Lennox & Addington County General Hospital

CONSERVATION AND DEMAND MANAGEMENT FIVE YEAR ENERGY PLAN FOR LENNOX & ADDINGTON COUNTY GENERAL HOSPITAL

2019

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Executive Summary

This report provides an assessment of the energy demands and conservation outcomes for Lennox and Addington County General Hospital in Napanee, Ontario. This report is intended to serve as the Conservation and Demand Management (CDM) Plan for Lennox and Addington County General Hospital as part of their approach to managing energy use, costs, and improving best practice opportunities. Greenhouse gas (GHG) emissions associated with energy consumption were also evaluated.

The details summarized in this report takes into consideration the building's HVAC, electrical and lighting systems, and a working energy model was created to help assess building performance since the previous conservation and demand management report was completed (2014), but also to determine areas for the largest potential energy savings as the hospital prepares for its next five year energy plan.

Overall, this report finds that the energy intensity of L&A Hospital in 2018 has decreased by 7.3% since 2013, suggesting that measures implemented to conserve energy use have been successful. Some of the measures that have contributed to these reductions include:

- Air Handling Improvements
- Replacement of walk-in refrigerators
- Changing fluorescent lighting to new LEDs

This report also describes a number of future energy conservation measures that the hospital could implement over the next five years that would not only save energy and reduce GHGs, but could also significantly reduce hospital operational costs long-term. Some of these measures recommended include:

- Increased Indoor lighting replacements
- Replacement of outdoor lighting
- Demand controlled ventilation
- Occupancy sensors
- Daylighting Controls

Where the majority of current energy demands occur are outlined in more detail in this report and suggestions on how these might be minimized in the future are discussed.

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1. Background

Lennox and Addington County General Hospital aims to promote good stewardship of our environment and community resources, adhering to their core values of efficiency and financial responsibility. Energy management is an essential aspect of every business and institution – energy costs money and reducing energy demands can decrease operational costs. But as the political atmosphere starts to address climate change more directly, there is now more pressure than ever to improve energy efficiency and reduce consumption in order to decrease GHG emissions address the social and economic impacts of climate change.

As a result, Lennox and Addington County General Hospital has been working to incorporate energy management techniques to become a leader in energy conservation and demand. In 2014, Lennox and Addington County General Hospital completed a five-year conservation and demand management (CDM) plan. The intent of the plan was to improve the management of energy costs and consumption, identifying best practices, and implement energy savings opportunities. The reporting information could then be compared against other similar facilities to get a benchmark of performance.

In the 2014 report, baseline energy use and greenhouse gas emissions for the hospital were calculated using 2013 utility and operations data. The CDM report identified a number of energy savings opportunities that the hospital could implement in the next five years to help reduce energy use and associated costs. Now that the five year plan period has ended, the same initiative is being taken but with additional goals and objectives to support the continuous improvement of energy performance and cost reduction. The goal of this report is to not only monitor and track the progress LACGH has made but also identify future energy savings opportunities that can be incorporated into future goals, as part of a new five-year plan.

2. Methodology

LACGH is located at 8 Richmond Park Dr, in Napanee Ontario. The hospital operates 52 beds including: 24 active care, 2 palliative care, 4 intensive care and 22 long term care beds that focus on rehabilitation. There is approximately 270 staff that are committed to providing high quality health care close to home for the residents of Lennox and Addington and the surrounding townships. The hospital building itself has a total area of 127,564 ft^2, but outdoor lighting areas were also assessed (Figure 1). To accurately assess LAGCH's energy performance several steps were completed, and these included:

i) An analysis of utility bills
ii) Site visits to assess building layout, lighting and scheduling, and HVAC systems.
iii) Analyze building schematics to determine lighting and historical HVAC details
iv) Produce a whole system analysis to determine trends associated with current and future operations and building user behaviours
v) Analyze data and produce a final report for Lennox & Addington County General Hospital

