Ottawa's Energy Outlook:

20 ENERGY MANAGEMENT CASE STUDIES

SustainableEasternOntario.ca

Celebrating sustainability efforts in Ottawa

20 case studies highlighting energy projects around the city

Raising the profile & capacity of sustainability initiatives.

Telling the story of transition & resilience in our community.

Ottawa ieso

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INTRODUCTION

BACKGROUND

Energy management - how energy is generated, transported, and used - is key to creating more liveable cities and combating climate change. Scale plays a role in these issues - some initiatives work better when developed at a national or provincial level, whereas others occur at the grassroots level, relying on individuals making changes in their own homes. In the middle, however, there is room for substantial improvement. Municipalities and medium-sized entities such as schools, hospitals and care homes, often fall between the cracks of programs designed to work at a larger or smaller scale, but they are major energy consumers who are often interested in reducing their energy use, both for financial and environmental sustainability reasons.

Sustainable Eastern Ontario (SEO) is a network organization that fosters collaboration, information sharing, and partnerships both within the environmental non-profit sector, and between non-profits and other stakeholders in sustainability issues, so it was only logical for SEO to become involved in this issue. Supported by the City of Ottawa (currently developing and implementing their own Energy Evolution: Ottawa's Community Energy Transition Strategy), SEO received funding from the Independent Electricity Service Operator (IESO) to research and document some of the great energy-focused work that individual organizations have undertaken on a mid-range scale, as well as facilitate the spread of these good ideas by disseminating the resulting information and insights. Through production of case studies, and targeted outreach to relevant organizations, we hope to celebrate the steps already taken towards sustainability by municipal departments, transit services, hospitals, and others, as well as ensure that further steps continue be taken.

The benefits of improved energy management go beyond environmental sustainability to include cost savings, increased safety and comfort, and public health benefits. However, the perceived complexity and expense of these projects is often a barrier for organizations taking action, or even realizing they could take action. We hope that by raising awareness about practical projects that are already underway or have been completed, in combination with concrete information regarding cost, payback time, and incentive programs, we can tilt the balance towards action for many others.

HOW TO USE THESE CASE STUDIES

In addition to this booklet, the results of our research are available as individual case studies, designed to be shared with interested individuals who could benefit from learning more about what other organizations similar to their own have done, or who are interested in a specific technology or technique in a mid-sized setting. These case studies are designed to quickly share the most important information on each project (such as cost, incentives received, payback time, and carbon reduction) in an engaging and approachable way. We hope that these examples, whether individually or together, will provide a solid starting point for those serious about creating change at their own organizations.

DISCLAIMER

This initiative was made possible in part through the financial support of the Independent Electricity System Operator's (IESO) Education and Capacity Building Program.

Sustainable Eastern Ontario is solely responsible for implementation of, and the content of any materials produced by, this initiative, and the IESO has no responsibility or liability whatsoever in the event that any person suffers any losses or damages of any kind as a result of the initiative. The opinions and views expressed here belong to Sustainable Eastern Ontario.

OTTAWA'S LIGHT RAIL TRANSIT PROJECT

Riding the O-Train to a Greener Future

Ottawa's O-Train network is undergoing a two-phase expansion

Confederation Line Stage 1 (2018): will improve transit efficiency and reliability through downtown core

Stage 2 LRT Project (2021-2023): will extend the network farther east, west and south

Within Ottawa, transportation is responsible for around 40% of all local greenhouse gas emissions. The completion of Ottawa's upcoming light rail transit (LRT) projects will result in the single greatest reduction of emissions in Ottawa's history.

"Ottawa's Light Rail Transit investment will change the way we move around the city creating shorter commutes, cleaner air, and a stronger economy".

– Steve Cripps, Director O-Train Construction, City of Ottawa

70%

Will bring 70% of residents within 5 km of rail by 2023

110,000

Will reduce annual greenhouse gas emissions by over 110,000 tonnes by 2048

1 INTRODUCTION

Residents of Ottawa have seen "Ready4Rail" and "pretpourletrain" across the city as OC Transpo prepares to launch the new Confederation Line. To date, the Confederation Line is Ottawa's largest infrastructure project and promises "shorter commutes, cleaner air, and a stronger economy"[2].

2 PROJECT DETAILS

The Ottawa City Council approved the Design, Build, Finance and Maintenance of Ottawa's Light Rail Transit Project Report in December 2012. This project, referred to as the "Confederation Line", is currently under construction and scheduled to open in 2018. This $2.1 billion investment in public transit is being implemented through a 30-year Design-Build-Finance-Maintenance agreement with the Rideau Transit Group. Once built, the Stage 1 Confederation Line will include 12.5 kilometres of rail and 13 stations from Tunney's Pasture in the west to Blair in the east, including a tunnel through the downtown core.

The second phase of work, called "Stage 2 LRT", will see the O-Train Confederation Line expand eastward to Trim Road and westward to Moodie Drive and Algonquin College.

Stage 2 LRT will also expand the O-Train Trillium further south to Earl Armstrong and Bowesville, including new stations at Walkley and Gladstone, and a four-kilometre split to the Ottawa Macdonald-Cartier International Airport.

These extensions will launch in staggered openings, with the O-Train Trillium Line South slated to open in 2021, followed by the O-Train Confederation Line East in 2022, and O-Train Confederation Line West in 2023.

3 RESULTS

There are many anticipated benefits to this LRT investment. One of the most recognizable results is the reduction in greenhouse gases (GHGs) and critical air contaminants (CACs). These have direct implications for the overall sustainability of urban growth and direct consequences on the health of the city's residents. It is estimated that the Stage 2 LRT project will result in nearly 50 million litres of savings in fuel consumption, and a reduction of approximately 110,000 tonnes of GHGs and 3,000 tonnes of CACs (including carbon monoxide, nitrous oxides, sulphur oxides and particulate matter) per year by 2048. The economic value of these reductions will total in the order of $438 million between 2023 and 2048.

Additional benefits include increased passenger capacity and improved reliability. When the Confederation Line enters revenue service in 2018, it will be capable of transporting 10,700 passengers per hour in each direction. Over time, should sufficient demand materialize, this capacity can be increased to 18,000 passengers per hour in each direction. Once Stage 2 LRT is complete, the O-Train network will be capable of transporting 24,000 passengers per peak hour in each direction.

The Confederation Line will be served by environmentally friendly Alstom Citadis Spirit trains able to accommodate up to 600 passengers on two, coupled vehicles, with zero emissions and a regenerative braking system that provides power back to other trains on the Confederation Line. Once Stage 2 LRT is complete in 2023, passengers travelling on the electric powered Confederation Line will be able to travel emission-free from Trim Road in the east to Moodie Drive and Algonquin College in the west.

The Stage 2 LRT project will encourage active transportation through the creation of more than 30 kilometres of multi-use pathways. Pedestrians and cyclists will benefit from these multi-use pathways being fully accessible to each Stage 2 LRT station. The communities adjacent to the stations were studied to identify opportunities to enhance connections, facilitate formal pedestrian and cycling connections to the station, and link to the Citywide Multi Use-Pathway system.

Finally, the Stage 1 Confederation Line is anticipated to create thousands of direct and indirect jobs, with the total economic output estimated at approximately $3.2 billion. Building on this, the total economic output for Stage 2 LRT is anticipated at approximately $4.5 billion (2018), creating over 21,000 person-years of employment.

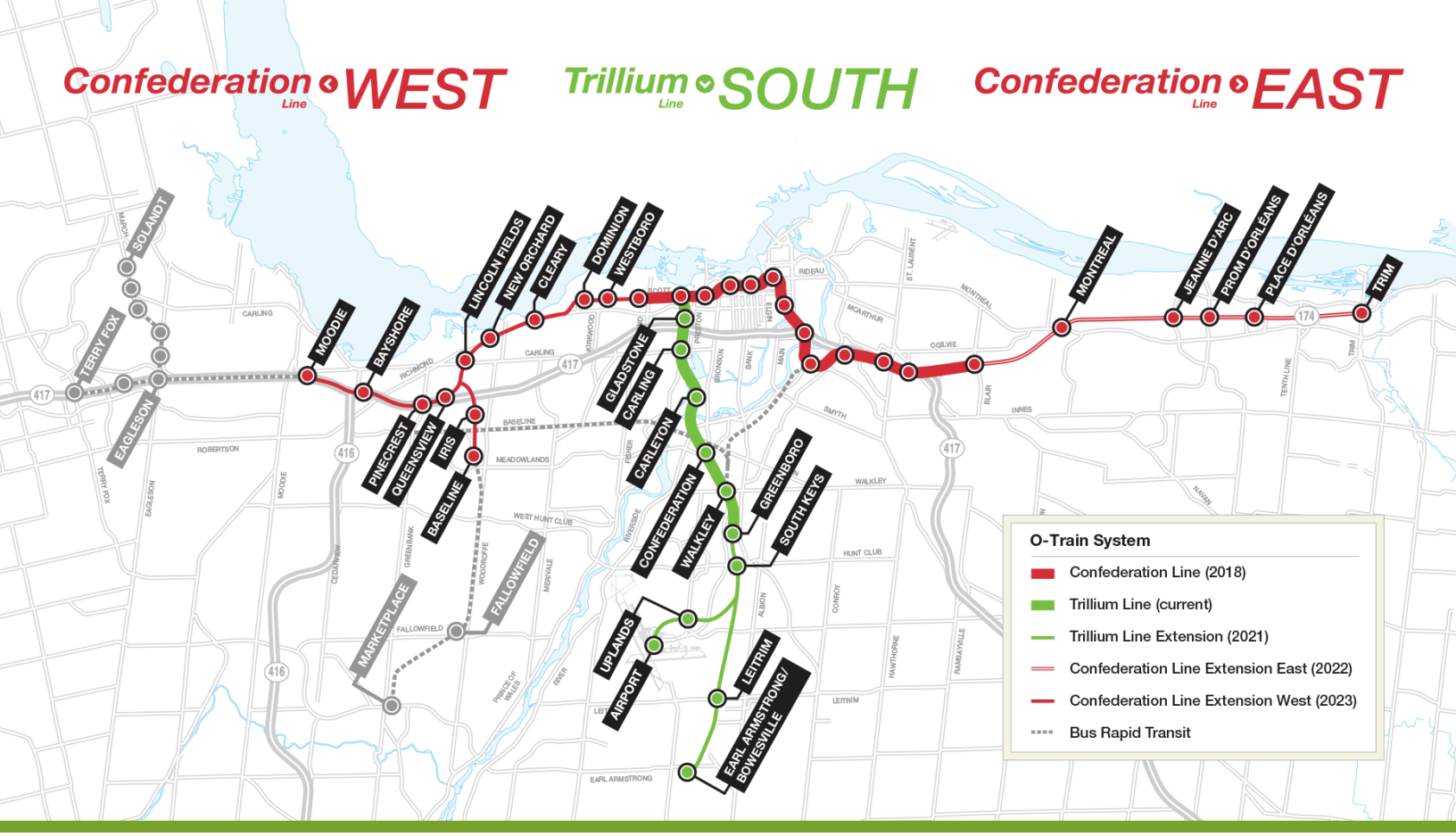

Figure 1: Map showing Phase 1 and 2 of the Confederation Line[2]

4 CONCLUSIONS & REFLECTIONS

The expanding LRT will change the way we move around Ottawa. When the Stage 2 LRT Project is complete in 2023, Ottawa's O-Train network will span more than 60 kilometres with 40 stations, bringing 70% of Ottawa's residents within five kilometres of rail. This means shorter commutes, cleaner air, and a stronger economy. With Ottawa projected to grow to 1.14 million people by 2031, these investments in our public transit system will help ensure our nation's capital continues to be one of the best places in the world to live and work.

60km

Ottawa's O-Train network will span more than 60 kilometres with 40 stations.

These investments in our public transit system will help ensure our nation's capital continues to be one of the best places in the world to live and work

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Charging towards a greener future

THE CITY OF OTTAWA'S CORPORATE ELECTRIC VEHICLE CHARGING STATION POLICY

Supporting electric vehicle use by providing charging stations on City property

City of Ottawa's Planning Infrastructure and Economic Development Department

With swimming lessons, dog obedience training and Jiu-Jitsu classes on offer, it's hard to imagine that our enjoyment of Ottawa's extensive municipal recreation facilities could be much improved. However, a brand new City policy may just change that. With the recent approval of the Corporate Electric Vehicle (EV) Charging Station Policy, the City has outlined its plan to increase EV charging infrastructure at new municipal facilities. How is that for an added bonus: a convenient and fast charge for your electric car while you are waiting for your children's hockey practice to finish or while you are perfecting your backhand swing on the tennis court?

"By providing charging stations at City locations, the City is supporting residents to make the switch to EVs and transition to a low carbon future."

- Jen Brown, Project Manager, Environmental Programs, Resiliency and Natural Systems Planning Unit, City of Ottawa

2017

New City of Ottawa Policy, approved in December 2017

Provides a framework for ownership of, paying for and managing new charging facilities

1 INTRODUCTION

Prior to the Corporate EV Charging Station Policy, the City of Ottawa had made some strides in developing the EV charging network in Ottawa:

- Before 2016, the City installed seven Level 1 charging stations and eight Level 2 charging stations on municipal property. (The level of an EV charging station refers to the voltage supplied by the charger. A Level 1 charger uses a standard 120 volt outlet, while a Level 2 charger delivers 240 volts thereby fully charging an EV in almost a third of the time.)
- Between 2016 and 2017, Electric Circuit installed an additional seven Level 2 charging stations and six DC Fast Chargers on City property, with the latter being some of the first DC Fast Chargers in Ottawa. (DC Fast Chargers deliver 480 volts, and are the fastest chargers available today, providing around 65 kilometers of range for every 10 minutes of charging time). Funding for these most recent charging stations was through the $20 million EV Chargers Ontario (EVCO) grant program[2]. Locations on City property included Park and Rides, municipal parking lots and a client service centre.

These individual projects helped grow the EV charging station network in Ottawa, however their installation generally occurred in an ad hoc and incidental fashion given that there was no framework in place outlining where, when and how to install and operate charging stations.

The Corporate EV Charging Station Policy changed this, with the 2014 Air Quality and Climate Change Management Plan[3] providing the direct impetus for this new policy's development. The new policy additionally complements ongoing efforts on the Energy Evolution: Ottawa's Community Energy Transition Strategy, with both initiatives working towards reducing community-wide emissions by 80% below 2012 levels by 2050[4].

2 PROJECT DETAILS

Introduced in 2017, the policy strives to address two goals. First, it supports the use of EVs by formalizing guidance about the installation of charging stations at new and renovated municipal facilities. And second, it contributes to reducing greenhouse gas emissions from the transportation sector in Ottawa (which is currently responsible for 40% of all local greenhouse gas emissions[3]) by supporting the transition away from fossil fuels within Ottawa's vehicle fleet.

The policy has a number of key recommendations regarding its application, including:

- Ownership and operation of the charging infrastructure should be prioritized to remain in the hands of the third party partners, as third party partners will be better equipped to adapt to changes in EV technology.
- Mandating the requirement of Level 2 charging stations at new and major expansions of City facilities, with Level 1 and DC Fast Chargers considered on a case-by-case basis.
- A fee structure that is representative of the different levels of service being offered. For instance, the DC Fast Chargers charge vehicles much faster than the Level 1 and 2 chargers and will thus have a higher user fee[6].

3 RESULTS

The draft policy was presented to the Environment and Climate Protection Committee on November 21, 2017, before being approved by the City Council on December 13, 2017. As such, it is too soon to report on any observed results as the policy was only approved recently.

The policy will be reviewed by Economic Development and Long-Range Planning staff at the end of 2018, as well as in three-year's time, to ensure it remains current and effective. Additionally, staff will periodically conduct a review to ensure that the policy is in keeping with legislative requirements and best practices.

4 CONCLUSIONS & REFLECTIONS

This new Corporate EV Charging Station Policy is only one piece of a larger effort to encourage community-wide adoption of EVs in Ottawa specifically and in Ontario more broadly. Other complementary components include a number of provincial initiatives including

- Amendments to Ontario's Building Code, coming into effect on January 1, 2018, will require that 20% of parking spaces in new buildings be equipped with EV charging infrastructure.
- A multi-year EV Incentive Program which offers incentives for the purchase or lease of eligible EVs, as well as for the development of charging stations in Ontario[7].

The new Corporate EV Charging Station Policy is an important next step in our journey to a lower emission transportation sector, and one that by its nature may be easy for other municipalities to adopt and learn from in their own journey to reduced emissions.

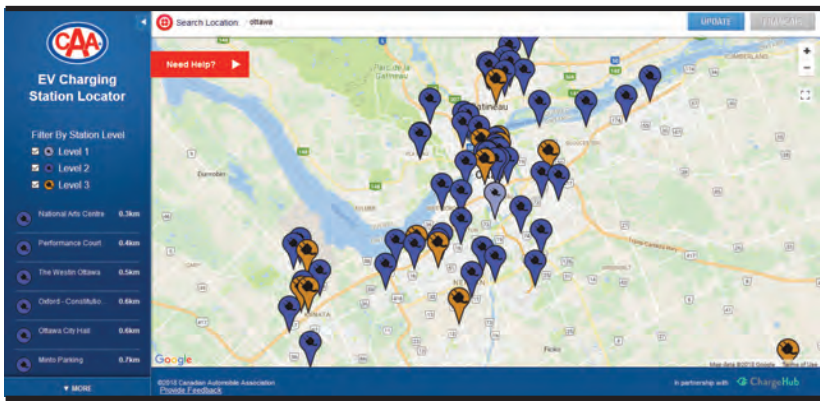

Figure 1: Location of EV charging infrastructure in Ottawa as of December 2017 [5].

