided with 100% fresh air 24-hours per day, 7-days per week; whereas in reality they are unoccupied after 6:00 pm and on the weekends. The ventilation supplied to these areas could be switched off or cut back to 50% during unoccupied times. Operating rooms in the hospitals could also be scheduled to have 50% airflow during unoccupied periods of time, with an emergency button to place them at 100% airflow if they are suddenly required.

The operation of the air handling units should also be reviewed to make sure all equipment is fully operational and is not causing additional energy usage. Examples would be valves passing steam or hot water, or dampers that are not operational allowing additional amounts of fresh air to flow to the facility, or variable frequency drives (VFDs) that are not operating properly.

5.8 Energy Awareness & Training

There is an opportunity to adapt and implement the well established education and awareness programs currently being implemented in some hospitals into those facilities are in the initial stages of design and those that have yet to consider education and awareness.[1]

5.8.1 Social Marketing

Social marketing is the systematic application of marketing to achieve specific goals for a social good. Its main purpose is to influence social change. In the context of energy, social marketing is designed to reduce energy consumption in a facility using social marketing tools that encourage staff to make simple changes in their daily energy behaviours. The tools used in social marketing with regards to energy include detailed discussions of the environmental impact of specific behaviours, implementation strategies for changing that behaviour (energy conservation), and an assortment of ‘action tools’, such as e-mails, banners and posters etc. that are used to promote and prompt changed and sustained behaviour. The behaviours targeted by social marketing are simple yet have large collective impacts. These behaviours complement the potential energy saving opportunities identified above and may include: more efficient use of lighting, computers and monitors and personal appliances. For example posters, stickers and banners etc. can be produced to encourage staff to turn off lights, computers and other personal appliances.

Social marketing tools could be adapted from those already in use and rolled out in a formal fashion. The energy saving behaviours targeted should complement the other potential energy saving opportunities identified for the hospitals.

5.8.2 Employee Engagement

Employee engagement is a marketing and communication tool or framework used to assist the hospital in identifying and implementing energy conservation actions. The difference between employee engagement and other types of communication tools such as social marketing is that employee engagement allows for the two-way flow of information regarding energy and energy efficiency. In employee engagement not only do staff receive messaging on energy conservation, but they also have opportunities to provide their ideas for improvements in energy efficiency. Peers then evaluate these ideas and the most appropriate energy measures are implemented. The results of implementing the measures are then reported back to the employees in a timely fashion

[1] For example, University Health Network’s Thermostats, Lights and Controls Program, TLC, can be adapted to hospitals across Ontario. The TLC program consists of social marketing, employee engagement, retro-commissioning and energy training, as well as audits, retrofits and the preparation of a hospital energy plan. UHN has prepared a program template to assist other hospitals to adopt all or parts of this comprehensive program to other hospital settings.

to motivate them. Employees are subsequently rewarded for their efforts. This process allows staff to become more aware of energy use and conservation and allows them to take ownership of the ideas and their implementation.

A formal employee engagement process should be developed for each hospital and expanded to include participation by other non-facilities staff within the building.

5.8.3 Energy Training

Training programs should be introduced to the hospitals for specialized staff to assist them in identifying process changes to ensure that equipment is utilized correctly and more efficiently. The training should address key equipment at the hospitals including the building automations systems, HVAC and ancillary equipment.

Employee engagement, operator training and employee engagement are inextricably linked and integral to each other. Operator training provided facilities staff with training in identifying opportunities for energy savings and technical expertise on how to implement them; employee engagement provided the process for recommending and implementing energy saving ideas.

Through the implementation of an education, awareness and training program the potential energy savings for hospitals are expected to be 5%+ for each facility

5.9 ENERGY MONITORING

Monitoring of energy use should be integrated as part of the operation for the facilities. The daily hydro use profiles are available from the interval meters at each hospital, either through the BAS or a web-based monitoring system. Reviewing and understanding the daily energy patterns and aberrations can lead to the identification of areas of waste. For example, high usage in the evenings and weekends can easily be identified for corrective action.

Monthly energy use for hospitals should be regularly compared the weather and occupancy corrected baselines to ensure that savings targets are met.

6 RECOMMENDATIONS

The analysis carried out on the energy profiles for a number of hospitals indicates that hospitals can reduces their total electricity bills by approximately 5% to 8% in migrating from the current Regulated Price Plan (RPP) to hourly electricity pricing (HOEP) as soon as possible. This, of course, is predicated on the assumption the HOEP will remain stable at 2008 levels.

The sector analysis and investigations carried out by Finn Projects for hospitals in Ontario identifies excellent opportunities for energy cost reductions.

In conclusion, Ontario's hospitals should embark on the following activities, as described in this report:

- Move from RPP to HOEP as soon as possible.
- Carry out energy audits and implement the resulting retrofit of energy efficiency measures.
- Undertake retro-commissioning of the building automations systems.
- Address energy and demand reduction strategies for HVAC, fume hoods, lighting, kitchens and laundries, and plug load.
- Enter into an energy awareness program that includes social marketing, employee engagement and energy training.
- Implement energy consumption monitoring and targeting systems.

The potential overall energy cost savings for the hospitals could be as high as 30%+ in carrying out the above recommendations.