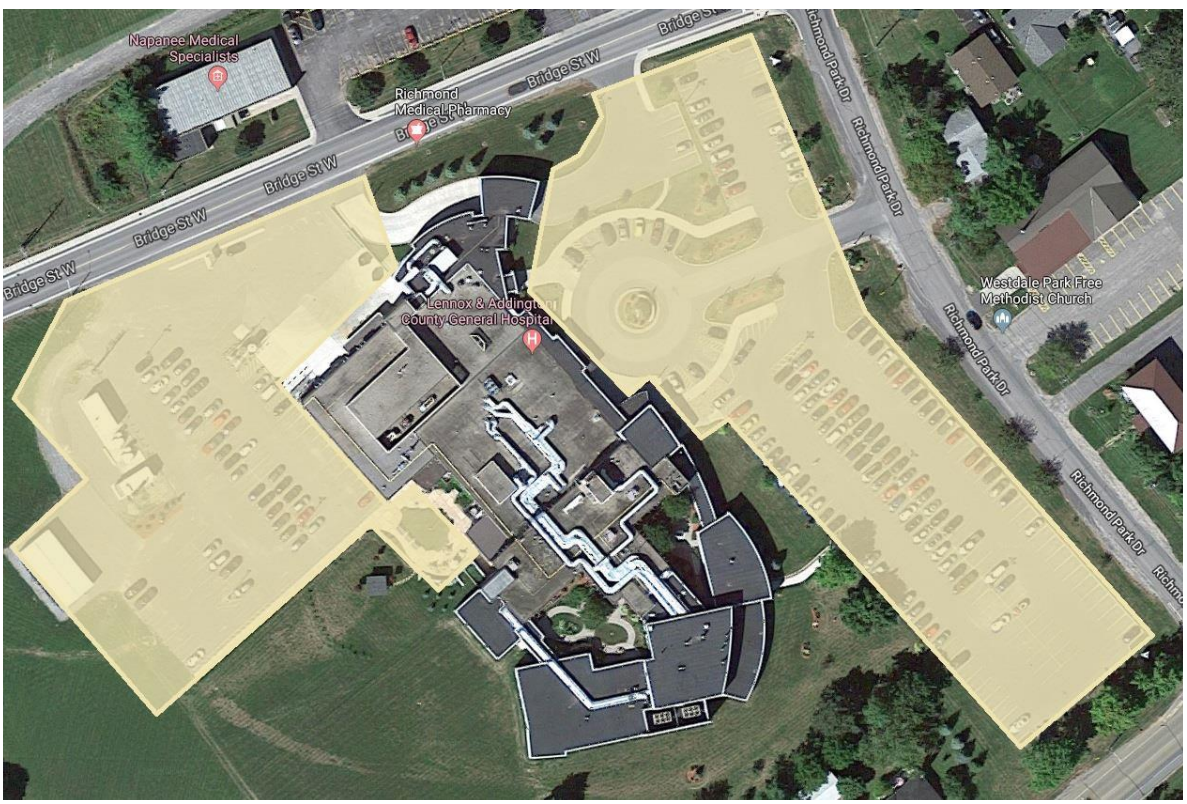


Figure 1. Overhead view of the Lennox & Addington County General Hospital in Napanee, Ontario. All work was performed within hospital walls, except for outdoor lighting evaluation which was confined to parking areas shaded in yellow.

3. Results

The baseline energy profile is summarized on a monthly basis, using utility data from the most recent full year of operation from January to December 2018. The electricity and gas consumption trends were also used to calibrate energy end use estimates and to provide a reference case for calculating current and potential future energy savings opportunities.

3.1 Baseline Energy Use

Compared with 2013 energy use statistics, 2018 data suggests that the energy intensity for the entire hospital site has decreased by 7.3%. The largest decrease was achieved through reduced gas consumption but significant reductions in electricity use were also observed (see Table 1).

Larger reductions in GHG emissions have been achieved where 2018 emissions are only 55% of those calculated in 2013. Some of these reductions are attributed to the decreased use of natural gas and electricity however, the majority of the reduction is because Ontario's electricity grid has changed substantially since 2013, with renewable energy technologies and natural gas power plants replacing coal power plants; this results in lower GHG emission factors for electricity use. A month-by-month break down of all energy uses and GHG emissions is summarized in Table 2.

Key Observations & Trends

- Total site energy intensity is 7.3% lower than 2013 – from 64.0 to 59.3 $ekWh/ft^2/yr$
- At 59.3 $ekWh/ft^2/yr$, the energy intensity of L&A Hospital is more than 10% below the median energy intensity of Hospitals surveyed in Ontario (66.2 $ekWh/ft^2/yr$) in 2014
- Total annual electrical consumption is 3,190,050 kWh – a 5.4% reduction from 2013 usage
- Total natural gas consumption is 420,980 m^3 – a 9.8% reduction from 2013 usage
- Total GHG emissions have decreased by 45%

Table 1. Comparison of current baseline energy consumption with 2013. Current values from 2018 were lower than 2013 for every category and the % reduction is calculated for each.

	2013	2018	% reduction
Total Electricity usage (kWh)	3,372,430	3,190,050	5.4
Total Natural Gas usage (m^3)	466,645	420,980	9.8
Electrical Energy Intensity ($ekWh/ft^2/yr$)	26.3	25	4.9
Natural Gas Energy Intensity ($ekWh/ft^2/yr$)	37.7	34.3	8.9
Total Energy Intensity ($ekWh/ft^2/yr$)	64.0	59.3	7.3
Total GHG emissions (tCO_{2e})	1596	885	45

Table 2. Summarized baseline energy consumption data from January – December 2018. Associated GHG emissions are calculated each month for electricity, natural gas, and total utility consumption.