Figure 2: An existing EV charging stations at municipal facilities: at 170 Second Ave[1].

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The City of Ottawa's

GREEN MUNICIPAL FLEET PLAN

How ambulances and other municipal vehicles are helping to reduce greenhouse gas emissions

City of Ottawa's Fleet Services

Commuting to work; road-trips; grocery runs; holiday travel: transporting people, products and things is a fact of life. Within Ottawa, transportation is responsible for around 40% of all local greenhouse gas emissions, second only to the building sector, which accounts for a further 49% of the city's emissions[2]. In addition to greenhouse gases, transportation is estimated to produce over 85% of total nitrogen oxide emissions, 90% of carbon monoxide, 60% of sulfur dioxide and smaller quantities of assorted carcinogens[3]. Through its Green Municipal Fleet Plan, the City of Ottawa has taken concrete steps to lead by example when it comes to reducing the harmful emissions associated with their municipal transportation operations[4].

"Fleet Services is always striving to reduce our carbon footprint. We aim to reduce the greenhouse gas emissions of our fleet of vehicles while still ensuring that services to our residents are maintained."

- Luke Senecal, the Manager of Fleet Lifecycle and Safety at the City of Ottawa

CO_2

Developing short-, medium- and long-term plans to reduce emissions from City of Ottawa municipal vehicles

Separately targeting emissions from public transit versus the remainder of the municipal vehicle fleet

1 INTRODUCTION

The current Green Municipal Fleet Plan stands on the shoulders of many policy instruments that came before it. In March 2002, the City Council approved the first ever Fleet Emission Reduction Strategy (FERS)[5]. This strategy, updated in 2004[6], set out a plan to achieve reduced exhaust emissions from the City's municipal and transit vehicle fleets, focusing on actions such as participation in ethanol-blended diesel trials, researching the potential of biodiesel, adding catalytic converters to older buses, and converting all City fuel sites to ethanol-blended gasoline, as well as laying the groundwork for a zero emissions transit bus fleet[5,6].

In 2008, Transit Services underwent a reorganization that resulted in the separation of the City's Municipal and Transit Fleets. Thus, post-2008, updates to the emissions reduction strategy were released in the form of a distinct Transit Vehicle Emissions Reductions Strategy (TVERS)[7] and a Municipal Fleet Emissions Reductions Strategy (MFERS)[8]. The first MFERS was released in 2009; however, staff soon initiated steps to broaden the scope of this initiative, ultimately incorporating it within the so-called Green Municipal Fleet Plan (GMFP).

The objective of the GMFP is to achieve large-scale greenhouse gas reductions and lessen the environmental footprint of municipal fleet operations[8].

2 PROJECT DETAILS

This first GMFP contained 24 action plans, focused on 6 priority areas, including the establishment of targets, exploring emission reduction options and monitoring emerging technologies[9]. To better align with new Council priorities and the 2014 Air Quality Climate Change Management Plan, the GMFP was updated once more in 2016. This most recent update outlined the plan for 2016 through 2018, with three main initiatives identified:

- Research and acquire alternative vehicle types (e.g. hybrid and electric vehicles)
- Research and pilot the usage of alternative fuels (e.g. compressed natural gas and biodiesel)
- Pilot and adopt the usage of vehicle telematics, which, among other things, allows tracking of idling for each individual vehicle in a fleet[9]

3 RESULTS

Since the development of the very first FERS back in 2002, the City has been setting and achieving important emission reduction milestones. In the 2002 FERS, the City committed to reducing its corporate emissions by 20% relative to 1990 levels, by 2005. This target was met in 2004, one year ahead of schedule. (One cannot ignore the hard work the former, un-amalgamated City of Ottawa had conducted between 1991 and 2001, already resulting in a 19% reduction in emissions relative to 1990 levels[5].) Subsequently in 2009, a revised corporate target of 30% emission reduction relative to 1990, by 2012 was approved by City Council[8], which has since been updated to be consistent with Government of Canada and Government of Ontario targets, seeking to reduce community-wide emissions by 80% below 2012 levels by 2050[10]. Within this larger community-wide target, the GMFP is working towards a 1% reduction in municipal fleet emissions per year[11].

Driven by these increasingly stringent targets, Ottawa Fleet Services spent a busy few years implementing a variety of different initiatives, before then turning their focus to the monitoring and evaluation of these new initiatives. To everyone's disappointment, they discovered that between 2012 and 2016, the municipal fleet's performance had in fact worsened by 11.9% (as quantified by the performance metric used at the time: liters of fuel consumed per 100 kilometers of driving)[12]! Closer inspection of these results raised two concerns:

- First, use of the metric liters of fuel per 100 kilometers ignored the benefit of transitioning from diesel or gasoline to cleaner fuel sources like biodiesel or compressed natural gas. This evaluation metric has since been updated to percentage greenhouse gas emission reduction, which takes fuel type into account and is consistent with other municipal initiatives[12].

- Second, the choice of 2012 as a baseline year ignored the fact that 2012 was a particularly warm and snowless year requiring well below normal levels of snow-removal, and the more than doubling of the size of the municipal garbage collection fleet that occurred in late 2012. (Garbage collection trucks are the least fuel efficient vehicle within the municipal fleet due to their size and extreme duty cycle). Both of these factors resulted in the fleet's performance appearing to worsen over time, whereas mild weather in the baseline year and service expansion after the baseline year were in fact to blame. The baseline year has since been updated from 2012 to the more representative 2013[12].

Having addressed these measurement concerns, monitoring results from 2016 suggest that municipal green fleet initiatives completed to date have reduced vehicle greenhouse gas emissions by 6.3% since 2013[13].

Looking in more detail at the Green Fleet's achievements of 2017, 11 new hybrid vehicles were acquired this year, further exploration of biofuels and the retrofitting of existing vans and pick-up trucks with hybrid technology was conducted; and 21 telematics devices were installed to track engine idling time. A particularly noteworthy project that is close to completion is the installation of anti-idling devices on all 77 ambulances in Ottawa[13]. Ambulances traditionally had to keep their engines running during their entire operating shift in order to prevent critical medicines inside the ambulances from either freezing in winter or overheating in summer. At a cost of around $3,000 each, these anti-idling devices enable automatic temperature control of the interior of the ambulance even when the engine is off. It is estimated that ambulances had been idling their engines as much as 50% of the time, suggesting substantial emission reductions can be achieved by installing these devices[12].

4 CONCLUSIONS & REFLECTIONS

Significant work has been done over the past few years to reduce Ottawa's greenhouse gas emissions, and the number of initiatives continues to grow. This case study documenting the work of GMFP focuses on just one small portion of a much larger effort, with the City of Ottawa's Complete Streets Policy, Corporate Green Building Policy and light rail transit project just a small sample of the vast array of other emissions reduction initiatives underway in this city. The City of Ottawa's future certainly looks greener as a result.

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Developing roads for all users

THE CITY OF OTTAWA'S COMPLETE STREETS POLICY

De-emphasizing automobile users in street design

Throughout Ottawa

From horse-drawn trams, to electric streetcars, to personal automobiles, the design and usage of a city's streets are good indicators of evolving societal trends and priorities. Within the city of Ottawa, the next step in that evolution is currently underway with the adoption of the City's Complete Streets policies. What is a Complete Street? "Complete Streets incorporate the physical elements that allow a street to offer safety, comfort and mobility for all users of the street regardless of their age, ability, or mode of transportation"[2].

"Complete streets are designed to take all users, ages, abilities and modes of travel into consideration. In other words, streets are more than through-ways for cars getting from point A to point B. Complete streets are about moving people – not just cars – and creating a more efficient transportation system in the process."

- says Robb Barnes, Executive Director, Ecology Ottawa.

Complete Streets are designed for all users, encouraging more transit use, walking and biking

Creation of safer neighbourhoods, reduction on car dependence and lowering of vehicle emissions

1 INTRODUCTION

In the past several decades, street use in Canada has been dominated by a focus on automobiles. Facilitating the efficient and timely passage of large numbers of personal vehicles has typically been the priority, while consideration of other groups of road users such as pedestrians and cyclists is often squeezed in, working around the needs of car-users.

Launched in 2004 in the United States by the National Complete Streets Coalition, the so-called Complete Streets approach to street design and use changes this, with equal emphasis placed on all road users, rather than simply adding additional modes of transport as an afterthought[3].

Complete Streets typically include features such as (protected) bike lanes, landscaped areas and traffic calming measures as well as wider sidewalks and crosswalks.

2 PROJECT DETAILS

Formally adopted by the City of Ottawa in November 2013 as part of the Transportation Master Plan Update[4], Complete Streets policies have previously also been adopted in Toronto (2009), Calgary (2009), Waterloo (2010), Edmonton (2013) and Ajax (2013)[5]. This initial adoption of Complete Streets policies in Ottawa was subsequently operationalized through the release of a Complete Streets Implementation Framework in October 2015 which outlined in more detail how these new policies were to be implemented[6].

Importantly, this framework aligned with new Multi-Modal Level of Service guidelines developed by the City[6]: the concept of Level of Service is a common metric used to evaluate the performance of a transportation system, typically from the perspective of a driver. As the historic emphasis of transportation planning has been on cars, such Levels of Service were previously defined only for motor vehicles.

These new Multi-Modal Levels of Service guidelines document the development of equivalent performance metrics for other modes of transport that have been overlooked in the past, such as guidelines and metrics available to help planners include pedestrians, cyclists, transit and trucks in their planning.

3 RESULTS

Complete Streets are lauded as offering a wide ranging of benefits as compared to traditional street designs[7]:

- they help reduce traffic and thus traffic accidents by encouraging more people to take public transit, bike and walk;
- they contribute to building safer, more livable and welcoming communities;
- they encourage more active forms of transport, which in turn have substantial public health benefits;
- less traffic on the roads results in reduced fuel usage and consequently lower greenhouse gas emissions and other pollution (the transportation sector in Ottawa is currently responsible for 40% of all local greenhouse gas emissions[8]);

They improve the lives of people with mobility impairments or disabilities because their needs are explicitly considered in the street design process.

So far, a number of road projects have been completed in Ottawa that incorporate Complete Streets design principles: O'Connor Street, Churchill Avenue and Main Street; Campeau Drive Extension in Kanata and Robert Grant Drive in Stittsville; as well as sections of St. Laurent Boulevard and Queen Street.

4 CONCLUSIONS & REFLECTIONS

In spite of this vast suite of benefits, Ottawa has experienced first hand some of the practical growing pains of the journey towards a Complete Streets approach to transportation. Following the 2016 transformation of Churchill Avenue and Main Street, some users have had difficulty acclimatizing to the reduced number of vehicle lanes, slower speed limits and the narrowed intersections. They have expressed concerns about the added attention drivers must pay to the new bike lanes and the high speeds of some cyclists, as well as excess new road signage[9].

Time will tell if these early impressions are simply a normal part of acclimatizing to this new normal or if they are a sign of true reasons for concern. According to Kornel Mucsi, Program Manager of Transportation Planning at the City of Ottawa, most users are experiencing the new streets as a win-win: in cases where elevated cycle tracks are implemented, bicyclists are typically happy to be safely off the road and away from cars, while drivers are likewise happy that bikers are off the road and out of the way. Looking to the future, the City of Ottawa has further Complete Streets projects planned for sections of Elgin Street, Bank Street and St. Laurent Boulevard[9], as well as many new suburban streets.

The City of Ottawa has further Complete Streets projects planned for sections of Elgin Street, Bank Street and St. Laurent Boulevard

Figure 1: Bikes in among vehicle traffic on Elgin Street, circa 2017[10]

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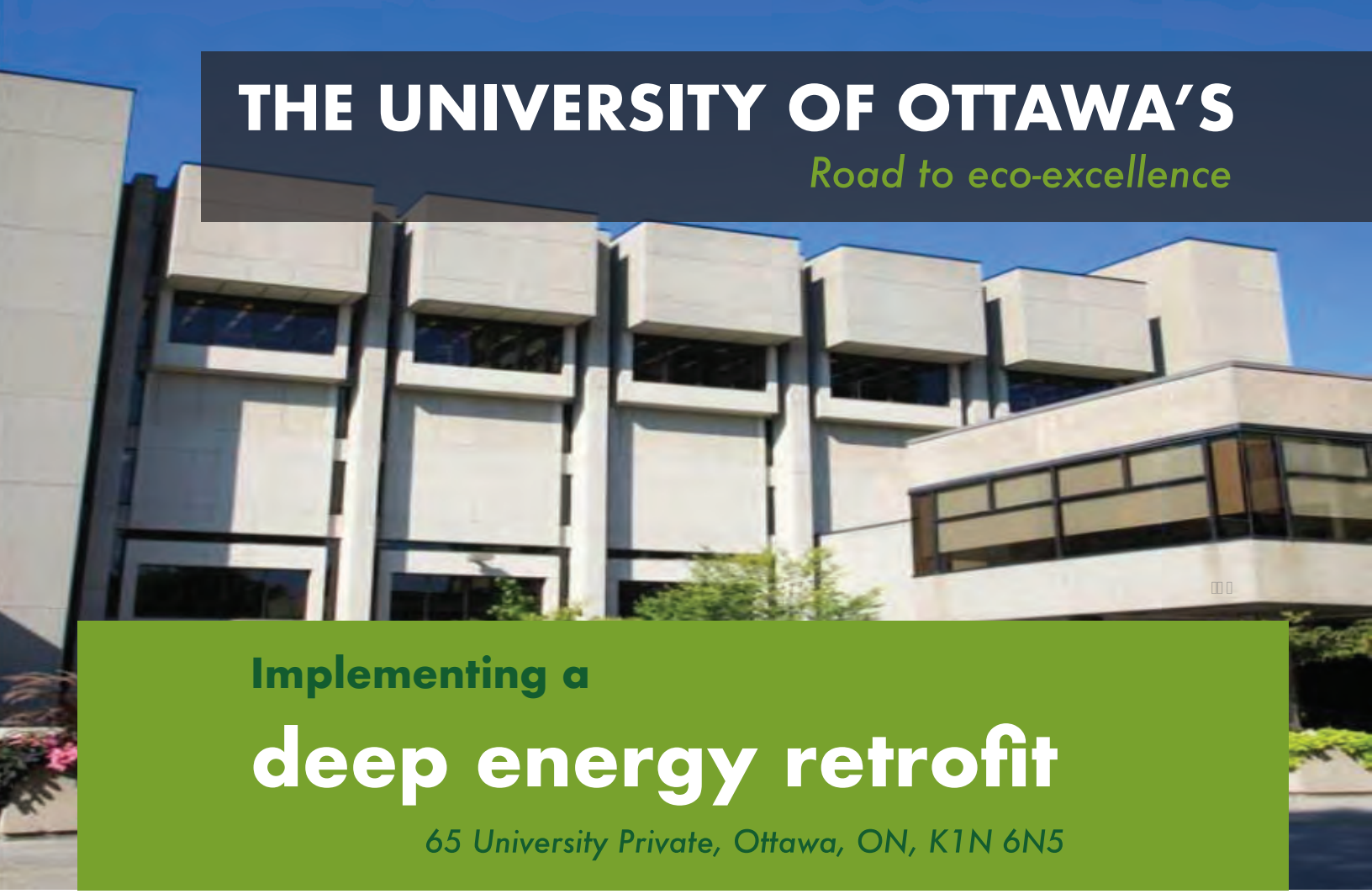

THE UNIVERSITY OF OTTAWA'S

Road to eco-excellence

Implementing a

deep energy retrofit

65 University Private, Ottawa, ON, K1N 6N5

The road to eco-excellence is paved with energy conscious decisions that lead to the highest efficiencies possible. That's why the University of Ottawa is cruising on the fast lane with its Morisset Library retrofit that has raised the bar in terms of efficiency.

"We look at the older buildings on campus and essentially modify and re-engineer the system so they run more efficiently. Thanks to advancements in HVAC techologies and lots of experience operating our buildings, we can achieve energy reductions that we once never dreamed possible."

- Jonathan Rausseo, Campus Sustainability Manager, University of Ottawa

Introduction of a low temperature heating system

70%

70% reduction in operating costs and $450,000 in savings per year

1 INTRODUCTION

Named after the director of the University's libraries, Father Auguste Morisset, the Morisset Library is a 20,000 m^2 structure that houses the University of Ottawa's main campus library[2]. The library was built in 1972 at a cost of $7 million, and was designed to hold 800,000 books, serving over 2,000 users at a time[2].

Today, Morisset Library also houses a map library, the Multimedia Distribution Service, le Centre de recherche en civilisation canadienne-française (CRCCF), Ottawa's campus and community radio CHUO-FM and laboratories and studios operated by the Department of Communications[2].