	Electricity			Natural Gas			Total		
2018	**Usage (kWh)**	**Energy Intensity (kWh/ft^2)**	**GHGs (tCO_{2e})**	**Usage (m^3)**	**Energy Intensity ($ekWh/ft^2$)**	**GHGs (tCO_{2e})**	**Total Usage (ekWh)**	**Energy Intensity ($ekWh/ft^2$)**	**GHGs (tCO_2 e)**
Jan	229,221	1.80	9.2	57,109	4.65	102.8	822,869	6.45	112.0
Feb	201,778	1.58	8.1	48,809	3.98	87.9	709,148	5.56	96.0
Mar	215,626	1.69	8.6	49,829	4.06	89.7	733,598	5.75	98.3
Apr	215,485	1.69	8.6	38,441	3.13	69.2	615,079	4.82	77.8
May	280,977	2.20	11.2	20,339	1.66	36.6	492,401	3.86	47.9
Jun	290,986	2.28	11.6	19,999	1.63	36.0	498,876	3.91	47.6
Jul	366,310	2.87	14.7	17,592	1.43	31.7	549,179	4.31	46.3
Aug	368,583	2.89	14.7	20,509	1.67	36.9	581,774	4.56	51.7
Sep	315,961	2.48	12.6	20,084	1.64	36.2	524,734	4.11	48.8
Oct	250,049	1.96	10.0	29,886	2.44	53.8	560,714	4.40	63.8
Nov	222,070	1.74	8.9	39,461	3.22	71.0	632,267	4.96	79.9
Dec	233,004	1.83	9.3	58,922	4.80	106.1	845,498	6.63	115.4
Total	**3,190,050**	**25.01**	**127.6**	**420,980**	**34.31**	**757.8**	**7,566,137**	**59.31**	**885.4**

3.2 Electricity Use Trends

Electricity consumption peaks during the warmer months, but remains relatively consistent throughout the rest of the year (Figure 2). The majority of electricity is used for HVAC (43%) and Lighting (26%) with seasonal demands influencing power used for space cooling (20%) (see Figure 3).A small rise in consumption occurs during the heating season in December and January, a result from the increased pumping of hot water for space heating. But the majority of the increase in electricity consumption above the baseload is due to space cooling.

Electricity consumption often has a strong correlation to cooling demand, measured in cooling degree days (CDD). When utility data from 2018 is compared with CDD, there is a strong correlation between energy use and outdoor temperature (see appendix A for calculations). Based on Hospital utility data, it suggests that each CDD will consume an additional 566 kWh.

The baseload consumption rate per month is on average 225125 kWh. Therefore, cooling dependent electricity consumption likely accounts for 15.31% of total electricity use, and non-cooling dependent (baseload) electricity consumption accounts for 84.69% of total electricity use. Given the increase in CDD days each year due to climate change, it is expected that space cooling costs and the overall cooling dependent electricity portion are likely to increase over the next several decades and should be considered as part of future energy plan costs and contingencies.

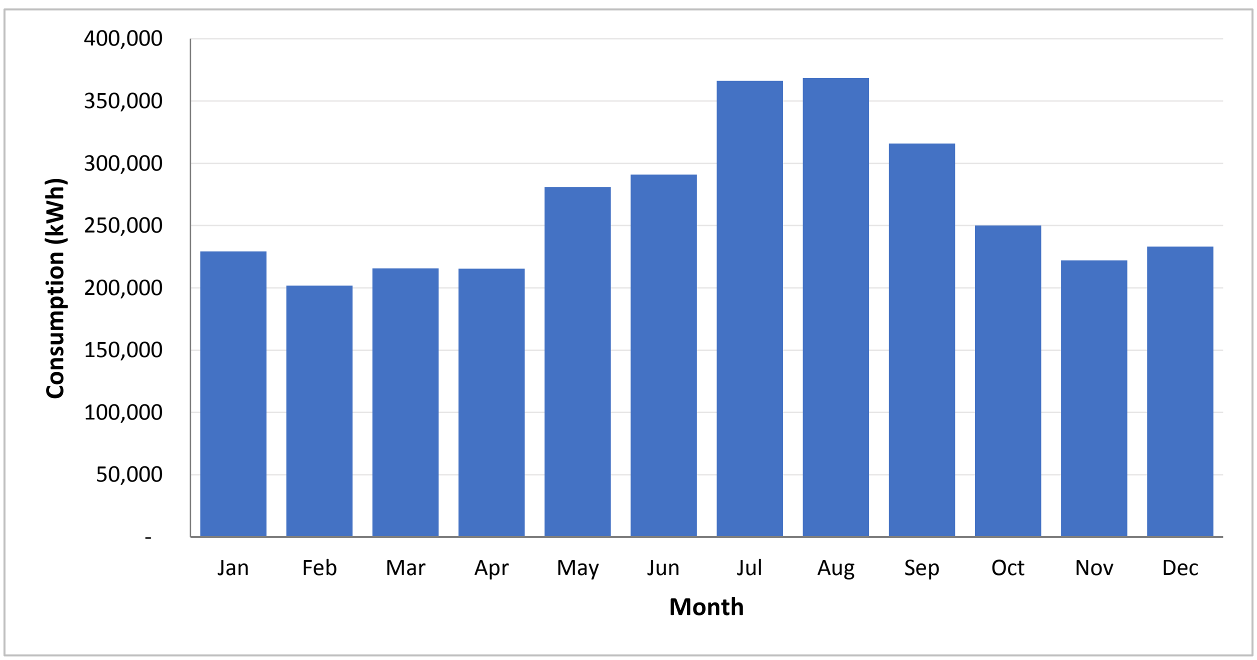


Figure 2. Monthly electricity consumption profile for 2018.

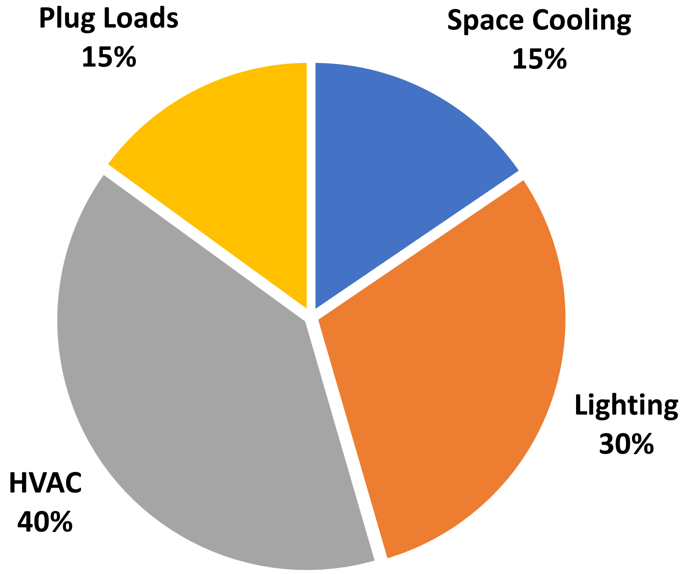


Figure 3. Electricity End Use (kWh) by area for 2018. Absolute values are found in Appendix C.

3.3 Baseline Natural Gas Use Profile

Natural gas consumptions peaks during the heating season in December and January, but remains relatively consistent through the warmer summer months (Figure 4). It shows that the baseload consumption per month on average is 18,139 m3. Natural gas use is split relatively evenly between space heating (47%) and domestic hot water and process (53%) (Figure 5) but uses significantly more in the colder months.

Natural gas consumption often has a strong correlation to heating demand, measured in heating degree days (HDD). When utility data from 2018 is compared with HDD, there is a strong correlation between heating and outdoor temperature (see Appendix B). Based on utility data, it suggests that each HDD will consume an additional 70 m3 of natural gas. Therefore, heating dependent natural gas consumption accounts for 48.29% of total natural gas use, and non-heating dependant (baseload) gas consumption accounts for 51.71% of total natural gas use.