The University of Ottawa's long-standing commitment to combat climate change and mitigate greenhouse gas emissions has cemented its place as a leader among universities across Canada. The University is targeting the reduction of direct greenhouse gas (GHG) emissions by 34% from 2005 levels by the year 2020. This means emitting no more than 13,000 tonnes of GHG per year in 2020.

The main campus library was a perfect opportunity to cut down on energy expenditure since it consumes a lot of energy to keep air circulating for the thousands of students that visit everyday, while maintaining optimal humidity so that the books are preserved for a long period.

2 PROJECT DETAILS

Since building codes have changed over time, the Morisset Library would have been subject to very low efficiency requirements by present-day standards at the time of construction. Conventional retrofits for these types of buildings only scratch the surface when it comes to the total possible energy savings.

In this case, a deep energy retrofit, which combines energy efficiency measures such as efficient equipment, controlled ventilation, and insulation was implemented so that dramatic energy savings are achieved alongside optimal building performance. This was done through the EcoProsperity program which was responsible for over $3 million in energy savings since its introduction[5]. The total cost to implement the project was $2,030,000 with a payback period of 2.75 years[6].

The project focused on re-engineering the entire Heating, Ventilation, and Air Conditioning (HVAC) system which included the installation of two heat pumps and six thermal wheels to recover waste energy more efficiently.

Moreover, the air handling units were reconfigured with static pressure reset based on zone conditions to prevent increased fan, heating and cooling energy consumption[4]. The project also facilitated the elimination of high pressure steam used for heating by adding heat recovery chillers and insulated pipes with higher R-value to allow the heating system to run low temperature water at 40°C[4]. Old lighting fixtures were also replaced with high efficiency fixtures which would also drive down operating costs.

Figure 1: Low Temperature Water System[7]

3 RESULTS

Energy results: The project was successful in cutting down electricity consumption by 33% and heating by 106%, saving over 25,000 GJ in the process[4]. This amounts to savings of $450,000 or 70% of the building's annual energy bills[6].

GHG reduction: The project prevents approximately 1,500 tonnes of carbon dioxide equivalent (tCO_2e) from being released into the atmosphere every year[6], which translates to 321 passenger vehicles taken off the road.

4 CONCLUSIONS & REFLECTIONS

As a socially responsible organization, the University of Ottawa is taking concrete steps to protect the environment and the Morisset Library retrofit is just one of many initiatives taking place on campus.

Energy efficiency is a large slice of the sustainability pie, and the implementation of such successful programs that demonstrate the potential for operational cost savings inspires others to act responsibly towards the environment and work for positive change in their communities.

As of 2015, the University has lowered its total GHG emissions by 23%[5], which keeps them on track in terms of their 2020 targets. Additionally, with the campus over-producing heat, the University is considering expanding its district heating/cooling network beyond the confines of its buildings into the neighbouring houses and buildings in the Downtown area[4].

Through leadership on various projects and devotion to achieving greater energy savings, the campus has taken one step closer to becoming a national leader in sustainable development.

23%

As of 2015, the University has lowered its total GHG emissions by 23%

The University is considering expanding its district heating/ cooling network beyond the confines of its buildings

Figure 2: Students hard at work[3]

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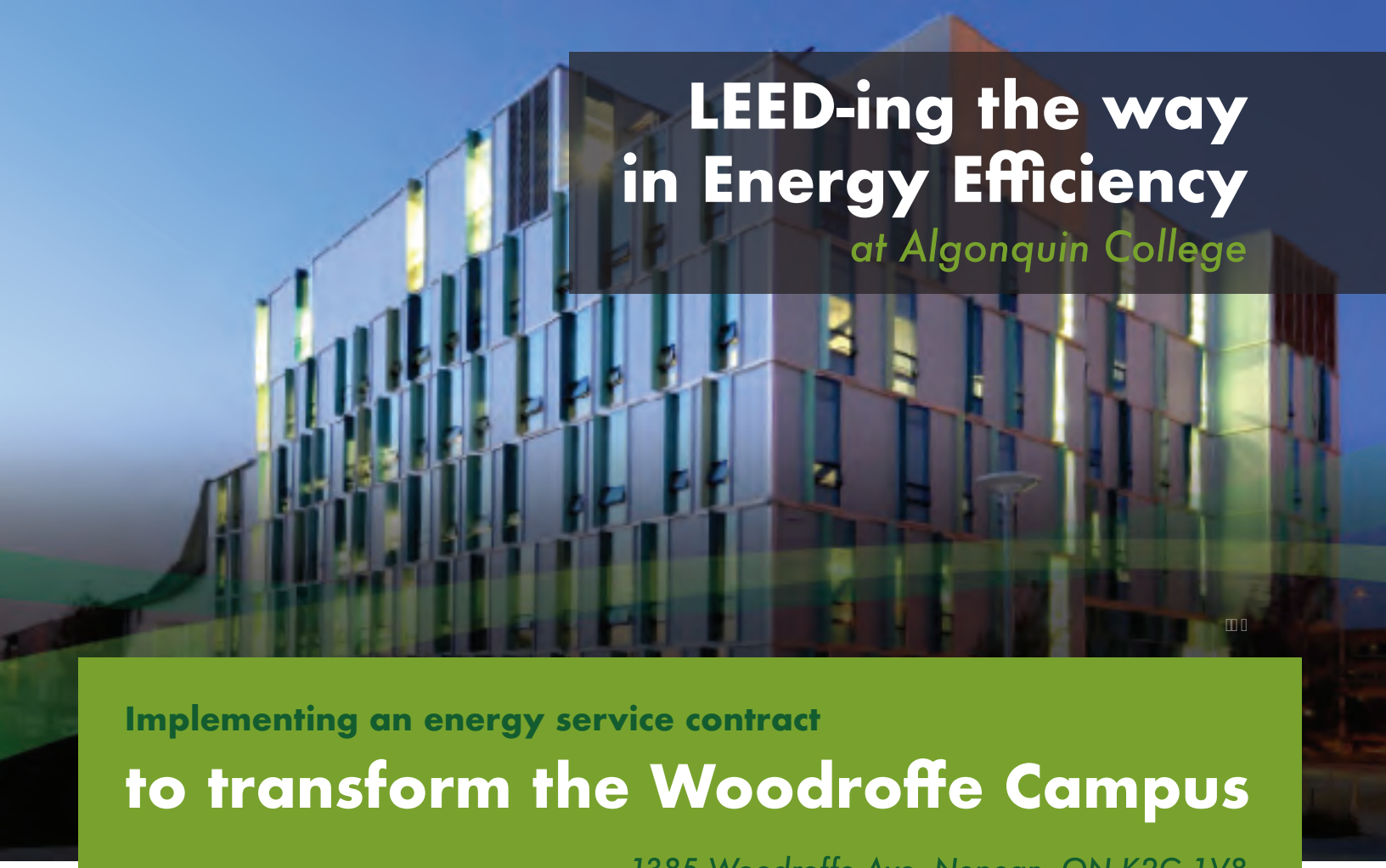

LEED-ing the way in Energy Efficiency

at Algonquin College

Implementing an energy service contract

to transform the Woodroffe Campus

1385 Woodroffe Ave, Nepean, ON K2G 1V8

Algonquin College partners up with Siemens Canada to introduce energy efficiency measures touching all areas of the Woodroffe campus within several areas of improvement. By reducing energy costs, the College is investing in student success.

"This project really fits well with our overall sustainability and resiliency goals at the College. Once the whole project is complete, we expect up to a 12 percent reduction in our carbon footprint. With the co-gen plant, we now have the ability to meet our base load of electricity needs and operate the entire campus. "

– Todd Schonewille, Director, Physical Resources, Algonquin College

$51 million

$51 million investment over 20 years

$3.7 million

$3.7 million in annual operating cost savings

1 INTRODUCTION

Algonquin College of Applied Arts and Technology is a publicly funded college located in Ottawa, Ontario. It is the largest college in Eastern Ontario with 19,000 full-time and 37,000 part-time students that are registered in over 266 programs[2].

The College was established in 1967 with the formation of Ontario's college system[2]. It is named after the Algonquin First Nations Peoples who were the original inhabitants of the area. Today, the College owns three active Ontario locations at Woodroffe, Perth and Pembroke.

Algonquin College has been a long time champion of environmental protection, demonstrating their dedication by becoming the first Canadian college to sign the Talloires Declaration, which commits post-secondary institutions to being leaders in sustainability[3].

However, budget constraints resulting in a growing deferred maintenance backlog negatively affect the campus' energy performance. Moreover, taking into consideration that 33% of the buildings on campus were built pre-1970 and another 38% are pre-1990s construction, it becomes apparent that there is a lot of room for improvement in terms of energy efficiency[3].

In 2014, the College released a detailed Conservation and Demand Management plan that aims to address these issues and reduce the electricity usage by 61% over 5 years[3]. The plan is guided by the institution's Sustainable Algonquin Framework which identifies a balanced approach to sustainability where social, economic, and environmental (S-E-E) aspects are considered in institutional decision-making with equal weighting[4]. Efforts to address areas relating to energy conservation are directly related to goals within the framework such as "Reduce our Ecological Footprint", "Enhance Student Success", and "Pursue Economic Strength", as examples.

Figure 1: The S-E-E Model of Sustainability[4]

2 PROJECT DETAILS

Fulfilling its ambitious targets requires collaboration and Algonquin College recognized the need for assistance from the private sector. This prompted the College to issue a formal Request for Proposal (RFP) to a select group of companies. After assessing the options, the College entered into a 20 year partnership with Siemens Canada to deliver a comprehensive Energy Service Contract ($ESCO_2$) that is financed through energy savings.

The contract allows the College to benefit from a project with a guaranteed predetermined level of savings. The College would keep its energy budget whole until the project is finalized, after which the savings become available to the College.

In 2013, work began on the first phase of the project and saw the implementation of energy efficiency renovations that spanned several areas including water efficiency improvements, HVAC retrofits, the replacement of cooling towers, chiller plant optimization, interior and exterior LED lighting retrofits, as well as building automation controls and intelligent lighting controls[5].

The project was also responsible for introducing a 4 megawatt cogeneration (cogen) plant[5].

The Cogen Plant would supply the College with electricity and use the waste heat from the power generator to heat its buildings in the winter. In the summer, this heat would be used to power a chemical process through an absorption chiller to cool the buildings.

3 RESULTS

Energy results: The first phase of the project is expected to save over $1.1 million per year in operating costs, as well as cut down deferred maintenance costs by $13 million[6]. The next phase aims to double operating cost savings to $2.2 million annually with the introduction of electricity co-gen. By the end of the 20 year contract, the College will reduce its electricity consumption by over 18,000,000 kWh and benefit from $3.7 million in savings per year[6].

GHG reduction: From the 2010/2011 baseline year, the project in its totality will reduce the College's carbon footprint by 12%.

Figure 2: The Cogen Engine[5]

4 CONCLUSIONS & REFLECTIONS

Algonquin College's perseverance to reducing its ecological footprint has shown many reasons to celebrate regarding the positive steps it is taking to conserve energy, innovate, and invest in a clean energy future.

The $ESCO_2$ strategic partnership between Algonquin College and Siemens Canada showcases a new approach to energy that looks at conservation, demand management, energy resiliency and new technologies aligned with decentralized electricity production and management.
Algonquin College continues to have a strong long-term sustainability vision and has articulated a direction toward carbon neutrality in its 2017-2022 Strategic Plan. This plan also identifies the institution's aspirations to be "...serving as a leader in the education, research and exchange of environmentally sustainable practices." Key components to deliver on these goals will be strong partnerships and support to research, test and implement a broad spectrum of clean energy approaches, such as renewable power generation, renewable natural gas, as well as advanced building and infrastructure technologies and approaches. Continued collaboration with internal and external stake-holders will also be vital for success.

$1.1 million

The first phase of the project is expected to save over $1.1 million per year in operating costs

2042

The College plans to achieve net zero emissions by their 75th anniversary in 2042

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Energy management throughout the

OTTAWA CATHOLIC SCHOOL BOARD

Celebrating years of efficient energy management

5740 W Hunt Club Road, Nepean, ON, K2G 3R4

Energy management is key to saving energy in any organization, and the Ottawa Catholic School Board is no different. With over 10 years of optimizing and fine-tuning its energy conservation targets, the School Board earned its spot in the top 5 sustainable schools in Ontario.

"If we can get a building that's better designed and more energy efficient, we can spend that money that we save from energy toward school resources"

- Don Wood, Architectural Project Officer

1/3

Third of the Board's annual energy budget allocated towards rooftop and building insulation

Replacement of old lighting systems with high efficiency systems with occupancy sensors

1 INTRODUCTION

The Ottawa Catholic School Board (OCSB) is a publicly funded institution that operates as a separate school board, which governs English-speaking Catholic schools in Ottawa. Formally known as the Ottawa-Carleton Catholic School Board, the Board decided to change its name in 2007 to the OCSB in order to focus their commitment to the Ottawa community[2].

The Board is responsible for 85 schools within the greater Ottawa area, employing around 4,000 teachers and staff members.

The OCSB introduced a framework for energy management and conservation in 2005 in an effort to reduce expenditures on energy utilities[3]. The goal of the energy management plan was to comply with the Ontario Green Energy Act, while maintaining the same level of comfort for occupants and leveraging energy savings to contribute to student and staff success[4].

The Board established a baseline from actual 2003-04 energy consumption data that was statistically balanced to account for climatic variations, and targeted a $670,000 reduction in energy consumption for the 2005-06 school year[5].

The Planning and Facilities Department of OCSB used the information gathered during the 2005-06 pilot year to subsequently establish reduction targets for future years[5]. Since 2006, the Department has provided energy conservation targets based on the energy savings potential for each facility on an annual basis.

2 PROJECT DETAILS

Nearly a third of the Board's facilities renewal budget is spent on upgrading existing equipment including rooftop insulation, which benefits the schools both from an energy and building integrity stand-point[3]. 12-inch insulation with high R-Values is being utilized (R-Value is a measure of insulating ability: the higher the value, the better the material insulates against the cold).

The energy plan's efforts also focus on retrofitting windows with thermal breaks to reduce the flow of thermal energy passing through the glass, as well as the installation of solar blinds to aid with the process[3].

Another area of focus is lighting. The Board commissioned the retrofit of their old lighting systems with high efficiency systems consisting of T-8 fixtures with high efficiency ballasts[3].

All their new facilities are fully equipped with LEDs and high efficiency ballasts. Furthermore, as the price of LEDs has dropped over time, the Board re-lamped all exterior lightings and some large gymnasiums and auditoriums with LEDs. They are also installing 30 occupancy sensors per year[3].

As for the Energy Management Control Systems, head caretakers organize and schedule HVAC systems to meet seasonal guidelines. Mechanical system economizer equipment are used when outdoor air conditions are between 7°C and 17°C[5].

At certain times of the year, opportunities for free cooling are used through make-up air units.

Moreover, the Board continues to benefit from revenue related to four large solar installations through Feed In Tariff[5]. St. Patrick and St. Dominic Elementary Schools have fixed mount solar installations, while St. Mother Teresa and St. Gabriel High Schools are equipped with full tracking systems to maximize solar capability[3].

Figure 1: Rooftop Solar Panel on St. Dominic High School[6]

3 RESULTS

Energy results: Since the implementation of their energy management plan in 2005, the School Board has reduced their annual electricity consumption by 19,290,000 kWh (33%) and their total natural gas consumption by 1.54 million m^3 (26%), despite the addition of 34,600 m^2 (5.2%) of new construction[5].

GHG reduction: The success of the Board's energy management plan has prevented approximately 52,000 tonnes of carbon dioxide equivalent (tCO_2e) from being released into the atmosphere[5].

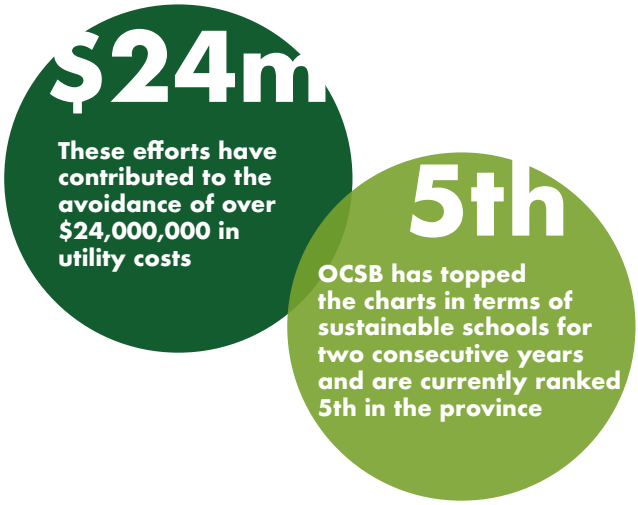
Equivalent to eliminating the carbon footprint of over 11,000 passenger cars.

4 CONCLUSIONS & REFLECTIONS

After running the energy management program for 12 years, the Board has come a long way in identifying energy savings potential for each facility. In addition to surpassing the provincial reduction requirement of 10%, these efforts have contributed to the avoidance of over $24,000,000 in utility costs[4].

Since the Ministry of Energy began collecting performance data for all school boards in Ontario, the OCSB has topped the charts in terms of sustainable schools for two consecutive years and are currently ranked 5th in the province, solidifying their stance as a provincial leader in energy management and conservation.