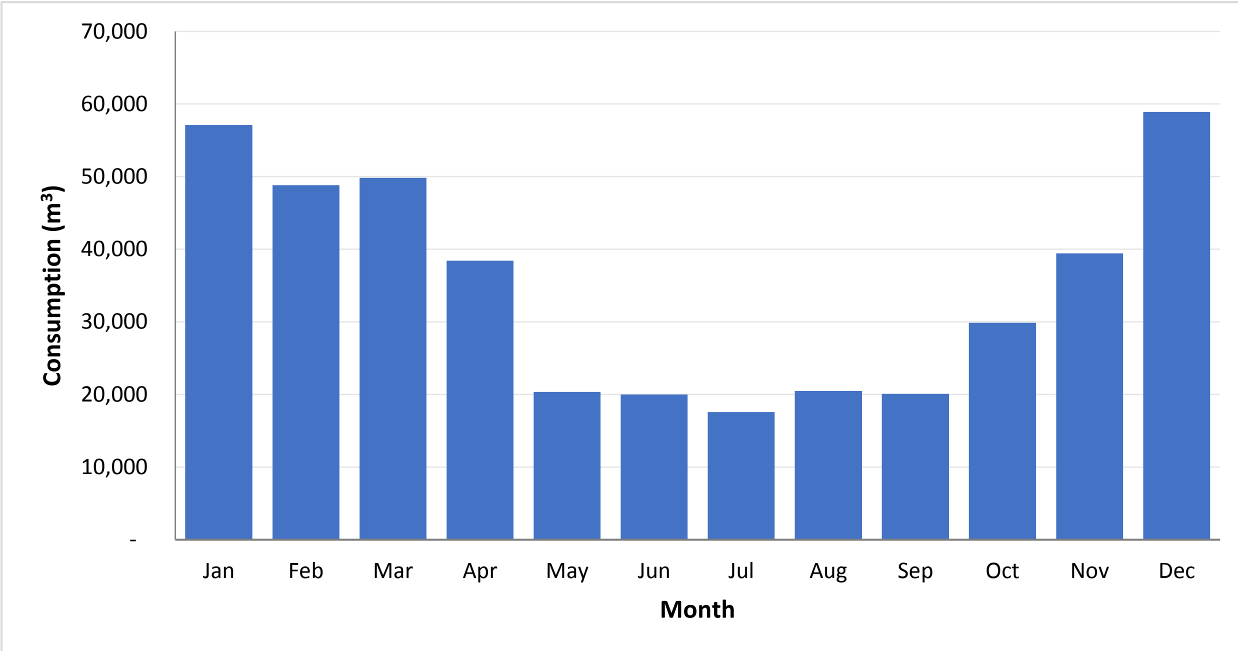


Figure 2. Monthly natural gas consumption profile for 2018.

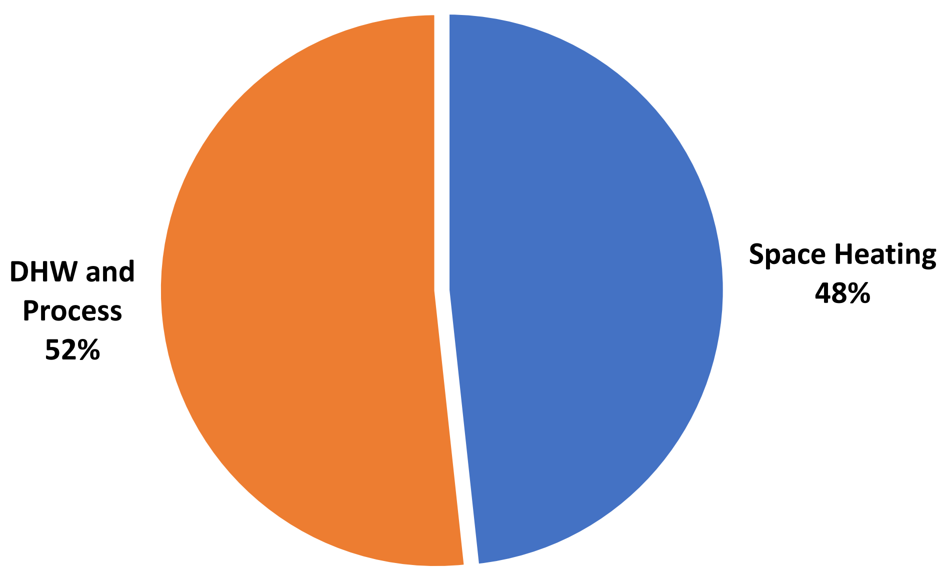


Figure 5. Baseline natural gas use (m^3) *in 2018 by area*. Absolute values found in Appendix D.

4. Infrastructure Improvements: 2013 – 2018

Since 2013, L&A Hospital has replaced and upgraded equipment and infrastructure that directly contributes to observed energy savings. For example, three air handling units have recently been replaced that project to save the hospital nearly 66,000 kWh annually (Table 3). The reduction in energy also translates into more than 2.5 tonnes of avoided CO_2 emissions. Other important upgrades that have contributed to the Hospital's reduced energy demand include a more energy efficient walk-in refrigerator, and ongoing LED light bulb replacements.

Table 3. Comparison of new air handling unit energy use with old unit performance. Savings are estimated assuming $0.14/kWh.

Air Handling Unit	Old Electrical Consumption (kWh)	New Electrical Consumption (kWh)	Savings (kWh)	Savings ($)	GHG Reduction (tonnes CO_2/yr)
AS09	87225	70889	16336	2287	0.65
AS08	62196	28487	33709	4719	1.35
AS07	85153	69200	15953	2233	0.64
Total	234574	168576	65998	9239	2.64

5. Energy Conservation Opportunities

This section identifies opportunities to reduce energy consumption and costs. An Energy Conservation opportunity is a type of project that is implemented to an existing building to reduce the consumption of energy. It can be implementing new technologies or upgrading existing ones, or be a change in operation or behaviour. In the case of the L&A hospital both options were taken into consideration.

5.1 Increased LED Replacement Rate

LACGH is currently undergoing an interior lighting upgrade throughout the building. T8 fluorescent lamps are being replaced by LED replacements. Building staff estimate they are replacing approximately 10% of the available T8s annually.

The cumulative lighting cost at the current rate of lamp replacement was compared with the cost of replacing all of the lamps immediately, and the cost differences are shown in Figure 6. It is estimated that by installing the LEDs in period over weeks instead of years, approximately

$360,000 could be saved over ten years. Labour costs and inflation have been included in the estimate. Based on these potential savings, it is recommended that the current replacement rate of 10% annually be significantly increased, even if labour needs to be outsourced to a third party, because the savings are substantial.

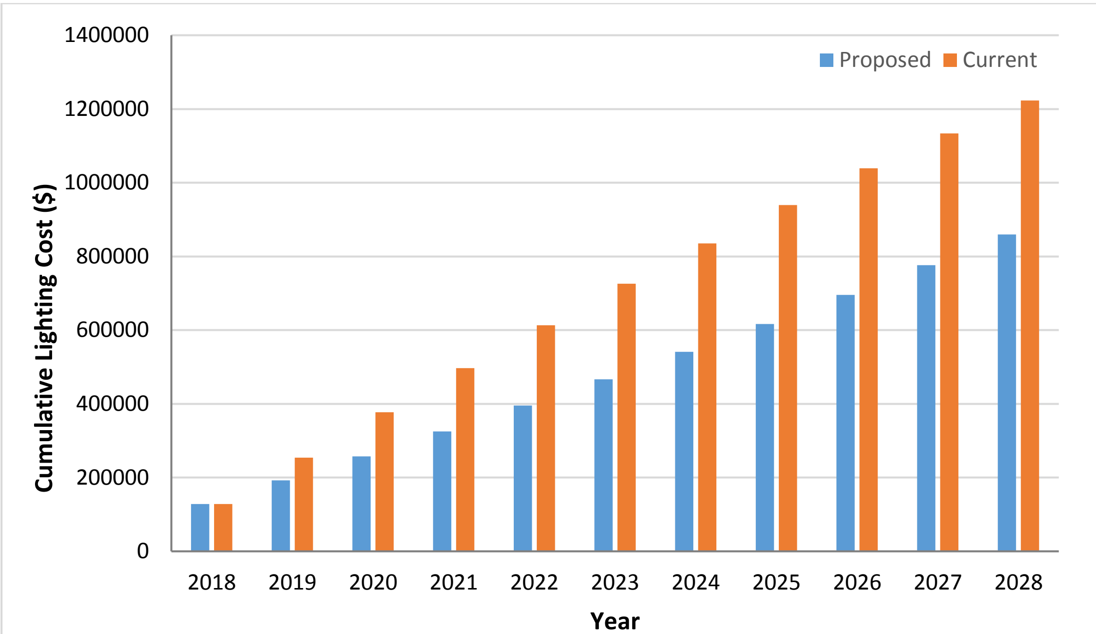


Figure 6. Annual Lighting costs for the current timeline Vs the proposed timeline over ten years.

5.2 Outdoor Lighting

There are currently twenty-two 400-watt metal halide lamps contributing to outdoor lighting at LACGH. The lamps are operating at an estimated 4804 hours per year consuming 42,275 kWh. It is recommended switching to 150-watt LEDs in order to save 22,422 kWh in electricity annually, but to also save significant amounts of money long term (Figure 7). While the cost of installation would be $6,726, the utility savings after the first year alone is $3699. Other benefits of switching outdoor lights:

- Simple payback on investment is only 1.8 years
- NPV value estimate of $26,602
- Reduction in GHG emissions by 1.05 tonnes CO_2/year