With utility costs projected to increase further, the Board is looking to refine their energy management practices by using renewal grants to further improve building envelopes as well as mechanical and electrical systems[5].



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Energy conservation & generation at the

OTTAWA CARLETON DISTRICT SCHOOL BOARD

Building Automation Systems

allow full control from a central location

133 Greenbank Road, Ottawa, ON, K2H 6L3

The Ottawa-Carleton District School Board is exceeding expectations with their 10-year Energy Management Plan that sees them benefiting from government initiatives such as FIT, microFIT, and Net Metering, in addition to implementing other innovative conservation measures.

"As the largest school board in Eastern Ontario we have a responsibility to be an environmental leader within our community and teach through our actions the leaders of tomorrow."

- Clem Laferriere, Supervisor of Maintenance & Energy Management

$1.9m

Solar installations under FIT and MicroFIT programs generating $1.9 million to date

Introduction of live monitors that display electrical demand for a given building

1 INTRODUCTION

The Ottawa-Carleton District School Board is an institution that governs and operates all English speaking public schools in the city of Ottawa[2]. It was established in 1998 with the merger of the Carleton Board of Education and the Ottawa Board of Education[2].

It is the largest school board in Eastern Ontario, serving over 70,000 students. This includes 119 elementary schools, 26 high schools and 5 secondary alternative sites, employing a total of 9,000 teachers and staff members[3].

To meet the requirements of the 2009 Ontario Green Energy Act, the Ottawa-Carleton District School Board came up with a Multi-Year Energy Management Plan to develop strategies to reduce energy consumption and promote sustainability throughout their schools[3].

The plan highlights the Board's energy conservation target to reduce their greenhouse gas (GHG) emissions by 10% by the year 2023, using 2013 as the baseline year[3]. However, due to early successes between 2013 and 2015, the Board decided to increase the target to 15% to demonstrate their commitment to real change[3].

This was done by introducing various initiatives that focus on construction and retrofits, operations and maintenance, as well as occupancy behaviour.

2 PROJECT DETAILS

The Board spends around $1.8 million per year on energy conservation[4]. System upgrades are done year on year with the annual budget taken into consideration. The total cost to implement the 10-year energy management plan was $13,740,100[3].

One of the Board's initial project was a large scale lighting retrofit. Their efforts replaced 254,000 32W T8 fluorescent lamps with 25W T8s[4]. As these lamps are now getting older, the Board is currently working on converting them to LED. Exterior lighting and new schools are fully equipped with high efficiency LED fixtures that feature automatic control systems that can be incorporated to reduce lighting levels when natural light is available, as well as completely turning them off when not needed[4].

Another area of focus is on Building Automation Systems (BAS). Across the Board's operations, various levels of BAS have been integrated onto a common platform, where they are managed and operated from a central location[3]. These systems enable users to adjust operating schedules effortlessly, allowing HVAC and electrical systems to operate at optimum efficiency.

The project also facilitated the replacement of pneumatic thermostats with Direct Digital Control (DDC) systems, which allow temperature programming: during the winter, most rooms are set to 21.5°C; in the summer, cooling is a sliding scale that varies according to outside temperature so that it is more accommodating to occupants wearing summer clothing without being too cold[4].

Moreover, the Board has enjoyed success with Feed In Tariff (FIT) programs since 2009[3]. They currently own and receive revenue from 13 MicroFIT systems, each having a capacity of 10 kW. Furthermore, the Board is also leasing the roof space of 28 schools for FIT systems ranging between 50 kW and 250 kW[3]. Combined, the solar installations have a total capacity of 2,620 kW[3]. Five net meter systems are currently being installed with a total capacity of nearly 800 kW.

Figure 1: Rooftop Solar Installation at Muchmore Public School[5]

The schools have also employed live monitoring systems that refresh at 2 minute intervals, where the students can actually look at the energy consumption of their school and contribute to turning off all the lights and computers and watch as the energy consumption drops on the monitor. This helps students and staff members understand the impact of reducing consumption[4].

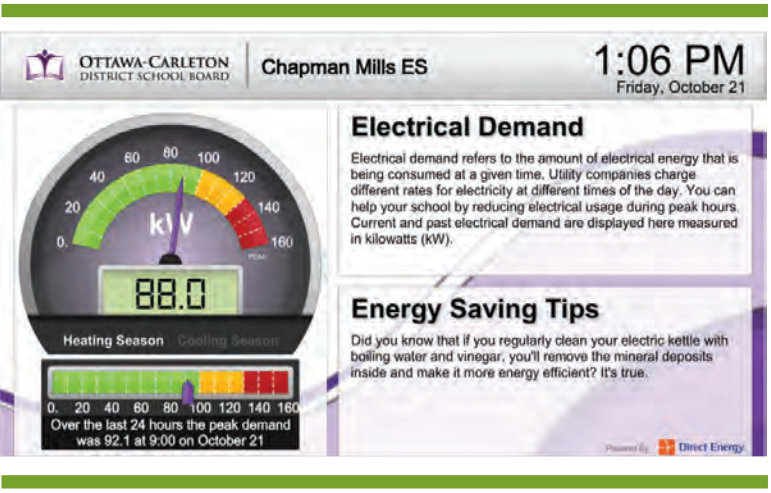

Figure 2: Electrical Demand Monitors are available for Students and Staff across the Board[6]

3 RESULTS

Energy results: Since 2013, the Board has been successful in accumulating energy savings of 32,186,863 kWh resulting in a cost avoidance of $4,457,670[3]. Revenues from solar installations are expected to reach a total of $1,948,242 by the end of 2018[3].

GHG reduction: To date the Board's energy conservation measures have helped prevent a total of 24,000 tonnes of carbon dioxide equivalent (tCO_2e) which is analogous to removing 5,100 passenger vehicles off the road.

4 CONCLUSIONS & REFLECTIONS

As one of the largest employers in Ottawa, the Ottawa Carleton District School Board has an important role to lead by example in the transition to a low carbon city. This role is exemplified in the Board's overachieving Multi-year Energy Management Plan.

Over the years, the Ottawa-Carleton District School Board has been successful in identifying areas where energy conservation measures can be applied. Schools have the ability to directly influence the next generation of builders, politicians and sustainability advocates that will inherit most of our climate change problems. For this reason, school boards must set high standards in terms of energy conservation in order to cultivate environmental stewardship in the minds of today's youth.

In an effort to continue to improve energy performance on an annual basis, the Board is constantly refining their strategies to incorporate new technologies and engineering concepts into their facilities.

2013

Since 2013, the Board has been successful in accumulating energy savings of 32,186,863 kWh

24,000

Energy conservation measures have helped prevent a total of 24,000 tonnes of carbon dioxide

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The City of Ottawa's

CORPORATE GREEN BUILDING POLICY

Emphasizing sustainability considerations in municipal building design

Municipal buildings throughout Ottawa

The City of Ottawa owns 984 buildings, spanning 13.7 million square feet, with an estimated total asset value of $3.6 billion[1]. In 2005, the City formalized their strong commitment to a more sustainable existence and to reducing the environmental impacts of their operations by developing and implementing a corporate Green Building Policy.

The City of Ottawa continues to make significant progress on building LEED Certified, environmentally sustainable buildings. Year by year the list of Ottawa green buildings grows. We are proud of the steps we have taken to become a leader in green building practices."

– Alain Gonthier, Director of Infrastructure Services at the City of Ottawa

Reducing operating costs due to improved building energy and water use efficiency

Improving building performance through Leadership in Energy and Environmental Design (LEED™) Canada building certification rating system

1 INTRODUCTION

The Green Building Policy was approved by City Council on 28 September 2005[2]. The policy resides with Infrastructure Services, part of the Planning, Infrastructure and Economic Development Department at the City of Ottawa. The enactment of this policy aligned with commitments made in the 2003 Ottawa 20/20 Environmental Strategy[3], which focuses on transforming Ottawa to "A Green and Environmentally Sensitive City"[4]. The green buildings policy uses the Leadership in Energy and Environmental Design (LEED™) Canada building certification rating system, developed by the Canada Green Building Council (CaGBC), to promote and track sustainability targets for newly constructed municipal buildings.

The LEED™ rating system is a sustainability scorecard, whereby the more "green" a building is, the more points it will earn. Currently in its 4th version, LEED™ v4 assesses projects and assigns points across several different categories, ranging from Location and Transportation, Sustainable Sites, and Water Efficiency, to Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality and Innovations incorporated in the design. Based on the resulting scores, buildings can qualify for one of four levels of certification, from Certified, to Silver, Gold and Platinum.

The intent is that by going through the LEED™ certification process, municipal buildings are designed and delivered with improved fiscal, environmental and corporate responsibility[3] over the course of their whole life cycle.

2 PROJECT DETAILS

In particular, the municipal Green Building Policy in Ottawa requires that all newly constructed buildings larger than 500 square meters be designed, delivered and certified to meet at least the LEED™ Certified rating. Furthermore, since 2015, in cases where upgrading to LEED™ Gold can be supported within the project scope and budget, the proposed building should be designed to this level instead[5]. Additionally, the policy encourages those involved with the design and implementation of all new and retrofit projects to apply sustainable design principles, even if they do not formally achieve LEED™ accreditation.

While benefits differ greatly from building to building, by design, LEED™ certified buildings offer some or all of the following benefits relative to traditional buildings: reduced operating costs due to improved building energy and water use efficiency; reduced landfill requirements due to less waste and greater reuse/recycling; increased use of public transit, cycling and walking by appropriate site selection, which in turn reduces greenhouse gas emissions and improves air quality; and safer and healthier working environments for building occupants[3].

3 RESULTS

A growing number of LEED™ certified municipal buildings have been completed in Ottawa, with the 9,300 square meter Ottawa Paramedic Service headquarters the very first. This building, completed in December 2005 through a Public Private Partnership between the City of Ottawa and Forum Leasehold Partners Inc., achieved a LEED™ Certified rating[6]. It offers energy savings of 25% over traditional designs, due to the clever incorporation of motion activated light fixtures, wastewater heat recovery, high efficiency boilers, pumps and fans, as well as high speed garage doors that minimize the loss of heated/cooled air from inside the building. These conservation measures result in reduced energy bills of up to $80,000 each year[7].

Subsequent projects include the Vars Fire Station (Certified), Rideau Valley Conservation Authority Headquarters (Gold), Shenkman Arts Centre (Silver), Huron Early Learning Centre (Silver) and Conroy Public Works Yard (Silver)[8]. As of April 2017, the City of Ottawa owns 26 LEED™ certified facilities: five Gold, 11 Silver and 10 Certified, with a number of additional buildings undergoing certification and under development[9].

One project worth highlighting is the Lansdowne Redevelopment project: aside from being an attraction in its own right, it is Ottawa's first green community designed to follow LEED™. It received Silver Plan Pre-Certification under the LEED™ for Neighbourhood Development program, joining only five other neighbourhoods in Ontario and 12 across Canada to have achieved this certification level[1].

4 CONCLUSIONS & REFLECTIONS

Through smart growth and green building, the Lansdowne neighbourhood has been transformed into a sustainable and vibrant mixed-use community, serving as a positive example for the rest of Ottawa. The redeveloped site is open and well-connected, encouraging walking, cycling and public transit use. The central location reduces urban sprawl and automobile dependence. All new buildings were designed to be energy efficient and incorporate green features. Through LEED™-guided redevelopment, Lansdowne has become a unique destination for both residents and visitors to live, work, and play.

The redeveloped site is open and well-connected, encouraging walking, cycling & public transit use

The Green Building Policy ensures that new buildings are designed to high standards, helping to create a more sustainable city & future, one building at a time

By design, buildings have long lifespans and represent a significant commitment to the future: the majority of the buildings that currently exist in Ottawa will still be in use in fifty years from now. Policies like the Green Building Policy ensure that new buildings are designed to high standards, helping to create a more sustainable city and future, one building at a time.

Figure 1: The Landsdowne Redevelopment Project [1].

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BEEM-ing with pride at the City of Ottawa's

BUILDING ENGINEERING AND ENERGY MANAGEMENT UNIT

Implementing more than 40 projects per year to "optimiz[e] tomorrow's energy use today"

Municipal facilities throughout Ottawa

Converting lighting to Light Emitting Diodes (LED). Motion sensors for building lighting and ventilation. Low flow toilets and automatically flushing urinals. These are just a few of the conservation initiatives the City of Ottawa has undertaken at its municipal facilities over the course of the last decade.

"It's very rewarding that BEEM has been able to not only cost effectively reduce the City's energy use and environmental footprint but also resolve problems and improve facilities at the same time"

- JP Rozon, Section Manager, Building Engineering and Energy Management, City of Ottawa

2002

BEEM Unit established in 2002

Responsible for developing an energy conservation and demand management plan

1 INTRODUCTION

Building on the successes of the Energy Reduction Program (2004-2009) and the Smart Energy Program (2010-2014), the City of Ottawa took another crucial step in their journey to city-wide energy efficiency and conservation by establishing the Building Engineering and Energy Management (BEEM) Unit.

This Unit was created with the goal of helping operations and maintenance staff run facilities not only efficiently, but also safely while maintaining comfort.

With a mandate of "optimizing tomorrow's energy use today", the BEEM Unit is faced with the challenge of conserving and reducing energy use in a growing city[2].

2 PROJECT DETAILS

The Unit's first Energy Conservation and Demand Management Plan, released in 2015, laid out a series of capital investment projects to be implemented each year between 2015 and 2018. With an annual budget of $1 million, these projects focus on the reduction of costs and the conservation of electricity, natural gas, oil, propane and water use. By design, these investments are chosen to have an average payback period of 5.5 years, resulting from cost savings derived from either increases in energy or water use efficiency. The bulk of the projects identified in this report focus on electrical savings measures (80% of total savings), with 10% of savings focused on each of gas and water efficiency projects. Actions include:

- Lighting upgrades
- Controlling ventilation and heating equipment more effectively by taking advantage of scheduling, occupancy sensors and carbon dioxide monitoring
- Heat reclaim
- Water efficiency measures
- Upgrades of heating ventilation and air conditioning equipment
- Installation of variable speed drives to much more effectively control fans and pumps[2]

3 RESULTS

A growing number of BEEM-led projects are currently underway in Ottawa, with the development of the City's Building Automation System (BAS) Integrator one of the most innovative and exciting.

Increasingly, City of Ottawa facilities are being controlled and monitored by a BAS, with 115 of the City's more than 860 facilities already using some kind of BAS. These systems help optimize energy use and comfort using computer controls for heating, ventilation, air conditioning and ice rink refrigeration systems. In the past, it was a challenge for facility staff to oversee these buildings effectively, given the more than 15 different BAS vendors who each use unique software. The efficiencies to be gained by having a single, integrated system have long been clear.

The recently developed BAS Integrator, a BEEM-led project, does exactly that: it is a single, online, front end portal which all building operation and maintenance staff can use to remotely monitor most aspects of a building's heating, ventilation and air conditioning. It allows facility and maintenance staff to use City computers and mobile phones to monitor sites, investigate problems and change schedules and space temperature set-points remotely. The different vendor control systems still control the individual buildings but mechanics can now be much more effective dealing with all the equipment through one software package. They can troubleshoot equipment while up on a roof through a portable computer or tablet. They can check on equipment at another site without leaving the roof. Operations staff can also remotely monitor satellite facilities.

For instance, at the start of hockey season when ice is being made, municipal rink personnel used to have to be on site every day to monitor and control ice making equipment. Now, personnel can remotely monitor progress and make equipment setting changes by accessing the Integrator via a laptop or smartphone[3].

Figure 1: Screenshot of the City of Ottawa's BAS Integrator tool[4]

It is estimated that facility staff can have a 20% impact on energy use. The use of the BAS Integrator gives them a tool to more effectively run facilities. It also gives them quick access to support should they experience control or mechanical problems[3].

Other opportunities identified in the 2015 Energy Conservation and Demand Management Plan include the replacement of Ottawa's streetlights with LEDs, electricity demand management, the installation of infrastructure (e.g. solar panels) to generate renewable energy at municipal facilities, performance of energy benchmarking exercises to compare the energy utilization of similar facilities, re-commissioning of existing buildings, as well as offering training for facility and maintenance staff[3]. Since its inception, the BEEM Unit has taken advantage of utility and government incentives of over $1.5 million to extend the energy management work they are able to implement.

10%

Between 2011 and 2016 the average energy intensity of City facilities has been reduced by 10%

$2.8 million

An actual measured reduction in energy use that is equivalent to $2.8 million annually

4 CONCLUSIONS & REFLECTIONS

Across all these measures, between 2011 and 2016 the average energy intensity of City facilities has been reduced by 10%. This represents an actual measured reduction in energy use that is equivalent to $2.8 million annually and is a significant reduction in the City's environmental footprint. Technology is constantly improving and the BEEM team is taking advantage of those improvements to help the City not only control costs but also significantly reduce its environmental impact.

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Deep freezer upgrades and more at

THE OTTAWA HOSPITAL

Installation of new

energy efficient freezers

501 Smyth Road, Ottawa, ON, K1H 8L6

The Ottawa Hospital demonstrates the importance of moving towards more sustainable operations that will conserve natural resources, generate long-term cost savings, and improve the health and safety of the hospital environment.

"If we put criteria for energy savings in evaluating our options in procurement and account for the life cycle cost of the new product at any size, we can achieve huge energy savings with relatively short payback."

– Faris Rashid, Energy Manager, The Ottawa Hospital

Replacement of aging deep freezers

85%

85% reduction in electricity consumption and around $20,000 in annual savings

1 INTRODUCTION

The Ottawa Hospital is one of the largest and most reputable teaching hospitals in Canada. It was established in 1998 through the merger between two academic hospitals and two community hospitals. The Hospital spans across three campuses: the General campus, the Civic campus, and the Riverside campus adding up to a combined area of 4 million square feet.

Today, the Hospital is a 1,117-bed acute care facility that serves 1.2 million people across Eastern Ontario boasting specialty centres in cancer, heart, and vision care. The Hospital's commitment to finding the most talented physicians, as well as expertise of the Hospital's more than 1,200 physicians and 11,000 staff members have solidified its stature as the top medical center in eastern Ontario.

After enduring a rough financial period in the late 90s, the Ottawa Hospital sought to regain long-term fiscal strength by identifying areas where it could be more efficient. The Hospital recognized the importance of reducing energy costs and improving building performance to create a healthier environment and leverage costs to provide better care for its patients.

To demonstrate its devotion to environmental stewardship, the Hospital provided the Minister of Natural Resources with a letter of commitment in 2003, and has since kept its core values of efficiency and financial responsibility.

In 2014, the Hospital came up with a 5 year Energy Conservation and Demand Management Plan with the aim of reducing their overall energy consumption by 10% below the 2012 baseline.

The plan focused on maximizing the Hospital's fiscal resources while reducing the impact on the environment and creating a culture of conservation within the hospital.

2 PROJECT DETAILS

The Ottawa Hospital Research Institute that serves as the research arm of the Hospital requires highly technical equipment with built-in modern IT capability in order to run their daily operations. Some of the equipment includes the Hospital's deep freezers which are used to maintain vaccines and medications at very low temperatures of up to -80°C.

In 2017, the Hospital applied for an incentive from Hydro Ottawa through the saveONenergy program, from which they receive $14,000 to replace their aging deep freezers. The project saw the replacement of the 15-year old deep freezers with six new energy efficient freezers that consume 20,138 kWh. The cost to replace the freezers was $80,000, yielding a payback period of 4 years.

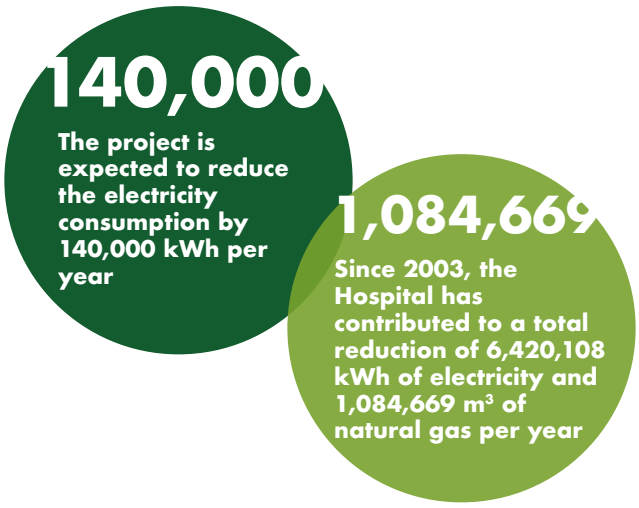
Furthermore, The Ottawa Hospital has allocated up to $24 million to complete projects that will improve operations while meeting an Internal Rate of Return (IRR) of 15%. Some of these projects include new lighting retrofits that saw the replacement of 800 A19, 300 PAR20, and 300 PAR38 light bulbs with high efficiency LEDs saving over 200,000 kWh in the process; and heating, ventilation and cooling (HVAC) equipment; improvements to mechanical systems; and upgrades to building automation systems to optimize energy management.

Figure 1: The Ottawa Hospital – General Campus[1]

3 RESULTS

Energy results: The project is expected to reduce the electricity consumption by 140,000 kWh per year which is an 85% decrease in operating costs adding up to $20,000 in savings.

GHG reduction: The project also managed to prevent around 5.6 tonnes of Carbon Dioxide equivalent (tCO_2e) from being released into the atmosphere.



4 CONCLUSIONS & REFLECTIONS

The Ottawa Hospital has demonstrated leadership in environmental stewardship by continually seeking additional ways to implement energy savings. Since the implementation of energy conservation measures in 2003, the Hospital has managed to build on its success through several projects contributing to a total reduction of 6,420,108 kWh of electricity and 1,084,669 m^3 of natural gas per year.

According to the Hospital's benchmarking results, its facilities operate at 5% less energy intensity than the average acute care facility in Ontario. This reinforces the idea of leading by example and puts The Ottawa Hospital at the forefront of sustainability when it comes to dealing with its resources.

The Hospital plans on continuing their energy saving efforts by monitoring the chiller plant on the supply side, while minimizing the running time of the Air Handling Units through precise and optimizing the operating parameters such as the static pressure.

Moreover, the Hospital wishes to streamline communication between departments such that the Biomedical Engineering, Capital & Renewal, and Purchasing departments work coherently to ensure that energy efficiency is taken into consideration in the life cycle cost analyses.

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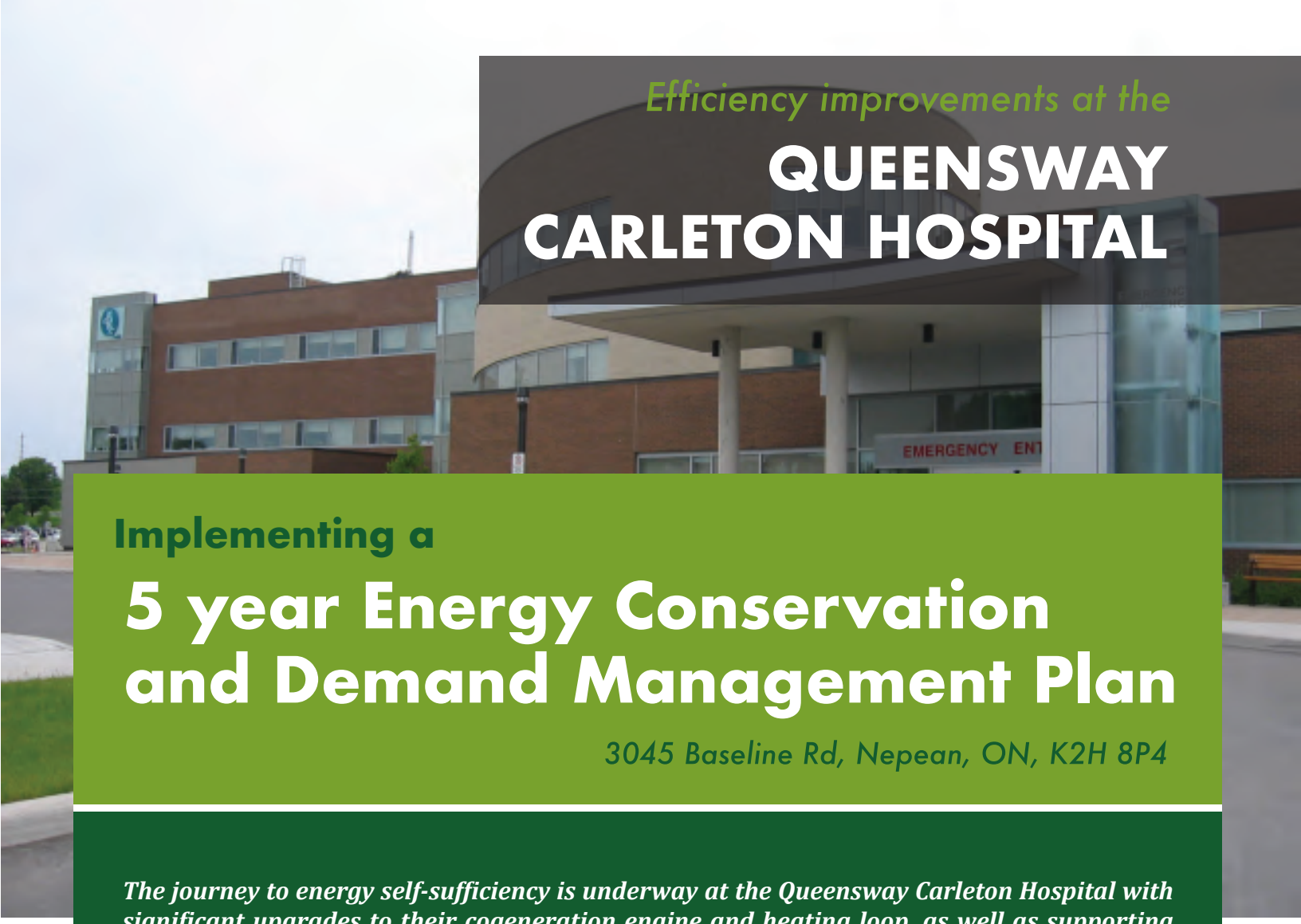

Efficiency improvements at the

QUEENSWAY CARLETON HOSPITAL

Implementing a 5 year Energy Conservation and Demand Management Plan

3045 Baseline Rd, Nepean, ON, K2H 8P4

The journey to energy self-sufficiency is underway at the Queensway Carleton Hospital with significant upgrades to their cogeneration engine and heating loop, as well as supporting energy efficiency opportunities in day-to-day and long-term operational planning.

"We, at the Queensway Carleton Hospital, are very energy conscious all the way from the technicians to the CEO, and with the help of today's technology we can enjoy savings that were unattainable 10 years ago."

– Gilles Lecuyer, Plant Services Manager

Parking lighting retrofits reducing electricity consumption

Redesigning James Beach building heating loop

1 INTRODUCTION

The Queensway Carleton Hospital (QCH) is a 282-bed that is patient and family-oriented acute care facility situated in the west end of Ottawa[2]. The Hospital opened in 1976 as a 240,000 ft^2 facility, before eventually expanding the facility to 680,000 ft^2 through a series of redevelopment projects over the years[2].

The recent 10-year expansion plan allowed for significant growth in the Emergency Department, which is the busiest in Eastern Ontario with almost 78,000 visits in 2017, and improvements to QCH facilities by introducing several new systems and equipment[1].

In an effort to ensure that their facilities are running at optimum efficiency, QCH has thoroughly committed to tracking and monitoring their energy consumption for the past 10 years[2].

However, due to the introduction of new equipment with steep learning curves, and new systems that have limited coordination with the older systems, the Hospital's Building Operators found it exceedingly challenging to adapt to these changes[2].

This led to an overall decline in energy efficiency in recent years, which prompted the Hospital to come up with a 5-year comprehensive Energy Conservation and Demand Management (ECDM) plan beginning in the 2014/15 fiscal year[2].

Figure 1: 1 MW Cogeneration System[3]

2 PROJECT DETAILS

The Hospital invested around $15 million to implement a list of projects highlighted in the ECDM[3]. One of these projects was the Parking Lighting Project, which saw the replacement of the parking lot's T8 fixtures with high efficiency LED fixtures with occupancy sensors. This reduced electricity consumption by 263,000 kWh per year[3].

In 2004, the Hospital added a 1 MW cogeneration (cogen) system that generated 6,600,000 kWh of electricity to the facility[3]. In recent years, the system's performance has been hindered by redevelopment projects that interrupted the cogen's normal operation.

With the aim of improving the cogeneration runtime performance from 75% to 85%, the cogeneration engine was replaced in 2015.

Maintenance schedules were planned such that they align with Hydro Ottawa to minimize remote transfer trips that halt generation capability[3].

Moreover, the Hospital identified room for improvement in the James Beach building. The project successfully redesigned the heating loop by connecting the supply side of the loop to the Hospital's main heating loop and matching the control sequence of both loops[3]. This will enabled the distribution of heat generated by the cogeneration unit to the James Beach building, resulting in a 155,000 m^3 reduction in natural gas per year, effectively eliminating 5 redundant boilers[3].

Other measures include fitting existing pumps with Variable Frequency Drives (VFD) and replacing six aging Air Handling Units (AHUs) with energy efficient units that are also equipped with VFDs on supply and return fans[3]. Prior to energy conservation measures, the AHUs ran around the clock regardless of occupancy. This is no longer the case since some of the AHUs are on schedules with night setback temperature setpoints (26°C in the summer and 18°C in the winter).

3 RESULTS

Energy results: In 2016, the cogen runtime capability reached 86%, generating 7,000,000 kWh of electricity[3]. Furthermore, the heating loop redesign contributed to the reduction of 3.5% of the Hospital's total gas consumption. Overall, the Hospital was successful in reducing its Energy Use Intensity by 6 kWh/ft^2, leading to annual savings of over $160,000[3].

GHG reduction: The expected annual impact of reduced emissions resulting from the implemented retrofits is approximately 1,400 tonnes of carbon dioxide equivalent (tCO_2e) per year, which is similar to the annual emissions from over 150 homes.

Figure 2: New AHU[3]

4 CONCLUSIONS & REFLECTIONS

The Queensway Carleton Hospital has enjoyed great success with its energy management plan, and demonstrated resilience in the face of adversity. These retrofits have taken the Hospital a step closer to fulfilling their goal of becoming a provincial leader when it comes to energy efficiency within the healthcare sector.

Identifying new conservation opportunities remains a continuous priority for the Hospital. The ECDM plan will be updated as soon as new initiatives are developed and put in place in order to build upon previous success[2]. Currently, the Hospital is looking at the feasibility of purchasing a second 1MW cogen engine, which would make the Hospital self-sufficient given that its total demand is 1.6 MW[3].

3.5%

The heating loop redesign will contributed to the reduction of 3.5% of the Hospital's total gas consumption

Purchasing a second 1MW cogen engine, which would make the Hospital self-sufficient given that its total demand is 1.6 MW

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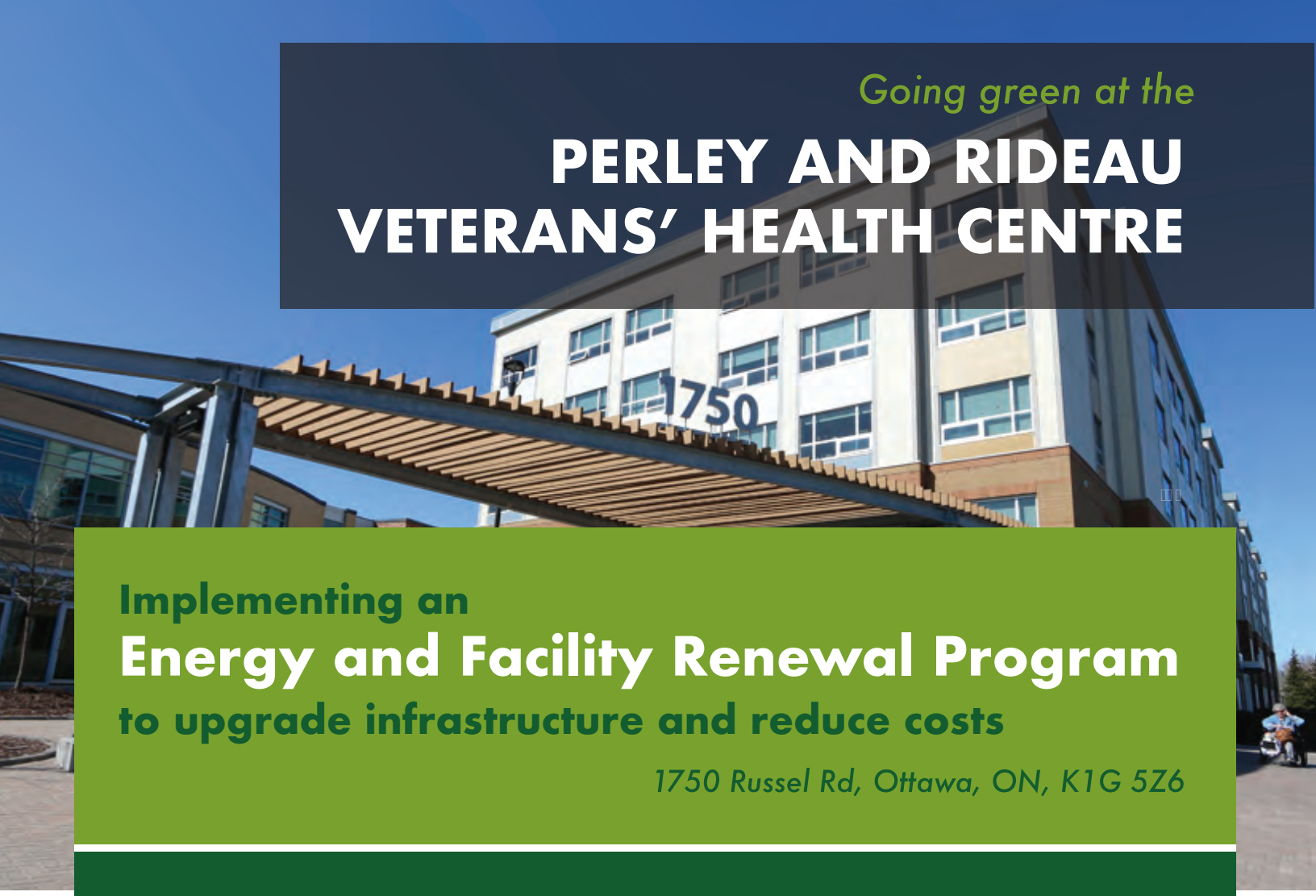


Going green at the

PERLEY AND RIDEAU VETERANS' HEALTH CENTRE

Implementing an Energy and Facility Renewal Program to upgrade infrastructure and reduce costs

1750 Russel Rd, Ottawa, ON, K1G 5Z6

The Perley and Rideau has struck not two, but three birds with one stone by upgrading their infrastructure and reducing energy costs, as well as improving comfort levels for their residentents.