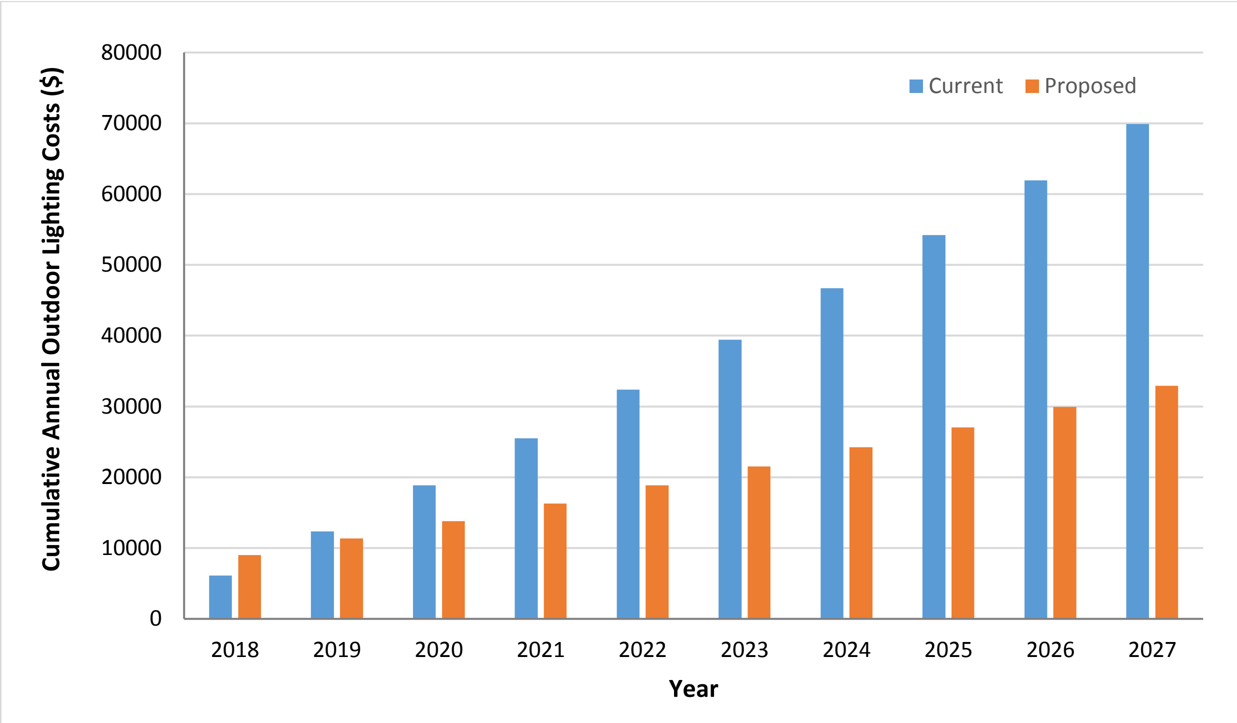


Figure 7. Cumulative Outdoor Lighting Costs - Current Vs Proposed outdoor lighting costs from 2018 to 2027.

5.3 Demand Control Ventilation

The current HVAC system at LACGH provides ventilation for all areas of the building 24/7, regardless of whether an area needs ventilation at that specific time. It is recommended that demand-controlled ventilation be incorporated into the ventilation and building automation system (BAS). This is traditionally done by installing CO_2 sensors into the return air ducts to continuously monitor the ventilation demands of the serviced area and make this information available to the BAS. The BAS would then control the air handling units (AHU) and their variable speed drives, adjusting the ventilation rates based on CO_2 measurements at the time.
Some areas may require adherence to specific ventilation codes such as a set air exchange per hour (i.e. labs, operating rooms), but due to the customizability of these systems, these specific areas could utilize more detailed sensors that monitor and respond to different parameters. The inclusion of this system would result in substantial savings from matching ventilation to demand, saving energy by not providing ventilation to areas where it is not required. The HVAC system currently accounts for approximately 40% of electricity use and is therefore a key area

for energy savings. More investigation is needed to provide accurate savings estimates, however the benefits of demand-controlled ventilation include:

- Improved Indoor Air Quality (IAQ)
- Improved energy efficiency and lower ventilation costs
- Lower maintenance costs
- Increased life expectancy of ventilation equipment
- ‘Smarter’ ventilation control

5.4 Occupancy Sensors

It is recommended that occupancy sensors be further installed throughout the hospital in all applicable areas. They are useful to control lighting, ventilation, heating and cooling in a space. Educating staff and the public to turn off lights in rooms is a positive approach, but automation reduces costs and ensures reliability. Areas to consider:

- Bathrooms and change rooms are good areas to be controlled by occupancy sensors because energy from the lighting and exhaust fans can be reduced.
- Lighting sensors can also minimize the spread of infectious diseases by minimizing contact with light switches and other controls in and around washrooms.
- Promoting the practice of shutting off lights when a space is not in use is recommended, but occupancy sensors automate this process and allows hospital staff to focus on their many responsibilities.

5.4 Daylighting Controls

By utilizing natural outdoor light, indoor artificial light can be reduced to save energy, money and contribute to a healthier environment. When adequate lighting is present from the outdoors through windows and doors, indoor lighting can be dimmed or turned off without negatively impacting the occupants of the building. These controls can be incorporated into the building automation system and involve lux sensors to measure the amount of natural light available. They also involve the incorporation of dimming switches on the indoor lighting to scale the light levels to a certain set-point. For example, in areas such as the main lobby that are well-lit by daylight, sensors could dim lights in those areas when there is sufficient natural light during the day. Daylighting controls are a relatively inexpensive way to save energy and costs associated with indoor lighting.