"Through consistent review of the facility and close monitoring of the outputs and efficiencies of these new programs, we have been able to defer capital costs and that can only help the larger health care system in the region"

- Akos Hoffer, CEO,
The Perley and Rideau Veterans' Health Centre.

Implementing energy retrofits to Perley and Rideau buildings

$560,000

Savings to the tune of $560,000 per year

1 INTRODUCTION

With 450 private rooms, the Perley and Rideau Veterans' Health Centre is the third largest long-term care home in Ontario. It serves as an advanced health centre for Veterans from both the Second World War and the Korean War, along with seniors from the community.

With roots that date back to 1897, Perley Rideau is the amalgamation of three care facilities: the Perley Hospital, the Rideau Veterans Home for service personnel and the National Defence Medical Centre. In 1995, the three facilities were united when the new hospital opened at the current Russell Road location. Following the amalgamation, the "hospital" label was changed and the Perley and Rideau Veterans' Health Centre was designated a long-term care centre.

In 2013, two seniors apartment buildings were constructed in the 25-acre property providing 139 units for lease by seniors from the general public and former members of the Canadian Armed Forces to establish a thriving village that is home for more than 650 seniors.

As the largest long-term care home in the Champlain region and striving to be an innovative leader in the field, the activities of the Perley Rideau require significant amounts of energy, which constitute a large portion of the Centre's annual budget.

Prior to the renewal program the Centre relied on a shared district heating system that left its residents vulnerable if the system failed. By the end of their contract, the Centre's leadership team understood that it no longer made sense to continue with that approach due to its high cost and inadequate reliability.

In parallel with the construction of two apartment buildings for independent living seniors, this prompted the Centre to implement a comprehensive Energy and Facility Renewal Program to reduce operating costs, upgrade their building infrastructure and maximize the potential Ottawa South property that is only 900 metres from the General Campus of The Ottawa Hospital. The program was designed and implemented by Honeywell through an Energy Savings Contract, which aimed to reduce operating costs and enhance the indoor environment for residents.

2 PROJECT DETAILS

The renewal program implemented a wide range of energy and infrastructure upgrades revolving around the construction of a new high efficiency central heating and cooling plant. During the fiscal year of 2012/13, the Perley Rideau introduced four dedicated high efficiency boilers, operating in such a way that if one unit can supply enough heat for the whole building just the one will run; if more are needed a second, and perhaps even a third one will start. The new high efficiency central heating and cooling plant will improve heating and cooling reliability while reducing operating costs by over $300,000 per year.

Figure 1: Boilers that supply the facility with heat and hot water[4]

Moreover, the program facilitated the installation of a rooftop solar generation system consisting of 1,250 solar panels that have the capacity to generate approximately 250,000 kWh of electricity per year, enough to power 23 average households for an entire year. The system is connected to the grid, allowing the Centre to benefit from selling the energy generated, yielding $239,000 annually through the Feed in Tariff (FIT) program.

Figure 2: Rooftop solar installations at the Perley and Rideau[4]

The overall project cost was $6.6 million with a payback period of just 11 years. Automation of HVAC controls such as scheduling of major fans and installing variable frequency drives on cooling towers, water pumps, and air handling units, as well as occupancy sensors to start-stop fan controls and a variety of other initiatives were also completed within the overall program.

3 RESULTS

Energy results: The Perley Rideau benefited greatly from energy savings totalling $560,000 per year, resulting from energy retrofits, facility renewals, and revenues from solar panels.

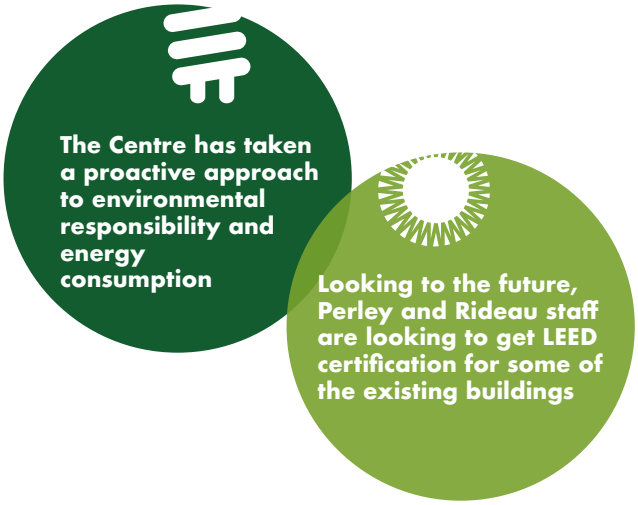
GHG reduction: The retrofits also resulted in 320 tonnes of carbon dioxide equivalent (tCO_2e) in reduced emissions per year, which is equal to 53 medium sized cars removed from the road.

4 CONCLUSIONS & REFLECTIONS

Environmental stewardship is a priority for the leadership team at the Perley Rideau; they are always seeking to decrease its carbon footprint. With the implementation of their renewal program, the Centre has taken a proactive approach to environmental responsibility and energy consumption.

Today the residents and apartment tenants benefit from an improved living environment that is both financially and environmentally sustainable. Savings from these programs allow the Centre to reinvest in new capital equipment and fund the care and programming that they continue to provide to their residents.

Looking to the future, Perley Rideau leaders are looking to get LEED certification for some of the existing buildings to further maximize operational efficiency while continuing to minimize environmental impacts.



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CARLETON LODGE LONG-TERM CARE FACILITY

Exterior lighting upgrades

Replacing outdoor lights with

high efficiency LEDs

55 Lodge Rd, Nepean, Ottawa, ON, K2C 3H1

The Carleton Lodge is enjoying reduced lighting expenditures thanks to initiatives such as the saveONenergy program and the City's BEEM unit, which will allow the Lodge to leverage the subsequent cost savings in order to further improve care for their residents.

"The project was implemented not only to save energy and replace equipment that was at the end of its life, but also eliminate some lighting problems."

– Jean Paul Rozon, Section Manager, Building Engineering and Energy Management

Replacing existing inefficient lights with new LED luminaires

kWh

Expected savings of around 35,000 kWh and $5,500 per annum

1 INTRODUCTION

The Carleton Lodge is a non-profit long-term care facility owned and operated by the City of Ottawa. It was built in 1960 as the first municipal home for the elderly in the Ottawa-Carleton region[2]. The site was later expanded with the construction of a new facility that opened its doors in the spring of 1989[2].

Today, the Lodge is a 161-bed facility located on a beautiful 12-hectare waterfront property by the Rideau River in South Ottawa[2]. The facility consists of 136 private rooms, 12 double rooms, and plenty of amenities providing quality service to its residents[2].

Carleton Lodge is equipped with various exterior lighting systems that can be divided into two categories: building-mounted lights and pole-mounted lights. The building-mounted lights include a mix of metal halide (MH) and high pressure sodium (HPS) wallpacks as well as 60W incandescent security luminaires, while the pole-mounted lights include MH bullhorn-mounted flood lights and a mix of post top-mounted luminaires[3]. Some of the existing lights can be seen in Figure 1.

While most of the existing lights are still operational, they are very old and consume a lot of energy.

All outdoor lighting at Carleton Lodge is controlled by a small number of central photocells that prompt the lights to turn on in the absence of ambient light[3].

Figure 1: Existing lighting systems[3]

2 PROJECT DETAILS

Energy Ottawa reviewed the existing equipment and conditions at the Lodge and recommended several upgrades that were carried out by the end of 2017. The project saw the replacement of the 175W MH and 150W HPS wallpacks with new 38W light emitting diode (LED) wallpacks, while the 70W HPS wallpacks were replaced with 18W LED wallpacks from the same product family[3]. The 60W incandescent security luminaires were also replaced with similar 20W LED security luminaires[3].

As for the pole-mounted lighting, the 250W MH bullhorn-mounted (resembling a bull's horn) flood lights were replaced with new 85W LED flood luminaires that were adjusted to increase light levels in the adjacent parking area[3]. The newly installed luminaires can be seen in Figure 2.

Figure 2: New LED wallpack, security luminaire and flood luminaire (left to right)[3]

For the remaining pole-mounted lights, Energy Ottawa evaluated four different product family options with respect to lighting level performance, price and other factors. The evaluation narrowed the proposal to two options, which can be seen in Figure 3.

The first option offered the lowest cost option that maintained desirable light levels. Conversely, the second option offered excellent performance of the luminaires, albeit at a higher cost.

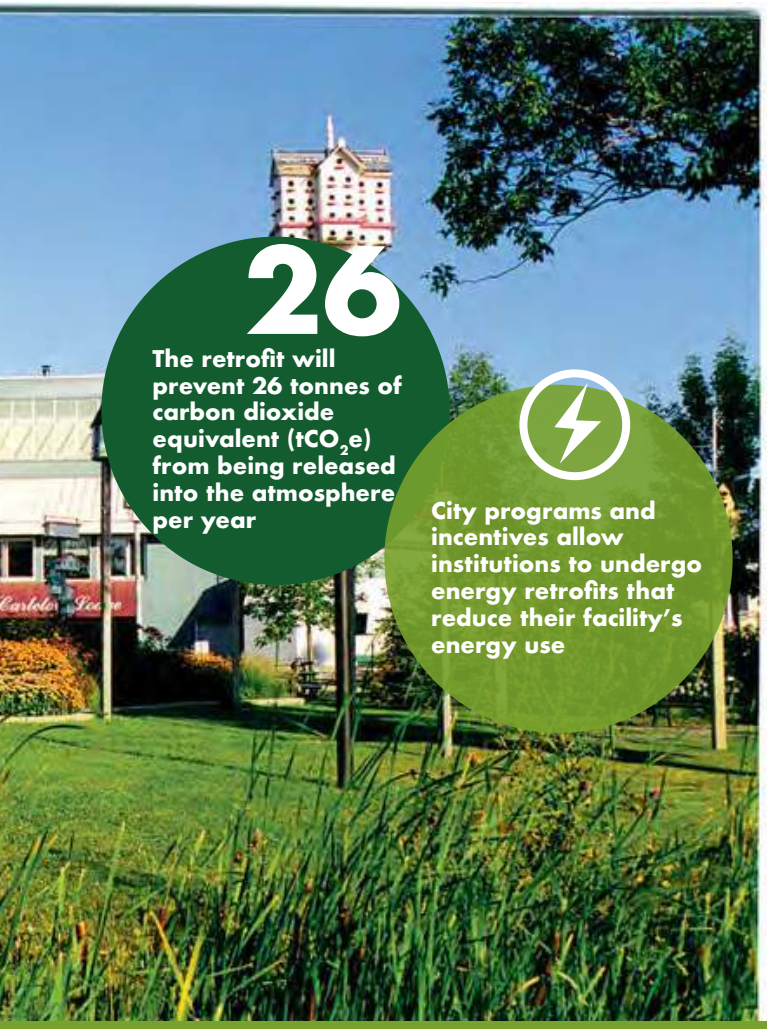
Ultimately, option 1 was chosen since the difference in cost savings was small compared to the project cost. This option included the installation of 40W luminaires along the pathways and in the courtyards, and a mix of 79W and 120W for parking areas[3].

The project cost $45,100 to implement. It is also expected to receive $2,100 in incentives provided by Energy Ottawa through the saveONenergy program[3]. The City's Building Engineering and Energy Management (BEEM) unit assumed around $30,000 of project cost to stay consistent with the BEEM unit's 5.5 year payback period mandate, whereas Carleton Lodge paid for the remainder of the cost[3].

3 RESULTS

Energy results: The project is expected to reduce electricity consumption by approximately 35,000 kWh and save $5,500 in utility costs per year[3].

GHG reduction: While the objective of the project was not to reduce greenhouse gas emissions, the retrofit will prevent 26 tonnes of carbon dioxide equivalent (tCO_2e) from being released into the atmosphere per year.



4 CONCLUSIONS & REFLECTIONS

Carleton Lodge is one of the oldest long-term care homes in Ottawa; however, lighting retrofits such as this are considered as "low hanging fruit" that will help renew the facility's overall energy infrastructure, while reducing operating costs and making sure that even the oldest buildings can benefit from new technologies.

Providing excellent care for their residents is of utmost importance to the Carleton Lodge, and with the help of the City's BEEM unit and incentives from Energy Ottawa, the Lodge can undergo periodic energy retrofits that focus on reducing the facility's energy use intensity.

Figure 3: Recommended post top-mounted Luminaires: Option 1- RAB RAL (left), Option 2- Cooper MESSA (right)[3]

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Ottawa's transition to

LED STREETLIGHTS

Retrofitting up to 58,000 streetlights

Throughout Ottawa

A streetlight revolution is currently underway in Ottawa: throughout the city, old high pressure sodium and metal halide streetlights are gradually being replaced by new and more energy efficient Light Emitting Diode (LED) lights.

"The LED project, with its dimming and asset management functionality, will provide the City with significant financial savings from the reduced energy consumption and also from reduced maintenance requirements"

- Roger Marsh, Chief Energy Services Officer at Energy Ottawa.

4 **Energy Ottawa is providing a turnkey solution to the City of Ottawa for the 4-year joint project**

66 **Only 1.5 years into project, new streetlights are averaging a reduction in consumption of 66%**

1 INTRODUCTION

Initiated in February 2016, this project is a partnership between the City of Ottawa Transportation Department and Energy Ottawa, a subsidiary of Hydro Ottawa. For the City of Ottawa, this partnership project aligns with the Building Engineering and Energy Management (BEEM) Unit's Energy Management and Investment Strategy[2] of the City's 2015-2018 Strategic Plan[3], focusing specifically on reducing the electricity consumption of their streetlight network.

In 2014, streetlights accounted for 17% of the City's total electrical use, at an annual cost of $7.2 million[4].

2 PROJECT DETAILS

Energy Ottawa (working with a number of private sector partners) is in charge of installing the new LED lighting over the course of the 4-year project horizon, from 2016 until 2020[5], as well as carrying out all necessary maintenance over the coming 6-10 years[6]. At the start of the project, the priority was on identifying and replacing those streetlights with the highest energy consumption and/or highest wattage, before moving on to the remainder of the network. In total, the City has around 72,000 streetlights and this project will replace up to 58,000 of them with LEDs[4]. Decorative lights are not included in this phase of the project due to their higher fixture cost and thus longer payback period.

An often overlooked, but particularly noteworthy feature of this project is its financing structure. The total cost of the streetlight replacement work is estimated at $32.6 million[7] ($31.4 million in project costs + 3% financing costs)[6]. Energy Ottawa approached the City of Ottawa back in 2014 with a proposal: the utility would design, install, finance and maintain every aspect of the replacement project. With an expected payback period of 6 years[6], the realized cost savings for these first 6 years would go towards paying off the costs of the project, before subsequently going to the City of Ottawa to allocate to other areas of the budget.

3 RESULTS

At the start of the conversion project, it was estimated that switching to LEDs would reduce energy consumption by an estimated 50%[6]. As of the end of 2017, a year and a half into the project, average energy savings of 66% are being documented! This gain in efficiency will save the City of Ottawa approximately $4 million in utility costs annually when the project is complete (equivalent to removing 2,500 homes from the electricity grid)[5], as well as decreasing CO_2 emissions by 1,000 tonnes every year[8].

There are a number of other reasons supporting this decision to transition to LED lights. Not only is the typical lifespan of LED lights 4 or 5 times longer than that of other light types with 50% lower maintenance costs, but the LED fixtures have built-in sensors that notify maintenance when a light has failed, thereby reducing down-time. Furthermore, controls within the new lights give system managers the ability to record actual consumption data, as well as support usage-based billing. Additionally, each light can be customized to offer the optimum illumination levels for each individual street location[4]. This has contributed in part to the greater than expected cost savings to date: in the past, certain areas were overlit due to the one-size-fits-all nature of the older streetlights.

These new dimmable lights allow a wide range of dimming options and thus enable energy conservation where less light is needed.

While the energy efficiencies and emission reductions of LED technology are difficult to argue with, critics of LED street lighting in Ottawa point to a recent report from the American Medical Association where some negative impacts of LED lighting were presented: high intensity residential nighttime lighting, such as bright LEDs, can disrupt the circadian rhythms of nearby residents and has been associated with poor sleep, obesity and impaired daytime functioning[9,10]. The City of Ottawa has taken steps to address these concerns by ensuring that the newly installed LED fixtures are calibrated to have similar colour temperatures to the old fixtures[4], with lights on residential roads having a warmer colour temperature than those on main arteries[7].