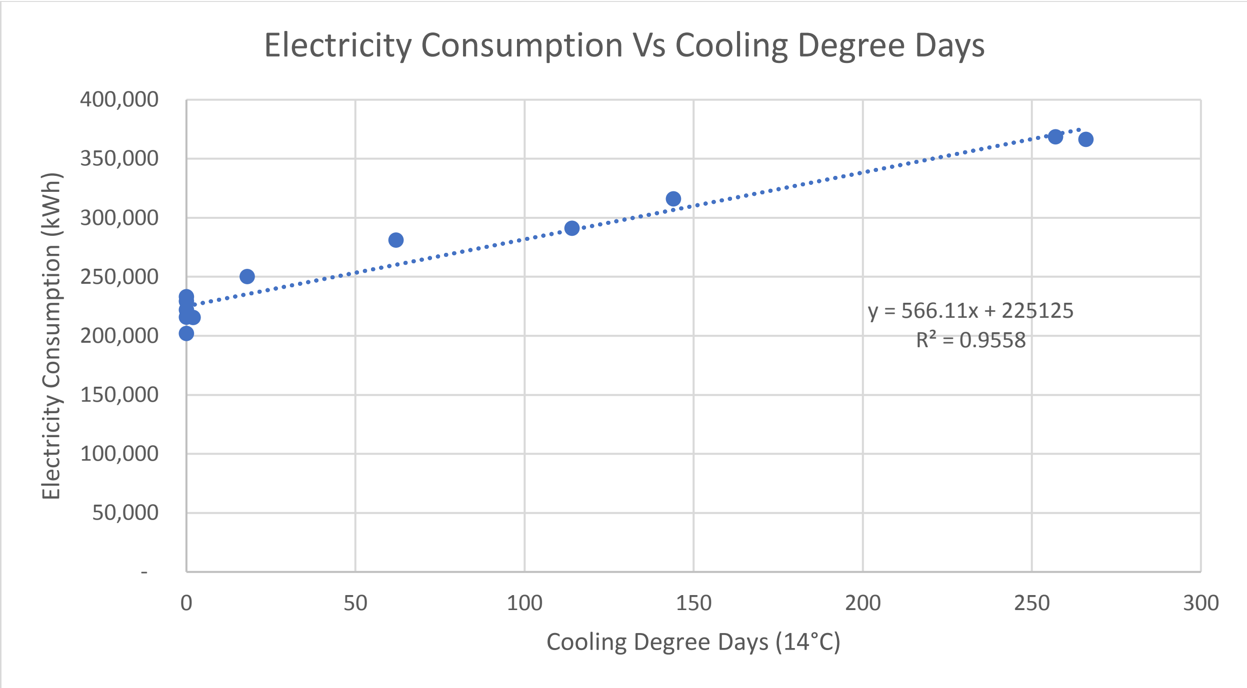
6.0 Report Takeaways

Overall, the main takeaways from this energy demand and conservation management report include:

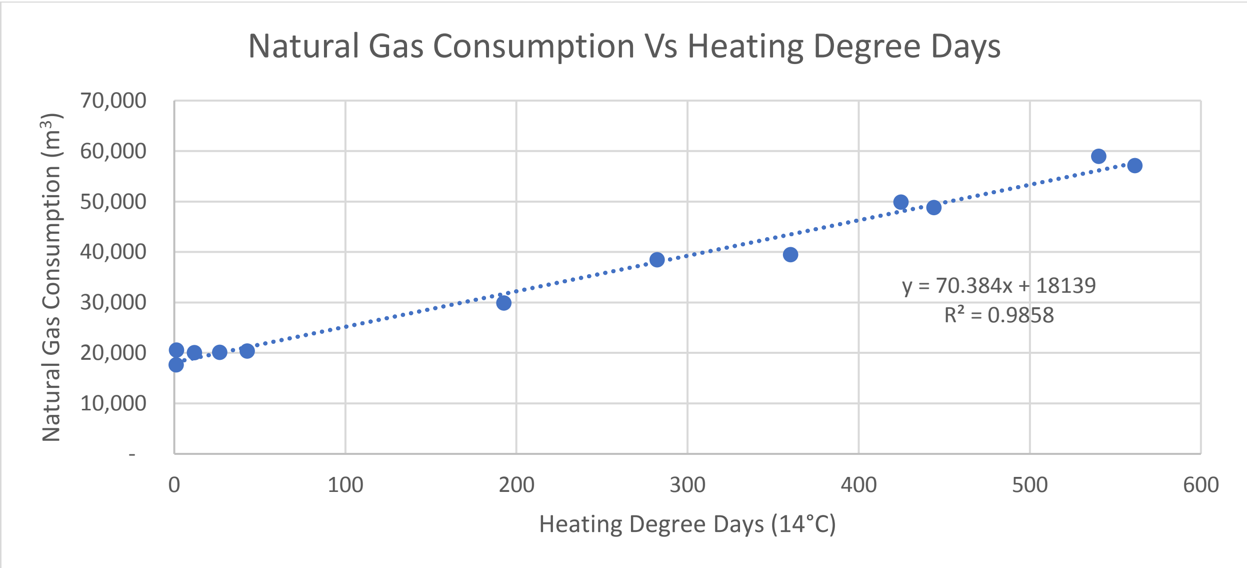
- Overall electricity and natural gas consumption in 2018 was down from 2013
- Total energy intensity for the hospital is less than 2013 and below the last reported provincial average
- There are significant improvements to energy use that can be made, but as identified in this report, they also offer significant economic savings long-term

Appendix

Appendix A – Electricity Regression Analysis



Appendix B – Natural Gas Regression Analysis



Appendix C – Electricity End Use Values

Electricty End Use	kWh	Percentage
HVAC	1,276,020	40%
Lighting	957,015	30%
Plug Loads	478,507.5	15%
Space Cooling	478,507.5	15%
Total	3,190,050	100%

Appendix D – Natural Gas End Use Values

Energy End Use	m^3	Percentage
DHW and process	217,668	52%
Space heating	203,311.222	48%
Total	420,980	100%