4 CONCLUSIONS & REFLECTIONS

As of the end of 2017, Energy Ottawa proudly reports that the project is on-time and on-budget. The 20,000th street-light was replaced during October 2017, and so far public sentiment towards the project has been favourable, with mostly positive/neutral feedback. (Roger Marsh, Chief Energy Services Officer at Energy Ottawa, confirms that the public treating changes like this as a non-event is in fact just the outcome one hopes for). Looking to the future, the project is on track to have all 58,000 fixtures converted to LED fixtures by 2020, and is perhaps even running a little ahead of schedule[6].

2020

all 58,000 fixtures to be converted to LED fixtures by 2020

20,000

The 20,000th streetlight was replaced during October 2017

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Parking lot lighting retrofit at

OC TRANSPO

Remediating safety concerns and upgrading lighting systems

at the OC Transpo HQ

1500 St. Laurent Blvd, Ottawa, ON, K1G 0Z8

OC Transpo is not only helping to mitigate climate change by providing public transit services, but it also goes one step further by ensuring that all its facilities are running at optimum energy efficiency.

Figure 1: Post top lighting fixtures before project - Employee parking lot[2]

Replacing pole top fixtures with 130W LED fixtures

kWh

Savings of over 117,000 kWh per year

1 INTRODUCTION

OC Transpo is a transportation service that provides comprehensive transit services to almost 1 million residents in Ottawa. These services include a transitway that is dedicated to OC Transpo and emergency vehicles, travelling from one end of the city to the other, as well as 5 O-train stops, a Park and Ride program, and finally a door-to-door service for people with disabilities called Para Transpo. The OC Transpo fleet consists of over 975 buses and 6 trains serving nearly 340,000 riders daily. When not in use, this fleet is parked at four bus depots around the city, with the headquarters located at 1500 St. Laurent Boulevard. OC Transpo operates under a mandate to deliver a safe and reliable service while reducing green-house gas (GHG) emissions and traffic levels on the road.

In 2013, Energy Ottawa conducted a site visit to collect information on various lighting equipment regarding adjacent parking lot sites within the OC Transpo 1500 St. Laurent complex. The visit flagged a number of safety concerns that required immediate attention with respect to existing pole assembly and concrete base in addition to lighting fixtures that needed to be replaced.

The St. Laurent garage building, which had undergone an interior lighting retrofit in 2012 that cut its energy costs by 43%, also required upgrades to its exterior lighting in the form of wallpacks. The exterior of the north garage was equipped with 400W high pressure sodium (HPS) wallpacks yielding a total system wattage of 465W, while the exterior of the south garage was illuminated with 175W metal halide (MH) wallpacks with a total system wattage of 210W.

2 PROJECT DETAILS

The project was one of the earliest parking lot projects that OC Transpo implemented using light emitting diode (LED) fixtures. It saw the removal of existing light pole assemblies and the concrete bases associated with some of these poles. The poles were replaced with new 20' aluminum poles that maintained the same height, while new concrete bases were installed.

New LED Gullwing fixtures with system wattage of 130W were supplied by Energy Ottawa.

The overall light levels will be slightly lower than before; however, the visual acuity of the space will be greatly enhanced due to the white light as opposed to the old yellow light of the HPS fixtures.

As for the wallpacks on the exterior of the St. Laurent garage, the north garage MH wallpacks were replaced with new 126W LED fixtures, while 72W similar fixtures replaced the HPS fixtures on the south garage.

The total cost to implement the project was $243,000: $151,000 for the exterior pole top LEDs at the parking sites, and $92,000 for the exterior LED wallpacks.

The project also qualified for approximately $6,000 in incentives from the saveONenergy program. Both measures have a combined payback period of 17 years, which is very long due to the replacement of the poles and concrete bases that do not contribute to energy savings. However, this project not only saved energy, but also resolved safety problems.

Figure 2: New post top Gullwing LED fixture (left) and AeroScape Wall Mount(right)[2]

3 RESULTS

Energy results: The project is expected to save over 117,000 kWh annually, which would reduce utility costs by around $14,000 per year.

GHG reduction: The project prevents approximately 87.1 tonnes of carbon dioxide equivalent (tCO_2e) from being released into the atmosphere every year. This is similar to removing 19 passenger vehicles off the road.

4 CONCLUSIONS & REFLECTIONS

OC Transpo has been taking solid steps in the journey to achieve the City's greenhouse gas emission reduction goals: from the Light Rail Transit project currently underway to smaller retrofits at their other facilities.

Although the payback period for this particular project was relatively long due to non-energy saving aspects of the infrastructure upgrades, it was definitely successful in reducing the facilities energy use intensity.

OC Transpo has been taking solid steps to achieve the City's greenhouse gas emission reduction goals

The project prevents approximately 87.1 tonnes of carbon dioxide equivalent (tCO_2e) from being released into the atmosphere

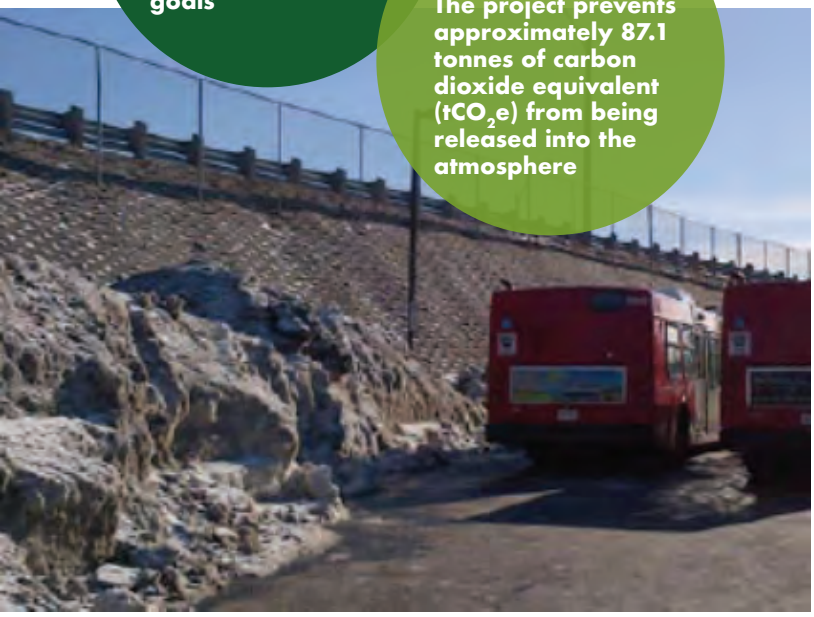

Figure 3: Post top lighting fixtures before project - (left) Bus lane/Parking North, (right) Bus Lane/Parking North East [2]

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Lighting upgrades at the

RIVERSIDE TRANSITWAY STATION

Upgrading transit stations

to reduce operating costs and ensure rider satisfaction

At the intersection of Smyth Road and Riverside Drive

OC Transpo demonstrates its commitment to environmental stewardship by ensuring all its stations are utilizing the latest in energy efficient technology in order to reduce operational costs and improve rider satisfaction.

Figure 1: Existing fluorescent strip luminaires[2]

Installing low-voltage dimming control system

$47,135

Savings of approximately 375,000 kWh and $47,135 annually

1 INTRODUCTION

Riverside Station is a bus stop along the OC Transpo transitway situated near the intersection of Riverside Drive and Smyth Road[1]. It was built in 1991 as part of the Ottawa Hospital's 390 m^2 expansion which included a platform with a new administration wing[1].

The Station is directly connected to the Riverside Campus of the Ottawa Hospital, making it easy for patients who travel by bus to get to their appointments regardless of the weather. Since there are no connecting bus routes, the Hospital remains the primary trip generator and the main purpose for this Station[1].

There are multiple lighting systems throughout Riverside Station: from recessed linear fluorescent strip luminaires that function as the primary lighting source for the transit platform, to metal halide luminaires that light up elevator lobbies and the tunnel under the platform.

All of the aforementioned lights are operated through an antiquated controls system in the electrical room. The system was designed to operate under three scheduling scenarios according to the time of day and ambient light sensing.

Upon investigation of the site in 2014, it was concluded that the control system did not function correctly and that the actual lighting configuration did not match the scheduling scenarios that the facility staff had programmed.

Figure 2: Riverside Station Tunnel[2]

2 PROJECT DETAILS

After conducting a site visit to verify the malfunction and collect information on facility operations and equipment, Energy Ottawa recommended implementing a full redesign of the platform and tunnel lighting.

The project saw the installation of new 4-foot, 8-foot, and 12-foot extruded aluminum Light Emitting Diode (LED) platform luminaires above the platform (as shown in Figure 3), with each 4-foot section consuming 71W at full output. However, in order to achieve the required illuminance, the luminaires are dimmed to 55% of this maximum output[2].

As for the tunnel, the existing 129 metal halide luminaires in the ceiling were replaced with 94 new LED luminaires that are designed specifically for tunnel application, such that they are able to reduce glare. Furthermore, a dedicated low-voltage dimming control system was installed to adjust the space lighting in accordance with the Illuminating Engineering Society of North America (IESNA), which recommends that tunnels be lit to a very high level during the day to match daylight conditions, and dimmed at night to match street lighting conditions[2].

The total cost to implement the project was $295,744 with payback period of 9.2 years. The cost includes an incentive rebate of $18,704 from Energy Ottawa on behalf of the Ontario Power Authority (OPA) through their saveONenergy program.

Figure 3: Light fixtures before retrofit (left) and after retrofit (right)[2]

3 RESULTS

Energy results: The project reduced the Station's power demand by 89.2 kW, cutting down electricity consumption by 374,090 kWh annually. This value translates to $47,135 in annual cost savings[2].

GHG reduction: The primary objective of the project was not to reduce greenhouse gas emissions; however, the retrofit helped prevent 278 tonnes of carbon dioxide from being released into the atmosphere[2]. This is equivalent to removing 60 passenger vehicles from the road for an entire year.

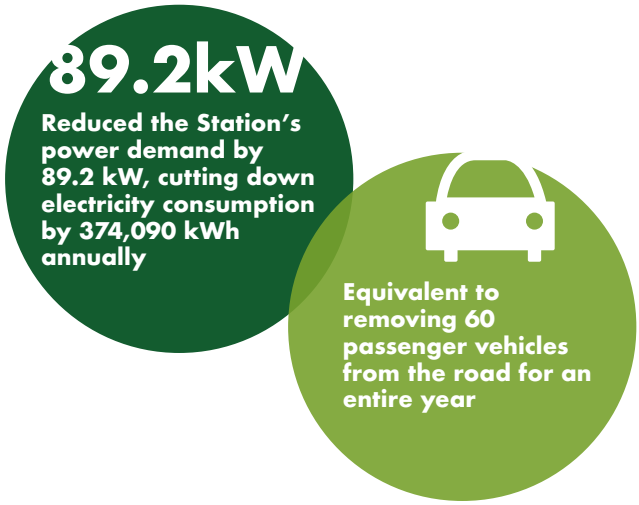
The total cost to implement the project was $295,744 with payback period of 9.2 years

4 CONCLUSIONS & REFLECTIONS

The project was successful in upgrading the Riverside Station's lighting equipment and ensuring that the control systems in the electrical room function properly and the lighting configuration matches the specified control scenarios[3].

Energy saving projects, such as the Riverside Station lighting upgrades project, highlight OC Transpo's commitment to reducing energy usage and maintenance costs for taxpayers, while setting high standards for efficiency at their facilities and taking steps to become a more sustainable workplace.

With the help of Energy Ottawa, OC Transpo continues to explore new opportunities to cut down energy costs and improve their energy portfolio[3].



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THE PEAKSAVER (PLUS) PROGRAM

Empowering individual Ontarians to contribute to grid reliability

Ontario-wide
demand response and behaviour change program

In homes throughout Ontario

Effective provision of electricity is a finely tuned balancing act on the part of the grid operator, always trying to ensure that electricity generated matches user demand as closely as possible. The Peaksaver and subsequent Peaksaver PLUS programs empowered individual residents to play their part in achieving this balance.

"Over the last ten years, the peaksaver PLUS program has provided Ontarians a unique opportunity to contribute to grid reliability. The program allowed the IESO, as grid operator, to curtail energy demand during hot days, reducing the need to rely on power plants to produce more energy."

-Independent Electricity System Operator (IESO).

Used smart devices to remotely reduce electricity demand on peak summer days

180

By 2017, program was equipped to reduce peak demand by up to 180 megawatts

1 INTRODUCTION

The Peaksaver program, launched in Toronto in 2005, and active throughout Ontario between 2007 and 2017, was an electricity demand response program designed and administered by the Ontario Power Authority (OPA) and co-ordinated by the Independent Electricity System Operator (IESO)[1].

Demand response programs focus on incentivizing electricity users to make short-term reductions in their energy demand.

Throughout Ontario, peak annual demand for electricity occurs during the summer time, on the hottest weekdays of the year when central air conditioning systems are running constantly and at full power. By allowing the grid operator, IESO, to install and remotely manipulate smart devices in resident's homes, the Peaksaver program enabled individual residents to help reduce the demand for electricity on these peak days.

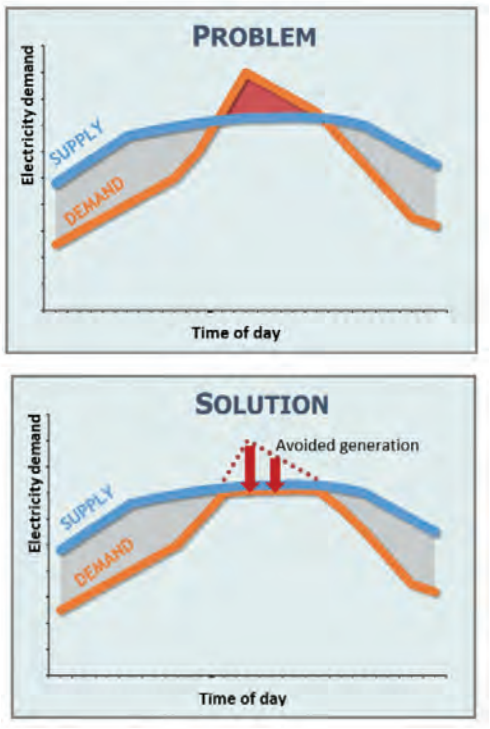


Figure 1: A graphic explanation of demand management[2].

2 PROJECT DETAILS

This program offered different smart devices to participants: from programmable thermostats for central air conditioning, to load control devices for residential water heaters and pool pumps. During a handful of hot and humid days each year when peak electricity demand was approaching the total generating capacity of the system, a signal was sent to these smart appliances to reduce the amount of electricity they were using at that time. A Peaksaver activation reduced the proportion of time that air was actively cooled down or water was actively heated up, and increased the time that previously cooled air/heated water was simply maintained at a steady temperature[3].

While the focus in the Peaksaver program (2007-2011) was on demand response through these remotely controllable devices, the later Peaksaver PLUS program (2011-2017) also incorporated a social behaviour change component by additionally offering free in-home energy display devices to participants so they could track their real-time energy consumption. All Peaksaver program contracts expired in 2017. IESO is now considering integrating these resources into a broader Demand Response Auction, selecting providers of future demand response services in a more transparent and cost-effective way[4].

3 RESULTS

Over the course of the last decade, the Ontario-wide program supplied smart thermostats to approximately 327,000 homeowners, or just under 10% of Ontario's energy customers, at a total cost of $270 million[1]. Of these, 34,000 were Hydro Ottawa customers, corresponding to almost 20% of Hydro Ottawa's eligible customers.

By actively responding to demand, programs like this are able to reap numerous benefits in terms of energy conservation, capital expansion cost savings, increased grid reliability and lowered emissions. Focusing first on energy conservation, by 2017, the program was theoretically equipped to reduce peak demand by up to 180 megawatts[1]. In practice, previous documented activations of the peaksaver program resulted in demand reductions of 110 megawatts, equivalent to the power needed for a medium city[3].

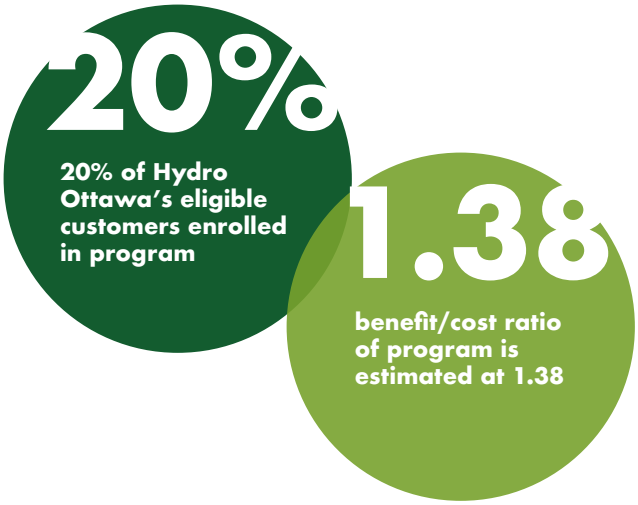
4 CONCLUSIONS & REFLECTIONS

A 2015 study estimated that a Peaksaver activation could reduce total electricity demand by around 18%[5].

Reducing peak demand in this way resulted in direct cost savings and emissions reductions due to the reduction in necessary electricity generation. In fact, a 2015 IESO report estimated the benefit/cost ratio of the program at 1.38, with benefits clearly outweighing costs[5]. There were also substantial indirect cost savings because this program eliminated the need to build additional generating capacity to meet these infrequently occurring peak demands. Lowering or entirely eliminating these peaks in the demand contributed to a more reliable grid that does not suffer from supply shortfalls or outages.

Additionally, most participants in the program confirmed that there was no noticeable difference in the temperature of their hot water or of the ambient air in their homes, confirming that these demand reductions did not occur at the expense of consumer satisfaction. Finally, those involved with administering this program considered it a success if for no other reason than that it raised consumer awareness of smart devices, and the role that they as individuals can play in managing their electricity usage[1].

Despite the large potential of this program to temporarily reduce demand, critics of the program are quick to point out that in its ten years of existence, only 21 province-wide peaksaver activations occurred[1]. Furthermore, on a provincial level, this particular program was only responsible for 0.1% of all residential energy savings from all ongoing conservation initiatives[6]. While these numbers may call into question the success of this program, it is important to remember that peak demand response initiatives of this kind are effectively a kind of insurance against relatively rare but high consequence events. One can liken a program of this kind to purchasing life or home insurance: assuming the price of purchasing such worst-case coverage is appropriate, people rarely complain when they never need to use it.



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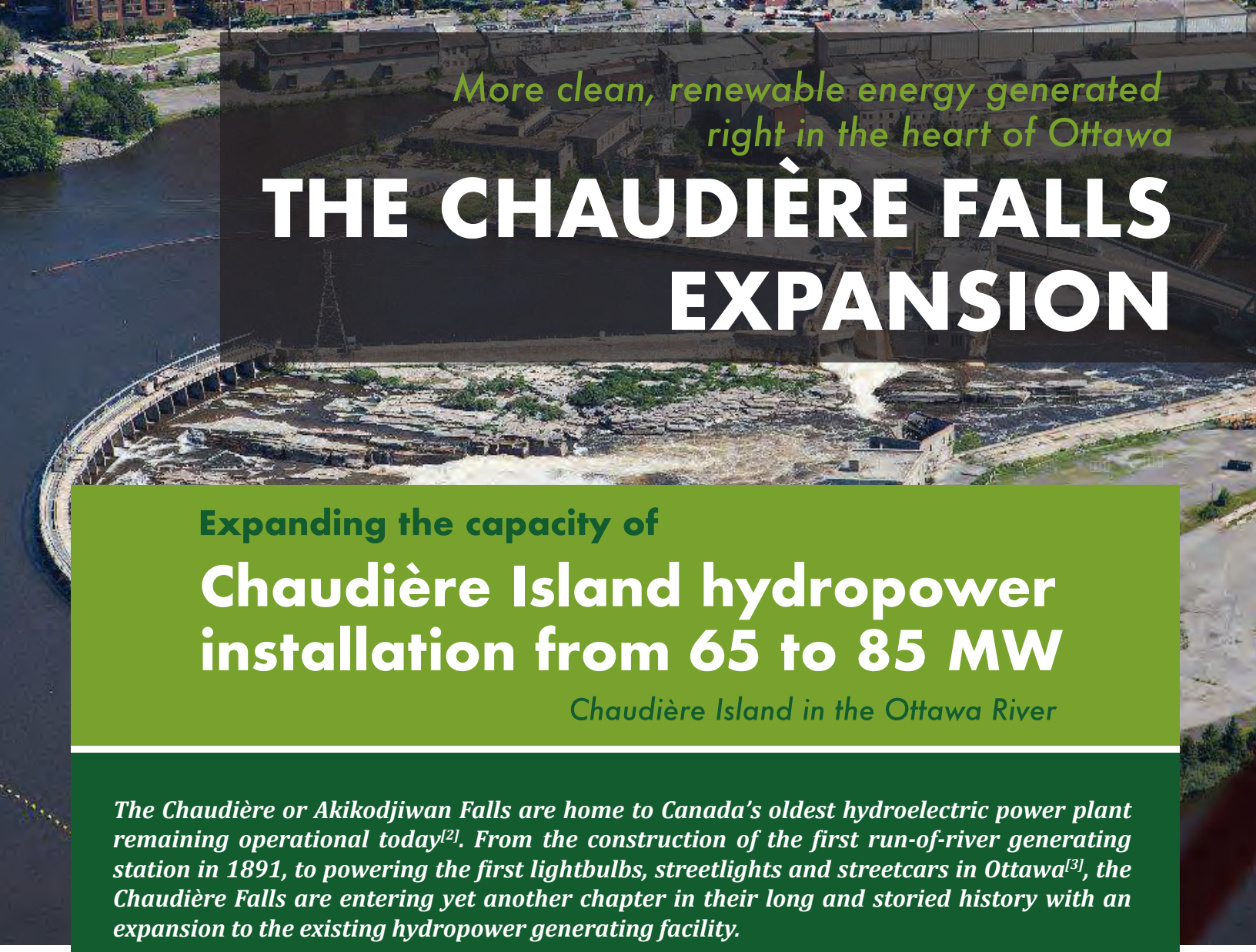


More clean, renewable energy generated right in the heart of Ottawa

THE CHAUDIÈRE FALLS EXPANSION

Expanding the capacity of

Chaudière Island hydropower installation from 65 to 85 MW

Chaudière Island in the Ottawa River

The Chaudière or Akikodjiwan Falls are home to Canada's oldest hydroelectric power plant remaining operational today[2]. From the construction of the first run-of-river generating station in 1891, to powering the first lightbulbs, streetlights and streetcars in Ottawa[3], the Chaudière Falls are entering yet another chapter in their long and storied history with an expansion to the existing hydropower generating facility.

"In as much as the City of Ottawa's past has been tied to this river. Today's Chaudière expansion project confirms that Ottawa's future is also tied to it."

- Ontario Energy Minister Bob Chiarelli

20,000

Generating enough clean, renewable power for 20,000 homes

115,000

Reducing greenhouse gas emissions by 115,000 tonnes of CO_2 every year

1 INTRODUCTION

At the start of this expansion project, the Chaudière Falls already hosted hydropower plants on both the Ontario and Québec sides of the Ottawa River, with a total generating capacity of 65 megawatts (MW). On the Gatineau side, Hydro Ottawa owned a 12 MW plant (purchased from Domtar Corporation in 2012) as well as a 27 MW plant (purchased from Hydro Québec in 2016). On the Ottawa side, Hydro Ottawa owned a 3 MW and a 6 MW plant (also purchased from Domtar Corporation in 2012), two 8 MW legacy plants dating back to the late 1800's and early 1900's respectively, as well as a 1 MW plant that was completed in 2007.

2 PROJECT DETAILS

On March 4th 2014, Hydro Ottawa was awarded a 40-year contract to expand their existing hydropower facilities at Chaudière Falls[3], with an estimated price-tag of more than $150 million[4] financed from the bond market[5]. Construction on the hydropower expansion started in 2015. The 3 MW and 6 MW plants on the Ottawa side of the river were first decommissioned, with the water rights from these plants redirected to the expansion project along with additional unused water rights owned by Hydro Ottawa.

The 29 MW expansion saw the installation of four new turbines below grade[6].

The decision to install the new turbines below grade was driven by a desire to minimize impacts on the local visual and natural environment.

While expanding clean, renewable electricity generating capacity was obviously the driving force behind the project, Hydro Ottawa additionally wanted the expansion project to serve as a public space to be enjoyed by the community, as well as a tangible reminder of the site's significance to First Nations and the local industrial past. These additional goals were be achieved through the inclusion of a First Nations Plaza. Three safe public viewing platforms, increased public access and a new pedestrian and cyclist bridge in the design[2].

Despite Hydro Ottawa's extensive stakeholder consultation with local First Nations groups, the project has experienced ongoing media coverage focusing on a call from select advocacy groups for the falls and islands to be returned to the Algonquin Anishinabeg Nation as an act of reconciliation [7,8].

3 RESULTS

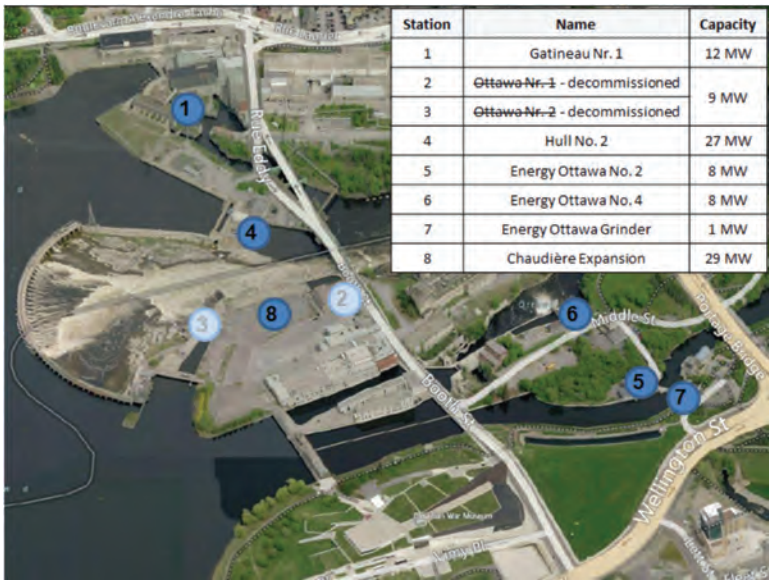
The expansion began producing power on the 18th of August 2017[5], and was officially opened on the 16th of October, 2017[9]. During its development, the project created 150 new jobs in the construction industry[10]. The project resulted in the net addition of 20 MW of generating capacity at Chaudière Falls, bringing the site total up to 85 MW. At present, 39 MW of this is destined for use in Québec, while 46 MW is for Ontario. While it is too soon for formal results to be available, the expansion is expected to generate enough clean energy to power 20,000 homes[2], which in turn will reduce greenhouse gas emissions by an estimated 115,000 tonnes of CO_2 every year[2], as this new clean energy displaces electricity previously generated from other dirtier sources. In addition, the expanded hydroelectric facility will help contribute to the province of Ontario's long-term target of generating 9300 MW of hydropower by 2025[6].

Finally, a power purchase agreement with the Independent Electricity System Operator in Ontario will generate $15 million of revenue annually for Hydro Ottawa, of which a dividend would ultimately go to the City of Ottawa as Hydro Ottawa's only shareholder[6].

4 CONCLUSIONS & REFLECTIONS

According to Hydro Ottawa CEO and President Bryce Conrad, the biggest challenges faced through the course of the expansion project were its size and location: "It's in the backyard in the city of Ottawa. Everyone can see it. Everyone can hear it when the dynamite goes off. So, just the logistics around a project of this magnitude are challenging"[6].

That said, the hydropower generating facilities have been operational for a few months now and aside from some routine adjustments such as calibrating sensors, this ramping-up period has gone very smoothly. Looking to the future, over the coming two years, Hydro Ottawa will upgrade the remaining two Québec-side hydropower plants (12 MW and 27 MW), subsequently transferring the power generated by these facilities to Ontario markets.



Station	Name	Capacity
1	Gatineau Nr. 1	12 MW
2	~~Ottawa Nr. 1~~ - decommissioned	9 MW
3	~~Ottawa Nr. 2~~ - decommissioned	
4	Hull No. 2	27 MW
5	Energy Ottawa No. 2	8 MW
6	Energy Ottawa No. 4	8 MW
7	Energy Ottawa Grinder	1 MW
8	Chaudière Expansion	29 MW

Figure 1: Hydropower generating facilities at Chaudière Falls[11].

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From garbage to renewable energy at

THE TRAIL ROAD GENERATING PLANT

Capturing previously flared-off landfill gas to **generate renewable electricity**

Trail Road Landfill, 4475 Trail Rd, Richmond, ON

Landfill gas used to be just a smelly byproduct of decomposing garbage. Not any more: landfill gas released by the Trail Road Landfill has become a valuable resource that is captured and used to generate electricity that powers homes and businesses in Ottawa.

"Why not do something productive with the gas, like generating electricity?"

- asks Greg Clarke, the Chief Electricity Generation Officer at Energy Ottawa.

6,000

Landfill gas-to-energy facility generates enough power for 6,000 homes

180,000

Reducing landfill's greenhouse gas emissions by up to 180,000 tonnes each year

1 INTRODUCTION

Operating commercially since January 2007, the Trail Road landfill gas-to-energy plant takes landfill gas from the City of Ottawa's Trail Road Landfill and converts it to renewable energy. This landfill gas is made up mostly of methane - 20 times more potent as a greenhouse gas than carbon dioxide, and in the past, it was simply flared-off without generating any power[2].

2 PROJECT DETAILS

Now, a vacuum pump cools and pressurizes the landfill gas before feeding it to several generators where it is combusted, producing renewable electricity, with carbon dioxide and water vapour as by-products. The generating facility is connected to the Fallowfield Distribution Station meaning that the electricity produced can be fed directly into the existing distribution grid. The generating facilities were developed by PowerTrail, a partnership between Energy Ottawa and Integrated Gas Recovery Services. Through a competitive bidding process, PowerTrail was also awarded a twenty year contract to operate the facility, coinciding with the plant's estimated twenty year operating life[1]. The capital costs of the project were around $10 million, with both partners sourcing the necessary financing internally[3].

The landfill gas-fuelled facility originally had five engines, for a total generating capacity of 5-megawatts[1]. In June 2012, after five years of operation, Energy Ottawa added a sixth engine to the plant to make better use of the abundantly available landfill gas.

At present, the site's generating capacity is 6 megawatts, producing more than 40,000 megawatt-hours of renewable energy each year, or enough electricity for 6,000 homes[4].

The generating facility operates 24 hours a day, 365 days per year, with interruptions only for routine maintenance.

3 RESULTS

In addition to the renewable energy generated, the drop in landfill gas flare-offs reduces annual greenhouse gas emissions from the landfill by up to 180,000 tonnes relative to the situation in 1990[1]. (Even though carbon dioxide is still produced as a by-product of the combustion process, because it is a much less potent greenhouse gas than methane, the result is still a substantial net reduction in emissions).

Furthermore, the renewable electricity generated at the landfill eliminates the need for an equivalent quantity of electricity generated from other, likely non-renewable sources, which in turn results in a further emissions reduction of 40,000 tonnes[1].

Additionally, this project is also reaping financial rewards. The City of Ottawa is the owner of the Trail Road landfill and receives an estimated royalty of $150,000 per year from PowerTrail as payment for the rights to the landfill gas[1]. (The exact royalty depends on the quantity of electricity generated in any given year).

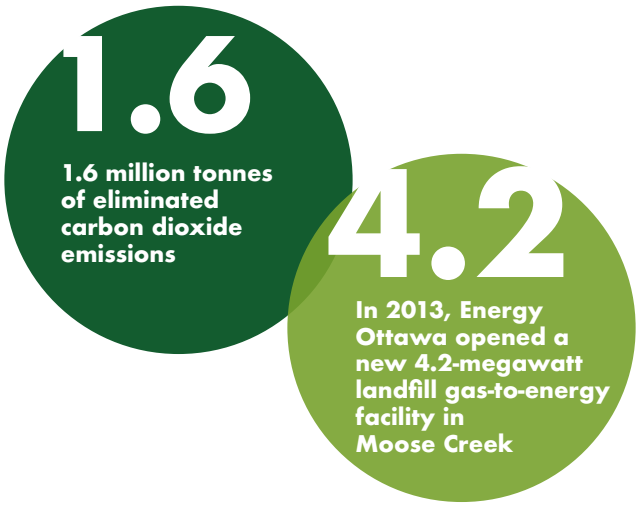
Prior to 2007, the City needed to invest heavily in upgrades and repairs to the existing landfill gas collection and venting system. By implementing the landfill gas-to-energy system, the City saved approximately $2 million in one-time capital costs, and is accruing recurring savings of between $200,000-$250,000 per year due to Energy Ottawa taking over responsibility for the operation and maintenance of the new system.

4 CONCLUSIONS & REFLECTIONS

2017 marked the 10-year anniversary of the Trail Road landfill gas-to-energy project. In these 10-years, the facility has had the same cumulative emissions reduction impact as taking 330,000 passenger vehicles off the road[5] (or around 1.6 million tonnes of eliminated carbon dioxide emissions). Reflecting on this first decade of operation, Greg Clarke, Chief Electricity Generation Officer at Energy Ottawa recalls some early growing pains, such as the snow-melt following a particularly snowy winter flooding the landfill gas collection wells (they subsequently invested in pumps for the wells) and the discovery that the garbage by-product siloxane has a detrimental impact on power generation equipment (they soon installed a siloxane filtration system)[3].

2017 saw Energy Ottawa submit a proposal to the Independent Electricity System Operator (IESO) in Ontario to add a seventh engine to the facility, to further increase the plant's ability to convert landfill gas to electricity[5]. IESO however rejected this proposal, citing reasons of overcapacity in the province's energy generating infrastructure[3].

While the Trail Road Landfill landfill gas-to-energy project was the first of its kind in Ottawa, its success is already being replicated in other locations: in 2013, Energy Ottawa opened a new 4.2-megawatt landfill gas-to-energy facility at the Laflèche Eastern Ontario Waste Handling Facility in Moose Creek, about an hour southeast of Ottawa. This facility produces enough electricity for 4,000 homes and reduces greenhouse emissions by around 100,000 tonnes[4].



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